

# **Benchmarking Programs: A Tool for Cities and Other Government Agencies**

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## **ABSTRACT**

Benchmarking programs, sometimes called lead-by-example programs, track electricity, natural gas, steam, and other utility usage in a building. Cities, counties, and states have adopted benchmarking policies to encourage energy efficiency through comparisons and reporting of buildings' energy use.

These policies generally include three components:

1. Benchmarking policies to compare building energy use to similar buildings.
2. Reporting policies to require owners to report their buildings' energy use to the appropriate city, county, or state policy makers.
3. Transparency policies that make building energy use publicly available.

Buildings are frequently less energy efficient due to market failures, behavioral anomalies, imperfect or missing information, credit constraints, principal-agent problems and prioritization of energy issues. Benchmarking programs and policies intend to address these failures.

In this session, we will review the specific characteristics of several existing benchmarking programs that address: 1) government buildings, 2) industrial companies and 3) commercial buildings. We also will explore the unique challenges presented in evaluating the effectiveness of benchmarking programs, including identifying and tracking market transformation indicators and measuring building-specific and program-wide savings and present initial findings from recent evaluations.

## **Introduction**

Utilities have operated energy efficiency programs for many years. These programs typically provide incentives for customers to install higher-efficiency equipment and building shell improvements—an approach that can be considered a market push strategy. Another approach might be considered a market pull strategy: embedding within the market a value competition between buildings and businesses. In any market, certain characteristics increase the value of buildings or businesses. These characteristics include the location, age, and condition of the building and public perceptions of the business. Performance benchmarking quantifies the energy efficiency and environmental impacts of a building or business. In doing so, this approach provides the market with another characteristic for assigning values to a building or to products produced by a business. This creates a natural competition between buildings and businesses as they vie to increase their value. This approach is typically implemented through legislation or city and county ordinance, a departure from traditionally utility lead programs. Several state and local governments have also taken the lead in adopting this approach by establishing targets for government-owned buildings.

We investigated energy performance benchmarking and lead-by-example (LBE) programs to illustrate the characteristics of representative programs and to investigate methodologies to evaluate savings intended to be achieved by the programs. In this paper, we present the Massachusetts Leading by Example (MA LBE) program as an example of a program that targets government owned buildings, the U.S. Department of Energy Better Plants Program that targets large commercial and industrial companies and several city and county programs that target commercial properties. We discuss evaluation challenges and methodologies for these programs.

## **Overview of Benchmarking Programs**

### **Government Buildings - Massachusetts LBE**

The MA LBE program provides leadership, technical assistance, guidance, and grant funding to ensure successful implementation of energy conservation and clean energy practices in Massachusetts government owned buildings. The program also provides assistance with waste reduction and recycling, environmentally preferable procurement, toxics use reduction, water conservation, sustainable transportation, and open space and natural resource protection within government buildings. This “lead by example” approach intends to influence non-governmental buildings to become more efficient by demonstrating the benefits in the government sector.

### **Goals**

Through various initiatives, MA LBE works to reduce the environmental impacts of state government operations. The MA LBE program promotes sustainability activities within state government to achieve the following sustainable energy targets:

- Reduce greenhouse gas emissions (GHG) from state government operations—40% by 2020 and 80% by 2050—using the MA LBE baseline (a three-year average, from FY2002 to FY2004).
- Reduce overall energy consumption by 35% at state owned and leased buildings by 2020, using FY2004 as the baseline.
- Procure 30% of all Commonwealth agencies’ annual electricity consumption from renewable sources by 2020.
- Require that all new construction and major renovations meet the Massachusetts Leadership in Energy and Environmental Design LEED Plus green building standard, established by the Commonwealth of Massachusetts Sustainable Design Roundtable.

A Clean Energy Committee submits an annual report to the governor, detailing the results of energy conservation actions taken by agencies during the prior fiscal year, the environmental and economic impacts of such actions, and recommendations for future energy reductions.

