Benchmarking Progress:
Examining the Effectiveness of Benchmarking and Transparency Programs

July 31, 2017

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Agenda

- Introduction – Andrew Burr and Zachary Hart
- Natalie Mims and Steven Schiller: “Benchmarking and Transparency Programs: Attributes, Impacts and Best Practices”
- Prof. David Hsu: “Estimating Energy Savings from Benchmarking Policies in New York City (and for Other Cities!)”
- Patrick Hughes: “NEMA Benchmarking Impact Survey: Measurement Prompts Management”
- Q&A

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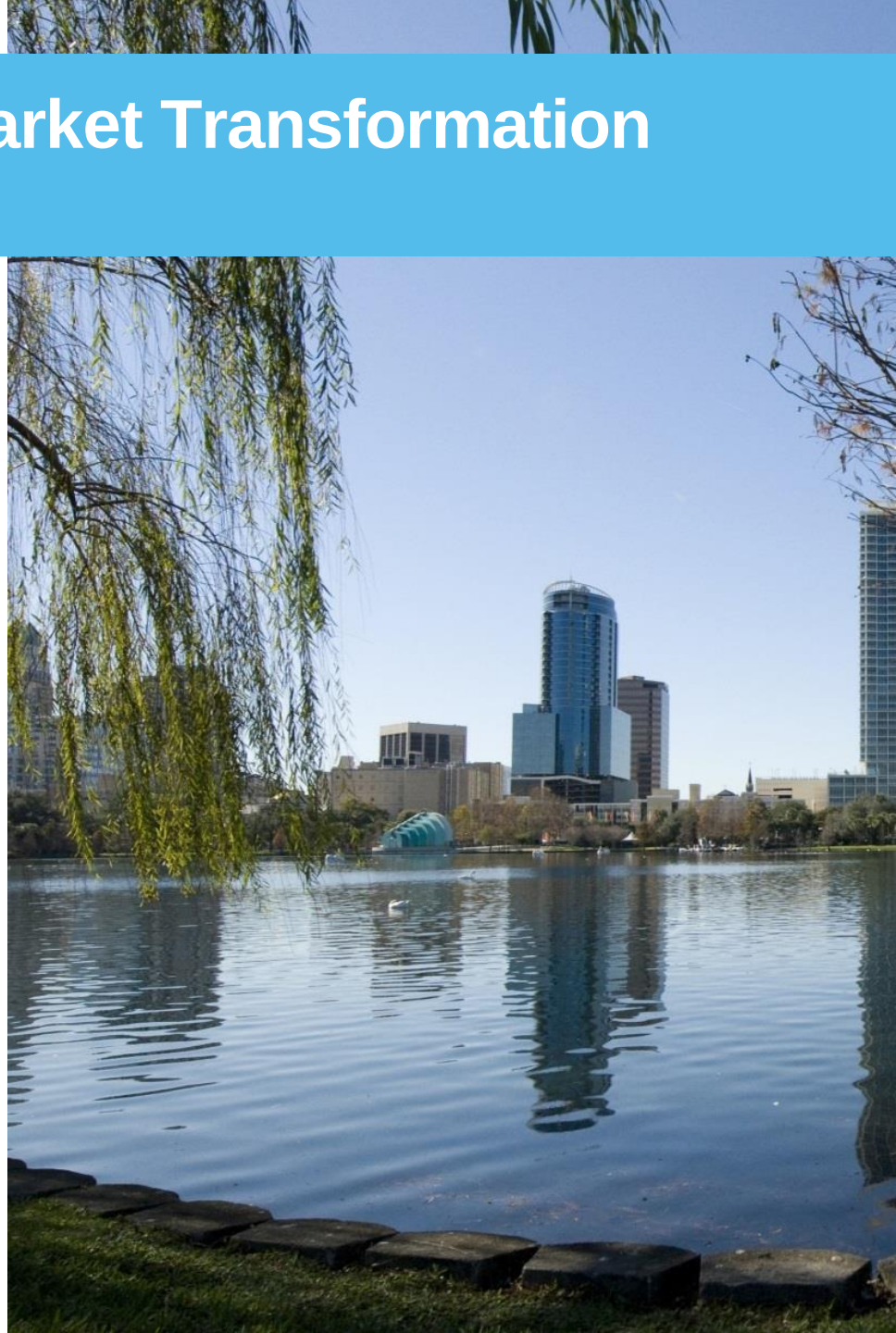
The Institute for Market Transformation (IMT)

Our Vision

A future in which the social, environmental, and economic value of energy efficiency is realized and all buildings are highly efficient.



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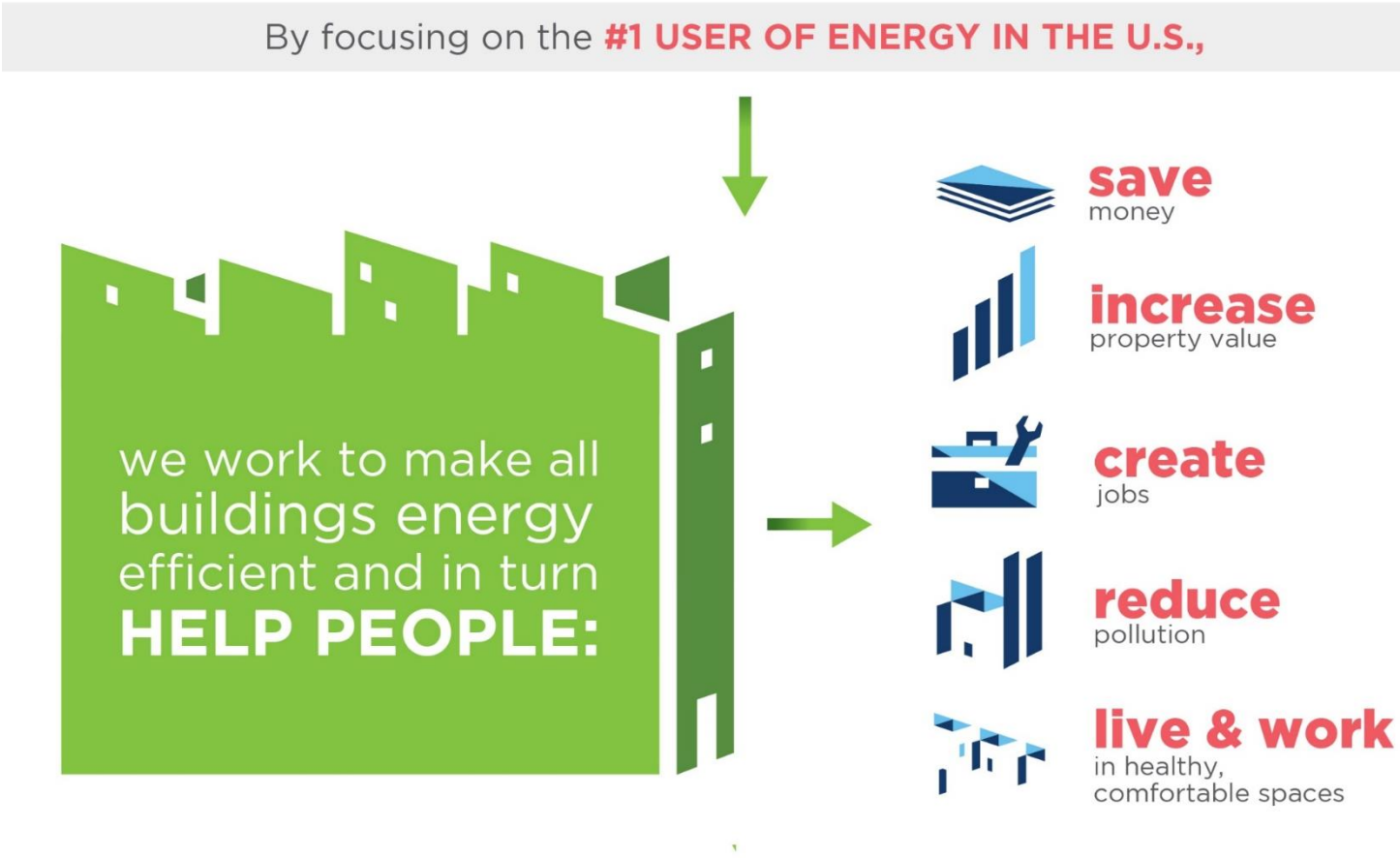
Why Buildings?



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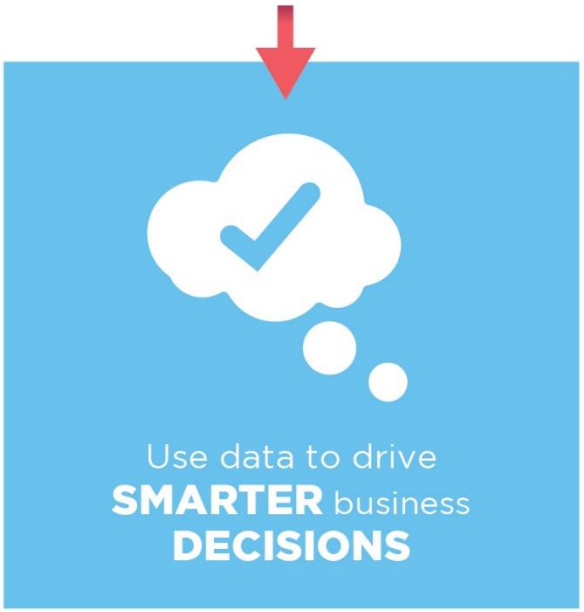
How We Work

The Institute for Market Transformation (IMT) supports building owners, tenants, governments, and other city and corporate stakeholders to:



