

I²SL Tools for Sustainability Success: The Labs21 Benchmarking Tool



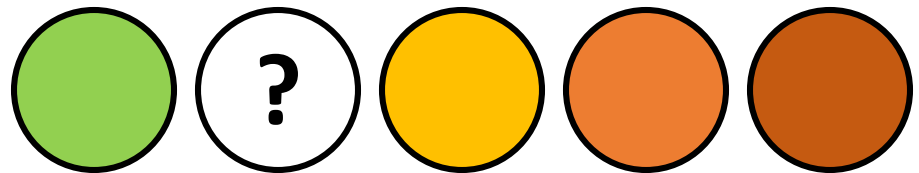
Alison Farmer

Outline

- Why we care about benchmarking
- The Labs21 Benchmarking Tool
- New upgrades by the I²SL Benchmarking Working Group and LBNL
- Future directions
- Your feedback and questions

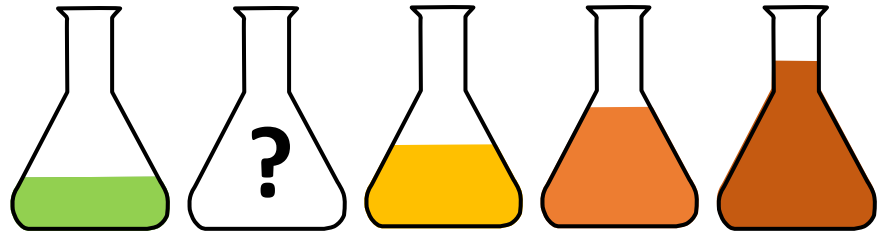
Defining Benchmarking

- Whole building energy benchmarking
- Comparing buildings' energy consumption
 - Contextualizing
 - Prioritizing
 - Ranking
 - Certifying
- Typically compare EUI (kBtu/sf/yr)



Defining Benchmarking

- Important for lab buildings
- But difficult
- Complex and varied functional requirements



Benchmarking Demands

- LEED O&M
- AIA 2030 challenge
- ASHRAE energy audits
- Context for disclosed energy data
- Identify opportunities
- Prioritize portfolios
- Conversation starter
- Research and policy



LEED O&M Certification



Option 1. Benchmark against typical buildings

Path 1. National average data available

Demonstrate energy efficiency performance that is 25% better than the median energy performance of similar buildings by benchmarking against the national source energy data provided in the Portfolio Manager tool.

Path 2. National average data not available

If national average source energy data are unavailable for buildings of similar type, benchmark against the building site energy data of at least three similar buildings, normalized for climate, building use, and occupancy. Demonstrate a 25% improvement.

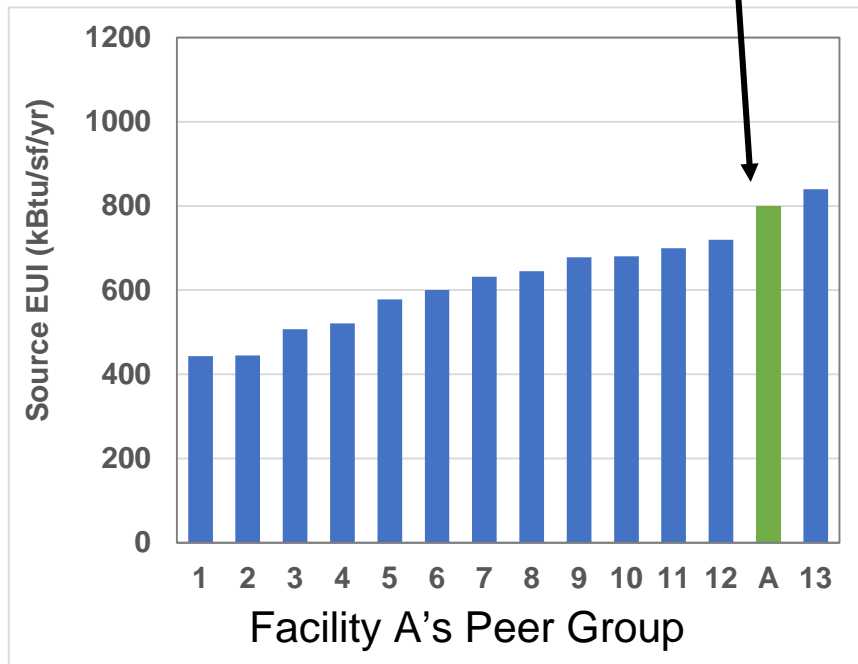
OR

Option 2. Benchmark against historical data

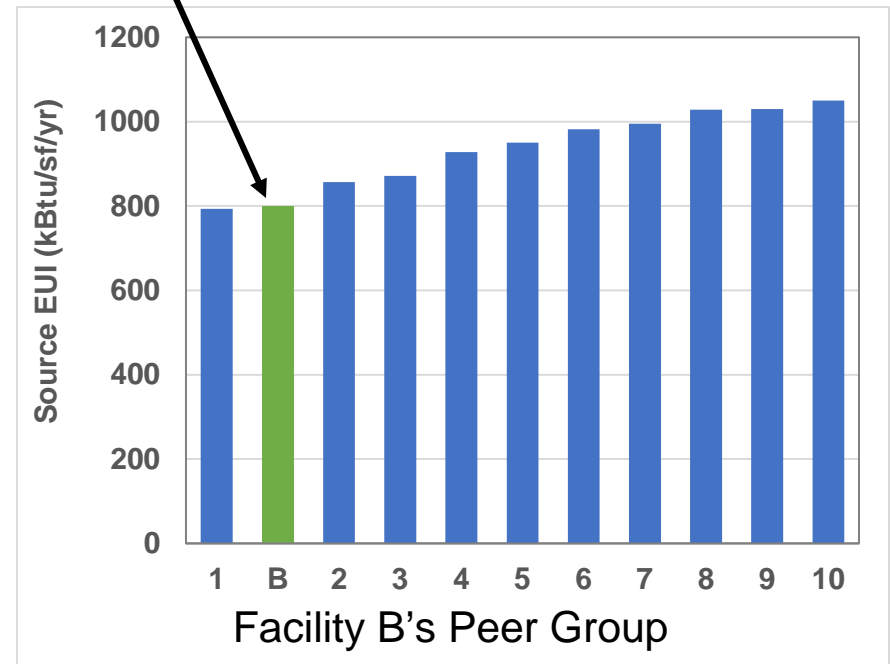
If national average source energy data are unavailable, compare the building's site energy data for the previous 12 months with the data from three contiguous years of the previous five, normalized for climate, building use, and occupancy. Demonstrate a 25% improvement.

Identifying Opportunities

What's going on here?



This seems good



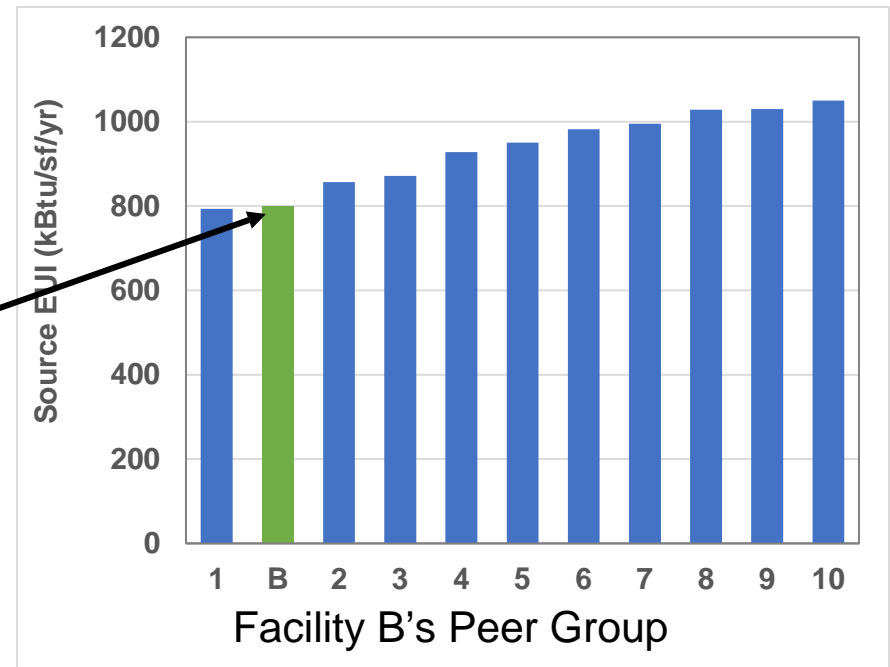
- Your facilities
- Other similar facilities

Starting Conversations

“What are the main energy drivers in your facility?”

