Viridiant Lecture Series
benchmarking: measuring building performance

People quantify many aspects of the world around them, from the fuel economy of vehicles to their heart rate while exercising. Benchmarking has become increasingly commonplace, but it has lagged behind in the building sector even though it is easier to do than many might think. In this bulletin, we show how to get started with building benchmarking and how to use the data to make more informed decisions.

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track

- Collect basic information on your building, such as the square footage, number of bedrooms, heating fuel, and hot water fuel.
- Gather energy and water data, either from utility bills, submeters, or circuit level monitors. If you're collecting data for a multifamily building, focus on the owner-paid utilities first.
- Collecting tenant-paid utility data can be challenging and can be part two of your benchmarking efforts.

quantify

- Benchmark the building against itself and to other buildings. Benchmarking the building to itself is simply assessing year over year data and, ideally, weather normalizing It. This serves as a check that everything is operating correctly.
- Benchmark a building to others in your portfolio or others like it to gauge the efficiency of the building. You'll need to normalize the data, usually by determining a usage/sq ft metric, or gallons/person for water. Software tools can make this easier.

repeat

- Benchmarking is an ongoing effort. While a static snapshot can provide valuable data, frequent monitoring provides greater insight into the operation of the building and can help spot costly usage spikes early.
- When retrofits occur, ongoing benchmarking allows the performance of the upgrade to be assessed almost immediately and will provide savings numbers to justify similar retrofits in other buildings.

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With advances in technology, benchmarking seems to be everywhere, from simple things such as the average fuel economy of a vehicle to devices for the "quantified self." The building industry has lagged behind with benchmarking but has seen more uptake in recent years as technology makes it easier. There are several ways to get started and begin using the data to increase operational efficiency, target buildings for retrofits, and reduce operating expenses.

As Peter Drucker famously said, "You can't manage what you don't measure." Many industries have taken this to heart, creating a world where many of our day-to-day activities can be quantified. We're accustomed to knowing how long a trip will take based on real-time traffic information, how much data we've used on our phone each month, the real-time fuel economy of our cars, or our heart rate when we're working out. For each of those, we also have benchmarks to compare to – how much data we've used on our phone before and our data limit, the EPA fuel economy ratings, and typical heart rates for other people like us. Yet, while we spend 90% of our time indoors, we often have no idea how much energy our buildings are using or how that compares.

To get started, collect the energy and water data for the building or buildings to be benchmarked. This data can be collected from utility bills. Utilities that have installed smart meters may provide access to 15-minute interval data. Some multifamily buildings bill utilities back to the tenants, making it possible to get access to that submetered data. Hardware can also be installed at the meter or at the breaker box to gain direct access to the usage of the building.

Utility bill data is typically the easiest and least expensive place to start when benchmarking. Historical data can often be downloaded from the utility company's web site. Data can be manually added to a spreadsheet each month when a new bill arrives or it can be uploaded to the EPA's Portfolio Manager tool. Alternatively, there are companies such as WegoWise, EnergyScoreCards, and WattzOn that will automatically import data directly from utility companies, minimizing the amount of manual work that needs to be done each month. WegoWise and EnergyScoreCards are primarily for multifamily buildings and charge a fee. WattzOn is only for single family buildings and is free for residents.

One of the benefits of using a specific benchmarking tool instead of a spreadsheet is that it provides a way to compare a building to other buildings like it. Portfolio Manager provides a 1-100 score based off a sample of buildings. WegoWise provides a live benchmark of the building compared to other buildings like it, which is updated as new data is put into the system. Monthly and annual benchmarks are provided, with monthly benchmarks allowing for quick feedback on any changes made to the building. WattzOn similarly provides a benchmark of the building compared to others like it.

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To collect energy usage data, there are also hardware options such as Neurio and Sense. These are installed in the breaker box and include an app that shows real time energy usage, along with information about how much energy different appliances in the house are using. Neurio also includes comparisons to other homes. For multifamily buildings, solutions such as eGauge, efergy, and Aquicore can provide building level data. Hardware can be a bit more expensive than software options, but it ensures a continual feed of new data.

