

Universal Energy Benchmarking for Commercial Buildings: Making It a Reality in California

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ABSTRACT

The EPA's Portfolio Manager (PM) tool for benchmarking the energy performance of commercial buildings has gained broad acceptance among energy managers, but it is still used by a small fraction of buildings.

In California, use of PM is being greatly expanded. The Governor's Green Building Initiative has set the goal of reducing the energy consumption of all state-owned buildings by 20% by 2015. All these buildings will be benchmarked in 2007, and PM is being used to track progress toward that goal, based on the weather-normalized source energy intensity, in annual energy use per square foot.

A second, even more ambitious goal, is to benchmark all commercial buildings. Recent legislation requires all California utilities to offer uploading of customers' utility billing information to PM so that customers' benchmarking data can be kept up-to-date. This capability is to be in place by 2009. Then, by 2010, all commercial real estate transactions (purchase, lease, refinance), will require disclosure of benchmarking information to the purchaser/lessee.

In order to make universal benchmarking possible, it has been necessary to improve the automated data transfer mechanisms between the utilities and the EPA Portfolio Manager system. A work group has been facilitating this process, standardizing data release authorization mechanisms, utility billing computer system data transfer protocols, Portfolio Manager procedures and reporting.

This paper will report on what it has taken to make this happen. It will be of interest to other utilities and states interested in automating the benchmarking of their building stocks.

Background

Benchmarking is a term applied to efforts to track and compare the energy use of commercial buildings. It is widely recognized as an important information tool for measuring the relative efficiency of buildings, for encouraging efforts to improve their efficiency, and for tracking energy use trends over time. In its simplest form, benchmarking is the annual energy use per square foot for a given building; this is known as the "energy use intensity", or the EUI. The EUI can include all of the energy sources and fuels, with the total converted into common energy units. The EUI can also include energy units converted to source (as opposed to site) energy, and/or can be adjusted to account for year-to-year weather variability, known as weather-normalization. Benchmarking can also include a rating, or relative efficiency score (say, on a scale of 1 - 100), which allows for simple comparisons among similar buildings within a group or across the nation. Benchmarking, because it is based on total energy use data, encompasses not only the physical energy efficiency of a building and its equipment, but includes the

operational efficiency as well. Improvements in either physical efficiency or operations will show up as improved benchmarking ratings.

California has decided, through an Executive Order (EO) from the Governor (Governor 2004), to benchmark all of its buildings, and to encourage all commercial buildings to be benchmarked. As part of this effort, the California Energy Commission (CEC) selected the benchmarking system developed by the US Environmental Protection Agency (EPA), known as Portfolio Manager (PM), as the most appropriate, universally available and consistently applicable benchmarking tool available for this purpose. At the same time, the CEC is sponsoring additional research into more advanced and capable benchmarking systems, which may be adopted in the future.

The above mentioned Executive Order also requires Leadership in Energy and Environmental Design (LEED) Existing Buildings certification or compliance for certain state buildings. Portfolio Manager benchmarking is a required element of this activity.

One of the important benefits of the PM system is that it is available nationally. If California were only interested in benchmarking its own state buildings, other benchmarking approaches could be considered. However, many large building owners in the private sector have facilities across the region or the nation, and they would not be interested in a California-only benchmarking tool. Another benefit of the EPA PM system is that it is tied to the ENERGY STAR[®] Buildings award, which recognizes buildings in the top 25th percentile of energy efficiency. The availability of a nationally recognized award can be a motivator for building owners to improve the efficiency of their facilities.

The ultimate goal in California (and ultimately the entire US) is referred to as *universal automated benchmarking*, with all buildings benchmarked in the PM system, and all benchmarking data automatically provided by the utility to keep the benchmarking rating and EUIs up to date over time.

Data Needed for PM Benchmarking

It is a simple enough process to benchmark a single building; it is quite a different matter to benchmark thousands of buildings, due to data gathering and data maintenance issues that become challenging as the task gets bigger. Benchmarking each building requires cooperation from at least three entities: the building owner/operator, the utility (or utilities) serving the building, and the EPA PM system.

Customer Supplied Data

The first step in benchmarking is for the owner of the building, or somebody designated by the owner, to create a facility account on the EPA PM system. With the manual method, this involves going to the PM website (ES 2008), creating a user account, and creating a separate facility account for each building. The minimum facility information needed is the name and address, and the year it was built. Then, for each major space type in the building, PM needs to know the occupancy type, the square footage, number of operating hours per week, number of occupants, number of PCs, and whether the space is heated and cooled. In addition, the utility billing meters must be identified.