### **Resources**

The program provides resources to advance energy efficiency and sustainability practices, including the following:

- Low and no cost energy reduction strategies
- Computer power management standards

- Tips for using the Massachusetts Enterprise Energy Management System (MEEMS) Data
- Massachusetts Wind Site Screening Tool
- Power purchase agreement guidance
- Renewable energy guidance
- GHG emissions calculator
- LBE is developing new guidance on GHG emission factors

### **Tracking**

MA LBE tracks energy consumption and cost data for a variety of fuel sources in the Commonwealth. DOER offers MassEnergyInsight, a free, web-based tool to assist Massachusetts cities and towns in understanding their energy use and in reducing their carbon footprints by delivering customized, easy-to-use reports on electricity, natural gas, and oil use.

DOER also tracks 15-minute interval energy data at 460 state buildings (covering over 25 million square feet) using building-level energy meters through the (MEEMS). Metered buildings include state hospitals, corrections facilities, community colleges, universities, trial courts, and office buildings. Building managers use MEEMS data to identify energy-savings opportunities and to verify the results of energy conservation measures.

### **Results**

In the October 2014 progress report, the DOER indicates the state has achieved significant results, including the following:

- Reducing GHG emissions by 25% from the LBE Baseline (the average from FY02 through FY04) to FY12.
- Reducing the use of fuel oil to heat state buildings by over 16.7 million gallons since 2006 (a 72% decrease), with 11 agencies or campuses ceasing all heating oil use and nine reducing it by at least 50%.
- Increasing state government's reliance on clean, on-site generated electricity (including combined heat and power [CHP], solar PV, hydro, wind, and anaerobic digestion) to some 210 million kWh of clean electricity in fiscal year 2012, approximately 15% of total electricity consumption at state facilities.
- Constructed 33 LEED-certified buildings (one achieving a Platinum rating and 21 achieving a Gold rating), with at least 30 more pending building projects registered with the LEED Program.

### **DOE Better Buildings, Better Plants Challenge**

DOE's Better Buildings, Better Plants Program (commonly called the Better Plants Program) is a national initiative to increase energy efficiency in commercial and industrial facilities. The Better Plants Program's Better Buildings Challenge component is a voluntary leadership initiative that asks chief executive officers and executives of companies, universities, school districts, multifamily residential organizations, and state and local governments in the United States to become partners by making a public commitment to energy efficiency.

Better Plants Program partners work with DOE to improve their energy intensity (usually by 25% over 10 years), develop energy management plans, and track and report their annual progress. DOE helps these companies establish key energy performance metrics, evaluate energy-saving opportunities, and organize plant-level training events.

Reporting requirements vary by sector:

- Commercial Partners commit to report publicly on energy consumption across their organizations and at the individual facility/building level every six months. Specifically, Commercial Partners in the Better Buildings Challenge provide the following: square feet of floor space, site energy use, source energy use, weather-normalized energy intensity, energy intensity adjusted for space attributes/operating characteristics (where available), total energy costs, and energy costs per square foot.
- Manufacturing Partners report corporate-wide data on energy consumption, energy savings, investment levels in energy efficiency, and financial returns on an annual basis. Facility-level data are also collected from manufacturers, but steps are taken to mask and aggregate the data to protect confidential business information.
- Multifamily Residential Partners currently work with DOE and Housing and Urban Development to identify specific data reporting and transparency requirements.

Manufacturers also can partner with DOE through the Better Plants Program or the Better Plants Challenge. The Better Plants Program is a broad-based initiative, composed of companies making long-term commitments to energy efficiency and reporting their progress annually. Partners in the Better Plants Challenge undertake additional commitments to publicly sharing their energy performance data and energy efficiency strategies.

Companies join the Better Plants Program by signing a two-page partnership agreement form. Neither the Better Plants Program nor the Better Plants Challenge require fees or other costs.

## **Goals**

The Better Plants Program and Better Plants Challenge aim to achieve the following:

- Increase the efficiency of commercial, industrial, and multifamily housing facilities by 25% or more in 10 years.
- Save more than \$80 billion in energy costs for organizations in the United States.
- Create jobs in the United States.
- Improve energy security.
- Mitigate climate change impacts.

## **Resources**

DOE provides national recognition and technical assistance to help partners meet their energy efficiency goals. These resources include the following:

- Access to program experts, who provide help in establishing and analyzing key energy performance metrics; identify emerging, energy-efficient technologies applicable to plant operations; and facilitate networking and peer-to-peer sharing with other program partners.