With the data in hand, it's time to put it to use. Data can be used to:

- Manage operating costs
- Create accurate utility allowances
- Budget plan and track
- Measure and verify improvements made via retrofit
- Market
- Identify the buildings that would most benefit from available utility company incentives

Ongoing assessment of energy and water data has been shown to reduce usage an average of 2.4%[1] each year. These savings stem from a few sources. The most common is identifying usage spikes in a timely manner. When comparing a building's usage to its historic usage, it's often easy to spot spikes. These spikes may be a result of an issue in the building, or it may be a result of a utility company error. It's also possible to identify equipment failures if usage trends upwards, which allows repairs or replacements to be made earlier than usual. For example, when water usage starts trending higher, it is often a sign of failing toilet flappers that would otherwise be unidentifiable without physical inspection.

Utility budgets are often created by assessing the previous year's expenses and adding a percentage to account for utility rate increases. This ignores if the previous year was abnormally hot or cold and can therefore lead to inaccurate costs.

A smarter way to create a utility budget is to take several years of usage, average them, and then apply current or projected utility rates to that usage. Benchmarking with monthly utility data allows an active comparison to the budget as the year progresses, allowing for course corrections to be made as needed.

For affordable multifamily properties that are required to produce utility allowances, benchmarking provides the ancillary benefit of having the data on hand that is needed to produce accurate utility allowances. In some cases, modeling or using a schedule of costs may be allowable, but collecting an ongoing sample of tenant data allows utility allowances to reflect actual costs the tenants pay for utilities. This results in more fair utility allowances for them, for the owner to potential charge more in rent, and for the owner to have more insight into what cost effective efficiency improvements may be able to be made to lower utility costs and in turn allow for higher rent to be charged.

Often, when energy efficiency improvements are made to buildings, the anticipated savings are projected. When energy and water use is tracked, the actual savings can be quantified, allowing a building owner to make sure the retrofit is performing as expected. This data can be used to make adjustments post-installation to gain the most savings from the retrofit. Data can also be used to make a case for performing similar retrofits on other buildings and better understanding the payback time.

2.4%
average reduction in energy usage per year with consistent benchmarking

Benchmarking data is often a valuable marketing tool. Tenant data can be repurposed into case studies or other forms of marketing collateral to highlight savings and a lower cost of living to potential renters.

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In a property with high turnover, benchmarking can be used to determine if high utility costs are a contributing factor and help identify the inefficiencies that need to be addressed to bring costs down. Consumers want to make informed decisions and are accustomed to doing so, with tools like the Energy Guide on appliances and the fuel economy labels on new cars. Providing them with a measure of efficiency for a home they may be renting or buying gives them a more complete picture of their monthly expenses so they can make a truly informed decision.

As the value of benchmarking is increasingly recognized, a number of cities have moved to require it. There are currently over 15 cities around the country that have energy disclosure ordinances. One of these cities, New York City, found a 5.7% energy savings over 3 years in buildings that were benchmarked, generating a cost savings of $267,492,147.[2] In addition to the cost savings benefit, ordinances like this push utility companies to provide whole building data, which can be challenging to get without such ordinances in place and is often impossible to get directly from utility companies otherwise.

While these ordinances typically involve aggregated whole building data being reported directly to the city, Austin, TX has gone a step further. Austin requires multifamily buildings have an energy audit conducted at least every 10 years with results provided to tenants. Tenants also receive an energy guide which includes the estimated average monthly utility costs. The worst performing buildings, those that use 150% more energy than the average of other buildings, are required to provide a notice of high energy use to prospective tenants and tenants at the time of renewal. They are also required to reduce their energy usage by 20%.[3] Providing this information allows renters to make informed decisions and provides incentive for owners to improve their buildings.

Between the increasing push by cities to require benchmarking, the current availability of technology to enable benchmarking, people's increased interest in quantifying the way the world around them operates, and the significant opportunity for cost savings, benchmarking will only continue to become more commonplace. For building owners, it is simply a matter of when, not if, they will begin to track their energy and water usage, just like they track occupancy rates and other metrics in order to maximize the operating efficiency and profitability. accustomed to doing so, with tools like the Energy Guide on appliances and the fuel economy labels on new cars. Providing them with a measure of efficiency for a home they may be renting or buying gives them a more complete picture of their monthly expenses so they can make a truly informed decision.

[1] ENERGY STAR, https://www.energystar.gov/sites/default/files/buildings/tools/DataTrends_Savings_20121002.pdf
[2] IMT.org, http://www.imt.org/uploads/resources/files/PCC_Benefits_of_Benchmarking.pdf
[3] Austin Energy, http://austinenergy.com/wps/portal/ae/energy-efficiency/ecad-ordinance/for-multifamily-properties/