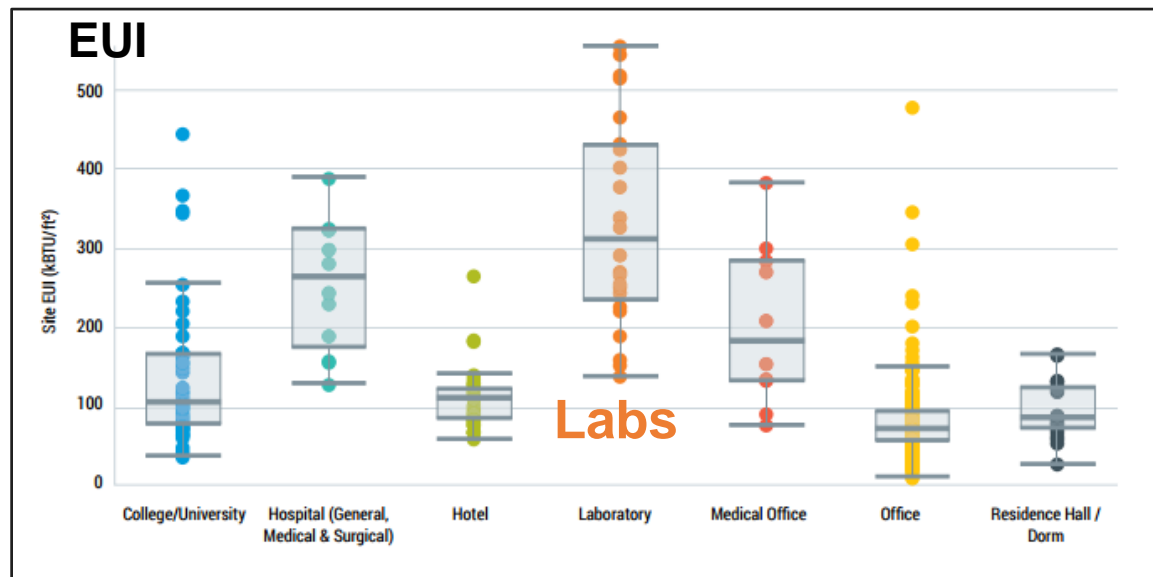
vs.

“Why might your building be **here** relative to its peers?”



Providing Context

- Energy disclosure ordinances are on the rise
- All labs look like energy hogs
- No energy score to identify high-efficiency labs
- Consequences include audits, penalties, shame



from City of Boston BERDO report August 2015

Lab Benchmarking Datasets

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

The Labs21 Benchmarking Tool

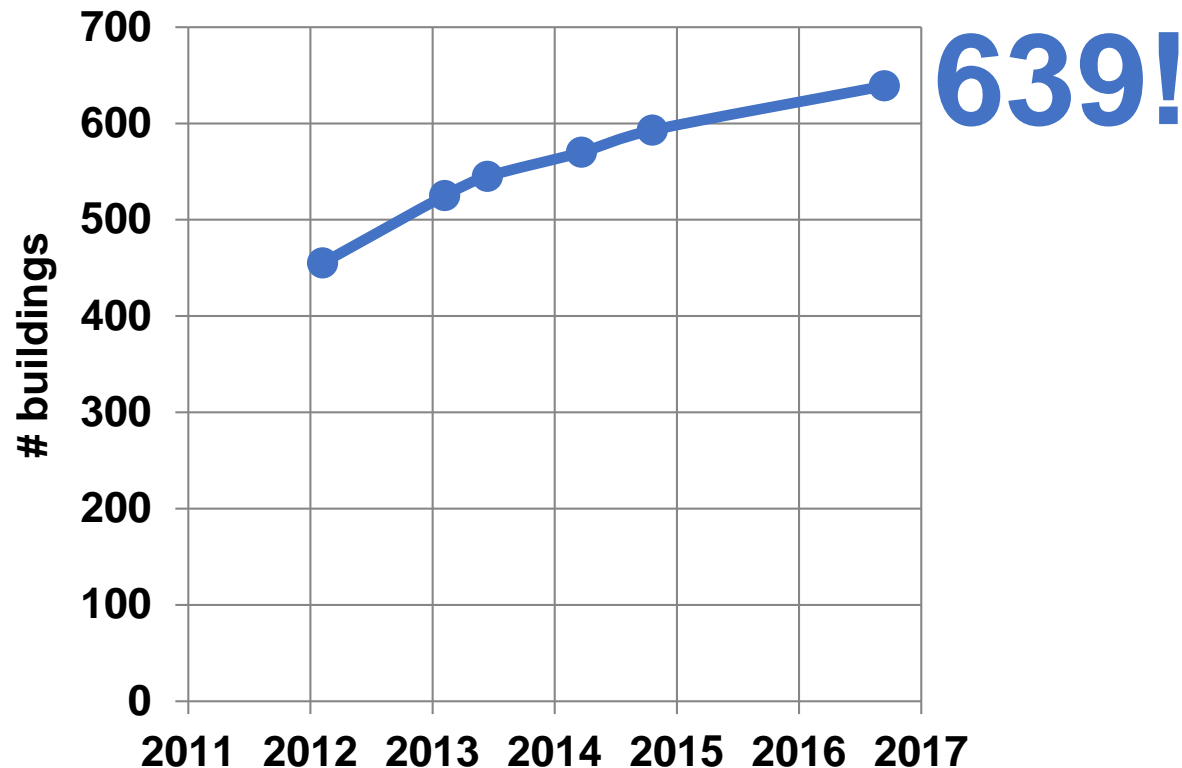
- Online crowdsourced database:
 - Lab building energy usage
 - Lab-specific functional requirements
- Developed by LBNL for Labs21 program
- Public since August 2002