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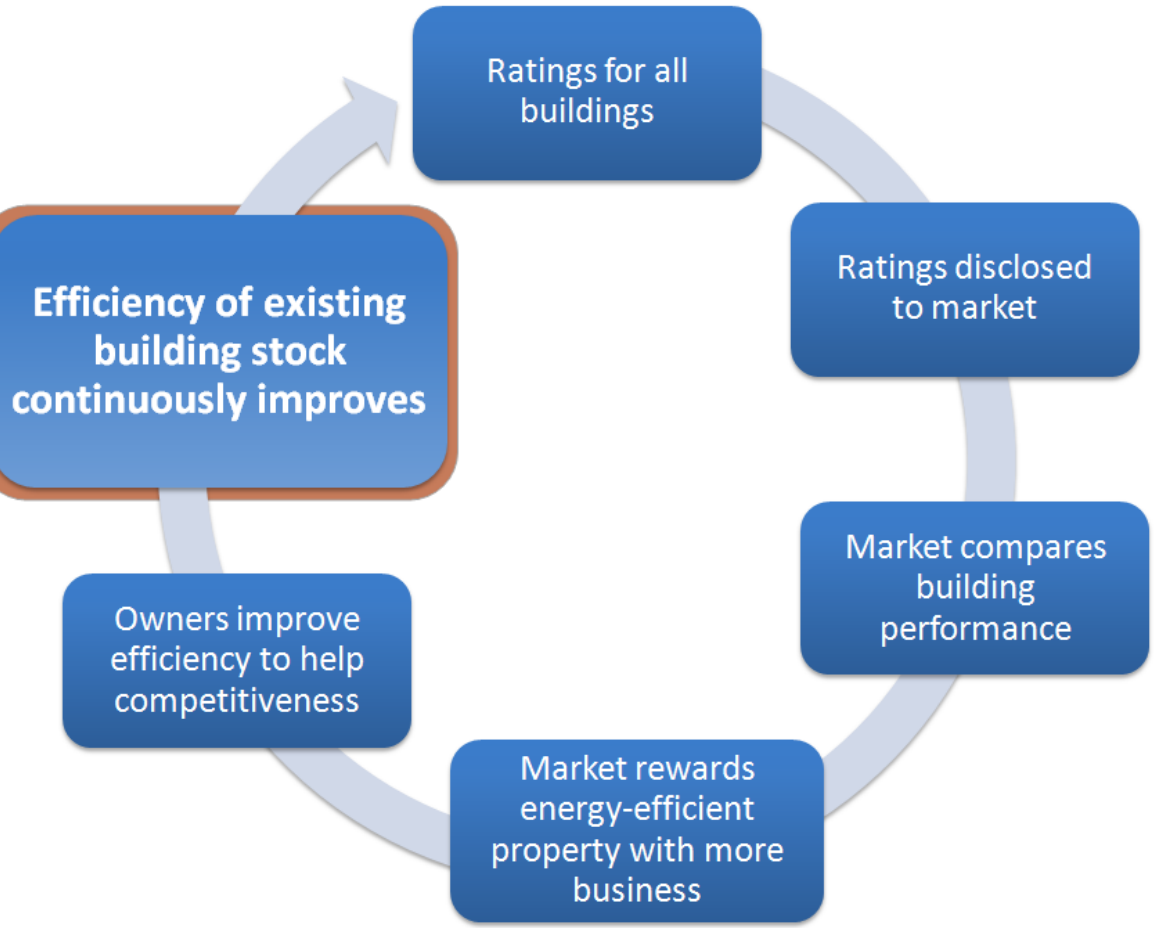
Benchmarking and Transparency Policy

Elements of Benchmarking Policy

Policy Framework

Component	Audience	Outcomes
Benchmarking	▪ Building Owners	Owners compare their properties to peers and look for opportunities to improve
Reporting	▪ Policymakers ▪ Utility program administrators ▪ Researchers	▪ Target incentives toward low performing buildings and market sectors ▪ Track progress toward goals
Transparency	▪ Buyers and tenants ▪ Brokers ▪ Financing and investment firms	▪ Purchasing and leasing decisions include information about energy use ▪ High performing buildings achieve higher valuations and lower vacancy rates

Benchmarking and Transparency Policy



When performance is measured, performance improves. When performance is measured and reported back, the rate of improvement accelerates.

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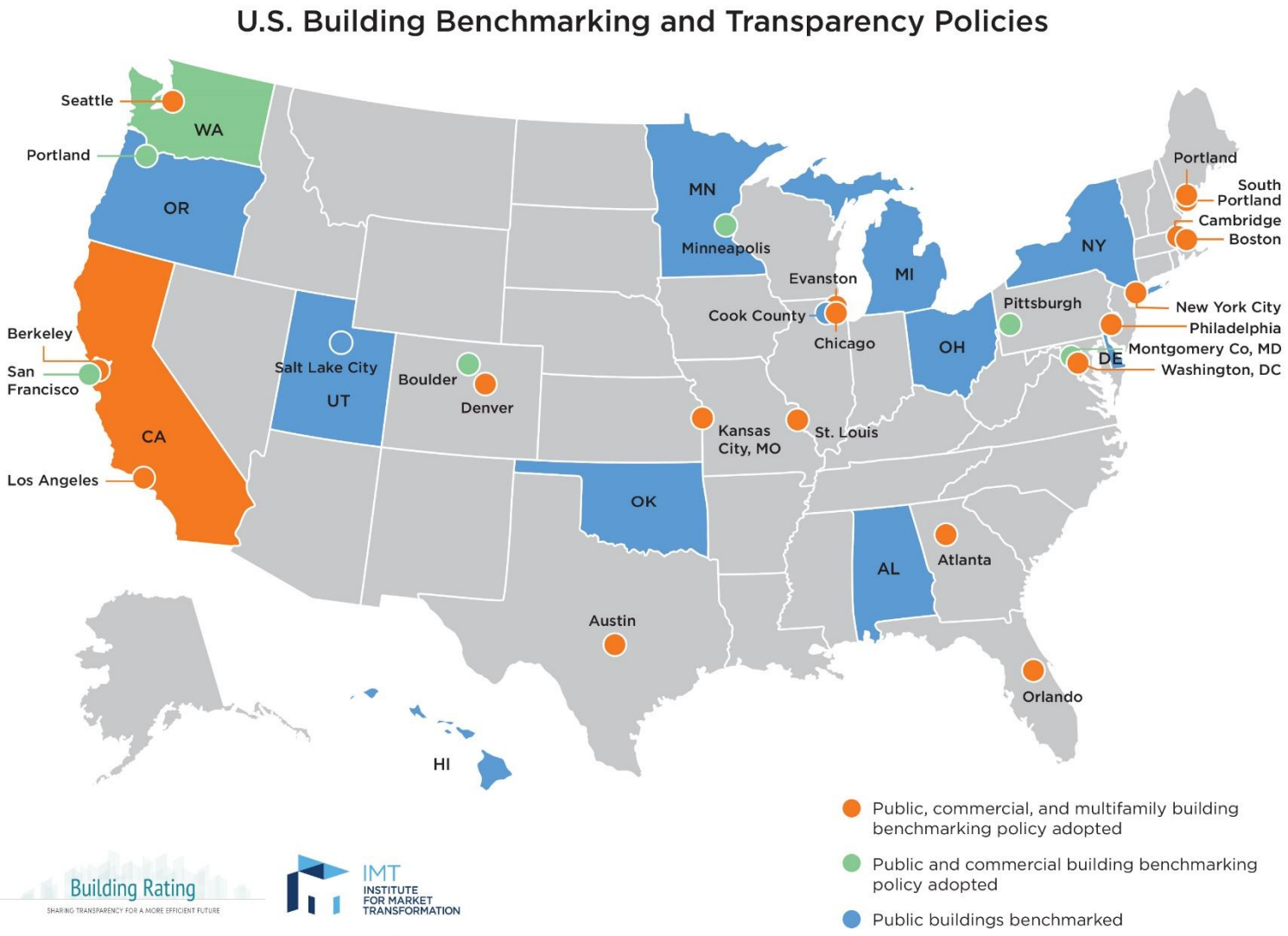
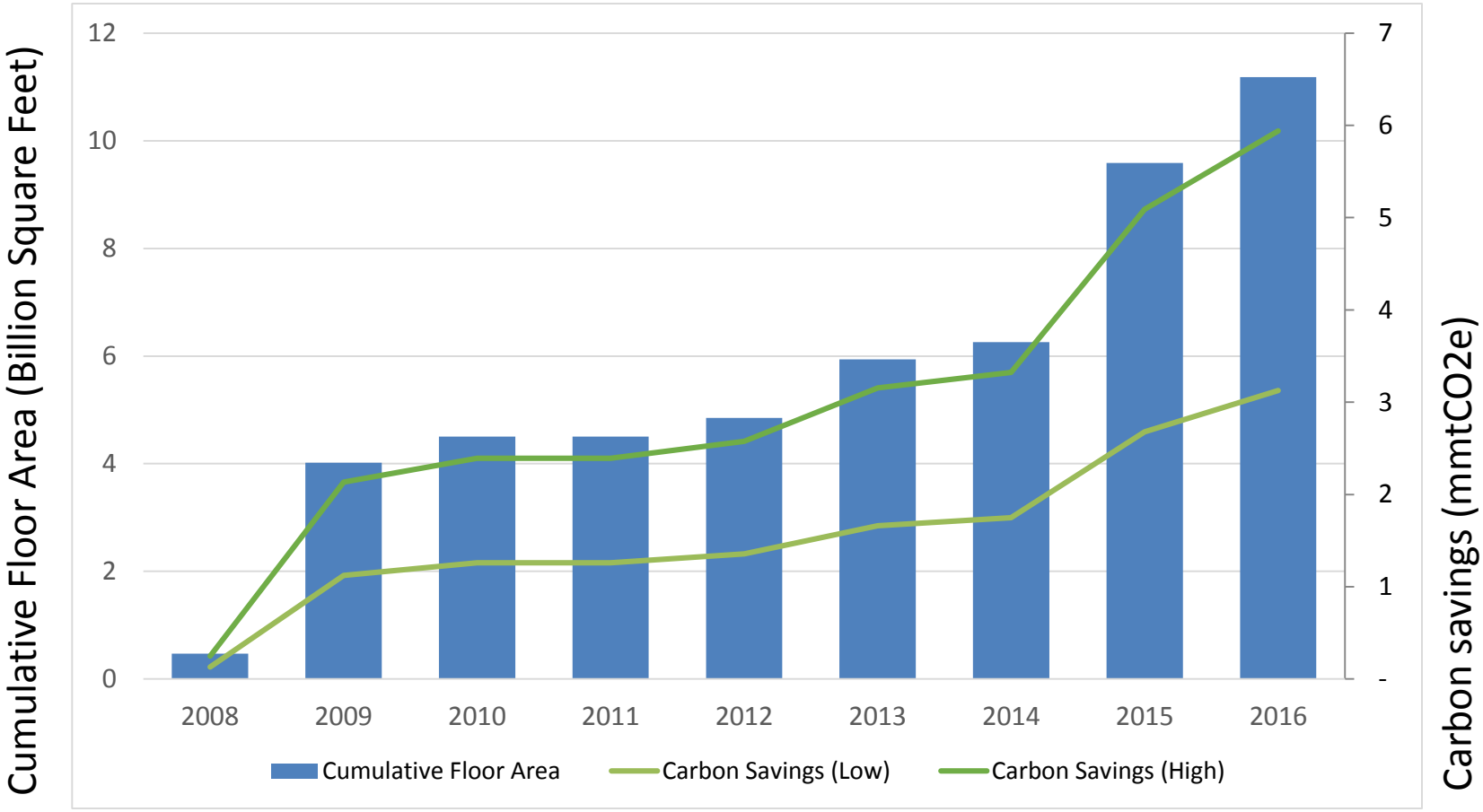
Jurisdictions with Benchmarking Policies



Square footage subject to benchmarking ordinances



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Energy Technologies Area Lawrence Berkeley National Laboratory