When there are many facilities to be set up in PM, the manual website method can be time consuming. However, all of the customer supplied data can also be inserted into PM

electronically, either using an Excel spreadsheet structured appropriately for PM, or through web services that accept the data directly. These electronic methods can be used either by the customer, by the utility, or by a third party data service.

Utility Supplied Data

The other part of the data needed for benchmarking is the utility billing data. PM requires, at a minimum, 12 months of billing data, in order to generate an EUI or a rating. If there are two or more billing meters serving the building, they also need at least 12 months of data entered into PM. Then, as time goes on, the building will accumulate time series data on the energy usage, allowing comparisons between base and current years.

The billing data can be entered manually via the website, or it can be entered through an appropriately formatted Excel spreadsheet, or it can be entered automatically by the utility or other service provider, via PM web services. This latter approach is known as *automated benchmarking*, and is currently available for only a handful of utilities and service providers.

Automating Utility-to-EPA Data Transfer

In order for universal benchmarking to be feasible, it is necessary to automate the transfer of facility billing data into the EPA PM system. If the system relied on manual data entry, it would only enlist a fraction of buildings, and the data would not likely be up-to-date. A group in California, known as the Benchmarking Work Group (WG) (Mahone 2008), has been working with state agencies, utility companies and the EPA, first to overcome the barriers to automated data transfer for state buildings, and then to expand automated benchmarking to all commercial buildings.

Data Release Authorization Issues

The first issue that was addressed was the requirement for customers to provide written authorization to their utilities for the automated release of their billing data to the PM system. This is a component of the utilities' fiduciary responsibility to maintain the confidentiality of their customers' data. While California investor-owned utilities had a common, California Public Utilities Commission (CPUC) approved procedure and form for obtaining customer authorizations, it was a cumbersome agreement that would have required wet signatures by both the customer and the third party recipient (EPA in this case). The form covered other circumstances than the release of benchmarking data, such as requesting a new rate tariff or cancelling service, which would naturally require such care.

Working with the utilities' attorneys, the WG was able to develop a simplified agreement that was limited to the simple purpose of authorizing billing data to be released to the PM system. It only requires one signature from the customer or authorized representative, and it can be used to authorize as many facilities as desired. The form provides the usual provisions to prevent the utilities being sued if the customers' data is somehow mishandled by EPA.

Another feature of the authorization form is that the customer grants the utility access to the facilities' PM account to which the utility will be transferring data. This allows for utility data accuracy checks, and also provides the utility with valuable data about their customers' facilities (square footage, occupancy, etc.). This data will help the utilities to conduct market

research for purposes of improving their customer services, and will also enable them to provide better facility-specific technical assistance.

At present, the authorization form remains a paper document with a wet signature. The next step will be to work out procedures for electronic or on-line authorization by the customer, which would streamline the process and reduce the cost of benchmarking.

Data Security Issues

Before the utilities would agree to automatically uploading their customers' data to EPA PM servers, they conducted a due diligence review of EPA's data security procedures. EPA documented their security procedures, which meet federal agency standards and which include both electronic and physical security for the computers and their data. The utilities' data security experts were satisfied that the confidentiality of their customers' data would not likely be compromised by EPA.

Automated Data Transfer Procedures

The PM system was initially designed with a customer-accessed web interface. As more companies used PM, third-party energy service providers started offering benchmarking as an additional service, and they took on the task of setting up PM facility accounts and uploading monthly billing data for their customers. EPA worked with them to set up semi-automated data uploading procedures using either Excel spreadsheets containing the data, or using web services that could accept XML data files with the data. When the California utilities became involved, it was these two data options that they used. The utilities that set up their initial automated benchmarking for state buildings using the Excel method quickly found that this was going to be too cumbersome to handle large numbers of customer facilities.

The utilities that set up the XML data transfer protocols encountered different problems. The XML data formats were found to be relatively straightforward, but the difficulty of extracting the correct customer billing data from their billing systems varied, depending on how those systems were configured and secured. Even the utility which had the greatest success with the XML data transfers, PG&E, ran up against some of the limitations of the EPA's web services. Those services were not developed with universal benchmarking in mind, and lacked sufficient flexibility. EPA released a draft of their next generation of automated benchmarking web services in the spring of 2008, which addressed many of the issues encountered by PG&E and others in their initial benchmarking of California state buildings (ES 2008). Those new services were scheduled to go online in mid-2008.

