

# The Boston Green Ribbon Commission's Lab Benchmarking Study



**Alison Farmer**

**HARVARD  
UNIVERSITY**



Office for Sustainability

**Quentin Gilly**

# Learning Objectives

- Recognize the demand for benchmarking that arises from mandatory public disclosure of energy usage and describe the potential use of benchmarking findings for building owners.
- Evaluate ways to reduce the scatter in building energy datasets and explain the reasons for pursuing reduced scatter; identify some of the difficulties found in the collection of high-quality building data.
- Compare the energy intensity of Boston area higher-ed lab buildings with that of labs in the rest of the country.
- Describe the challenges associated with the construction of an energy score for lab buildings, and identify the relative potential for a score for different types of lab buildings



# BOSTON Green Ribbon COMMISSION

The Higher Education Working Group represents the unique constituency of large research and residential campuses in Boston and neighboring cities.

**Boston Area  
Laboratory Energy  
Benchmarking Study**  
Data Analysis Report  
A Boston Green Ribbon Commission Report

Prepared by kW Engineering  
for the Boston Green Ribbon Commission  
Higher Education Working Group  
MAY 2017



**Institutional  
Renewable Energy  
Procurement:**  
Guidance for Purchasing and Making  
Associated Environmental Impact Claims  
A Boston Green Ribbon Commission Report

Prepared by Meister Consultants Group  
for the Boston Green Ribbon Commission  
Higher Education Working Group  
OCTOBER 2016



**2016 Green Labs Symposium**  
Hosted by the Boston Green Ribbon Commission Higher Education and  
Health Care Working Groups in partnership with Eversource.

## Green Labs Symposium

Bringing together lab experts from the higher education, health care, and biotech sectors to explore challenges and solutions to making our labs more sustainable.

Hosted by the Boston Green Ribbon Commission Higher Education and Health Care Working Groups. With generous financial support for the event provided by Eversource.

# Harvard's science-based climate goal

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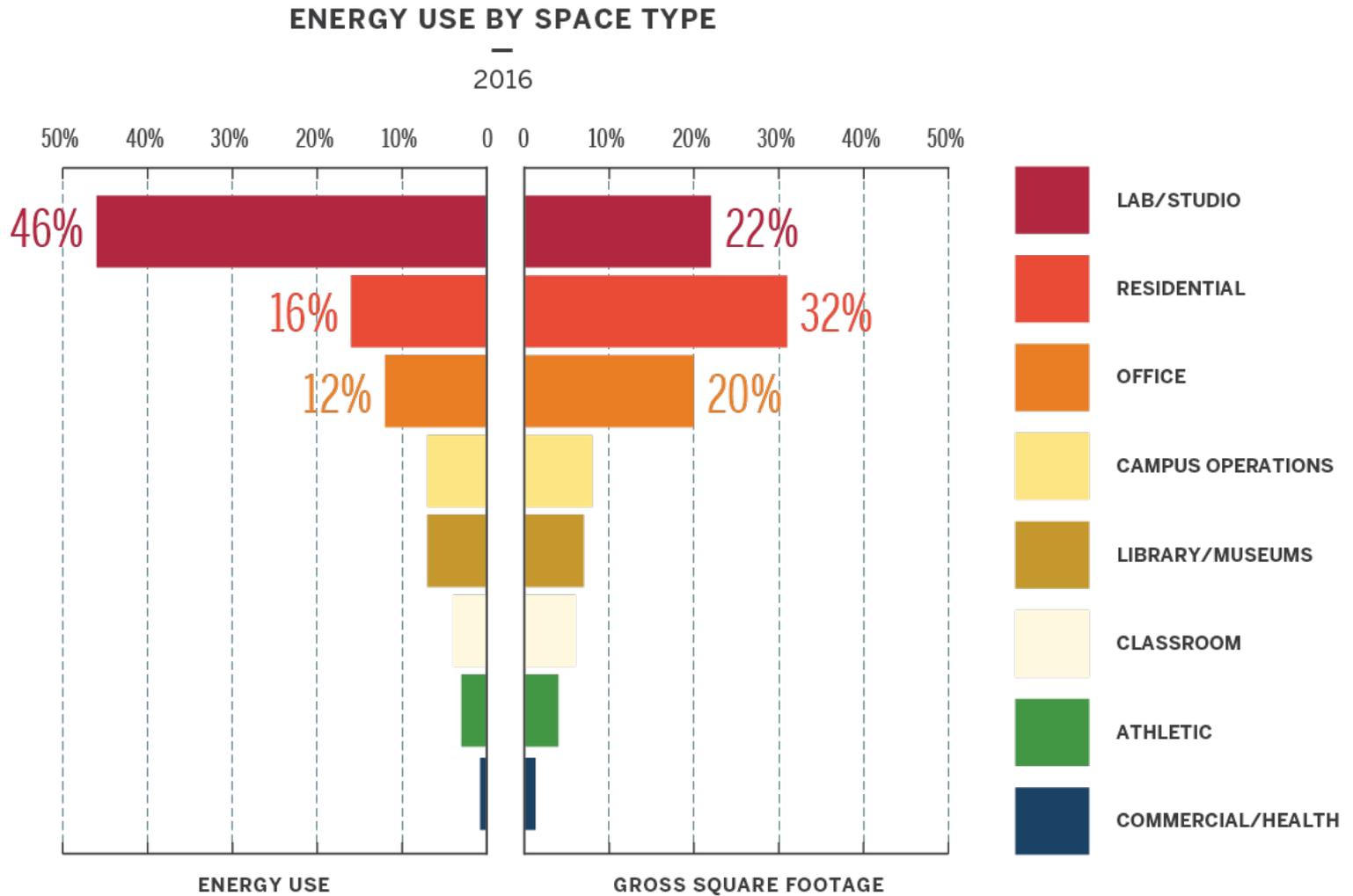
*Reduce emissions 30% from 2006–2016  
(established in 2008)*