labs21benchmarking.lbl.gov



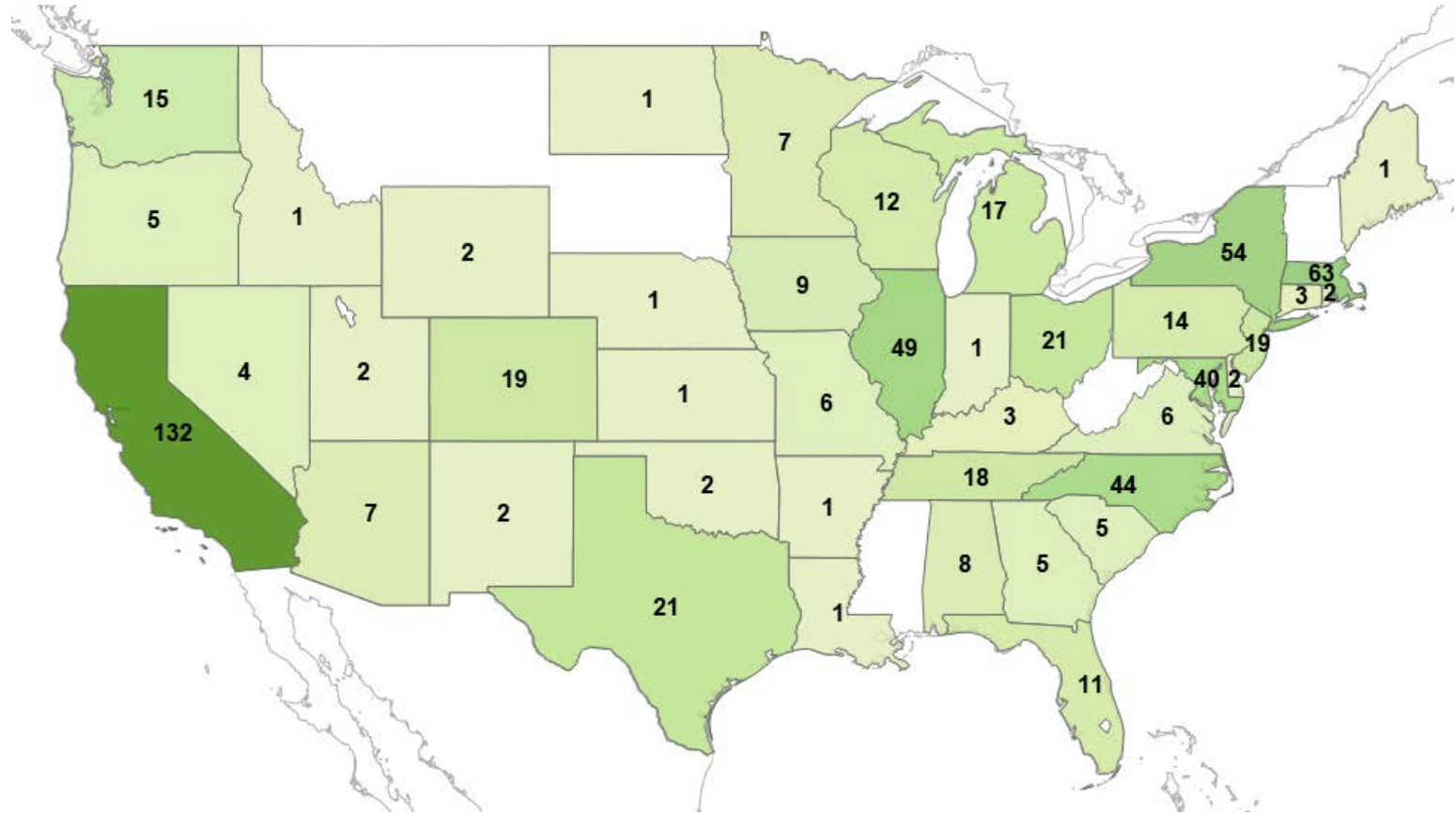
Labs21 Benchmarking Tool: Dataset

- Currently ~40 new buildings per year
- Half of data is less than 5 years old



Labs21 Benchmarking Tool: Dataset

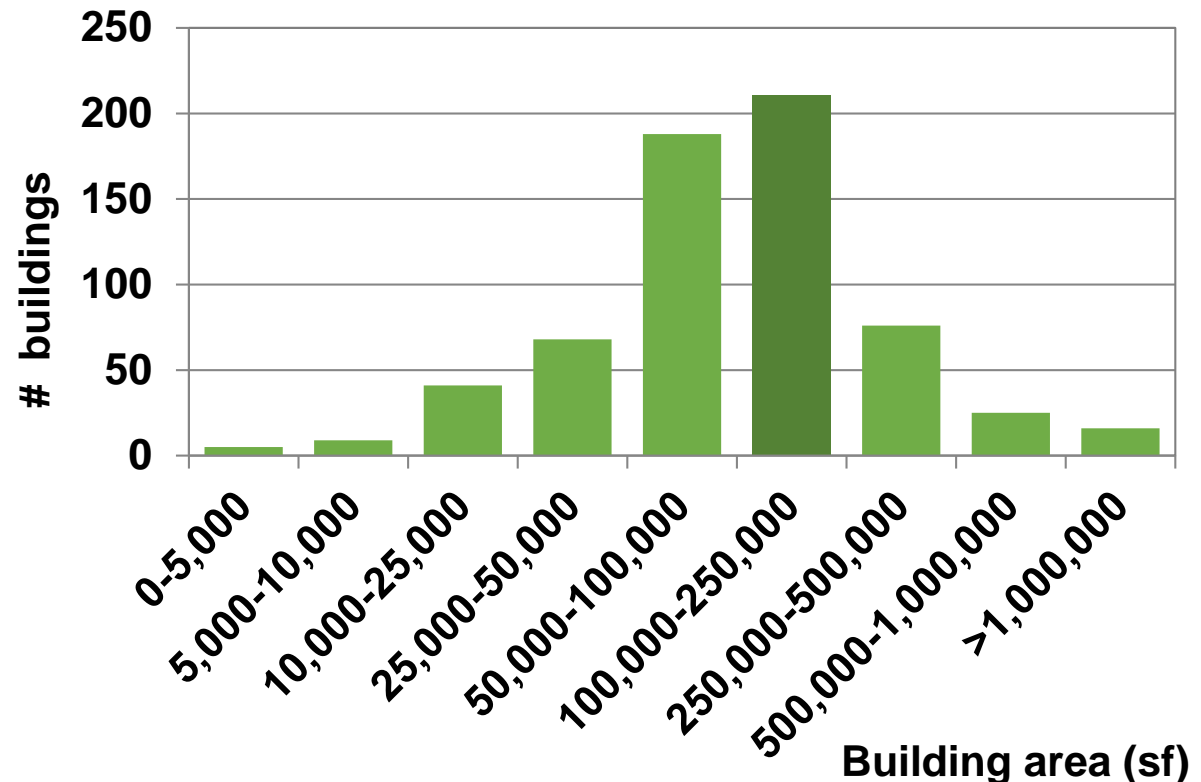
- Distribution of buildings across country



Labs21 Benchmarking Tool: Dataset

- 122 million sf of buildings
- 58 million sf of lab space

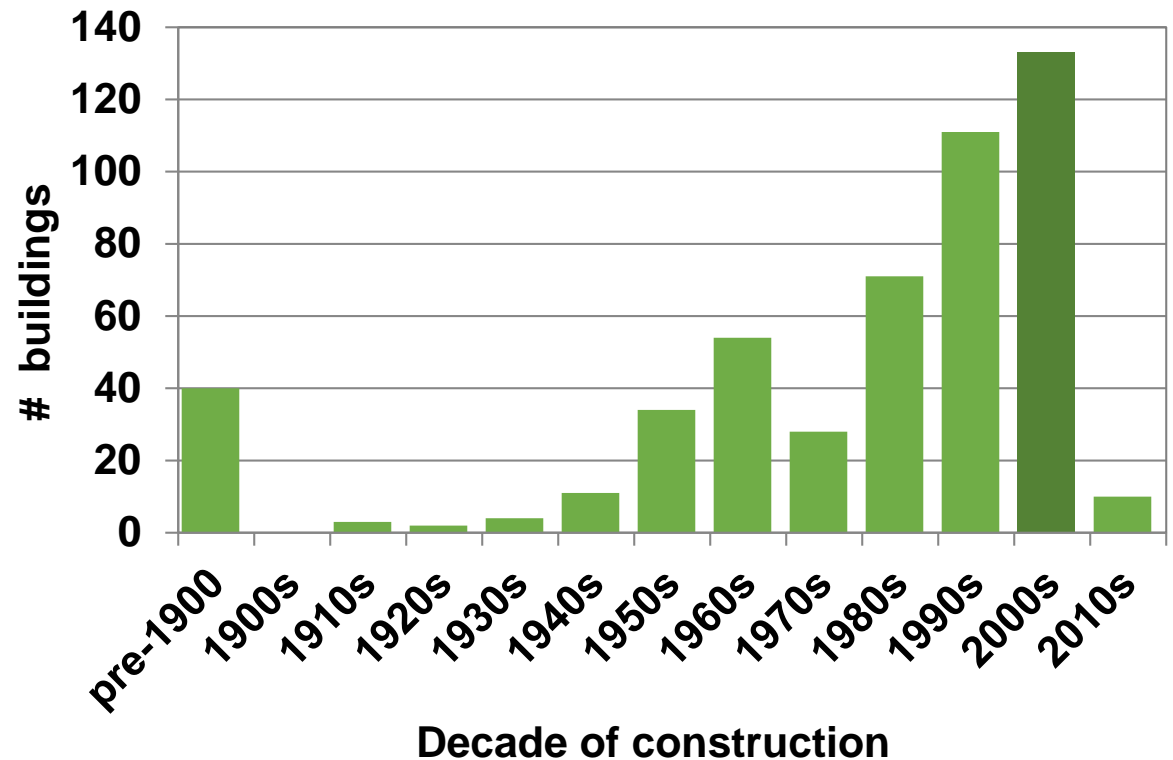
5-10% of total!