Benchmarking California State Facilities

Progress in Benchmarking

The process of benchmarking all state facilities required the efforts of energy or facility managers at 13 agencies and 33 departments, covering over 1450 facilities. Gathering the data to establish PM accounts for all of these facilities required many more months than originally anticipated - it took over a year and a half - and there were unanticipated difficulties in getting the data properly formatted and entered into the PM system. Similar difficulties were

encountered in identifying the billing meter accounts for all of the facilities. Each of the utilities had its own ways of identifying the billing accounts, and many of the facilities had more than one utility and multiple meters.

Staff of the Department of General Services, supported by staff from the Benchmarking Work Group, coordinated and facilitated the effort among the state agencies and departments, and the process may never have been completed without the technical and logistical support that was provided. By the spring of 2008, however, all of the state facilities had been entered into the PM system, and most of the utilities were providing automated data uploads for those facilities.

The remaining task was to enlist the numerous municipal utilities and water districts which are energy providers to state facilities within their territories; some of these are quite small and may find the automated data transfer procedures challenging. We expect, however, they will find automating the procedures to be more cost effective than providing the billing data manually.

Tracking State Building Efficiency Goals

When the Governor's order to benchmark all state buildings was issued (Governor 2004), it did not specify how progress toward the 20% energy use reduction would be measured. While several alternative measurement approaches were discussed, the only practical answer was to use PM as the system to track utility bills and energy use over time. In particular, the weather-normalized EUI value generated by PM provides a reasonable metric to compare base year (2003) energy consumption to any selected year, and to calculate the percent reductions. (The utilities are supplying historic data for the buildings, going back to 2003.) As the automated benchmarking system allows PM to accumulate annual values for EUI, state energy managers will be able to plot trends in EUI. PM also allows the benchmarking data to be rolled up by department, by agency, for all state buildings, or for any other group of facilities desired. This will help managers to track progress toward meeting the goals, and to identify leaders and laggards in the effort.

Future of Universal Benchmarking

The effort to benchmark California state buildings is only the beginning. In many ways, it was a trial run for the utilities. As discussed above, a lot of useful lessons were learned, which will make it possible to streamline and further automate the benchmarking process. Based on this experience, the WG and its member utilities have been helping the EPA to develop improved data transfer methods that will make universal benchmarking easier and less costly to implement.

There are a number of avenues for improving benchmarking:

Utilities and Customer Service Benefits

As one of the prominent utility members of the WG reminds the group, benchmarking is not an end in itself; rather, it is the means to encouraging actions that save energy. Indeed, EPA originally conceived benchmarking, and their rating system, as a way to recognize the top quartile of energy performing buildings with the ENERGY STAR Building designation, and in so doing to challenge and encourage facility managers to act.

The utilities in California see benchmarking as a way to inform and motivate their customers to participate in their energy efficiency programs. The initial effort has been focused on the utilities' retrocommissioning programs, which ask customers to benchmark participating facilities and to do a before/after comparison using the benchmarking results. The utilities are also looking at other ways to use benchmarking information to increase program participation. This can be done passively, whereby the customer is encouraged to benchmark their facilities, on the assumption that they will then come to the utility programs for help in improving efficiency and their ratings. It can also be done proactively, whereby the utility uses the benchmarking data to identify customer facilities that are lagging in their efficiency, and to approach the customer with offers of help and incentives.

Another possible model for the utilities would be to make benchmarking into a routine customer service offering. Under this model, commercial customers would be offered the automated benchmarking service. The utility could use their website to inform and assist the customers in the initial facility setup process, and in identifying their billing meters to the PM system. One could imagine the benchmarking outputs printed on the monthly billing statements, along with analysis of trends or notification of significant changes. Alternatively, the utility's customer website could offer to display benchmarking results and provide some analysis to help the customers understand the information.

Real Estate Valuation Benefits

Benchmarking also has a role to play in setting the value of commercial properties. It has long been recognized that more energy efficient buildings should be more valuable than comparable inefficient buildings, because their energy costs will be lower. Real estate appraisers and purchasers, however, have generally lacked reliable data about the relative efficiencies of the buildings within a given area. Benchmarking data could provide the basis for comparing the energy efficiency of buildings, if the data were available. Of course, this comparison will implicitly include operational efficiency along with asset efficiency, giving owners an incentive to operate their buildings efficiently (and to encourage their tenants to do likewise).