## What Made The Goal Unique:

- ▶ Based on established climate science
- ▶ Imposed a short-term target in order to spur immediate action
- ▶ Reflected absolute emissions, inclusive of campus growth
- ▶ Included all properties within operational control throughout North America

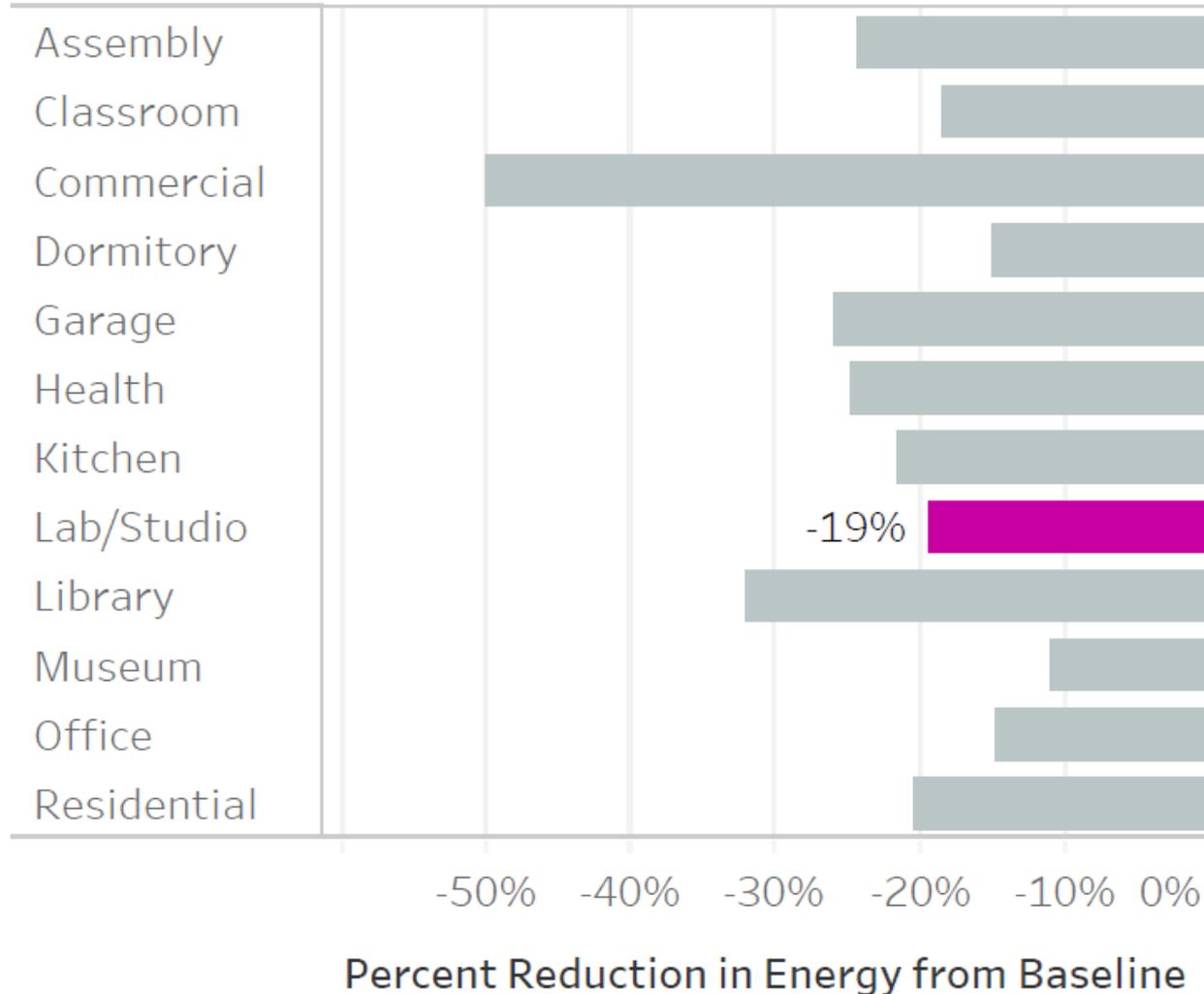
# Labs drive energy use



# Green Labs Program focuses on energy use



FY06-FY16 Energy Reduction (Growth Excluded)



# Why lab benchmarking is important



- Set a foundation of lab EUI data for the New England region.
- Inform city benchmarking energy disclosure ordinances.
