Forging a New Era in Lab Benchmarking
Learning objectives

• List some ways in which high-quality benchmarking data can help to catalyze positive change as part of the new-building design process or the design of an energy efficiency program for existing buildings.

• Explain why benchmarking for lab buildings is more challenging than for most other types of facility.

• Describe the ways in which the new lab benchmarking tool will be a more useful resource than the retiring Labs21 Benchmarking Tool.

• Contribute to the ongoing discussion on the long-term plan for I²SL’s lab benchmarking resources.
Outline

• Lab benchmarking background
• The Labs21 dataset
• The new lab benchmarking tool!
  – Story and scope
  – Sneak preview
    • Features
    • Feedback
    • Naming competition
  – Future directions
    • Expanded features and outreach
    • Sponsorship opportunities
Defining benchmarking

Am I normal?

• Comparing ourselves to others (or our past selves)
  – Often energy usage (but doesn’t have to be)
• Doing so constructively
Energy benchmarking applications

- Prioritize portfolios
- Certifications:
  - LEED O&M (up to v4)
  - ASHRAE BuildingEQ
  - AIA 2030 challenge
  - ENERGY STAR
  - ISO 50001
- ASHRAE energy audits
- Context for disclosed energy data
- Research and policy
- Conversation starter
Benchmarking tools

• Tools have become sophisticated
• But not for labs

• No Energy Star score
• Confusion about lab EUIs

Site EUI 78.8 kBtu/sf/yr ??
Why is it so hard for labs?

• Complex and detailed functional requirements

• But it’s important
  – Especially for context
Lab benchmarking resources

- Datasets include:
  - CBECS
  - Portfolio Manager
  - Energy disclosure datasets
  - Data aggregators
  - Private libraries
  - The Labs21 Benchmarking Tool
The Labs21 Benchmarking Tool

- Online crowdsourced database:
  - Lab building energy usage
  - Lab-specific functional requirements
- Developed by LBNL for Labs21 program
- Public since August 2002

labs21benchmarking.lbl.gov
Labs21 Benchmarking Tool: Dataset

- Typically ~40 new buildings per year
- Big uptick recently

Most of the data is pretty recent
Labs21 Benchmarking Tool: Dataset

- Distribution of buildings across country
Labs21 Benchmarking Tool: Dataset

- 140 million sf of buildings
- 64 million sf of lab space

5-10% of total!
Labs21 Benchmarking Tool: Dataset

- Buildings from all eras
Most (75%) are from R&D and academic sectors.
Labs21 Benchmarking Tool: Dataset

- Large spread of energy intensity (some of it real)
- Average source EUI: 580 kBtu/sf/yr
- Average site EUI: 270 kBtu/sf/yr
- Median lab area: 41%
The Labs21 Tool: summary

• Good
  – Lab-specific dataset
  – Public
  – Dataset unsurpassed in size
  – Valuable dataset worth preserving

• Bad
  – Accessed via clunky tool
  – Inconsistent maintenance
  – Some outdated fields
  – Not national statistical sample
  – Some data quality issues

• The only real game in town
  – The source for pretty much all lab benchmarking (e.g. ASHRAE BuildingEQ, AIA 2030, LEED O&M up to v4)
Where do we want to go?

- The $I^2SL$ Lab Benchmarking Working Group
- Important recent work
- Plans and proposals for the future
The I²SL Lab Benchmarking Working Group

- Volunteers from I²SL community
- Formed in 2014
- Mostly focused on Labs21 Benchmarking Tool
  - Preservation
  - Understanding usage and needs
  - Maintenance
  - Succession
Working group achievements

- 2014-15 industry benchmarking survey
- 2016+ data QC assistance to LBNL
- 2016 website facelift
- 2017 FAQ updates
- 2018 NIST proposal advice
- 2018 Labs21 database field updates
- 2018 advisory role on new tool
Recent work: Boston GRC study

- 3-year study by the Boston Green Ribbon Commission’s Higher Education Working Group
  - 121 buildings, 7 academic organizations, 15 million sf
- High data quality, weather scatter removed, detailed data analysis
  - Showed what is possible!
- Reports available online at greenribboncommission.org
- Data now in Labs21 dataset
Lab energy scores