Benchmarking and Transparency Programs: Attributes, Impacts and Best Practices

Natalie Mims and Steven Schiller

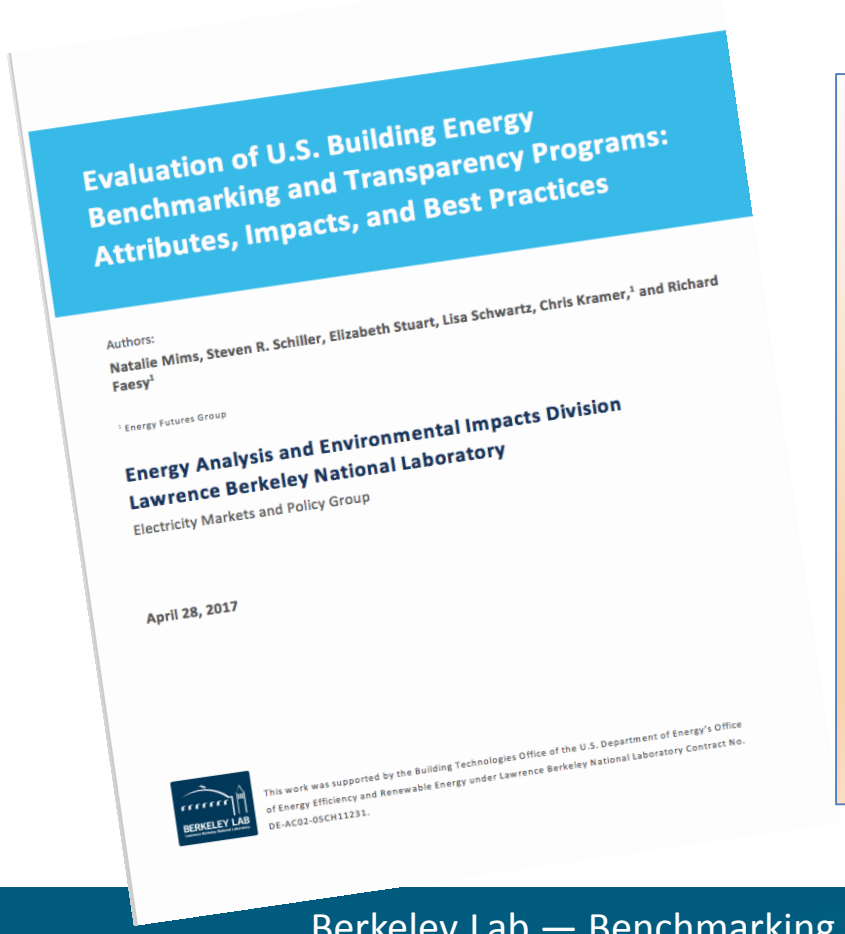
July 31, 2017

This work was supported by the DOE Office of Energy Efficiency & Renewable Energy Building Technologies Office under Lawrence Berkeley National Laboratory Contract No. DE-AC02-05CH11231.

Report overview

Evaluation of U.S. Building Energy Benchmarking and Transparency Programs: Attributes, Impacts and Best Practices (April 2017)

https://emp.lbl.gov/publications/evaluation-us-building-energy


Evaluation of U.S. Building Energy Benchmarking and Transparency Programs: Attributes, Impacts, and Best Practices

Authors:
Natalie Mims, Steven R. Schiller, Elizabeth Stuart, Lisa Schwartz, Chris Kramer,[1] and Richard Faesy[1]

[1] Energy Futures Group

Energy Analysis and Environmental Impacts Division
Lawrence Berkeley National Laboratory
Electricity Markets and Policy Group

April 28, 2017

This work was supported by the Building Technologies Office of the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy under Lawrence Berkeley National Laboratory Contract No. DE-AC02-05CH11231.

Report Purposes:

- The Energy Efficiency Improvement Act of 2015 required the Department of Energy to provide Congress with an overview of policy and implementation attributes of benchmarking and transparency (B&T) policies.
- Focus of report was on the 24 jurisdictions (as of end of 2016) that require privately-owned commercial buildings to participate in B&T policy

Report components

(1) Summarizes B&T policy design and implementation characteristics:

- Building types and sizes
- Phased implementation
- Data requirements
- Enforcement and compliance
- Market education and outreach
- Data quality assurance
- Compliance help centers
- Implementation costs
- Data access and privacy
- Complementary policies
- International experiences

(2) Summarizes the enabling role of B&T policies and how effects (impacts, indicators, and milestones) are evaluated and determined; with some initial indications of identified impacts

(3) Identifies some best practices in B&T policy design, implementation and research

Report approach

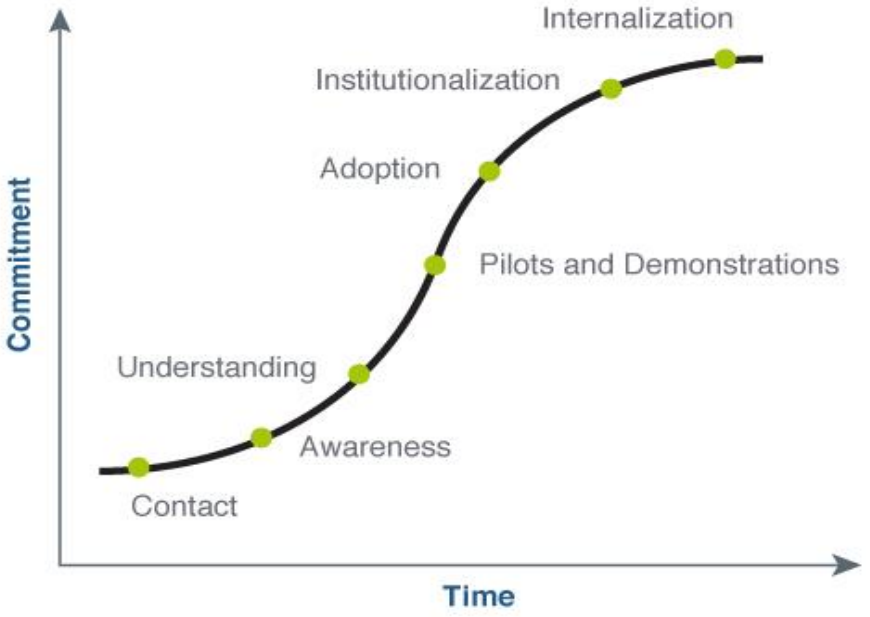
- Interviewed staff from 13 jurisdictions that have implemented B&T policies for at least three years
  - Austin, TX; Boston, MA; Cambridge, MA; Chicago, IL; Minneapolis, MN; Montgomery County, MD; New York, NY; Philadelphia, PA; San Francisco, CA; Seattle, WA; Washington, D.C; and the states of California and Washington
- Reviewed jurisdiction B&T ordinances
- Reviewed recent research, including:
  - Annual reports and data from jurisdictions that compiled information
  - Data and reports from sources such as Portfolio Manager, DOE, IMT, and Resources for the Future
  - Third party evaluations from sources such as U.S. DOE, NEMA and MIT

Three types of B&T performance metrics discussed in the report

Metric Category	Examples
Energy Impacts As used in common practice, *energy impacts* are defined as those directly associated with reductions in energy consumption, demand, or both.	• Energy use intensity • Normalized energy use intensity • ENERGY STAR Score
Non-Energy Impacts *Non-energy impacts* are the wide variety of positive and negative effects beyond energy savings that are delivered to utilities, participants, and society as a consequence of delivering energy efficiency programs and measures.	• Understanding of the building's energy use • Use of benchmarking data to make utility efficiency programs more effective • Indicators that enable governments to better understand building stocks in their jurisdictions • Metrics to rank the building against others in a portfolio, allowing prioritization of energy efficiency investments
Market Transformation/Adoption *Market transformation* is a reduction in market barriers resulting from a market intervention, as evidenced by a set of market effects that is likely to last after the intervention has been withdrawn, reduced, or changed.	• Increased awareness of energy use by building owners and increased market actor awareness of energy • Increased energy awareness by occupants/users (e.g., store customers)

Understanding how B&T policies support lower building energy use and cost

- B&T policies are enabling strategies that rely on market transformation to support improvements in energy efficiency
- These policies themselves do not improve energy efficiency or reduce water consumption and pollution
- B&T policies address barriers to achieving these goals (e.g., lack of information on potential opportunities and benefits of reducing energy waste in buildings)



An analogy for B&T policies are information labels on food products that compare their nutritional content to an established benchmark. In this case, the primary goal is healthier people. The nutritional information does not directly result in healthier people or healthier eating habits, but provides the information that allows people to make their own eating habit choices.

B&T data

- Berkeley Lab did not do new impact analyses; relied on reported information from jurisdictions and third party studies.
- What we found:
  - Currently jurisdictions are only tracking building-specific data such as energy consumption and building square footage
    - Some form of energy impact data (year to year changes have been reported for just eight cities)
  - Little to no systematic or comprehensive non-energy impact or market transformation data being gathered or analyzed
    - An exception is the NEMA work, which will be presented today
    - With exception of one report on New York City jobs, no non-energy impact reports were found

B&T policy energy and non-energy performance data

Jurisdiction	Jurisdiction Annual Report(s)	Third-Party Report(s) Available	Data for Privately Owned Buildings Available for at Least One Year	Data for Privately Owned Buildings Available for Multiple Years	Energy Impacts Metrics Data Available	Non-Energy Impacts Metrics Data Available	Market Transformation Metrics Data Available	Interim Implem-entation Milestone Data Available
Austin	No	Included in third-party evaluation of four cities	Yes	2013–2015	Yes	No	No	No
Boston	Program year 2013	No	Yes	2014 and 2015, not weather- normalized	No	No	No	Yes
Cambridge	Program year 2014	2016 ACEEE Summer Study paper	Yes	No	No	No	No	Yes
Chicago	Program years 2015 and 2016	No	Yes	2014 and 2015, weather- normalized	Yes	Yes	No	Yes
Minneapolis	Program years 2012, 2013, and 2014	No	Yes	2014 and 2015, weather- normalized	Yes	No	No	Yes
New York City	Program year 2013	Several third-party evaluations	Yes	2012–2015, weather-normalized	Yes	Yes	Yes	Yes
Philadelphia	Program years 2013 and 2014	No	Yes	2013 and 2014, not weather- normalized	Yes	Yes	No	Yes
Portland, OR	Program year 2015	2016 ACEEE Summer Study Paper	Yes	No	No	No	No	Yes
San Francisco	Performance report for 2010–2014	Included in third-party evaluation of four cities	Yes	2011–2015, weather-normalized	Yes	Yes	No	Yes
Seattle	Program Years 2011–2013	Process evaluation and included in third-party evaluation of four cities	Yes	2011–2013; 2015 available online	Limited	No	No	Yes
Washington, D.C.	Program years 2013–2014	2012 Office Building Performance	Yes	2011-2015, weather-normalized	Partial	Partial	No	No