- Helps Harvard and its neighbors develop more informed energy goals with renovations and new construction projects.

# Collecting lab energy use data



## Lesson learned:

- Planning ahead and making sure you get accurate data on the front end is vital to success.

## Data collection process:

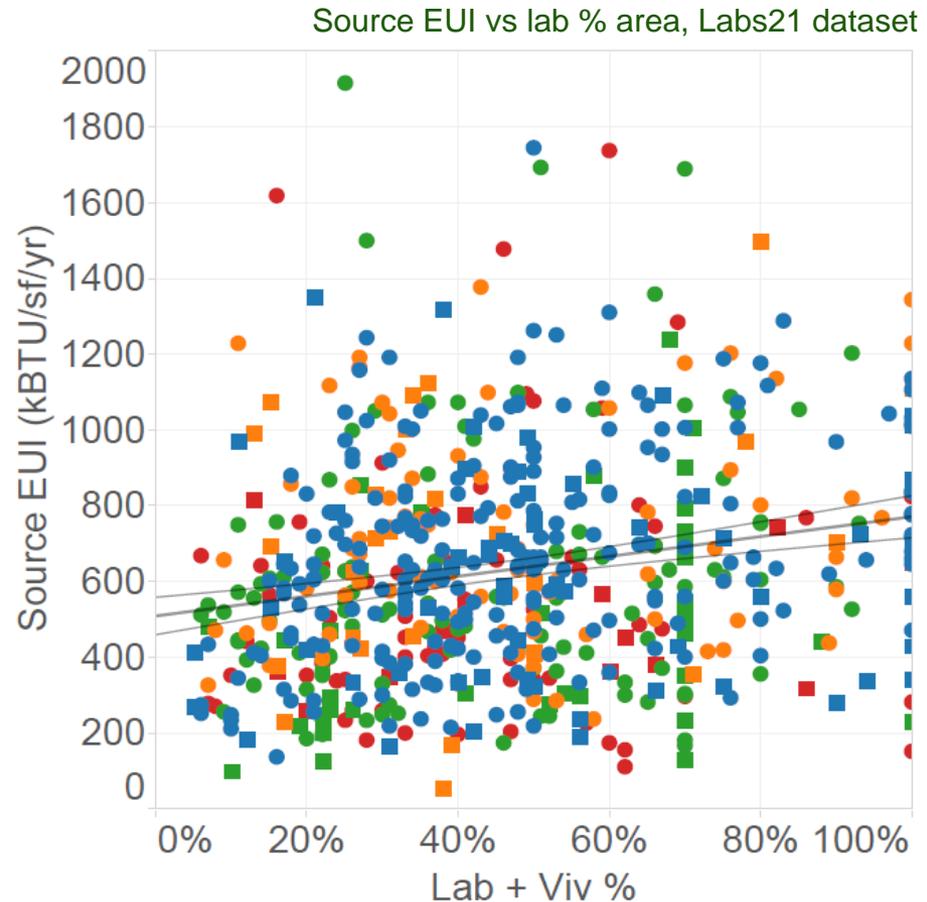
- Alison sent out questions to participants.
- At Harvard, the questions were incorporated into another screening form that we were already working on.
- Data took longer than anticipated to collect.
- We spoke with central data resources, building managers, and Siemens (in-house service providers).

