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Benchmarking: Understanding building performance

Conducting an energy performance comparison, known as benchmarking, can boost energy efficiency and lower building operating costs.

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Imagine trying to get directions without knowing the starting address. Or assembling a competitive sports team without holding tryouts to rank and compare athletes. Or even attempting to lose weight without stepping on a scale to figure out how much you weigh now. You end up lost, unaware of how your competition is doing, and oblivious to how to achieve your goal. To get to where you want to go, you have to know where you are now. Benchmarking a building's energy performance is placing your building on the map.

As energy prices increase and building operating costs climb, property managers and owners are seeking out sustainable options—not only to lower their environmental impact, but also to improve their bottom line and gain a competitive edge over their peers. City and state governments are addressing the vast amount of energy consumed by the building sector by requiring benchmarking and disclosure of energy performance. This seems to be a growing trend as there are several legislative bodies that have similar mandates on the table.

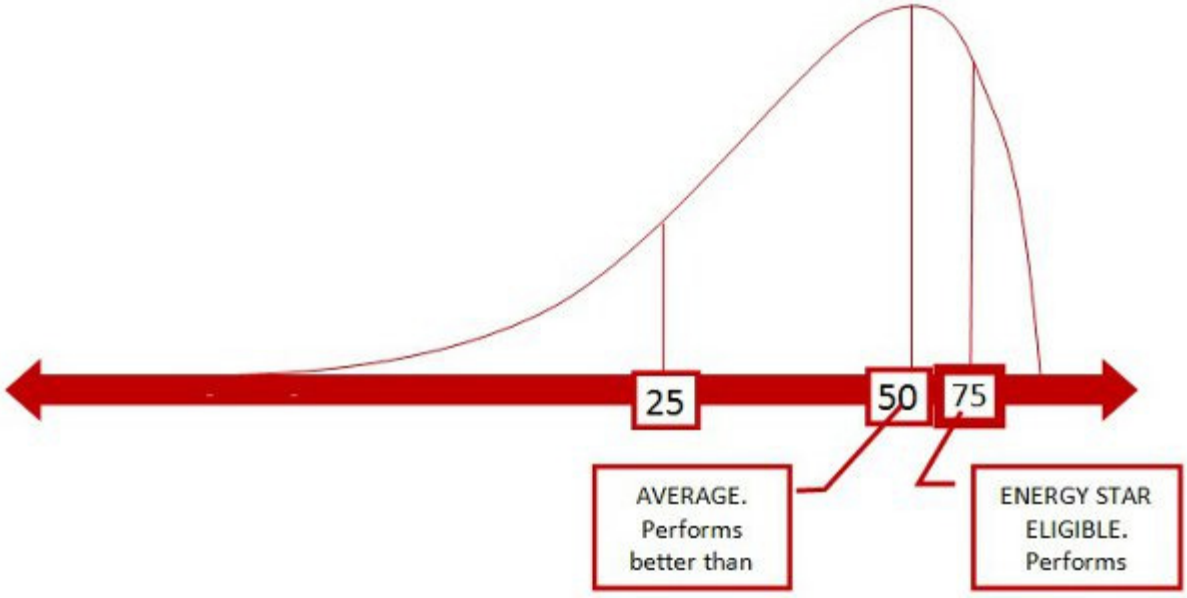
Recently, however, the U.S. Energy Information Administration (EIA) announced its Commercial Building Energy Consumption Survey (CBECS) results will not be released due to cheaper survey methodology yielding statistically invalid data. This database has been used for the past decade to benchmark facilities against their peers. In addition, the EIA's immediate future survey work has been suspended due to budget cuts. It is unclear how this will affect legislation and other institutions, such as the green rating certifications; however, regardless of the immediate effects of this particular methodology, it remains imperative to understand the energy performance of buildings.