- Technical in-plant training on energy management and common energy-use systems, such as compressed air, fans, motor-driven systems, steam, process heating, pumps, and Energy Management/ISO 50001.
- Access to proven energy analysis software tools and other technical resources from DOE, states, utilities, and other partner organizations.
- Priority access to DOE's Industrial Assessment Centers for small- and medium-sized facilities and CHP screenings for qualifying facilities.
- Opportunities to participate in Better Plant's targeted supply chain efficiency and water.
- Savings initiatives.

## **Tracking**

Better Plants partners must establish a baseline year for tracking energy performance. Typically, this is the year the company joins the program or the most recent calendar or fiscal year before joining the program. Partners can, however, set the baseline year as much as three years prior to joining the program to capture recent energy-savings accomplishments (i.e., implemented before joining the program) or to match an earlier baseline that aligns with existing GHG or other corporate sustainability targets.

DOE recognizes the achievements of partners that meet their 25% targets by issuing certificates, letters, and other items, presented by DOE management at conferences or other events<sup>1</sup>. Companies meeting the initial 25% target are encouraged to set a new goal in partnership with the Better Plants Program and to build on their achievements. DOE considers past accomplishments in setting these targets. New goals will need to be ambitious, though not necessarily equivalent to 25% over 10 years.

DOE maintains the confidentiality of energy data submitted by Better Plants Partners. Though not required, DOE encourages partners to voluntarily disclose their cumulative energy performance improvements (in percentage terms) through their web profiles and case studies. Case studies provide useful cost and savings information that encourage other companies to participate. We present a representative case study below.

## **Case Study – Jamestown Engine Plant**

Cummins is undertaking a deep energy retrofit project at its Jamestown Engine Plant (JEP) in Lakewood, NY, as part of its corporate-wide commitment to reduce energy intensity. The project combines a suite of energy efficiency measures and necessary infrastructure upgrades to achieve significant energy savings alongside optimal systems performance for the entire facility. JEP includes three large gas fired steam boilers, related distribution piping, 26 large heating and ventilating units, 29 dock heaters and 5 snow melt systems. This equipment has become unreliable, incurring significant repair costs and operational interruptions. Through this project, steam is almost entirely being eliminated by replacing the major equipment (air handlers, dock heaters, etc.) with direct fired gas units, eliminating the need for a plant wide distribution.

Beginning in January 2012 through 2015, Cummins implemented a phased, whole building energy and infrastructure improvement project, including \$5.1 million in energy efficiency improvements. In 2014, the plant installed a new, 2 megawatt solar installation,

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<sup>1</sup> See for example DOE's recognition of General Mills at: <http://energy.gov/eere/articles/energy-department-recognizes-general-mills-leadership-and-innovation-iowa-plant>

capable of generating about a third of the plant's power on the sunniest days. The plant has also installed three regenerative dynamometers that recover energy from engine testing and provide power to the facility. The energy efficiency components of the project include heating and cooling upgrades, compressed air optimization and controls upgrades.

Prior to the project, JEP partnered with Duke Energy One and Mazza, to complete a thorough site assessment. The significant uses on energy were identified, equipment condition assessed and replacement and improvement alternatives individually analyzed. The energy savings of the alternatives were calculated and the needed funding for the entire project is planned within the corporation's capital process. The plant's investment has been planned within Cummins' multi-year budget and is included in the business' simulation to ensure profitability. Cummins uses a 20% internal rate of return as its criteria for priority projects.

Cummins anticipates a 33% energy savings resulting in \$1.4 million a year in cost savings, which includes gas, electricity and solar photovoltaic savings. The ongoing sub-metering project will help JEP quantify the performance of the improvements.

### **City, County, and State Benchmarking and Transparency/Disclosure Programs**

Cities, counties, and states adopt benchmarking policies to encourage energy efficiency through comparisons and reporting of buildings' energy use. These policies generally include three components (IMT 2015):

1. Benchmarking policies to compare building energy use to similar buildings.
2. Reporting policies to require owners to report their buildings' energy use to the appropriate city, county, or state policy makers.
3. Transparency policies that make information on building energy use publicly available.