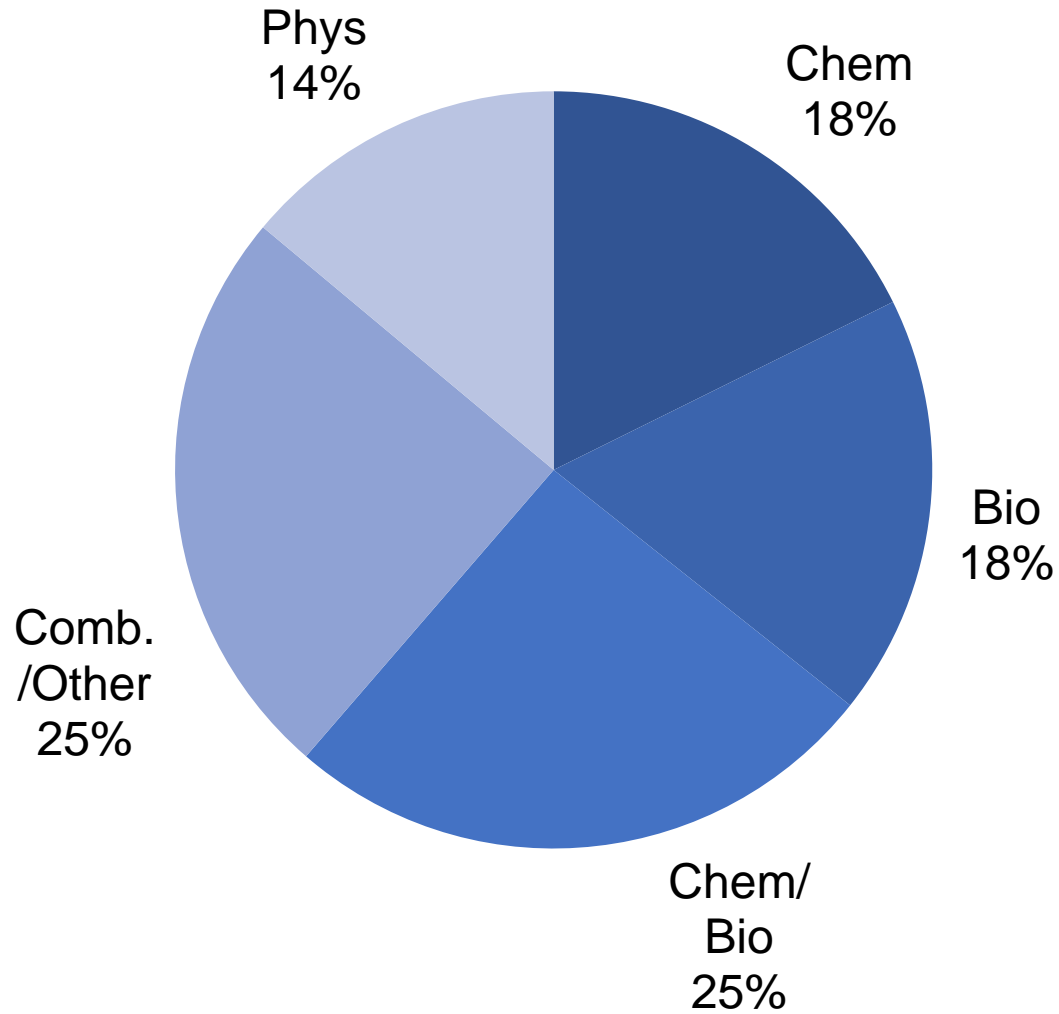
Labs21 Benchmarking Tool: Dataset

- 122 million sf of buildings
- 58 million sf of lab space

5-10% of total!