# Next steps now that we have data

- Continue to expand the dataset to include more laboratory buildings.
  - Invited other sectors to participate (health care and private sector labs)
  - Expanding university participants beyond Boston region
- Review the opportunity of benchmarking lab building water usage and other new metrics.
- Consumer's perspective.

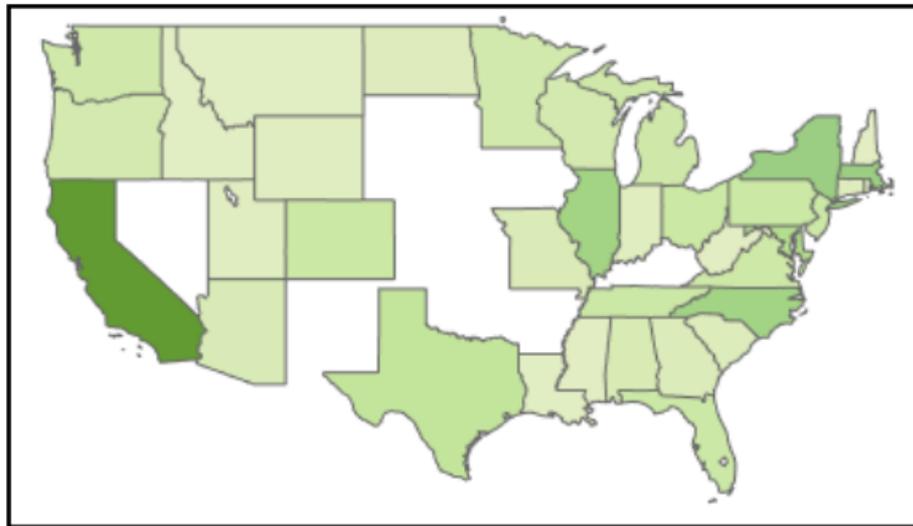
# The State of Lab Benchmarking

- Benchmarking labs is not new, but...
- Labs21 set: **639** buildings in 2016
- Lots of scatter
- Why so much?
- Can this dataset be useful?



# The Analyst's View

- An **opportunity** to elevate the state of lab benchmarking:
  - Motivated participants
  - Lots of labs from one place and time
  - Current industry interest in benchmarking
  - Chance to develop an energy score for labs



Locations (by state) of buildings in Labs21 dataset (as of 2016)

# Data Gathering

Basic Info	CY 2014 Energy Usage	Building Breakdown	HVAC Systems	Occupancy	High-Intensity Spaces	Perceptions
Institution	Electricity	<b>Gross building area</b>	<b># fume hoods</b>	<i>Typical occupied hours</i>	Freezer farms	Efficient design?
Building name	Chilled water	<b>Predominant non-lab space type</b>	FH control type	Partial occupancy in 2014?	Data centers	Efficient operation?
City	Natural gas	<i>Lab type</i>	Lab HVAC system type		Clean rooms	
Year built	Steam or HW	<i>Lab purpose</i>	HVAC control type			
	Metered or modeled	<b>Total lab area</b>	<i>Design min ACH in labs</i>			
		<b>Total vivarium area</b>	Night airflow setback in labs?			
			24/7 HVAC operation?			
			100% outside air?			
			Exhaust air heat recovery?			