To address this problem, California has adopted legislation, AB 1103 (Soldaña 2007), which requires that benchmarking data be disclosed in all real estate transactions in the state (sale, lease or refinance), beginning in January, 2010. Presumably this information will be disclosed as part of the due diligence phase of each transaction, and it may even be included in the real estate multiple listings services data so that it is available to all market participants. AB 1103 also requires all California utilities (both public and investor-owned) to offer Portfolio Manager based benchmarking data services to their customers, beginning in January, 2009. As of this writing, there are many details yet to be worked out as to how these services will be provided to customers, but the outcome should be that customers in real estate transactions will have much better information about the energy efficiency of the buildings they acquire.

Energy Efficiency Actions

Customers can use benchmarking data for many purposes that all point toward more energy efficient buildings. At the most basic level, benchmarking gives facility managers a way to compare their buildings' energy use from year to year, including all energy sources on a weather normalized basis. Because benchmarking incorporates both the physical efficiency of

buildings and equipment, with the operational and behavioral aspects of energy use, changes to any of these parameters will show up as improved benchmarking ratings. This provides motivation to take care of the “soft” energy use factors, often as low-cost/no-cost actions, as well as to invest in more efficient equipment or systems. For owners of multiple buildings, they can compare between them to identify the best and the worst, and to take action on the worst. At a more sophisticated level, benchmarking data can help to highlight the differences between energy use for different fuels (and, by implication, for different building systems). At the high level, of course, there are the bragging rights of having a top performing building, and of earning the ENERGY STAR Building designation and plaque. Properly used, benchmarking can motivate efficiency actions at all levels in an organization, and can provide the information for rewarding good performance.

The PM benchmarking system is technically simple and uncomplicated. It does not collect or process the detailed information about each building’s energy systems or occupancy details, and so it cannot explain which parts of the building are least or most efficient, nor can it break down the energy usage by end use. There are more sophisticated benchmarking systems that can do those things. With more detailed information, customers would be able more precisely to focus their energy efficiency efforts and investments. The California Energy Commission is currently sponsoring research to develop a more sophisticated benchmarking system that will provide many of these more detailed energy assessments, and hopefully produce even more efficient buildings over the long run.

Measurement and Evaluation

The general tendency in measurement and evaluation (M&V) of energy efficiency programs, and indeed in the implementation of those programs, is to focus on the hard energy savings due to equipment and systems upgrades. Behavioral and operational improvements in energy consumption are often ignored or discounted. Consequently, M&V protocols go to lengths to separate out the hard efficiency from the soft. Engineering calculations hold behavioral parameters constant on both sides of the before/after comparison, so that only the hard efficiency improvements are counted.

For many people, however, the bottom line for energy efficiency programs is “Have they reduced the total energy use of the building?” For those people, benchmarking can provide the answer, by providing data for the before/after comparisons (at least for retrofit situations) at the whole building level and over time. An M&V system built around benchmarking would be simpler and less costly than the previously described “hard efficiency only” approach.

Engaging Smaller Utilities and Other States

The benchmarking system being pioneered in California has not yet engaged many of the smaller utilities, and none have developed electronic billing data transfers to the PM system. Similarly, many other states have not yet joined the effort toward universal benchmarking. This is not to say that all of the other states and small utilities are sitting on the sidelines; there have been significant benchmarking efforts in several states, including [brief list]. The authors hope that the California experience will help to streamline the procedures and reduce the start-up costs for these other jurisdictions to embrace universal benchmarking.

Benchmarking Enhancements Wishlist

Another outcome of the California experience with benchmarking has been the development of a wishlist of enhancements that we would like to see in the PM system. They fall into four categories:

Easier facility account setup. Improve PM web services to make it easier for customers (or their energy service providers) to set up multiple facility accounts with a minimum of effort, and with as much automated data validation as possible. This latter will be especially helpful when identifying meter account numbers, which can vary widely between utilities.

More flexible account maintenance. Over time, many if not most customer facility accounts will require adjustment. This could be due to meter changeouts, new rates, facility alterations, etc. The system should be able to accommodate these changes using automated procedures, while at the same time allowing customers to manually change account details over the web.

Multi-year reporting capabilities. While the PM system currently offers a degree of report customization, it is quite limited. For example, it only supports comparisons in benchmarking data between a single year and a single base year. Customers will ultimately need to compare trends over multiple years. Both multi-year tables and graphs should be supported.

Tracking of demand. PM is currently configured for energy consumption (and greenhouse gasses and water), but it does not offer tracking of peak demand. Many customers and utilities care as much or more about demand reductions. Although there are technical difficulties to work out, demand is an important aspect of electricity use that PM should track.

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