In response to these pressures and mandates, firms are taking broad snapshots of their building portfolio to help decide how to decrease costs and where to get the biggest bang for their buck. This can be an overwhelming task, prompting questions such as, "Where do I start?" and "How do I begin this process?" Numerous methods can be successfully executed to reduce building energy consumption, such as MEP upgrades, energy audits, and recommissioning or retrocommissioning efforts. However, these strategies cannot be implemented blindly; it is imperative to benchmark first in order to understand how each building is currently performing relative to others with similar operating characteristics.

Benchmarking involves measuring and rating a building by comparing it to a standard. Some owners and managers collect energy data for their entire portfolio of buildings, calculate the energy use intensity (EUI), which is energy consumed per square foot, and then choose a baseline as the year with the highest consumption. This methodology is simple—providing a quick, yet not as robust analysis of energy performance. Another approach involves constructing two energy models: one to present a baseline building, most often modeled after ASHRAE Standard 90.1 Appendix G, and another one to represent the actual building parameters and operation, calibrated to actual

consumption bills. This analysis can be very informative, though time-consuming, and therefore probably not realistic to perform on a large portfolio-wide level.

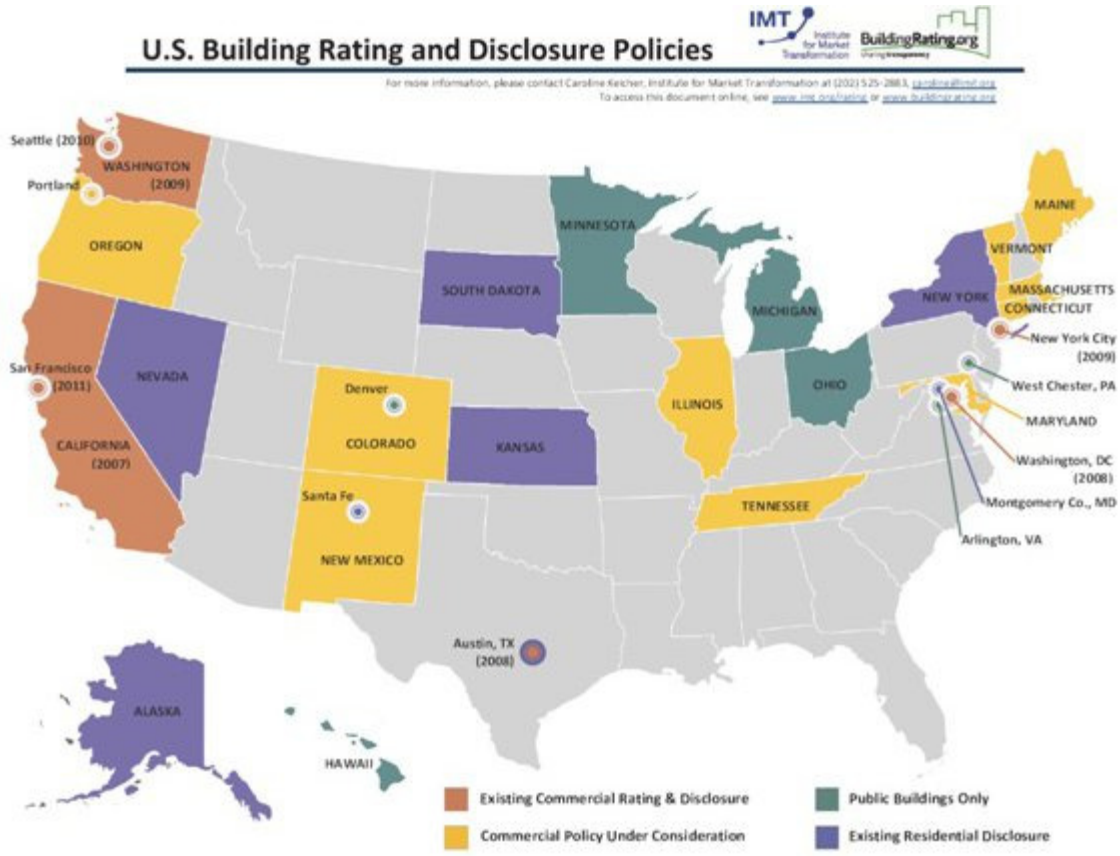
One of the most widely used energy benchmarking systems in the United States is Energy Star Portfolio Manager, a free Web-based tool maintained by the U.S. Environmental Protection Agency (EPA). Users input basic building parameters, such as space type, square footage, hours of operation, number of occupants, and number of personal computers (PCs), as well as 12 months of total energy data. This information is normalized to weather conditions and run through an algorithm that compares the input building to one with similar operating characteristics from the CBECS database. The program calculates a rating of 1 to 100 based on the building source EUI; source energy accounts for both the raw fuels and the energy products from the raw fuels consumed. This score represents the percentile performance above other comparable buildings. For example, a score of 67 means the building is performing better than 67% of all similar buildings nationwide. A rating of 50 is average, and 75 earns the building an Energy Star certification label for that year. This system compares all buildings on one scale and allows for tracking throughout the lifetime of the facility.