**Legend:**

Mandatory data requests in **bold**.

Standard Labs21 Benchmarking Tool data points in **green**.

Functional requirements in *italics*.

- Energy usage plus...
  - Building properties
  - Reputation
  - HVAC system properties
- All data reviewed
  - Quickly but **consistently**

# Results

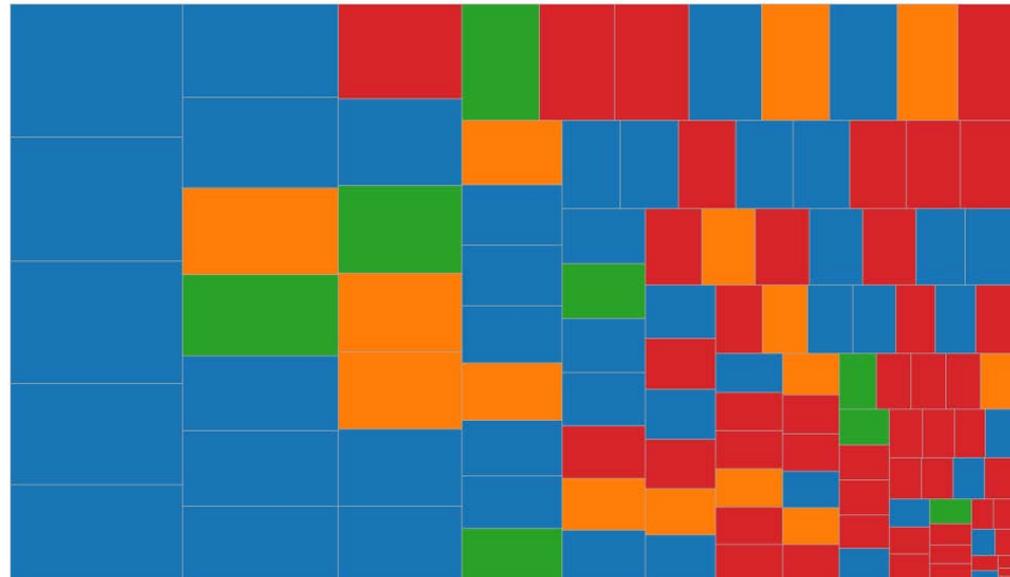
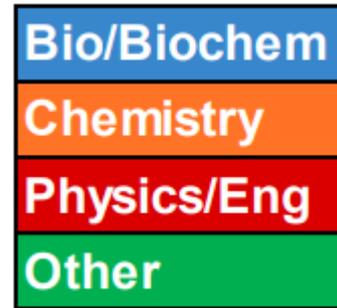
- **121 buildings!**

- Energy usage and building properties for most (CY2014 and 2015 so far)

- Boston academic labs use about same energy as others. OK...

- **3 things:**

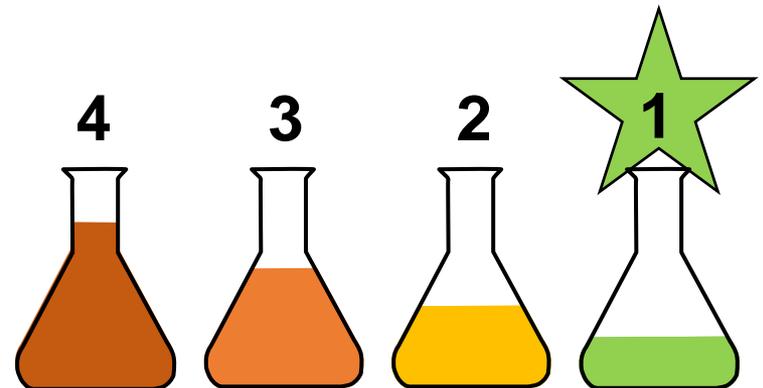
- Energy scores
  - Data quality
  - Best practices benchmarking