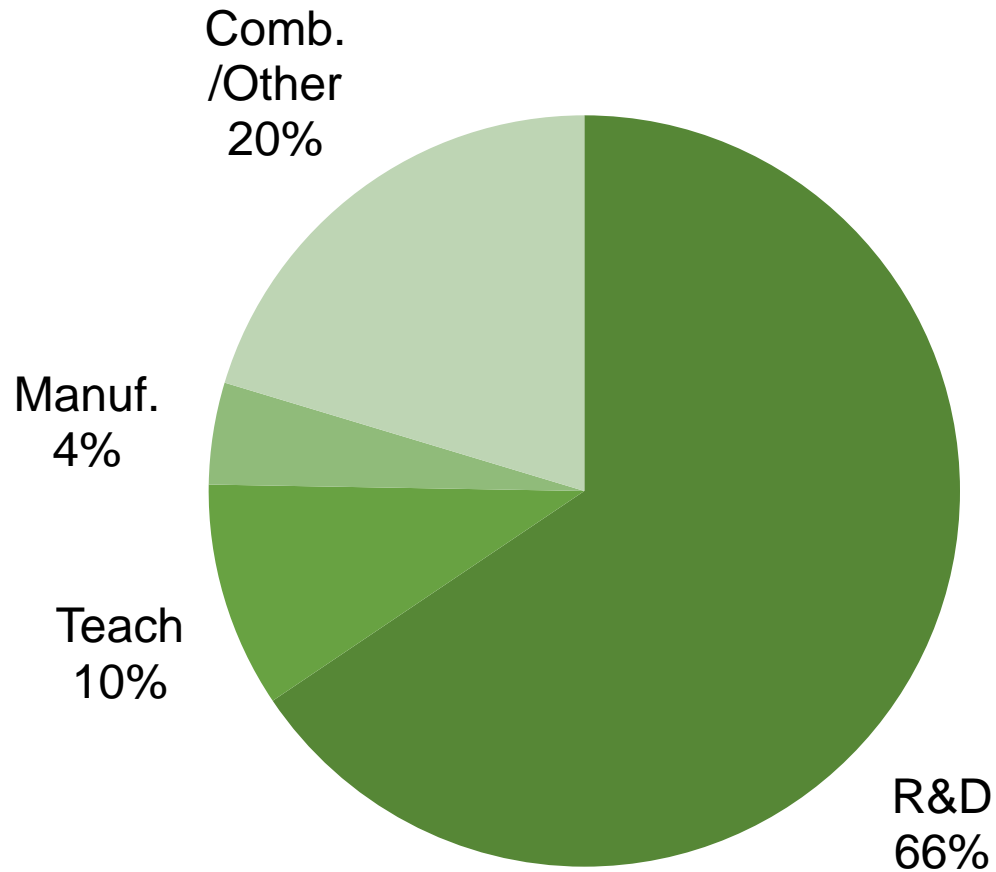


Labs21 Benchmarking Tool: Dataset



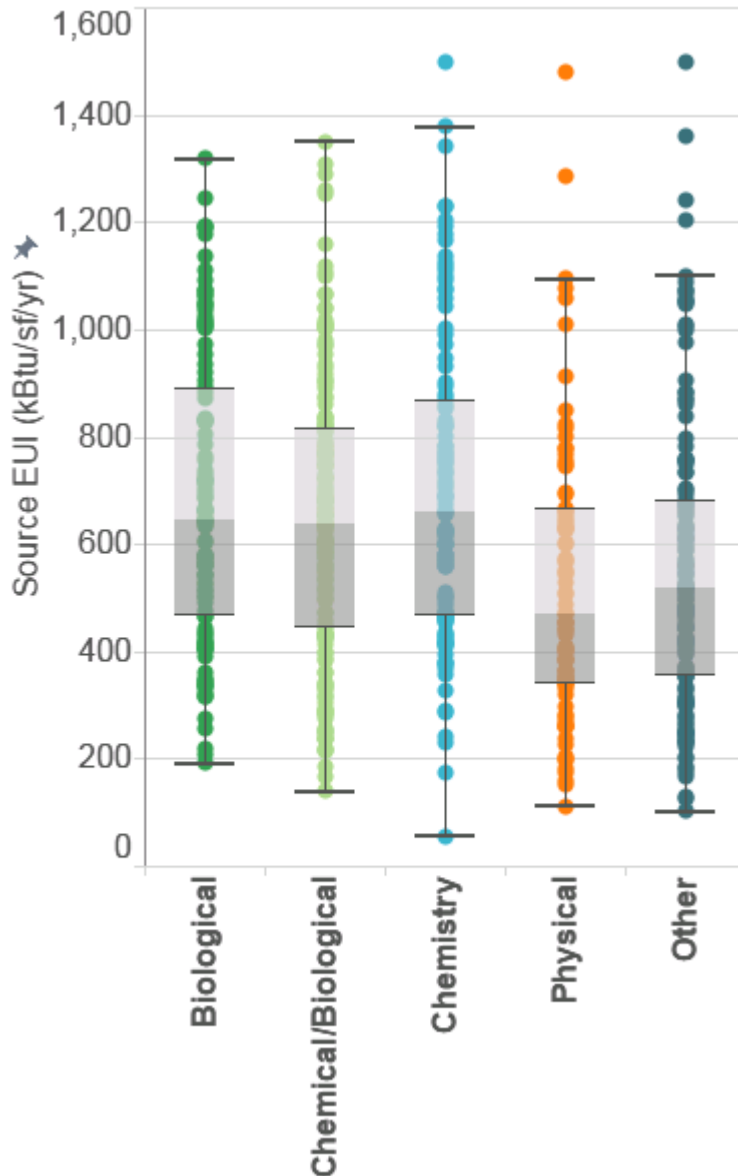
Lab Type

Labs21 Benchmarking Tool: Dataset



Lab Use

Labs21 Benchmarking Tool: Dataset



- Large spread of energy intensity
- Average source EUI: 630 kBtu/sf/yr
- Average site EUI: 319 kBtu/sf/yr
- Median lab area: 41%

Contributing to the Labs21 Dataset

BENCHMARKING



Welcome to the Labs21 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.

Buildings in database: 639

Last database update: July 2016

Enter Data

Enter your data into the database.
Your facilities appear in output reports.
Username and password required.

View Data

View data already in the database.
Output reports show database facilities only.
No login required.

Viewing the Labs21 Dataset

BENCHMARKING



Welcome to the Labs21 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.

Buildings in database: 639

Last database update: July 2016

Enter Data

Enter your data into the database.
Your facilities appear in output reports.
Username and password required.

View Data

View data already in the database.
Output reports show database facilities only.
No login required.

Benchmarking with the Labs21 Tool

Can be done via “Enter Data” and “View Data” pathways.

Benchmarking by data filtering:

1. Select metric for comparison
2. Select a peer group of buildings for comparison
3. Compare energy use intensity with peer group

1. Select Metric

Select metric:

Note: most buildings in the database include Total Building data only. Other categories contain limited data.

System

Total Building ▼

Energy / Efficiency Metric

BTU/gsf-yr (source) ▼

Tips:

- Total Building has the most data
- Source energy is the best metric
- Read the instructions and tooltips

2. Select Peer Group

Tips:

- Iterative process
- Expand selection if selected peer group is too small
 - Climate zone
 - Lab type
- Use measured data

Specify data filtering criteria:

1. Lab Area / Gross Area ratio *i*
is greater than or equal to and is less than or equal to

2. Occupancy hours per week *i*

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

3. Lab Type *i*

- Chemical
- Biological
- Chemical/Biological
- Physical
- Combination/Others

4. Lab Use

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

5. Climate [Climate Code, Climate Type, Representative City]
[\(Click here to see map of climate zones\)](#)

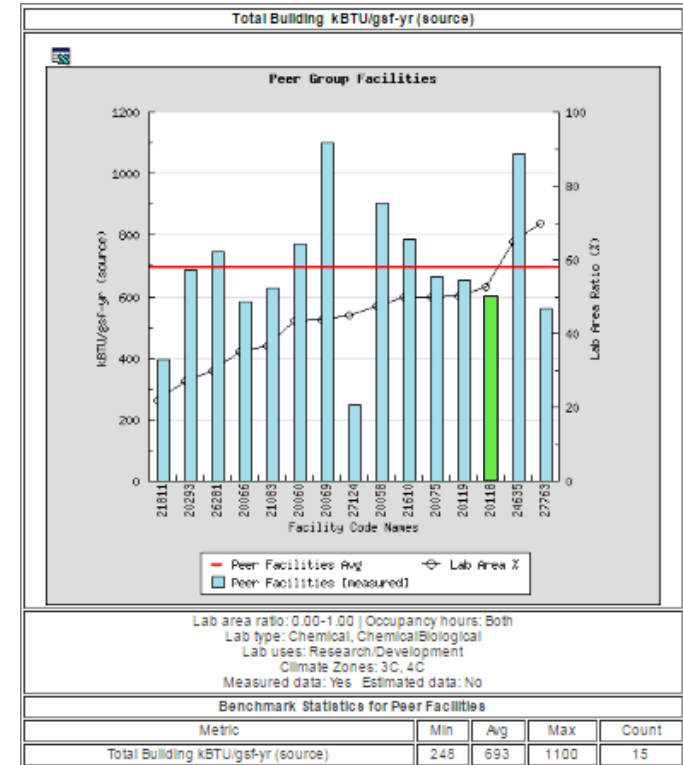
- All Climate Zones
- 1A, Very Hot - Humid (Miami, FL)
- 2A, Hot - Humid (Houston, TX)
- 2B, Hot - Dry (Phoenix, AZ)
- 3A, Warm - Humid (Memphis, TN)
- 3B, Warm - Dry (El Paso, TX)
- 3C, Warm - Marine (San Francisco, CA)
- 4A, Mixed - Humid (Baltimore, MD)
- 4B, Mixed - Dry (Albuquerque, NM)
- 4C, Mixed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

6. Measured and Estimated data

- Measured
- Estimated

3. Compare Energy Usage

- Chart shows EUIs of peer group facilities
- **Red line** is average EUI
- Facilities sorted in order of increasing % lab area
- **Your facilities** will also appear (if applicable)



Tips:

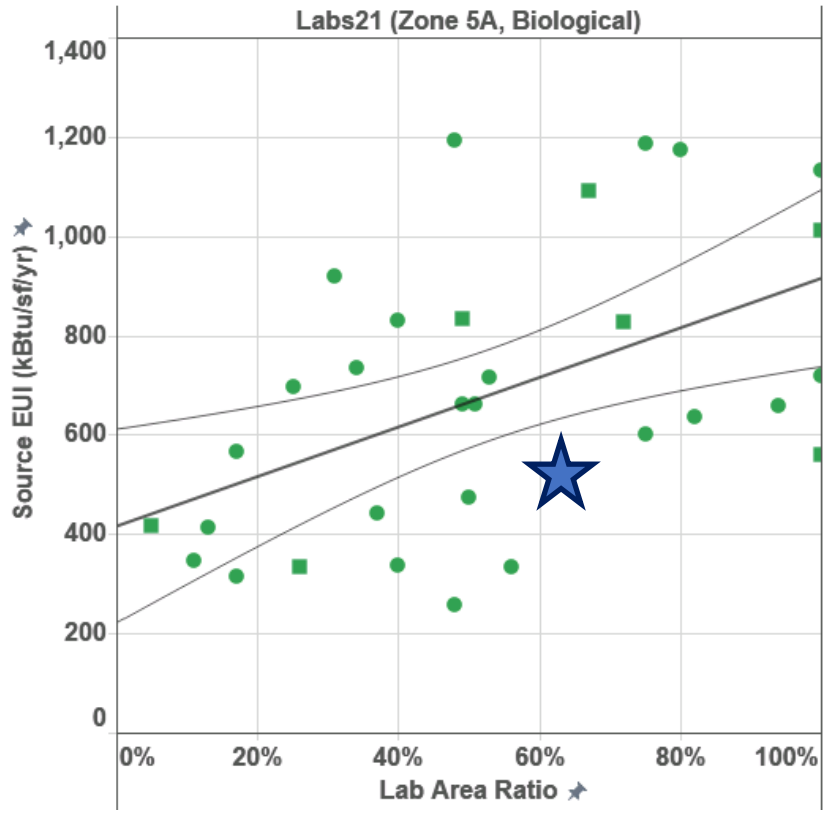
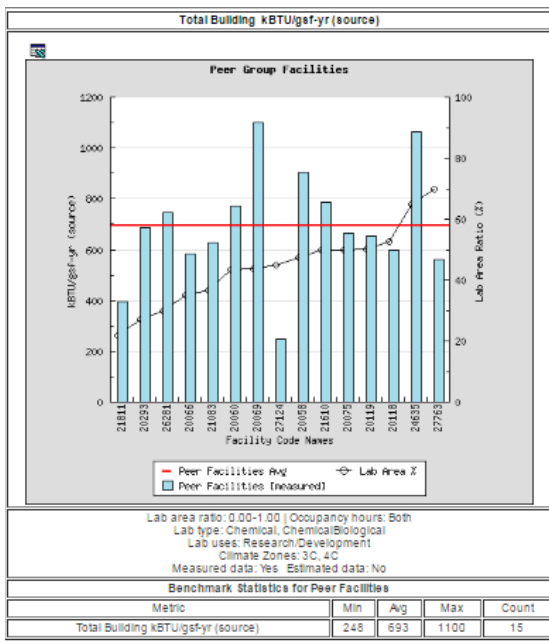
- Create your own plots using outputs

Click titles of columns below to sort
 Data for your facilities are highlighted | Estimated data are indicated in *italics*

Facility	Lab Type	Year	kBTU/gsf-yr (source)	Lab Area Ratio	Occupancy hours per week	Climate
21811	Chemical	2009	395.26	22%	80	3C
20293	ChemicalBiological	2008	685.51	27%	168	3C
26281	ChemicalBiological	2007	747.57	30%	50	3C
20066	ChemicalBiological	2003	581.98	35%	72	3C
21083	ChemicalBiological	2010	629.08	37%	72	4C
20060	ChemicalBiological	2004	771.49	43%	72	3C
20069	Chemical	2003	1099.76	44%	72	3C
27124	ChemicalBiological	2012	248.05	45%	60	4C
20058	ChemicalBiological	2003	903.47	47%	72	3C
21610	ChemicalBiological	2009	786.8	50%	45	3C
20075	ChemicalBiological	2004	664.92	50%	66	4C
20119	Chemical	2014	654.07	50%	60	4C
20118	Chemical	2014	599.49	53%	60	4C
24635	ChemicalBiological	2011	1064.53	65%	80	3C
27763	ChemicalBiological	2012	560.2	70%	60	3C

Reformatting the Output

- Copy the output table into Excel



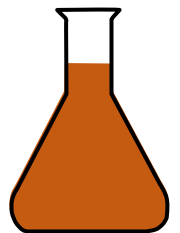
Click titles of columns below to sort
Data for your facilities are highlighted (Estimated data are indicated in *italics*)

Facility	Lab Type	Year	kBTU/sf-yr (source)	Lab Area Ratio	Occupancy hours per week	Climate
21811	Chemical	2009	395.26	22%	80	3C
20293	Chemical/Biological	2008	655.51	27%	165	3C
26281	Chemical/Biological	2007	747.57	30%	50	3C
20066	Chemical/Biological	2003	851.98	35%	72	3C
21083	Chemical/Biological	2010	839.88	37%	72	4C
20060	Chemical/Biological	2004	771.49	43%	72	3C
20069	Chemical	2003	1099.76	44%	72	3C
27124	Chemical/Biological	2012	248.05	45%	60	4C
20058	Chemical/Biological	2003	903.47	47%	72	3C
21610	Chemical/Biological	2009	786.8	50%	45	3C
20075	Chemical/Biological	2004	664.92	50%	66	4C
20119	Chemical	2014	654.07	50%	60	4C
20118	Chemical	2014	599.49	53%	60	4C
24635	Chemical/Biological	2011	1064.53	65%	80	3C
27763	Chemical/Biological	2012	560.2	70%	60	3C

Labs21 Benchmarking Tool: Summary

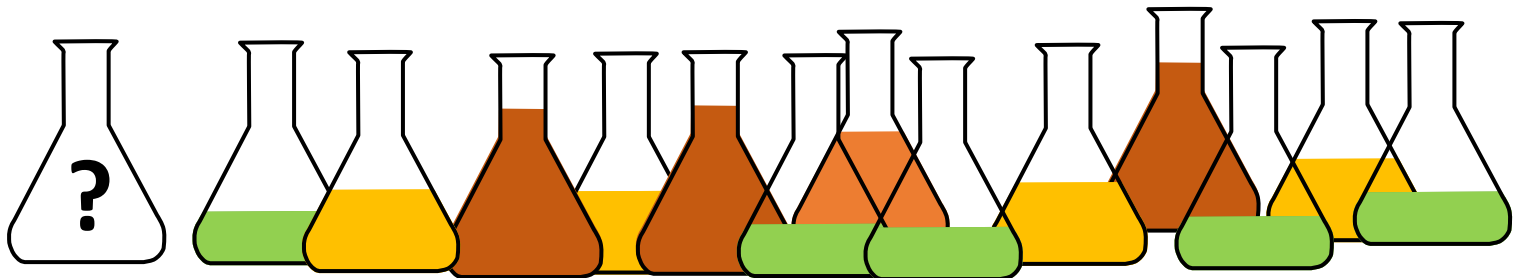
- Rich dataset
- Unsurpassed in size and function
- Simple to use
- Enormously useful

- But not perfect...