B&T impact evaluations

Jurisdiction	Title of report(s)	Period of time covered by report (s)	Energy savings
Chicago	Chicago 2016 Annual Report (City of Chicago 2016)	2013–2015	Cumulative 1.6% decrease over three years (212 buildings analyzed in 2015) Cumulative 4% decrease over three years (200 buildings analyzed in 2016)
Minneapolis	Minneapolis 2014 Annual Report (City of Minneapolis 2016)	2013–2014	Approximately 2% increase in EUI from 2013 to 2014. The 2017 report showed a 1.8% decline in EUI from 2014 to 2015.
New York City	NYC 2013 Annual Report (City of New York 2016)	2010–2013	Cumulative 6% reduction over three years
	MIT/University of PA Study (Meng et al. 2016)	2011–2014	Cumulative 14% reduction over four years
	DOE Report (Navigant Consulting Inc. and Steven Winters and Associates, Inc. (2015b).	2010–2013	Cumulative 5.7% reduction over four years
Philadelphia	Philadelphia 2014 Annual Report (City of Philadelphia 2016)	2012-2014	"Raw energy usage increased in 2014, but when normalized for weather, building performance improved between 2013 and 2014."
San Francisco	San Francisco Annual Report (SFE 2015)	2010–2014	Cumulative 7.9% reduction
Seattle	Seattle 2015 Annual Report (2013 data) (Seattle Office of Sustainability 2015)	2012–2013	Decrease of 0.6% (2012–2013) Decrease of 2.7% (2014–2015)
Austin, New York, San Francisco, and Seattle	Resources for the Future 2015 Report (Palmer and Walls 2015b)	Post early 2012 when the first program took effect through 3rd quarter of 2013	About 3% reduction in quarterly utility expenditures

B&T impact evaluation findings

- Most B&T policy impact evaluations found that there are reductions in energy use, energy cost, or energy intensity.
  - 3-8% reductions in gross energy consumption or energy use intensity over the 2-4 year period of B&T implementation studied.
  - Two studies to date (one to be covered on this webinar) indicate that there is a causal relationship between B&T policies and energy savings, or at least energy cost savings.
- However, these indications should be considered preliminary. Future analyses may confirm, or not, these hypotheses and provide greater specificity on the range of energy impacts and their causes (to inform policy design and implementation)

Recommendations for B&T policy design, implementation, and research

- Our report included recommendations on:
  - Benchmarking and transparency policy design and implementation
  - Access to data
  - Performance metrics
- Examples of data and data analysis recommendations:
  - Collect comprehensive data on the subject buildings with a focus on consistent definitions (such as square footage) and quality control checks/verification.
  - Provide publicly available data, in a user friendly way, that can be used for assessing both high level metrics such as changes in energy intensity from year to year, but also more granular assessments of other metrics of interest

Recommendations for B&T policy design, implementation, and research (cont'd)

- Examples of implementation recommendations include:
  - Provide annual B&T reports with summary statistics of data, performance metrics, and identified areas of opportunity for improvements in the jurisdiction's building stock
  - Provide a range of support services and complimentary programs at the local level. For example:
    - Create user-friendly, online resources such as "how-to" guides and online forums
    - Use webinars, in-person trainings, and online training documents and videos
    - Establish help centers with jurisdiction staff, contractors, or local trade association volunteers
    - Provide additional support at designated periods in the B&T policy implementation—e.g., during initial implementation and during "high traffic" times when compliance deadlines approach
    - Consider creation of national/regional help desks to encourage data consistency across jurisdictions and reduce implementation costs

Recommendations for B&T policy design, implementation, and research (cont'd)

- Examples of implementation recommendations include:
  - Support high levels of compliance by, for example:
    - Measure compliance every year by building type and size category
    - Collect data on barriers to compliance and develop a range of strategies to address the barriers (e.g., educational efforts)

Technical Assistance

- LBNL's provides technical assistance to state utility regulatory commissions, state energy offices, tribes and regional entities in these areas:
  - Energy efficiency (e.g., EM&V, utility programs, behavior-based approaches, cost-effectiveness, program rules, planning, cost recovery, financing)
  - Renewable energy resources
  - Smart grid and grid modernization
  - Utility regulation and business models (e.g., financial impacts)
  - Transmission and reliability
  - Resource planning
  - Fossil fuel generation
- Assistance is independent and unbiased
- LBNL Tech Assistance website: https://emp.lbl.gov/projects/technical-assistance-states
- US DOE Tech Assistance gateway: http://energy.gov/ta/state-local-and-tribal-technical-assistance-gateway

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Berkeley Lab provides technical assistance to state regulatory commissions, state energy offices, tribes and regional entities, and other public entities see: https://emp.lbl.gov/projects/technical-assistance-states

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Estimating Energy Savings from Benchmarking Policies in New York City (and for Other Cities!)

Prof. Ting Meng
China Agricultural University in Beijing

Prof. David Hsu
Massachusetts Institute of Technology

Dr. Albert Han
University of Alberta, Calgary

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Important:

- advocacy for new laws
- impact evaluation
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- multiple possible mechanisms
  1. preparation: is it owners becoming more aware of their own energy use?
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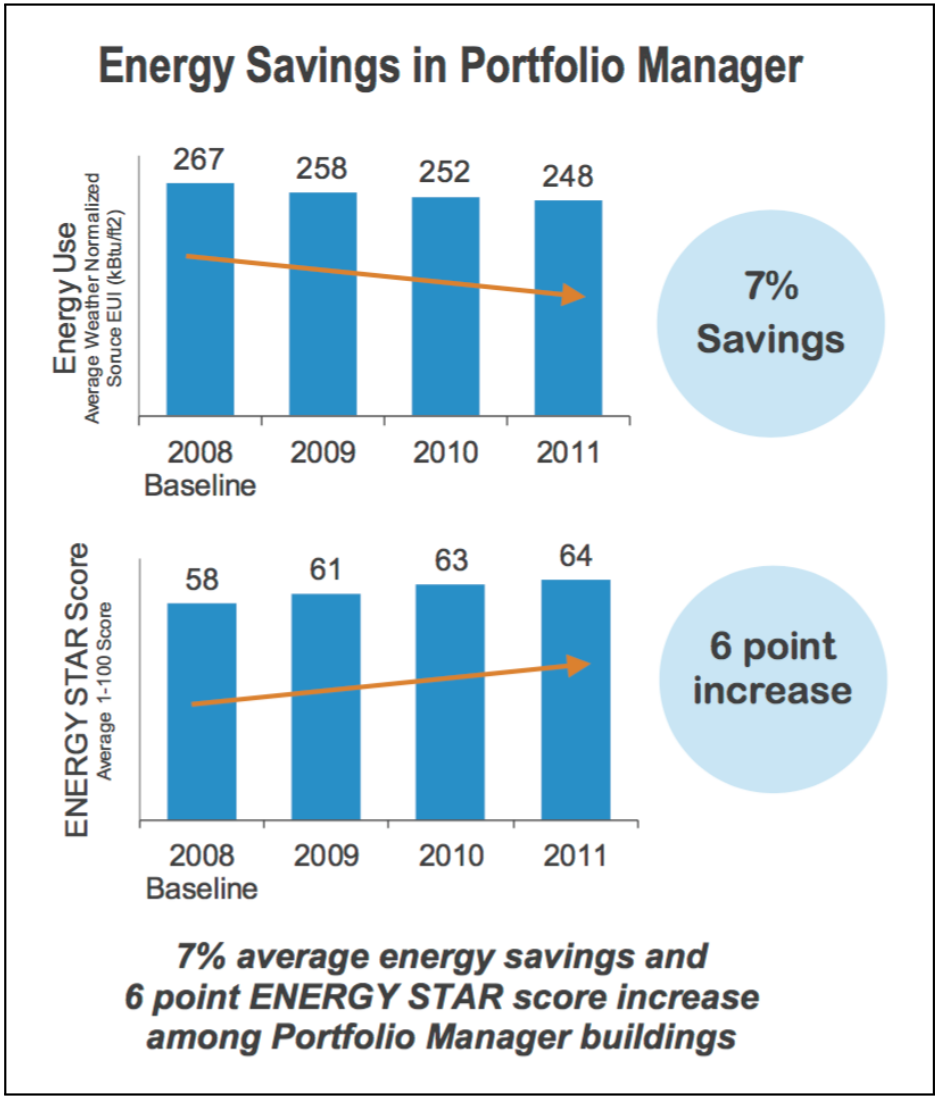

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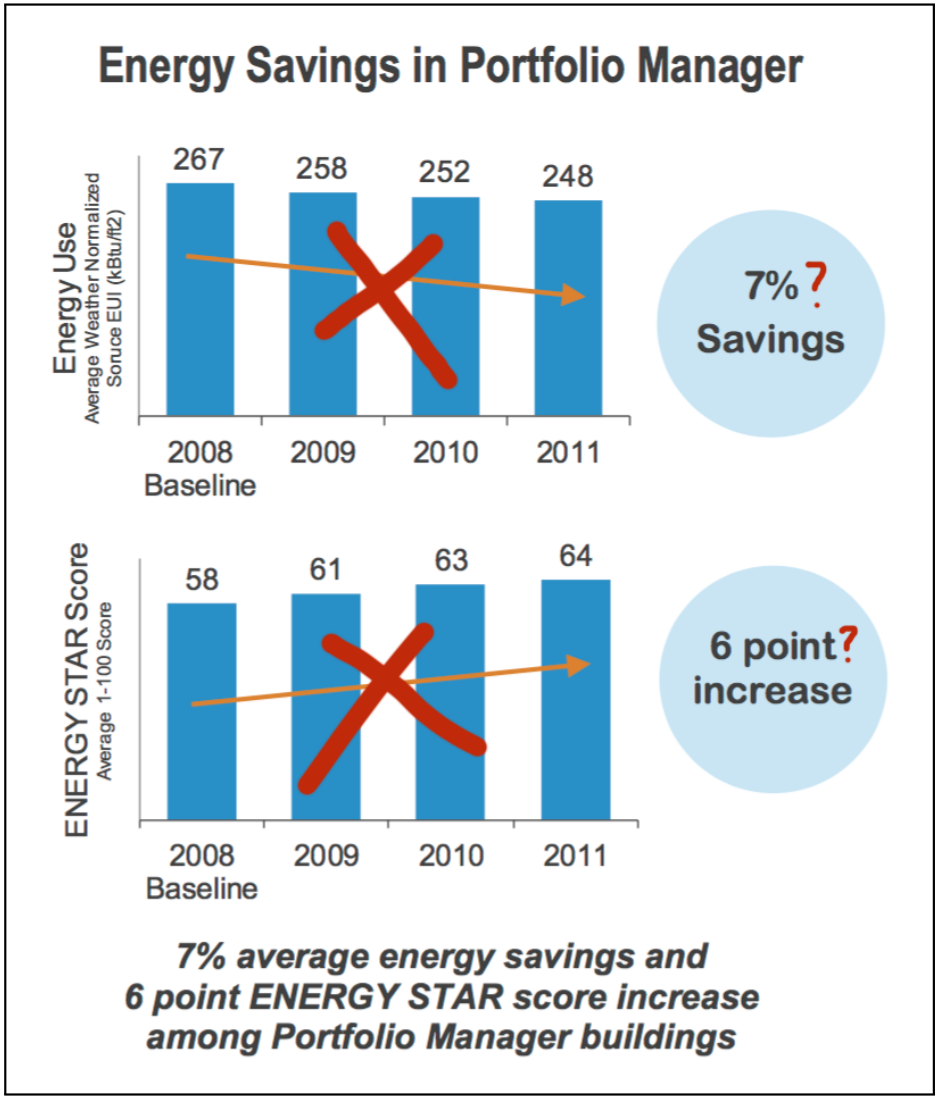