Placing buildings in an easily understood comparative metric puts this EUI statistic in perspective. Understanding the implications of the score and aligning this with the building marketing strategies will drive the basis for developing a target score. Is the goal to reduce spending by decreasing annual operating costs by 10%? Is the objective to increase leased tenant space by achieving Energy Star or another green certification? Are you aiming to gain a competitive edge over similar commercial buildings in your region? Benchmarking a facility or achieving a high rating may not only provide avenues for cost savings and certifications opportunities, but may be a necessity to comply with city or state legislation.

Policies that mandate the use of a benchmarking tool to rate and disclose the score for commercial facilities are currently being written and implemented throughout the world. New York City's Local Law 84 in the Greener Greater Building Plan is an excellent example. A study by New York City revealed that buildings are responsible for 75% of the city's total annual carbon emissions. Of these buildings, 85% are expected to still exist in 2030. This information, coupled with expensive retail energy prices, drove the effort for an energy efficiency policy. The law mandates annual energy and water benchmark reports for city buildings that are more than 10,000 sq ft, as well as for privately owned buildings that are more than 50,000 sq ft. It requires the use of Energy Star Portfolio Manager and the disclosure of the score.

Several other U.S. cities, including San Francisco, Seattle, Austin, and Washington, D.C., have already adopted similar legislation (see Figure 3). Of these, New York and San Francisco are coupled with a plan of action to reduce energy consumption for commercial buildings. Methods such as ASHRAE Energy Audits or retrocommissioning are included as mandatory efforts on a timed cycle.



The policies in place do not require achieving a specific score; however, some legislation mandates audits for buildings with low ratings, such as Washington's Efficiency First bill, law SB 5854. For public buildings greater than 10,000 sq ft with an Energy Star score less than 50, a preliminary Energy Audit is required.

All of the current legislation relies on Energy Star. Due to the release of information explaining no results of the 2007 CBECS survey will be published and no 2011 survey will be administered, Energy Star will be based on 2003 data for the foreseeable future. This leaves cities in a possible conundrum if funding isn't restored. However, there are alternatives on the horizon. The National Institute of Building Sciences is establishing a High-Performance Building Data Collection Initiative to determine a methodology for collecting and disseminating energy and building attribute data. Also, on Feb. 10, 2011, ASTM E2797-11 Standard Practice for Building Energy Performance Assessment for a Building Involved in a Real Estate Transaction was released. The standard aims to standardize collection, compilation, and analysis of building energy use and cost data.