Tree diagram: 2014 source energy consumption of all buildings

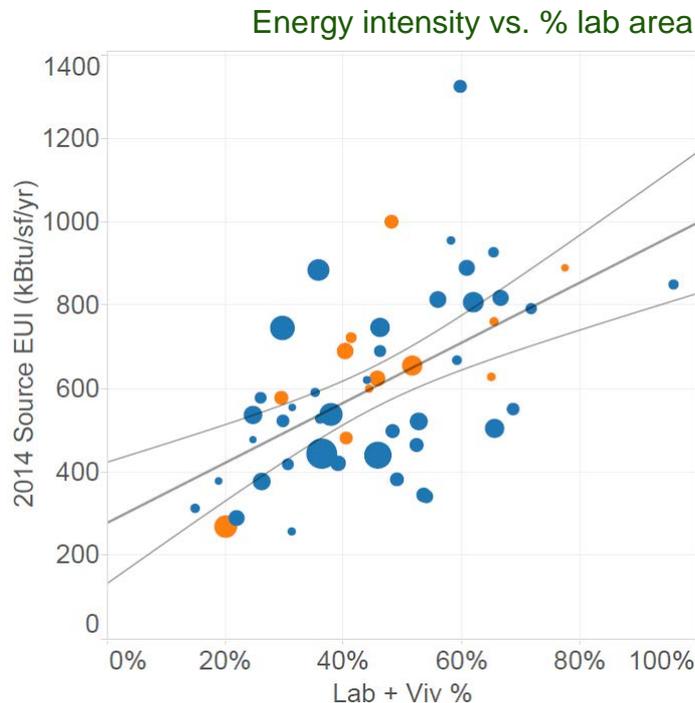
# Energy Scores for Labs?

- No Energy Star score for labs
- Is it even feasible?
  - No, based on Labs21 data
- **Why do we care?**
  - Makes comparison fairer
  - Compare with “all” labs at once
  - Gauge progress using single number



# Developing a Lab Energy Score

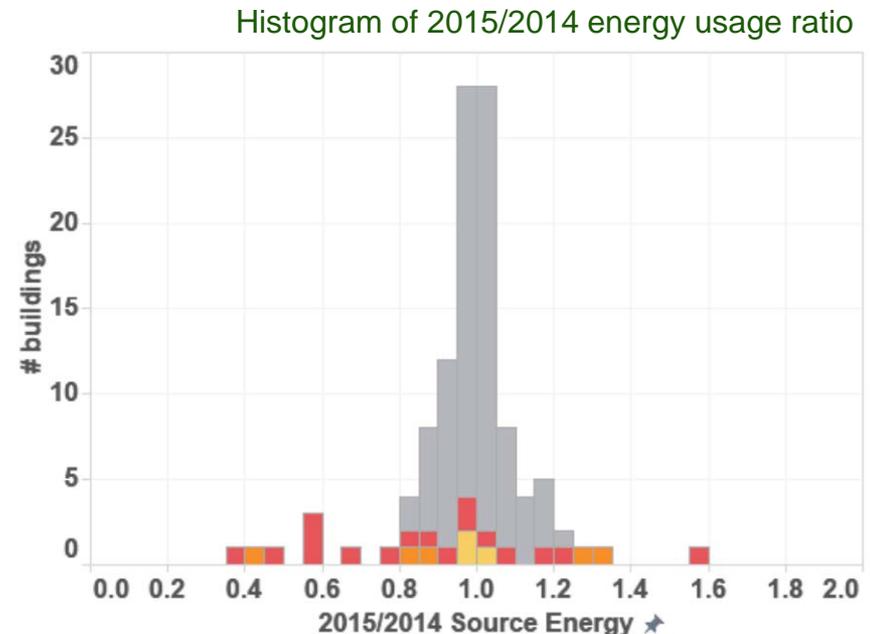
- Multivariate regression analysis
  - % lab area
  - Lab type
  - # fume hoods per lab area
  - Occupied hours/wk