### **Goals**

Benchmarking policies seek to reduce energy usage and CO<sub>2</sub> emissions through disclosures of energy use to buyers and tenants. More efficient buildings can command a premium in rent or purchase agreements. This creates a natural market force to increase the efficiency of buildings as they compete for tenants and buyers.

### **Tracking**

Most of these programs use the U.S. Environmental Protection Agency's Portfolio Manager (PM) software program to report energy usage on an annual basis.

Often, these programs also require disclosures of a subset of this information through a public website, sometimes incorporating a delay or exempting the first year of data from public disclosure. Several cities do not require public disclosures of building data, but do require disclosures for certain real estate transactions or for current building tenants. Others limit public reporting to summary statistics for buildings in various categories.

Appendix A lists buildings covered by current benchmarking programs and lists benchmarking tools used by cities, including required disclosures.

### **Evaluation of LBE Programs**

Market transformation programs, such as LBE, differ from resource acquisition programs, which rely on direct incentives to achieve near-term savings. The key element of a

market transformation program focuses on eventually eliminating public funding while maintaining the changes. In contrast, resource acquisition programs typically function as purchase options for utilities, designed to provide a utility with an alternative to purchasing energy. The utility will likely continue program funding as long as program costs remain below the cost of purchasing additional energy.

An evaluation plan for a benchmarking program should present an evaluation framework sufficiently detailed to determine the program’s progress, while allowing flexibility to tailor the evaluation to the specific needs of a program sponsor or policy maker. Table 1 illustrates various stakeholders’ evaluation information needs.

Table 1. Evaluation Audiences and Information Needs

Audience	Decisions	Information/Needs
Utility/Program Administrator	Should the program be modified? Are incentive levels correct? How can this project be designed most effectively? How does one engage retailers?	Process evaluation. Performance on key progress indicators. (Does the program transform markets? If not, why not?) Savings assumptions. Program cost. Validation of program theory/logic model.
Stakeholders	Short-term: Will the program be an effective use of ratepayer money over the planning horizon? Long-term: Has the program demonstrated its effectiveness?	Savings assumptions. Program cost.
Regulators/Policy Makers	How will the program be measured? Should the program be included in the utility portfolio? Is the program eligible for shareholder incentives (if applicable)?	Process evaluation. Performance on key progress indicators. Savings assumptions. Program cost.

Measuring market impacts relies on identifying key market transformation indicators and tracking those over time.

### Measuring Energy Impacts

A benchmarking program typically meets the following criteria for savings estimations, using the U.S. Department of Energy’s Uniform Methods Project for Determining Energy Efficiency Program Savings (UMP) protocol for a whole-building retrofit:

- The program offers a mix of measures affecting the whole building.
  - For benchmarking, actual measures deployed or actions taken are determined by the building owner rather than specified by the program.
- Expected whole-building savings from combined measures supported by the program will be of a magnitude that produces statistically significant results, given the following:

- Natural variation in consumption data;
- Natural variation in savings; and
- The size of the evaluation sample.
- The baseline for determining savings equals the condition of the participating building before retrofits rather than the standard energy efficiency of the new equipment.
- Sufficient consumption data are available for participants (and for a control group, if employing a control group method).

Energy impact evaluation methods, potentially applicable to benchmarking programs and policies, can be grouped into control group and participant-only approaches:

- Control group approaches use energy-consumption data from buildings subject to the policy (a participant group) and those that are not (a control group). Savings are estimated by comparing energy use of participant buildings to energy use of the nonparticipant building control group.
- In participant-only approaches, savings are estimated by comparing baseline (pre-program) energy use for participants to post-program energy use for the same participants.

The UMP whole-building retrofit protocol recommends using the control group approach, if possible. If a control group approach proves impossible (generally due to an inability to identify a suitable control group), a participant-only approach serves as an alternative.