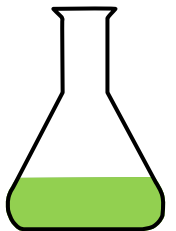
The I²SL Lab Benchmarking Working Group

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



Working Group Achievements

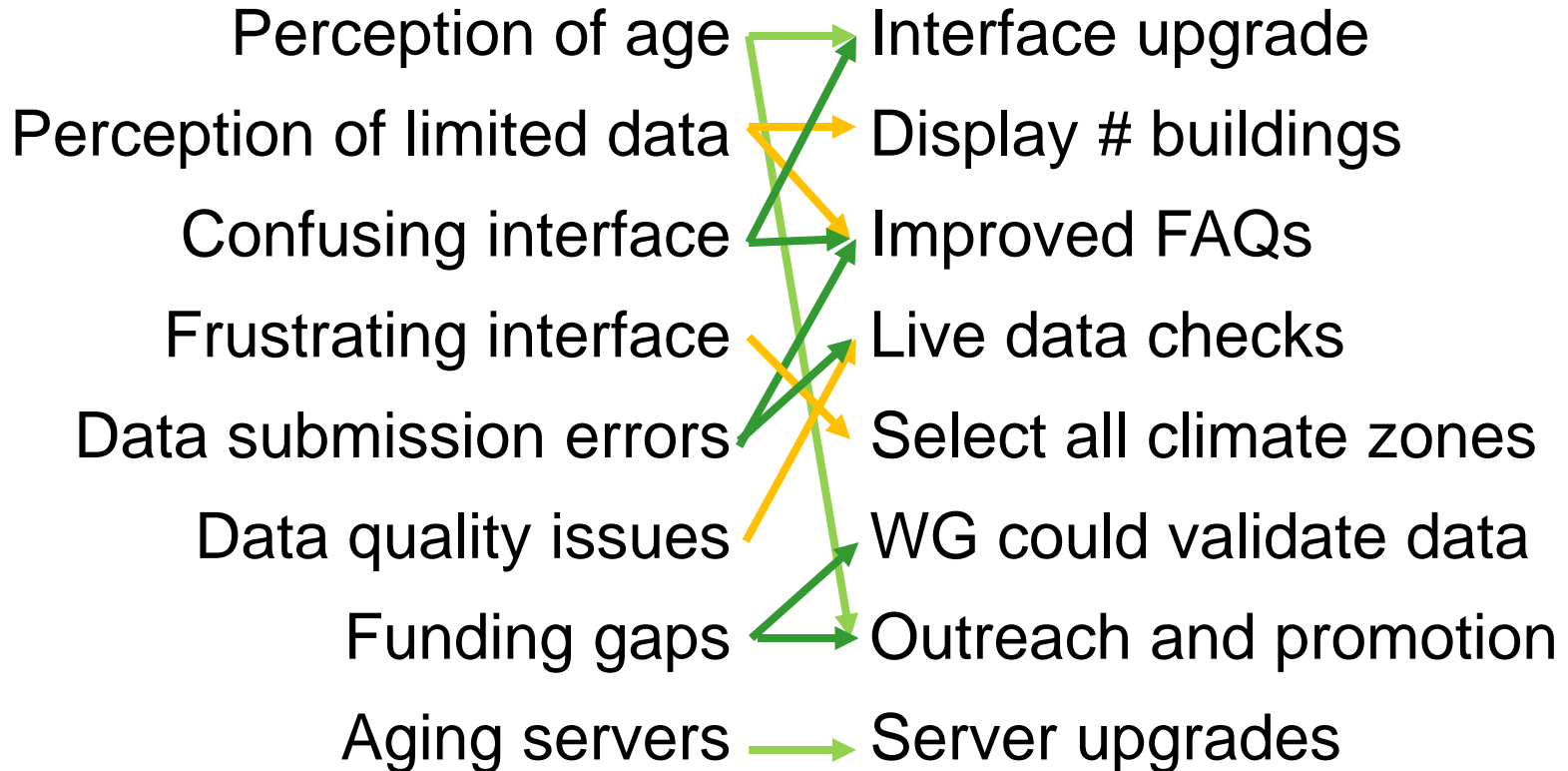
- Kept the lights on!
- 2015 Lab Benchmarking Survey
- New regression analysis of tool data
- Website upgrades
- Identified future potential upgrades



Issues Addressed

Issues

Solutions



Before

LABS FOR THE 21ST CENTURY

benchmarking

Introduction

The purpose of this benchmarking database tool is to allow laboratory owners to compare the performance of their laboratory facilities to similar facilities and thereby help identify potential energy cost savings opportunities. The tool will allow benchmarking with energy use metrics (e.g. BTU/sf/yr) as well as system efficiency metrics (e.g. W/cfm).

To benchmark a facility, you will need to input facility characteristics (e.g. lab type, gross area) and energy use data (e.g. annual electricity use). Although measured data is preferred, estimated data may also be provided. The data you provide will remain anonymous to other users of the database.

Note: You will be prompted for a username and password in order to enter data and benchmark your lab. You may input data over multiple sessions. If you only wish to view the data, without inputting data for your lab, login is not required.

- [Acquire a username and password, or edit your existing profile](#)
- [Bulk data input spreadsheet \(to input 5 or more facilities\)](#)
- [Guidance on how to use this tool for LEED-EB](#)

[Frequently Asked Questions](#)

[Benchmark Your Lab \(login req'd\)](#)

[View Data \(as guest user\)](#)

After

BENCHMARKING



Welcome to the Labs21 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.

Buildings in database: 639

Last database update: July 2016

Enter Data

Enter your data into the database.
Your facilities appear in output reports.
Username and password required.

View Data

View data already in the database.
Output reports show database facilities only.
No login required.



Live Data Checks

Gross Area (sq. ft.)*	<input type="text" value="100000"/>
Lab Area (sq. ft.)* <i>(Area requiring 100% outside air)</i>	<input type="text" value="40"/>
% Biological	<input type="text" value="0"/>
% Chemical	<input type="text" value="0"/>
% Physical	<input type="text" value="100"/>
% Other	<input type="text" value="0"/>

Continue

labs21benchdev.lbl.gov says:

Lab area entered is less than 100 square feet. Please verify lab area

OK

Peer Group Selection: Before

4. Lab Use

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

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

[\(Click here to see map of climate zones\)](#)

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

6. Measured and Estimated data

- Measured
- Estimated

Reset Values

Continue...

Peer Group Selection: After

4. Lab Use

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

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

[\(Click here to see map of climate zones\)](#)