- Works well for **bio** and **chem** buildings ( $R^2 = 38\%$ )
  - All of these assigned a score (1 to 4)
- More scatter for **physics / engineering** – no scores for now

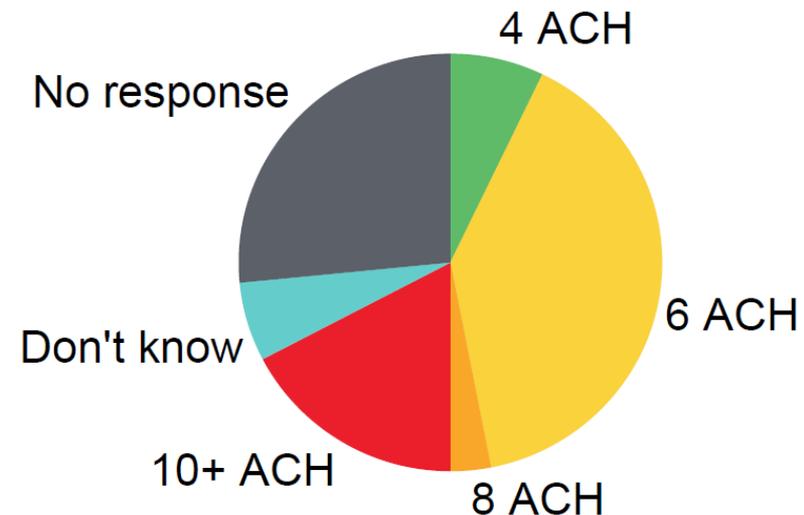
# Data Quality

- High quality data! **But...**
  - Comparing 2014 and 2015 data revealed inconsistencies
  - 30% of buildings reported more than 10% change in energy use
  - Back-checks revealed various causes
  - Revised results...
- Also: missing data on some building properties



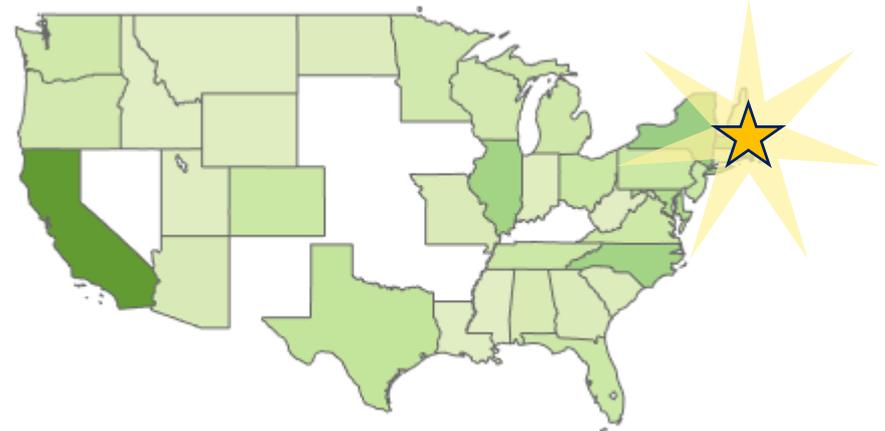
# Best Practices Benchmarking

- 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



# Summing Up

- Thanks to the GRC HEWG for the opportunity!
- Useful for Harvard, the GRC, and the industry as a whole
- Data now in the Labs21 database
- Stay tuned for the final year's report



# Questions?

## Year 1 Report:

<http://www.greenribboncommission.org/document/boston-area-lab-energy-benchmarking-study/>

## Year 2 Report:

<http://www.greenribboncommission.org/document/boston-area-laboratory-energy-benchmarking-study-supplemental-report-2015-data/>



[www.greenribboncommission.org](http://www.greenribboncommission.org)



**Alison Farmer**

[afarmer@kw-engineering.com](mailto:afarmer@kw-engineering.com)

**HARVARD**  
UNIVERSITY



Office for Sustainability

**Quentin Gilly**

[quentin\\_gilly@harvard.edu](mailto:quentin_gilly@harvard.edu)