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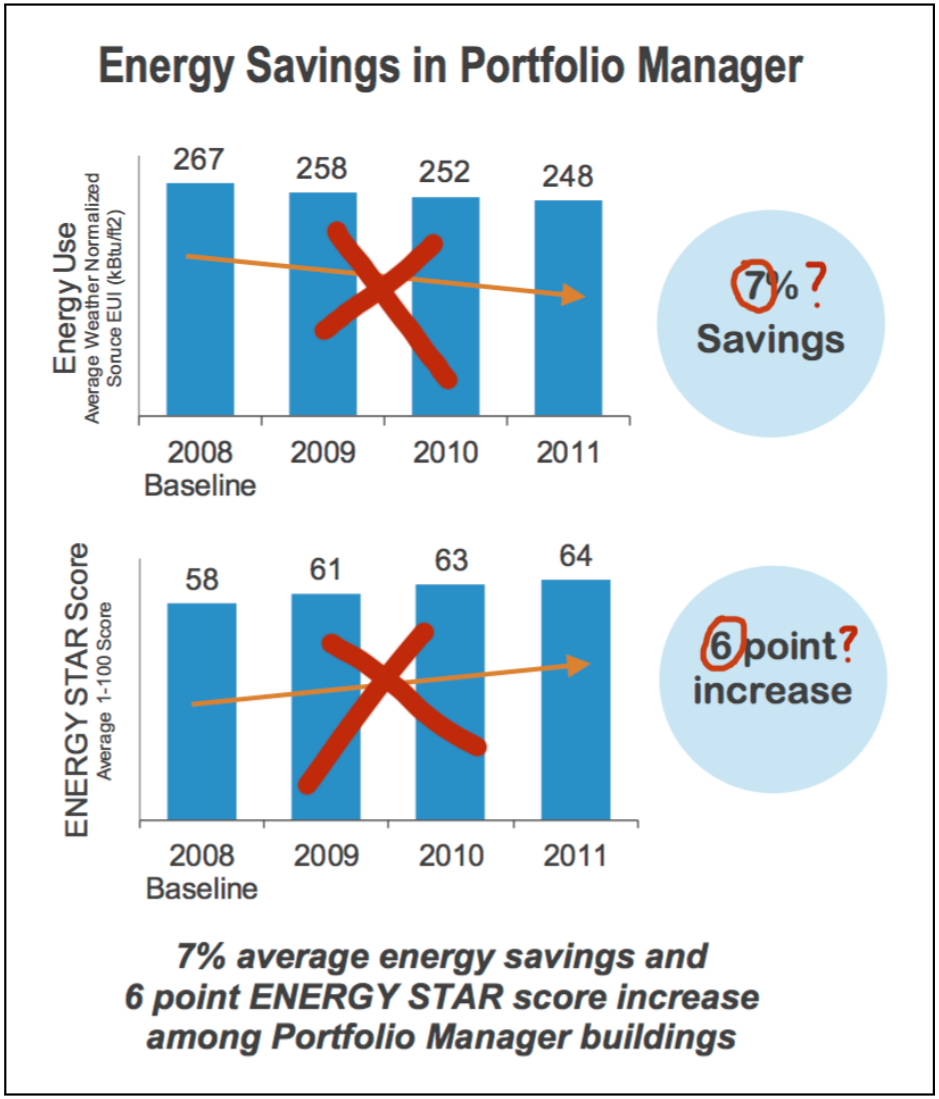

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Specification:

$$Y = \beta_0 + \beta_1 \mathrm{A} + \beta_2 \mathrm{T} + \beta_3 \mathrm{A} \times \mathrm{T} + \mathrm{X}\beta + \epsilon$$

where Y is outcome; A, T are binary indicator variables, X are control variables, ϵ is the error term, and β are the coefficients to be estimated.

Multiple policy aspects / mechanisms

City of New York implemented their benchmarking policy in many steps:

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  continue gathering and disclosing commercial data
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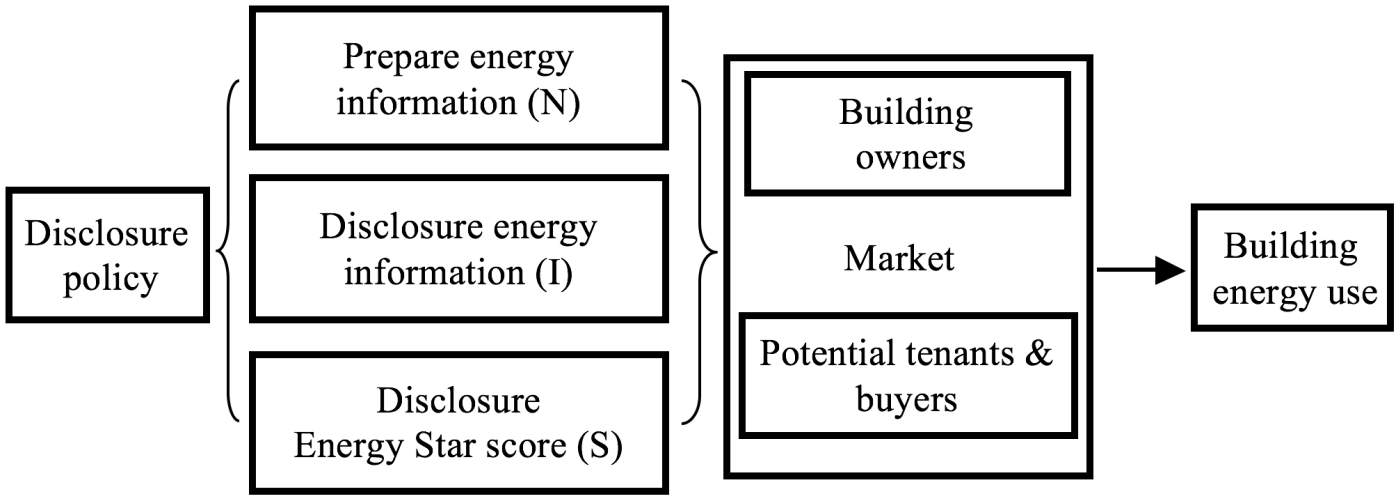

where N is preparing energy use information; I is the disclosure effect of basic energy use information; S is the disclosure effect of Energy Star scores.

Disclosure effects for various mechanisms

Identified and matched groups in panel data:

- treatment: 261 commercial office buildings

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	Before	After	
Private, scored (T, n=261)	N	N+I+S+O	I+S+ O (1st diff., before-after)
Private, non-scored (C2, n=39)	N	N+I+ O	I+ O (1st diff., before-after)
			S (2nd diff., treatment & control)

where N is preparing energy use information; I is the disclosure effect of basic energy use information; S is the disclosure effect of Energy Star scores, and O are other co-founded factors.

Results for energy data + EnergyStar scores (I + S)

Regression model for log EUI: panel data with clustered standard errors, standard-normalized predictors.

Variable name	Coefficient	Cluster.SE	p-value	Signif.
Intercept	1.5702	1.0836	0.1476	
Disclosure dummy	0.0081	0.0662	0.9023	
Year 2012 dummy	-0.0132	0.0114	0.2467	
Year 2013 dummy	0.0040	0.0288	0.8904	
Year 2014 dummy	0.0440	0.0393	0.2624	
Disclosure x 2012	0.0253	0.0205	0.2166	
Disclosure x 2013	-0.0599	0.0334	0.0729	*
Disclosure x 2014	-0.1426	0.0452	0.0016	***
Building area (MSF)	0.7793	0.6028	0.1956	
Number floors	0.0028	0.0021	0.1866	
Built year	0.0019	0.0006	$<$0.001	***
Natural gas %	-0.0018	0.1210	0.9883	
District steam %	0.0954	0.1235	0.4402	
Fuel oil no. 2 %	-0.5202	0.1379	$<$0.001	***
Fuel oil no. 4 %	-0.3914	0.1439	0.0066	***
Fuel oil no. 5, 6 %	-0.4874	0.1827	0.0077	***
Sandy effect dummy	-0.0289	0.0347	0.4051	

Results for EnergyStar scores (S)

Regression model for log EUI: panel data with clustered standard errors, standard-normalized predictors.

Variable name	Coefficient	Cluster.SE	p-value	Signif.
Intercept	1.1461	1.2342	0.3533	
EnergyStar dummy	0.0308	0.0705	0.6625	
Year 2012 dummy	0.0758	0.0401	0.0590	*
Year 2013 dummy	0.0203	0.0424	0.6323	
Year 2014 dummy	0.0315	0.0350	0.3674	
EnergyStar x 2012	-0.0647	0.0429	0.1318	
EnergyStar x 2013	-0.0855	0.0434	0.0493	**
EnergyStar x 2014	-0.1292	0.0395	0.0011	***
Building area (MSF)	0.8514	0.5985	0.1553	
Number floors	0.0023	0.0021	0.2809	
Built year	0.0791	0.0556	0.1553	
Natural gas %	-0.2397	0.1554	0.1233	
District steam %	-0.0267	0.1311	0.8387	
Fuel oil no. 2 %	-0.6856	0.1349	<0.001	***
Fuel oil no. 4 %	-0.5955	0.1261	<0.001	***
Fuel oil no. 5, 6 %	-0.6148	0.1468	<0.001	***
Sandy effect dummy	-0.0132	0.0365	0.7190	

Conclusions and next steps

This method of analysis can be replicated in most of the cities doing benchmarking, since they also sequentially introduced their policies.

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Basis for findings:

- quasi-experimental research design
- statistically significant treatment effects found using panel data, clustered standard errors, and two matched treatment and control groups
- results are within 1 standard deviation of each other
- possibly point to different effectiveness of data sources and communication

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- quasi-experimental research design
- statistically significant treatment effects found using panel data, clustered standard errors, and two matched treatment and control groups
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- possibly point to different effectiveness of data sources and communication

Further research:

- we'd like to repeat this in other cities
- will these effects be persistent?

Citation

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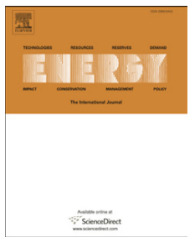

Estimating energy savings from benchmarking policies in New York City

Ting Meng [a], David Hsu [a, *], Albert Han [b]

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ABSTRACT

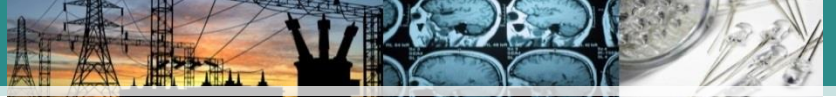
A growing number of governments have begun to implement benchmarking or energy disclosure policies. By requiring owners to measure and disclose their energy use, these policies are intended to transform the market for energy-efficient investments in existing buildings. To improve future policy efforts, two critical questions are: first, how much energy do these policies save? and second, what

Thank you!