• Comparison is inevitable: can we make it fair(er)?
  – Historically too much scatter in Labs21 data
  – Boston GRC study showed that an Energy Star-like score is feasible for labs
  – ASHRAE BuildingEQ used the Labs21 dataset to create rankings
Beyond energy benchmarking

• Compare **operational practices and policies**

• Useful for facilities:
  – Behind or ahead of the curve?
  – Demonstrate that projects have been achieved elsewhere
    • No need to reinvent from scratch
  – Best when combined with case studies

• Useful for community:
  – Take industry’s pulse
  – Identify trends
The wish list

- **Usability:**
  - New tool with modern graphing capabilities
  - Intuitive user interface

- **Data quantity and quality**
  - More data, especially submetering data
  - Improved data validation
  - Modernized lab and facility classifications
  - Automatic energy data upload (Portfolio Manager connection)

- **Analytics**
  - Access to more data fields
  - Energy scores
  - Operational practices benchmarking
  - Showcase buildings and case studies
  - Actionable insights module
  - Interface with rating programs
Tool upgrade

• DOE-FEMP funding to upgrade tool and enable long-term maintenance.

• Features
  – Updated data fields
  – New benchmarking metrics
  – Completely redesigned user interface

• Longevity
  – Robust “professional grade” software
  – Business plan for long term support
Software approach

Industry role: “user apps”

Federal role: “data librarian”

Developed and maintained by I²SL

Developed and maintained by LBNL for DOE
Leverage the DOE Building Performance Database

- The nation’s largest publicly-accessible dataset of information about the energy use and characteristics of real buildings
- Over 1 million residential and commercial buildings
- Cleanses data from >50 sources, translated into standard format.
- Allows users to create third party applications through an API.
<table>
<thead>
<tr>
<th>Application</th>
<th>Milestones</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>BPD API extension</td>
<td>Software spec for new features</td>
<td>Completed. Will be updated as needed</td>
</tr>
<tr>
<td></td>
<td>Test version</td>
<td>Nov 2018</td>
</tr>
<tr>
<td></td>
<td>Production version</td>
<td>Dec 2018</td>
</tr>
<tr>
<td>New user interface</td>
<td>Proposal for long term maintenance w/o DOE funding</td>
<td>Outline Oct 2018 Final Dec 2018</td>
</tr>
<tr>
<td></td>
<td>Software spec</td>
<td>Oct 2018</td>
</tr>
<tr>
<td></td>
<td>Test version</td>
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</tr>
<tr>
<td></td>
<td>Production version</td>
<td>Feb 2019</td>
</tr>
</tbody>
</table>
New features + feedback

• Specific features
• Tour of the mockup
• Naming the new tool
• Long-term plans

Q: Asking for your feedback!
# Updated and more detailed use classifications

<table>
<thead>
<tr>
<th>Organization Type</th>
<th>Predominant Lab Use Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic: Higher Ed</td>
<td>R&amp;D: Basic Research</td>
</tr>
<tr>
<td>Academic: K-12</td>
<td>R&amp;D: Product Development</td>
</tr>
<tr>
<td>Government: Federal</td>
<td>Process Development / Pilot Plant</td>
</tr>
<tr>
<td>Government: State and Local</td>
<td>Manufacturing</td>
</tr>
<tr>
<td>Corporate: Biotech</td>
<td>Teaching</td>
</tr>
<tr>
<td>Corporate: Pharmaceutical</td>
<td>Testing / Quality Control</td>
</tr>
<tr>
<td>Corporate: Electronics</td>
<td>Crime Lab / Forensic</td>
</tr>
<tr>
<td>Corporate: Chemical / Oil &amp; Gas</td>
<td>Other</td>
</tr>
<tr>
<td>Corporate: Consumer Goods</td>
<td></td>
</tr>
<tr>
<td>Corporate: All Others</td>
<td></td>
</tr>
<tr>
<td>Healthcare</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

Q: Are we missing anything important?
Lab type classifications

Before:
– Total lab area
– Lab type:
  • Biological
  • Chemical
  • Chemical/Biological
  • Physical
  • Combination/Other
– Vivarium area
  (% bio/chem/physics possible but not normally used)