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

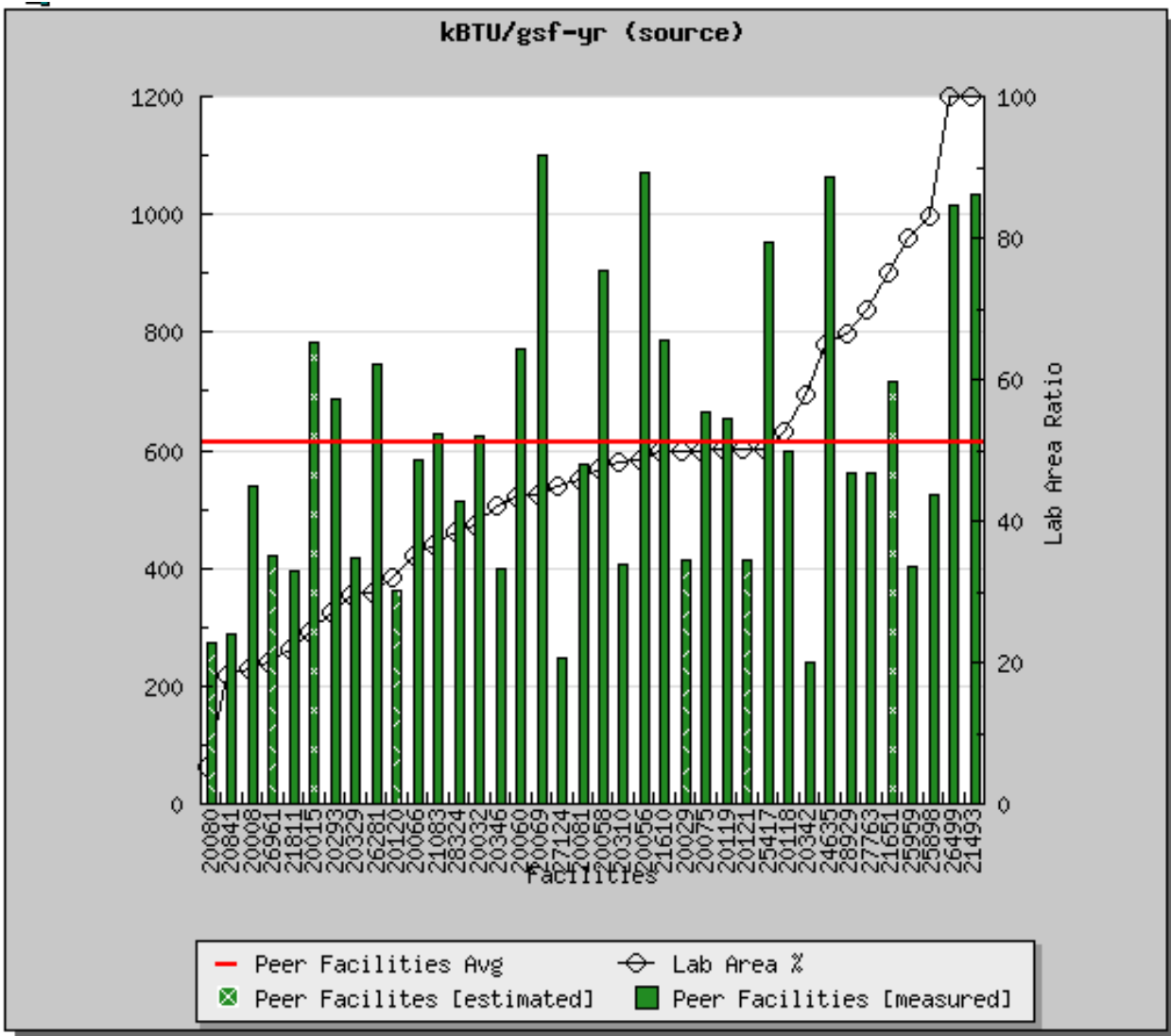
6. Measured and Estimated data

- Measured
- Estimated

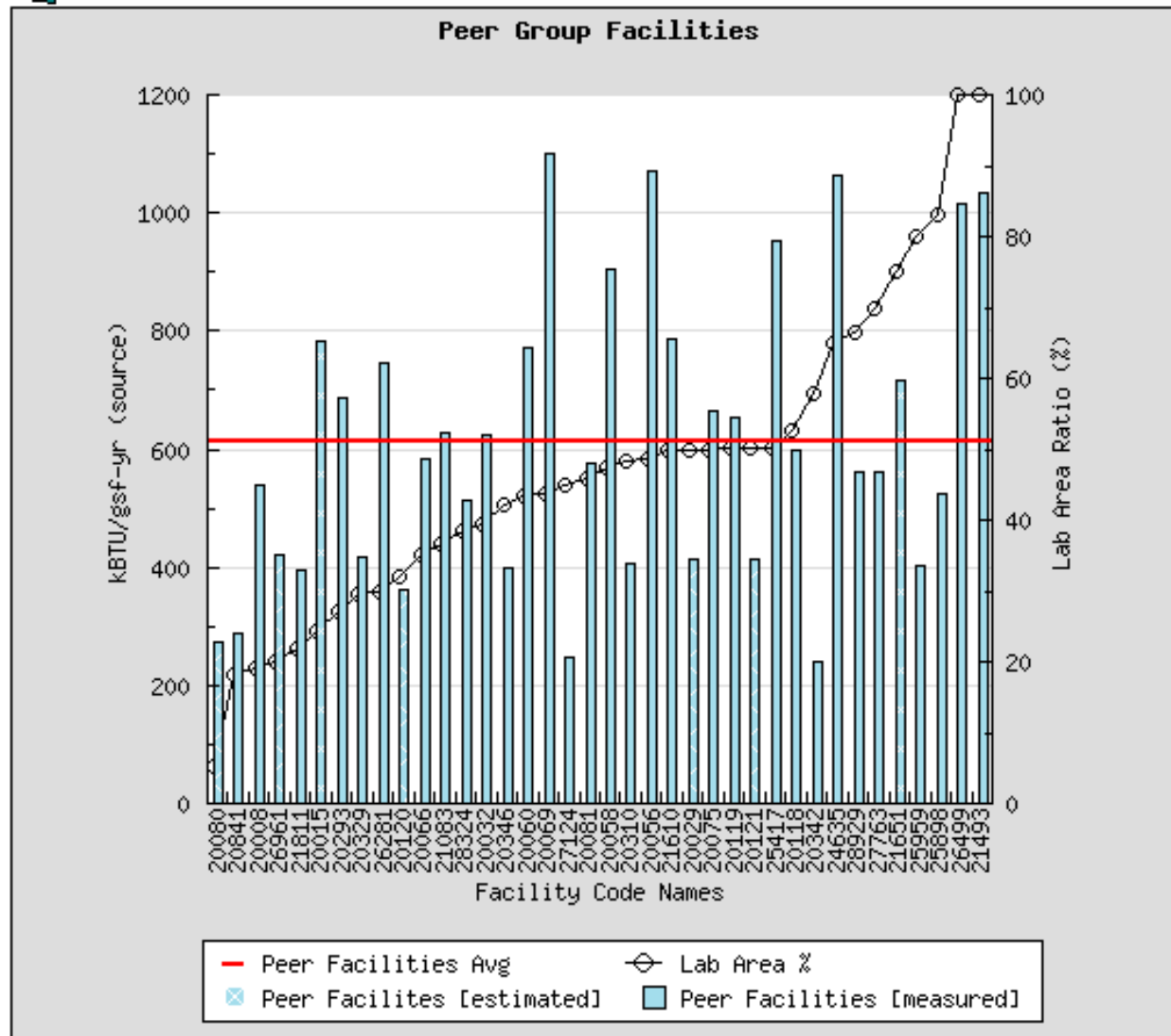
Reset Values

Continue

Output Plot: Before



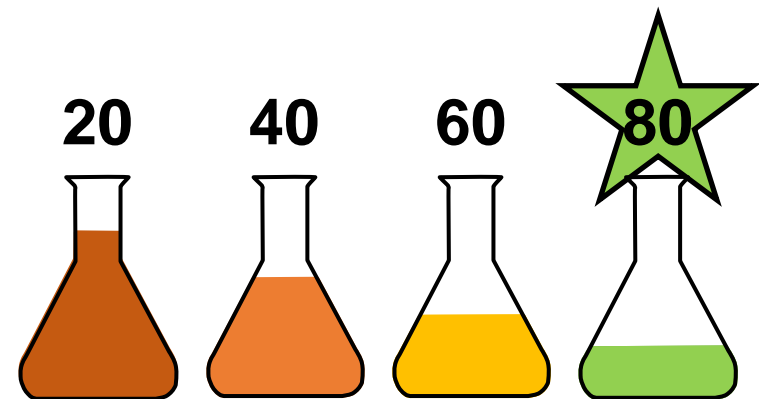
Output Plot: After



There is more work to be done...

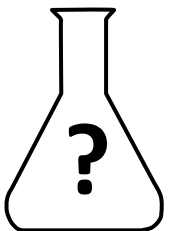
Next Steps: An Energy Score?

- Purpose of benchmarking is comparison
- Energy disclosure: comparison is inevitable
- Could there be an official ranking for labs?
 - We have enough data...
- Could it be fair?



Next Steps: Other Possibilities

- Interface enhancements
 - Interactive graphing interface
 - e.g. BPD, SeventhWave
- New or expanded metrics
 - Energy cost
 - Water use
 - System-level and submetering data
 - Too much to ask?
- Integration with other tools and programs
 - Live data import from Portfolio Manager
 - API for use by others
 - Incorporate use in incentive programs
- Normalization
 - Energy use per research paper published?
 - But many requirements are area-based



Summary

- The Labs21 tool is a unique, valuable, simple, and **free** lab benchmarking resource
- Updates and upgrades:
 - Successful collaboration between I²SL and LBNL
 - More work is required
 - Let us know what you need!
- **Benchmarking Symposium:** A2, Mon 10:30am
- **Working Group Meeting:** Wed 1pm