Questions, comments, complaints: ask now or at ydh@mit.edu

Work funded by the U.S. DOE Consortium for Building Energy Innovation.

Thank you to the City of New York for providing data, assistance, and feedback.



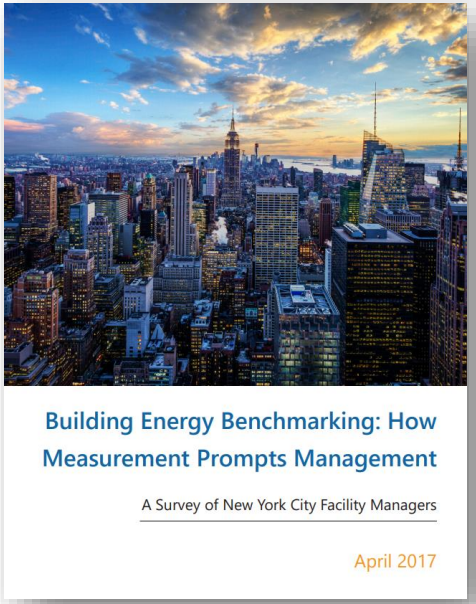
NEMA Benchmarking Impact Survey: Measurement Prompts Management

Patrick Hughes
Senior Director, Government Relations and Strategic Initiatives
National Electrical Manufacturers Association

July 31, 2017

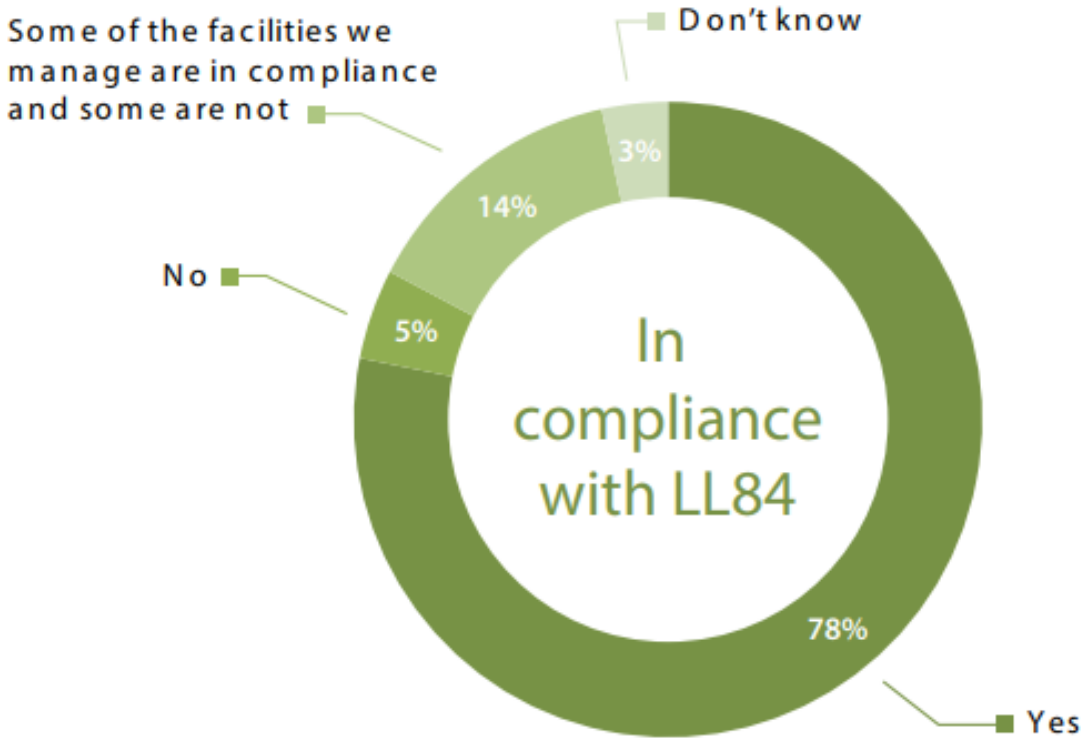
NEMA Benchmarking Impact Study

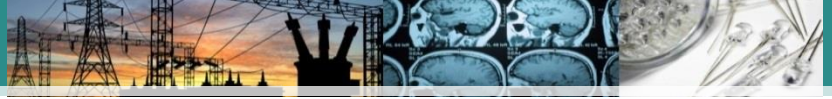
- 151 New York City facility managers
  - 69% Commercial
  - 50% Residential
  - 13% City-owned
- Decision-makers
  - 68% Final decision-maker
  - 30% Significant decision-maker
  - 1% Minimal decision-maker



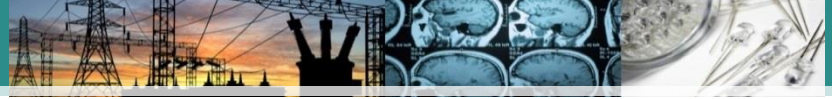
Download: www.nema.org/hpb

Surveyed both compliant and non-compliant facilities

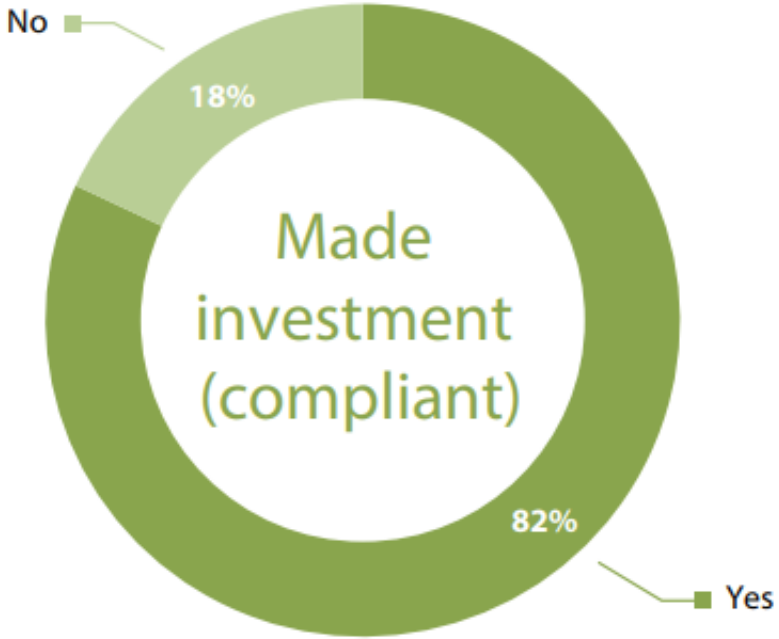


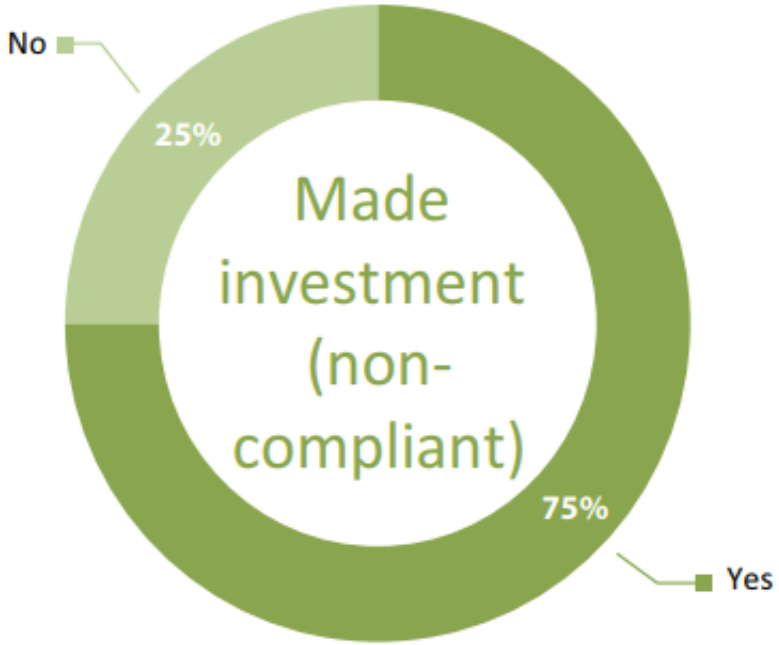


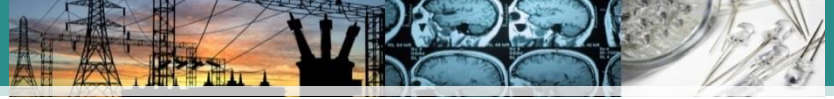
Capital Expenditures



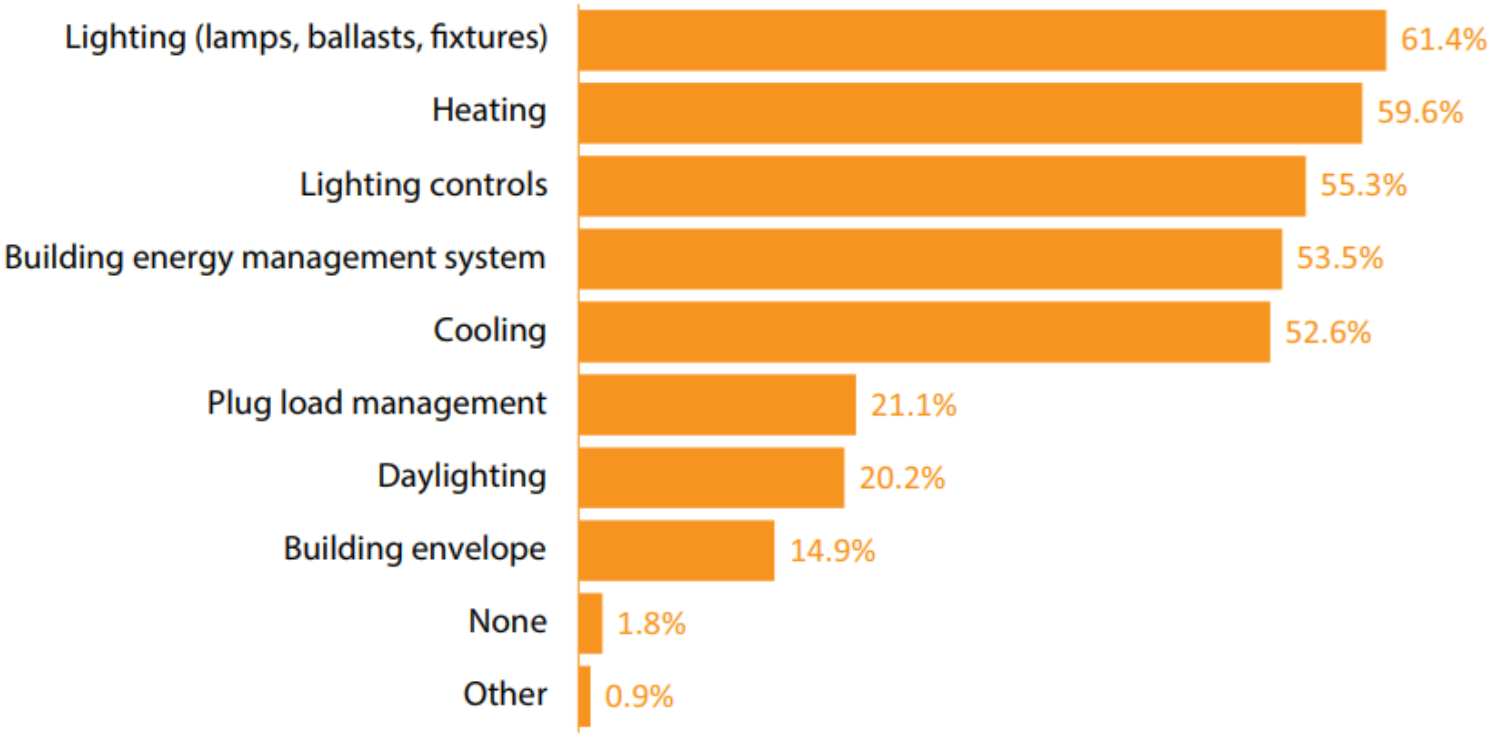
82% of compliant facilities made an investment