## Evaluation of Current Programs

Evaluations of current programs is very limited, however certain evaluation issues and findings have emerged either anecdotally or formally. Often, data quality has been an issue. Participants at a Workshop on City Experiences, Market Impacts, and Program Evaluation report that common problems include incomplete compliance with the requirements of the program, unreliable data, and complications with address matching (O’Keeffe, L., Palmer, K., Walls, M. and Hayes, K. 2015). They report compliance is improving as building owners become more familiar with the laws. Seattle’s 2013 Building Energy Benchmarking Analysis Report indicates that data quality is improving with support from the city and the free help desk. Seattle also reports a 99 percent compliance rate and a median Energy Star score of 68. Seattle’s high compliance rate and improved data quality is a direct result of their help desk (Slobe, D., Heller, G. 2014).

The U.S. DOE commissioned an evaluation of the New York City benchmarking program in 2015 (U.S. DOE 2015). The report indicates that the policy is having impacts on City building owners and their usage of energy. However, the report notes that it is too soon in the implementation process to draw firm conclusions regarding changes in market actor behavior, or to directly attribute the increased amounts of energy and non-energy benefits the report found to the program. The report states that interviews conducted with participants and the estimated energy savings, greenhouse gas and jobs impacts provide early evidence that the policy’s impacts do exist.

The report determined that New York saw a cumulative energy savings of 5.7% during the first four years of the policy from 2010 through 2013 and that the percentage savings steadily



increased between 2010 and 2013. The percentage savings between 2010 and 2011 was 0.3%, as compared to 3.7% between 2011 and 2012 and 4.4% between 2012 and 2013. The building types that were most positively impacted by the policy were colleges and universities and office buildings and that energy savings are higher for older buildings and lower for newer buildings.

## Conclusion

Benchmarking programs can effectively use market forces to increase energy efficiency and sustainability. Measuring the policies' impacts may be a challenge and scant evaluation has been done to date. Identifying key market transformation indicators and tracking these indicators over time will provide program impacts. As these programs evolve, we expect new approaches to emerge for evaluating savings and impacts and program enhancements, such as Seattle's free technical assistance, to improve program savings.

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The Uniform Methods Project. *Methods for Determining Energy Efficiency Savings for Specific Measures, Chapter 8: Whole-Building Retrofit with Consumption Data Analysis Evaluation Protocol*. <http://energy.gov/sites/prod/files/2013/11/f5/53827-8.pdf>

U.S. DOE Better Plants Program. <http://energy.gov/eere/amo/better-plants>

U.S. DOE Better Buildings Challenge. <https://www4.eere.energy.gov/challenge/about>

U.S. DOE, 2015, *New York City Benchmarking and Transparency Policy Impact Evaluation Report*, <http://energy.gov/sites/prod/files/2015/05/f22/DOE%20New%20York%20City%20Benchmarking%20and%20Transparency%20Policy%20Impact%20Evaluation....pdf>

U.S. Environmental Protection Agency’s Portfolio Manager. <http://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager>

## Appendix A

### Benchmarking Tool and Information Disclosure Provisions (Palmer and Walls 2014)

State	Jurisdiction	Tool	Information Disclosed	Other Key Provisions
CA	Berkeley	PM	The most recent ENERGY STAR Performance Report and a summary version of the most recent Energy Report, including a Building Energy Score.	Energy report every 5 years for large buildings and every 8 years for medium and small buildings.
CA	San Francisco	PM	Public disclosure of aggregate statistics only, including: site energy use intensity (EUI), weather-normalized source EUI, indoor water intensity, ENERGY STAR score, GHG emissions, floor area.	Energy audits required every 3 years. Benchmarking not required for new buildings (Certificate of Occupancy is less than 2 years old) and unoccupied buildings (less than 1 full-time equivalent occupant for the previous calendar year).
.C.	Washington D.C.	PM or ENERGY STAR Target Finder Program	Property ID, address, owner, property type, year built, site EUI, weather-normalized source EUI, indoor water intensity, ENERGY STAR score, GHG emissions, floor area, electricity use, natural gas use, district steam use, other fuel use.	No disclosure for the first year of reported data from a building. New buildings and buildings currently sold need not report in the year they were built or sold.