Internationally, countries such as Australia, Russia, and Singapore have implemented policies to help regulate benchmarking and energy efficiency transparency. In the European Union (EU), the Energy Performance of Buildings Directive (EPBD) mandates that an energy performance certificate is provided to the owner or by the owner to the prospective buyer or tenant when buildings are constructed, sold, or rented out. Countries within the EU can develop their own systems for benchmarking buildings for the energy certificate. In Italy, for example, the buildings are given a score from A+ to G based on their EUI. EPBD has raised the awareness and importance of energy

efficiency but has been a challenge for many of the member states to implement. In May 2010, EPBD was recast in hopes to simplify the language and process, increase the scope, strengthen quality control of the certificates, and promote low/zero-carbon buildings. As in all institutions, each benchmarking procedure or tool is different and has various nuances.

Energy Star Portfolio Manager is among the most popular benchmarking tools and is cited most often in U.S. legislation, and therefore this article will take the time to explore the specifics of benchmarking using this method. Even though the lack of updated CBECS data could halt future revisions of Portfolio Manager, current legislation mandates its use. Following is a review of frequently asked benchmarking questions that can help building owners avoid incorrect data entry or user confusion.

Your facility is not compared to other buildings that are using Energy Star Portfolio Manager as a basis for their ratings. The Energy Star score is based on an algorithm that compares your facility inputs to other buildings in the CBECS database that have similar regional location and operating characteristics. CBECS is a national sample survey conducted every four years to collect data on commercial buildings in the U.S., namely their energy-related characteristics and energy consumption. The last survey was completed in 2007, but data will not be released due to invalid results and the 2011 survey will not be conducted because funding has been cut. Therefore, Energy Star is currently using CBECS data from 2003 and will be for the foreseeable future. If funding is restored, as buildings increase in energy efficiency, however, it would be expected that the database of facilities would increase in energy efficiency and create a stricter benchmark comparison. An Energy Star rating is only valid for the 12 months of energy data being analyzed; therefore, facility owners are encouraged to maintain, track, and update the parameters and energy data.

One of the common factors that contribute to incorrect ratings is a misunderstanding of the definition of "weekly operating hours." Energy Star defines it as the "number of hours per week that a building (or space within a building) is occupied by at least 75% of the tenant employees, and is therefore considered to be operational." This does not include HVAC warm-up or cool-down hours or the time that 10% of the occupants remain after typical hours. This also means that the weekly operating hours should be set to zero for vacant spaces, because no occupants are present even though the space may be supplied with conditioned air.

Energy Star has several classifying space types such as office, bank, school, retail, hotel, data center, and so on. The EPA has recently further defined data centers, characterizing them as "spaces specifically designed and equipped to meet the needs of high density computing equipment such as server racks, used for data storage and processing… When a data center is located within a larger building, it will usually have its own power and cooling systems. The data center space is intended for sophisticated computing and server functions; it should not be used to represent a server closet or computer training area." For spaces that do not qualify as data centers but are still considered server rooms that run 24/7 and have separate cooling, the space should be entered as "office space" with 168 operating hours per week, zero number of occupants, and the number of PCs equal to the number of servers. This is one exception to the weekly operating hours rule described above. For spaces that are more similar to IT closets or server rooms that lack separate cooling systems, the space is considered a supporting function and the square footage should be aggregated with the total office space.

Energy Star recently provided a module for more detailed data center inputs. Several commercial facilities with high-density computing areas encountered difficulties in accurately representing their facility. The changes allow the user to input IT energy metering configuration as well as the energy consumption for the IT energy, defined as "the total amount of energy required by server racks, storage silos, and other IT equipment in the data center." This designation does not include HVAC equipment needed to cool the space or lighting needed to illuminate the space. Energy Star requires the output of any UPS to be submetered. Most UPSs connected to IT equipment have the capability to provide peak kilowatt consumption but do not have the immediate capability to provide kilowatt-hour consumption data. The UPS will need to be retrofitted or a submeter will need to be installed to

capture the kilowatt-hour consumption for just the IT equipment. The EPA will make the IT energy a mandatory requirement for data center space types beginning June 15, 2012. Consequently, buildings must have their IT Energy submetered as early as June 15, 2011, for applications submitted in June 2012 (because 12 months of energy data is required).