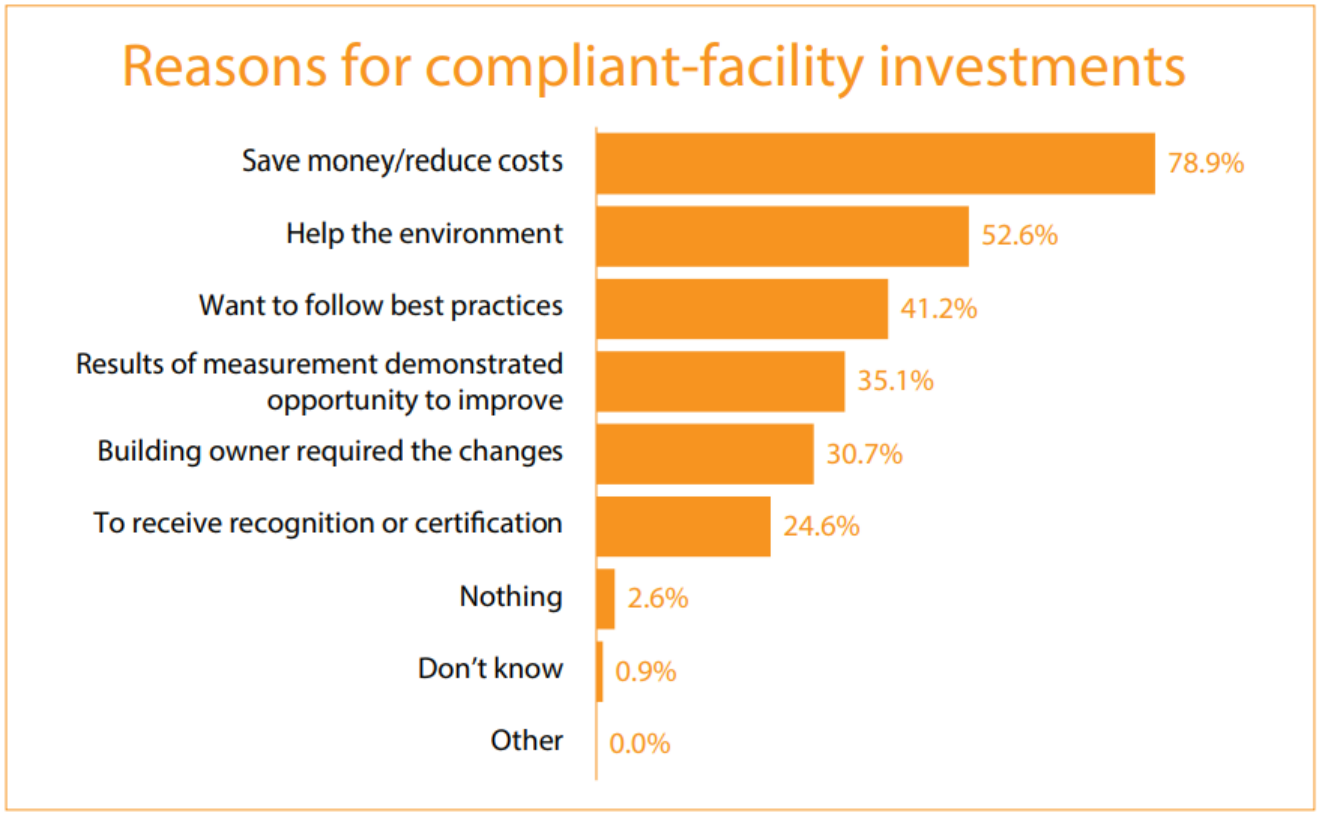




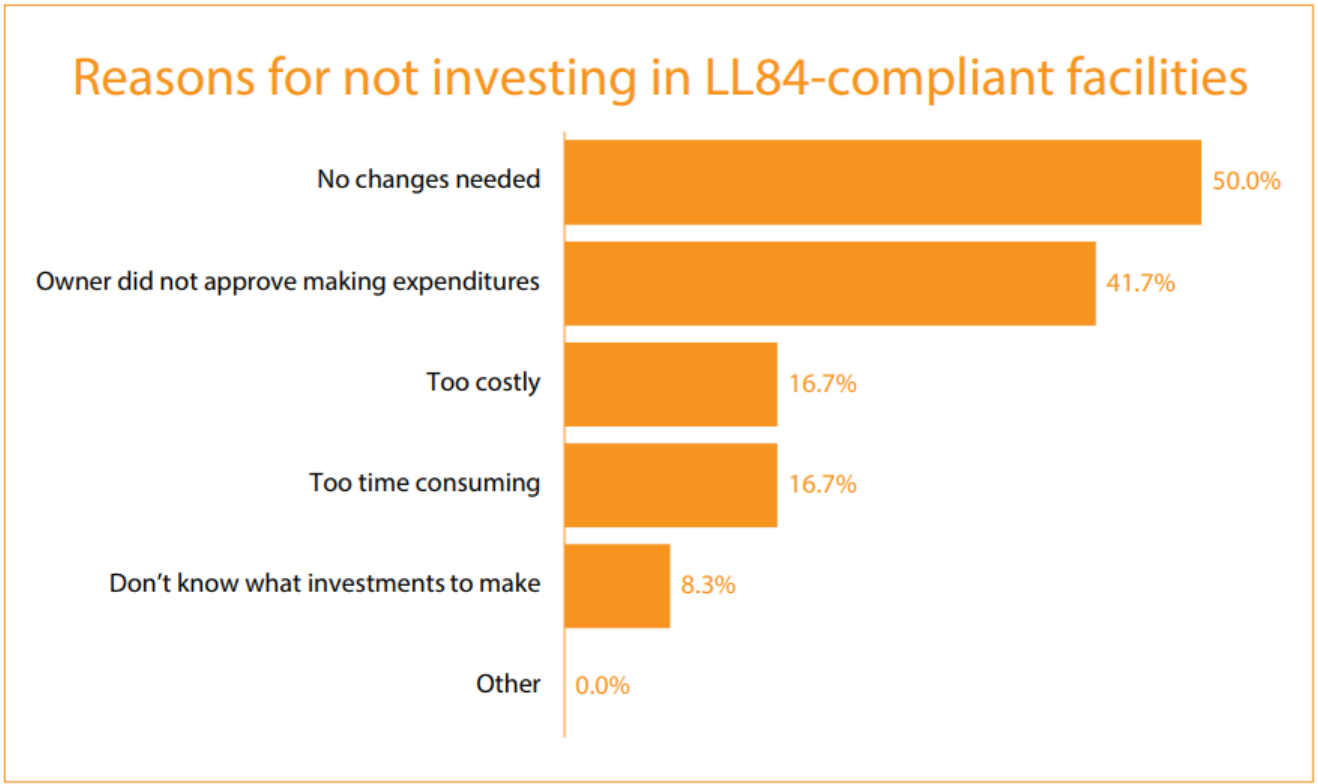
Investments made in LL84-compliant facilities

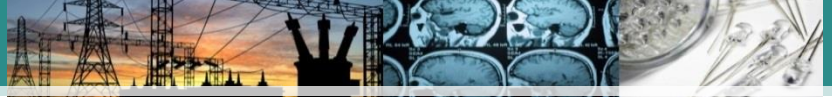


Most motivated by cost savings



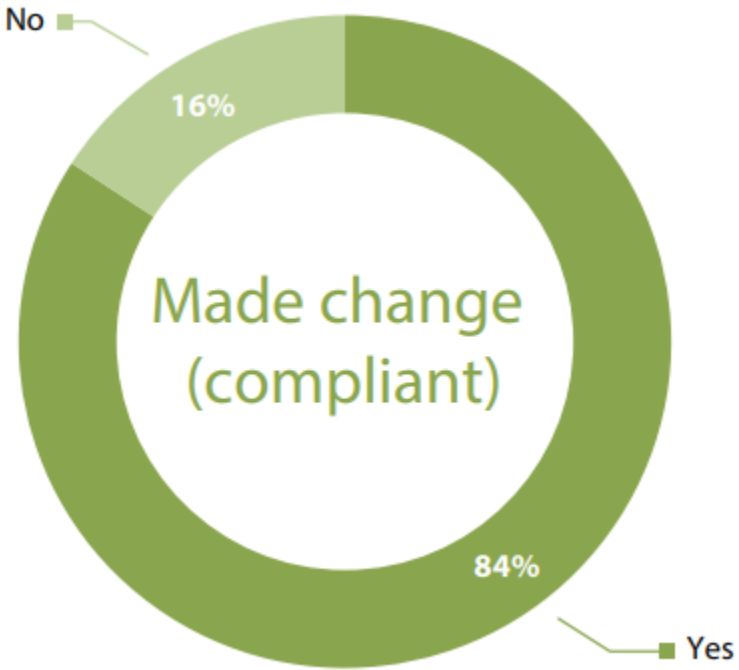
Owners a potential obstacle to investment