State	Jurisdiction	Tool	Information Disclosed	Other Key Provisions
MA	Boston	PM	At a minimum, building identification, EUI, GHG emissions intensity, ENERGY STAR score, water consumption per square foot (if available).	Buildings registering poor energy, emissions, and water performance will be required to undertake energy audits every 5 years. No requirement to act on audit results.
MA	Cambridge	PM	Annual summary statistics, including: EUI, annual GHG emissions, water use per square foot, and an energy performance score where available; a comparison of benchmarking information for any years the property has provided the total energy consumed; other descriptive information.	
IL	Chicago	PM	Energy consumption and performance scores.	Possible exemption due to financial distress, if building <50% occupied during the calendar year or Certificate of Occupancy issued <2 years prior to the acceptable benchmarking deadline.
MN	Minneapolis	PM	Address, EUI, annual GHG emissions, water use, energy performance score (if applicable), summary statistics on energy consumption, overall compliance by city-owned buildings.	Possible exemption due to financial distress, if building <50% occupied during the calendar year or Certificate of Occupancy issued <2 years prior to the acceptable benchmarking deadline.
NY	NYC	PM	Building ID, address, property type, site EUI, floor area, weather-normalized source EUI, indoor water intensity, ENERGY STAR score, GHG emissions.	
PA	Philadelphia	PM	City required to disclose benchmarking results online, specific variables yet to be identified.	Licensed professional must verify benchmarking data initially and then every 3 years thereafter.
TX	Austin	PM or Austin Energy-approved software	No public disclosure required. Energy rating calculation disclosed to relevant parties in real estate transactions.	Multifamily units must undergo an energy audit, and results must be posted in the building; buildings that exceed 150% of the average multifamily EUI in the city must improve efficiency by 20% and notify prospective tenants of the higher rating.
WA	Seattle	PM or other approved	No public disclosure required. Building owners must disclose copies of the most recent energy benchmarking report (EUIs and ENERGY STAR Scores) to tenants, lessees, and potential buyers.	

## Commercial Benchmarking and Disclosure Ordinance Provisions (Palmer and Walls 2014)

State	Jurisdiction	Enactment Date	Coverage and Effective Date for Disclosure		Disclosed too				
			Commercial (sq. ft.)	Multifamily	G	P	B	T	L
CA	Statewide	10/2007	>5k (07/2013)		X		X		X
	Berkeley	03/2015	>25k (10/2016)	>25k (10/2016)	X	X	X	X	X
	San Francisco	02/2011	>10k		X	[d]	X	X	X
D.C.	Washington D.C.	08/2008	>100k (04/2013) >50k (04/2014)	>100k sq. ft. (04/2013) >50k (04/2014)	X	X			
IL	Chicago	06/2013	>250k (06/2014) >50k (06/2015)	>250k sq. ft. (6/2015) >50k sq. ft. (6/2016)	X	[c]			
MA	Boston	02/2013	>50k (05/2014) >35k (05/2016)	>50k sq. ft. or 50 units (5/2015) >35k sq. ft. or 35 units (5/2017)	X	X			
	Cambridge	07/2014	>25k municipal (12/2014)	>50 units	X	X			
MD	Montgomery County	04/2014	>50k (06/2015)		X	X			
MN	Minneapolis	01/2013	>100k (06/2014) >50k (06/2015)		X	X			
NY	New York City	12/2009	>50k (05/2010)	>50k sq. ft. (5/2010)	X	X			
PA	Philadelphia	05/2012	>25k (11/2013)		X	X	X		X
TX	Austin	11/2008	>75k (06/2012) >30k (06/2013) >10k (06/2014)	>5 units and > 10 years old (6/11)	X		X	[b]	
WA	Statewide	05/2009	>10k (01/2011)				X		X
	Seattle	02/2010	>50k (04/2012) >20k (04/2013)	>50k sq. ft. (10/2012) >20k sq. ft. (04/2013) >5 units	X		X	X	X

<sup>a</sup> G=government, B=buyers, T=tenants, L=lessees and lenders, P=Public

<sup>b</sup> Only multifamily buildings must report to tenants or prospective tenants.

<sup>c</sup> Starts in year two; buildings with >10% of floor space in certain businesses are exempt from public disclosure.

<sup>d</sup> Only summary statistics are publicly disclosed.