Energy Star is meant to be a straightforward but accurate way to benchmark a facility. The easiest way to model a commercial facility in Portfolio Manager is to aggregate all of the tenants and supporting functions into one office-space-type input. If there are tenants that are generally present for 10 hours or more per week outside the typical occupied hours of the facility, those tenants should be separated out to better represent their occupied hours.

There are two ways this issue is currently being addressed: laws mandating tenants to disclose data, and utility programs reporting combined base building and tenant usage. An increasing number of utility providers are supplying their customers with aggregate monthly energy data without the individual tenant breakdown, therefore avoiding tenant disclosure issues and streamlining and simplifying the energy data collection and input. Commonwealth Edison (ComEd), a northern Illinois energy delivery company, developed a Web-based tool called Whole Building Energy Usage. This tool allows the user to first confirm the tenants and accounts present on-site, and then view one aggregate number each month for the base building and tenant usage combined.

One of the newest changes in Energy Star concerns the way the EPA is awarding the year in which you are labeled. Previously, a facility was awarded an Energy Star label based on the period ending date, or the last date of the 12 months of energy information under consideration. The application was good for 120 days from that period ending date. If a facility had 12 months of data from Jan. 1 to Dec. 31, 2010, and submitted an application in February 2011, the certification would be for 2010. Energy Star is now awarding certification labels based on the date the application is approved.

You've put your building on the map. You have a starting point. But where do you want to go and how do you plan to get there? The benchmarking analysis creates a fork in the road—meeting and surpassing the target versus falling short of the objectives. In either case, the facility owner or manager is, at a minimum, aware of how the building performs relative to similar buildings. If the facility already meets its target, that doesn't mean there is no work to do. Energy Star ratings and other benchmarking scores are only valid for the 12 months being analyzed. With nationwide energy and disclosure policies, stricter energy standards and codes, numerous available green certification labels, and a competitive commercial market, a facility can quickly lag behind its rivals. To remain sustainable, the facility and owner must be environmentally friendly, economically profitable, and socially equitable.

A simple first step to maintaining a competitive edge is to regularly update a building's benchmark and consciously monitor the usage trends and score. Performing this exercise once won't get the results you are looking for. Continuously updating the benchmarking analysis is simple and inexpensive. It can save time and energy if action is taken when monitored values slide outside expected ranges.

The building energy performance field is evolving in response to market demands. If a building is rated as less efficient compared to its peers, it can negatively affect financial performance and competitive market presence, possibly raising red flags to lenders or other financers. In addition, there is a growing public concern for verification of energy savings and true performance. Local, state, and federal policies address some of this concern by mandating not only energy benchmarking, but also the public disclosure of the results. Not only are policies using benchmarking to drive energy reductions, but so are some green certification systems, which many building owners and managers use as a marketing tool. The U.S. Green Building Council's (USGBC) LEED Existing Building Operations and Maintenance Energy and Atmosphere Prerequisite 2 requires the use of Energy Star to benchmark the facility and achieve a score of at least 69 to qualify for a potential certification. Green Building Initiative's (GBI) Green Globes and the Building Owner's and Manager's BOMA 360 program also use Energy Star to document points awarded for energy performance. It is unclear how the lack of future

data will affect these rating systems; however, it is clear the benchmarking is a critical path and the driving force behind energy reduction, tracking, and performance disclosure.

As more owners properly benchmark their facility and begin to "place their buildings on the map," establish a target, develop a roadmap, and monitor progress, we are collectively working toward reducing the environmental impact of buildings.

Skolnik is an associate with Environmental Systems Design, where she is responsible for green rating system consulting, energy auditing, commissioning, energy modeling, and Energy Star certification. Her expertise is in benchmarking and energy analysis for building portfolios. She is a 2011 40 Under 40 winner.