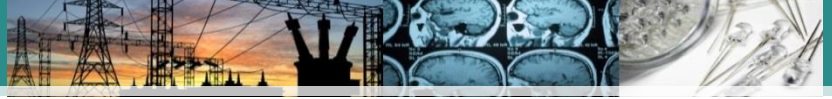




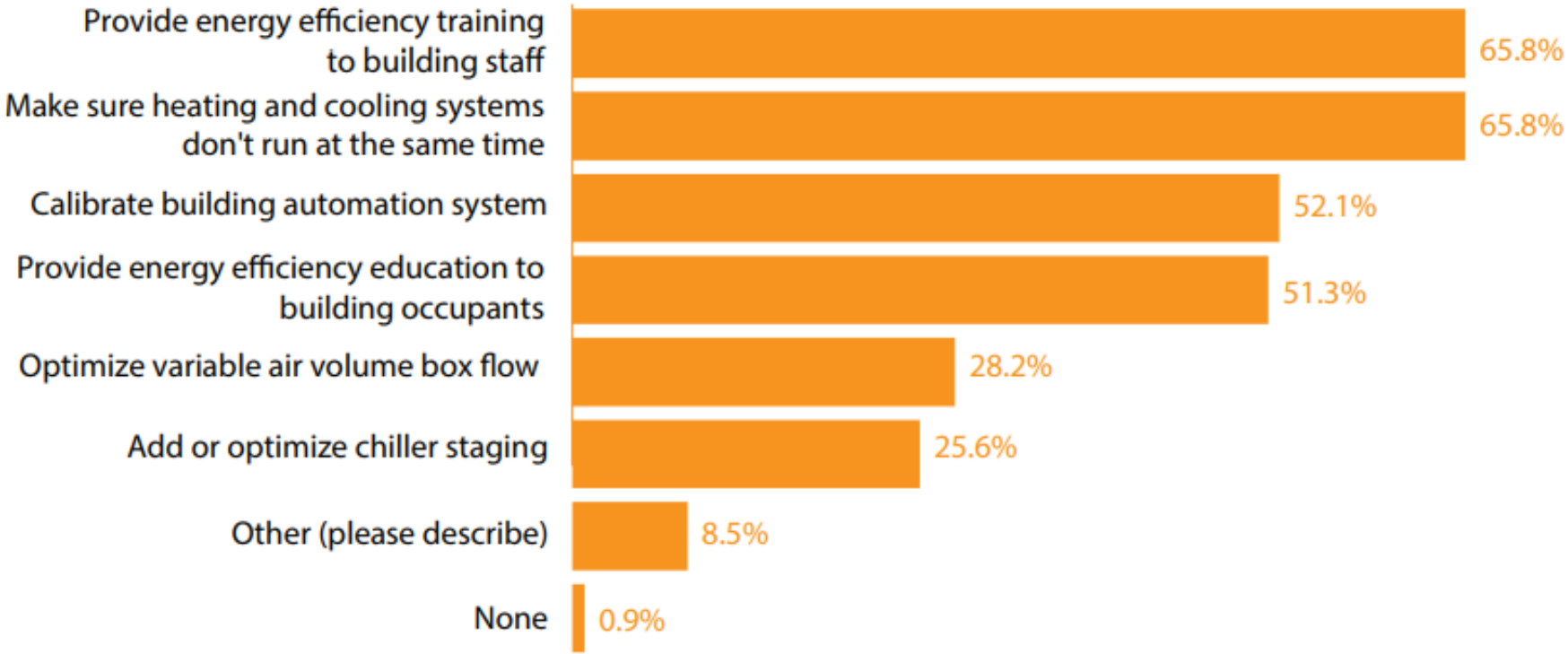
Operational Changes

84% of compliant facilities made operational change



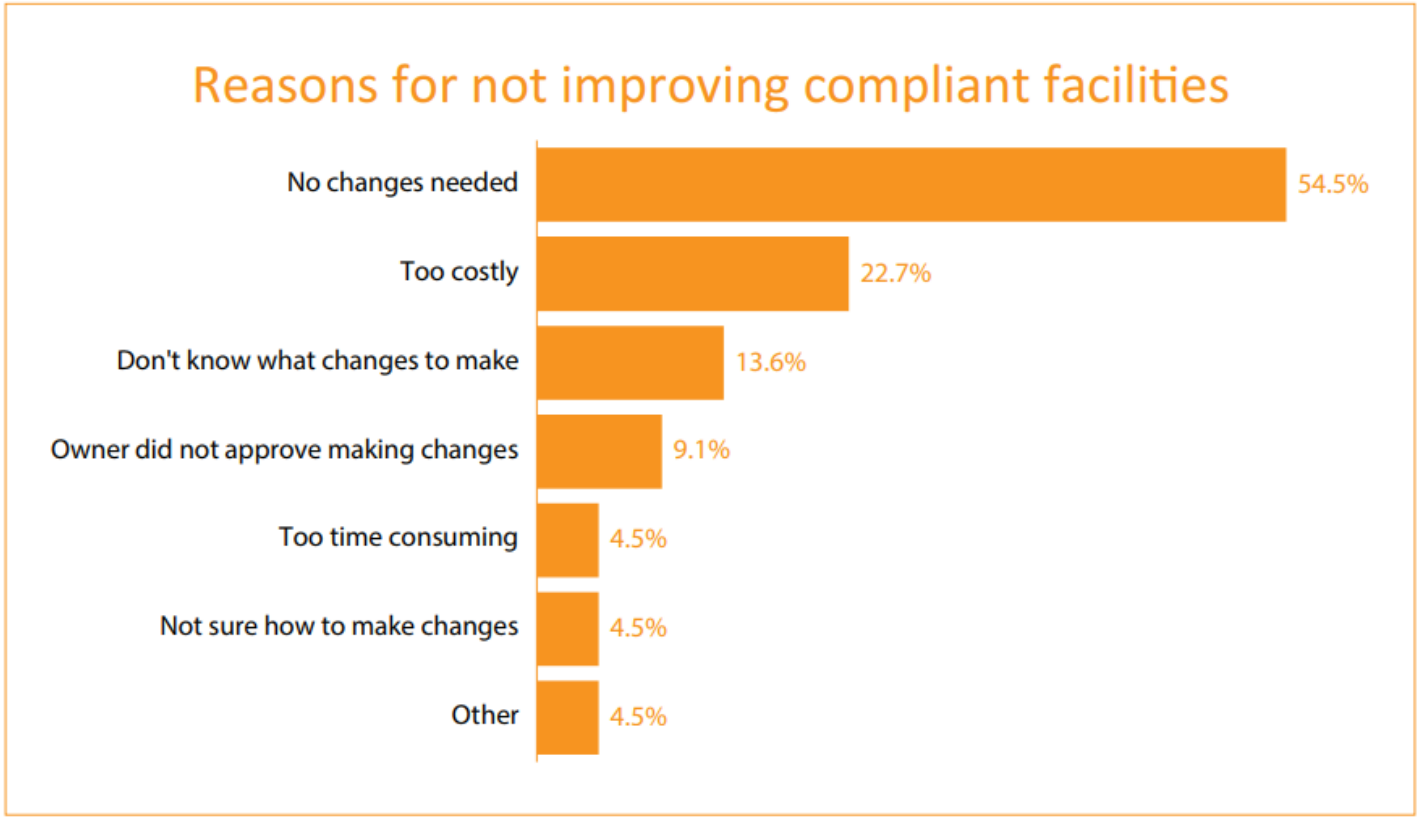


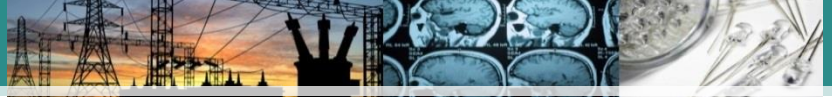
Operation changes made in LL84-compliant facilities



Most motivated by cost savings

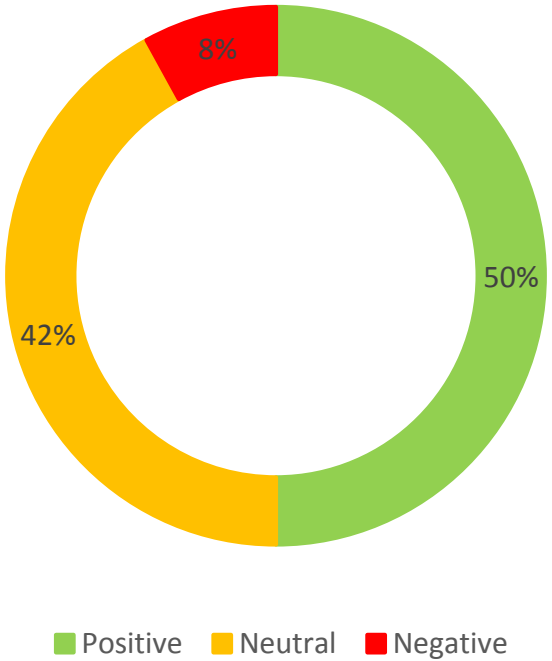
Education needed on low-/no-cost improvements

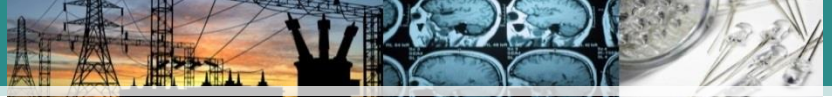




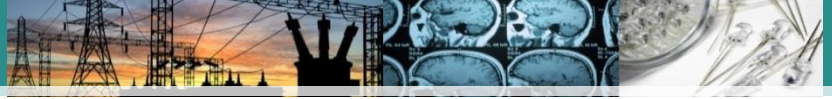
Additional Comments

Open-ended responses were mostly positive

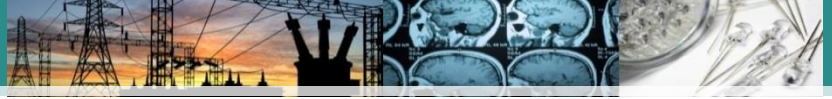




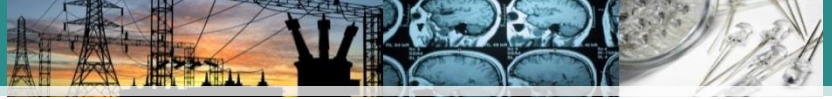
we were motivated to make changes



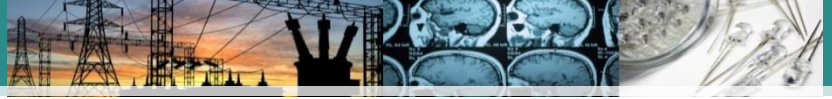
Always interested in hearing about and implementing more cost effective energy efficient programs that result in cost savings.



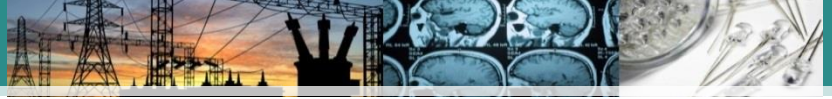
We have installed nest thermostats and changed the light bulbs to much more energy efficient models. We have seen a significant reduction in electricity usage.



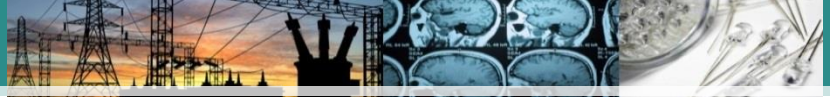
I don't have anything to add really except that the change to more efficient lighting in the common areas was not well received by tenants.



LL84 is a waste of time



it is added work, but proved informative



I JUST LIKE SAVE ON ENERGY

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