After:
– Total lab area
– Sub-areas by type:
  • Biological
  • Chemical
  • Physical/Engineering
  • Vivarium
  • Other
– Special lab types:
  • BSL3/4 area
  • Clean room areas
    – Class 100
    – Class 1000
    – Class 10000

Q: Does this make sense? Are we missing anything?
New benchmarking metrics

- Water usage!
- GHG intensity
- New 2018 Energy Star site-to-source conversions
Updated HVAC system types

- Constant Volume with Reheat
- Variable Volume with Reheat
- Dedicated Outdoor Air System with Chilled Beams
- Dedicated Outdoor Air System with Fan Coil Units
- Displacement Ventilation
- Dual-duct Constant Volume
- Dual-duct Variable Volume
- Multi-zone
- Other Or Combination

Q: Are we missing any important types?
New user interface

- **Graphing:**
  - Live filtering
  - More fields exposed for filtering
  - Modern graphs (like BPD interface)

- **Data entry:**
  - More organized
  - Enhanced data validation

Q: Feedback on the mockup?
Switch to mockup!
Naming the new tool

- Working title: Lab Benchmarking Tool
- Needs a better name
- Suggestions so far:
  - LabBe (lab benchmarking)
  - Able (annual benchmark for lab energy)
  - Alec (annual lab energy comparison)
  - LCBM (lab comparison benchmark)
  - LuC (lab utility comparison)
  - Dame Judi Bench
- Prize for the best idea!

Q: Got any ideas to share?
Long-term plans

• Additional modules:
  – Operational practices benchmarking
  – Energy scores
  – Showcase buildings and case studies
  – Portfolio Manager connection
  – Actionable insights module
  – Interface with rating programs

• Maintaining and growing the new tool
  – Software updates
  – Outreach efforts to populate new fields
  – Annual benchmarking reports

• Sponsorship opportunities!
  – Siemens supporting some of above
  – More opportunities available

Q: Potential sponsors? Thoughts on other funding sources, e.g. user subscriptions for enhanced features? Best avenues for outreach for data collection and training? Potential partner organizations?
Questions?

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Paul Mathew
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Backup screenshots
Welcome to the Lab Benchmarking Tool!

Use this tool to compare the energy use of your lab buildings with that of similar facilities in the US. The tool's database contains owner-submitted data from an ever-growing number of lab facilities.

Current total: 760 facilities

Sign up  Sign in  View data as guest

© 2018 Lab Benchmarking Tool.
<table>
<thead>
<tr>
<th>Building Name</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>BioFun B</td>
<td>![Icon] ![Icon]</td>
</tr>
<tr>
<td>BioFun C</td>
<td>![Icon] ![Icon]</td>
</tr>
</tbody>
</table>
New Building

- **Building Details**
  - Facility Name
  - Year built
  - Is this an existing building? (Yes)
  - Street Address
  - State (Alabama)
  - Zip Code (5 digit)
  - Organization type (Academic: Higher Ed)
  - Predominant lab use type (R&D: Basic Research)
  - Total number of occupants
  - Occupied hours per week

- **Lab Area**
- **Building Systems**
- **Utility Usage**

© 2018 Lab Benchmarking Tool.
New Building

No. of Buildings

Building Gross Area - SF

Building Net Area - SF

Total Lab Area - SF

Component Lab Areas

Vivarium Area - SF

Biological lab area - SF

Chemical lab area - SF

Physical lab area - SF

Other lab type (not listed) - SF

Lab Area Not yet Assigned: 0

Specialty Lab Types
**Benchmark Analysis**

**Summary Statistics**

**Peer group buildings**
Filtering criteria: lab types: biology, chemistry | lab area: 0-100% | climate zones: 5A, 6A | building properties: all
Source EUI: mean 400 kBtu/sf/yr | median 430 kBtu/sf/yr
Percent lab area: mean 40% | median 34%
Benchmark Analysis

Your Buildings

<table>
<thead>
<tr>
<th>Building Name</th>
<th>Source Energy Usage</th>
<th>Percentile Rank</th>
</tr>
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<tbody>
<tr>
<td>BioFun B</td>
<td>30% below peer group mean</td>
<td>25th</td>
</tr>
<tr>
<td>BioFun C</td>
<td>50% below peer group mean</td>
<td>89th</td>
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Benchmark Analysis

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