Manage Campus Building Performance through Benchmarking to Save Energy and Water

College campuses spend nearly two billion dollars every year on utility costs, a figure that is forecasted to rise as energy and water costs become increasingly volatile in the future.[1] On average, **30 percent of the energy consumed in buildings is wasted** due to inefficient building systems, inadequate building operations and wasteful occupant behavior.[2] Improving the efficiency of existing buildings on your campus, strengthening building operational practices and engaging building occupants in resource conservation can dramatically reduce energy and water consumption, operations costs and greenhouse gas emissions. In 2014, Emory University reached their aggressive goal to reduce energy use by 25 percent per square foot by 2015 from 2005 levels through building efficiency improvements and operational changes. In addition to focusing on energy conservation measures, **implementing water efficiency practices can decrease operating costs by 11 percent, energy use by 10 percent and water use by 15 percent.**[3] **The Georgia Institute of Technology achieved annual savings of $123,000 from energy and water efficiency measures deployed on a single building**. The Sustainable Endowments Institute has reported an average return on investment of 18 percent for capital building upgrades involving energy efficiency from a sample of nearly 1600 buildings. Savings produced from these projects can be reinvested while significantly reducing your institution's carbon footprint and improving resiliency to fluctuating energy and water pricing.

Technology Square Research Building

"Georgia Tech's Technology Square Research Building began its retrofit effort just before joining the Atlanta Better Buildings Challenge in late 2011 and quickly benefited from the Atlanta BBC assessment. The Atlanta BBC assessment provided 15 additional energy and water saving solutions that spanned from lighting retrofits to additional building system controls. The building moved quickly into implementation and has completed upgrades saving $123,000 annually on electricity and water costs"
–Vic Clements, The University Financing Foundation (TUFF)

College and university campuses' diverse mix of property types and sizes, coupled with expansive square footage, can make identifying savings opportunities a challenge. Historically, the largest buildings and those consuming the most energy have been the primary focus for energy and water savings efforts, while smaller buildings (≤50,000 square feet) have been overlooked leaving a wealth of savings opportunities untapped. **Considering a typical college campus is characterized by a higher percentage of small buildings than large buildings, continuing to let smaller buildings fall through the cracks is a clear misstep in energy management.** By shifting the paradigm to include small commercial buildings as targets for energy and water efficiency improvements on college campuses, considerable reductions in energy and water usage and costs can be achieved nationwide.

Southface developed this *Campus Benchmarking Guide* to help colleges and universities assess the energy and water usage of both small and large buildings and compare them to ENERGY STAR's index of average energy usage for over 80 relevant building types. This enables the buildings with the greatest opportunities for savings to be easily identified regardless of size. **Following the benchmarking and energy and water management process will support the achievement of the 20 percent energy and water reduction goals on your campus as outlined by the U.S. Department of Energy, Better Buildings Challenge** and goals for other programs such as STARS and the Climate Leadership Commitment.

Energy Reduction Process

The benchmarking and efficiency improvement process consists of seven steps as outlined in *Figure 1*, and described in detail in the guide. Integral to the process is a good communication plan as illustrated in *Figure 2*.

Figure 1. **Energy reduction process**

1. **Plan** - Create a project team and determine the organization's energy and water conservation goals.
2. **Benchmark** - Establish a baseline year to track the energy and water reduction progress. Compare annual energy and water usage to baseline usage to see changes in consumption overtime.
3. **Identify Underperforming Buildings** - Find which buildings are using the most energy and water relative to other buildings on campus and similar buildings nationwide.
4. **Perform Energy Assessments** - Conduct assessments to prioritize energy and water capital improvements, operational changes and identify opportunities for commissioning.
5. **Implementation** - Plan, budget and identify funding resources to implement the energy and water improvements. Deploy energy and water efficiency improvements and commission upgraded systems.
6. **Tracking & Reporting** - Monitor post-implementation performance to verify utility savings and return on investment were achieved.
7. **Recognition** – Communicate achievement throughout the institution, the local community, recognition programs and the higher education sustainability network.

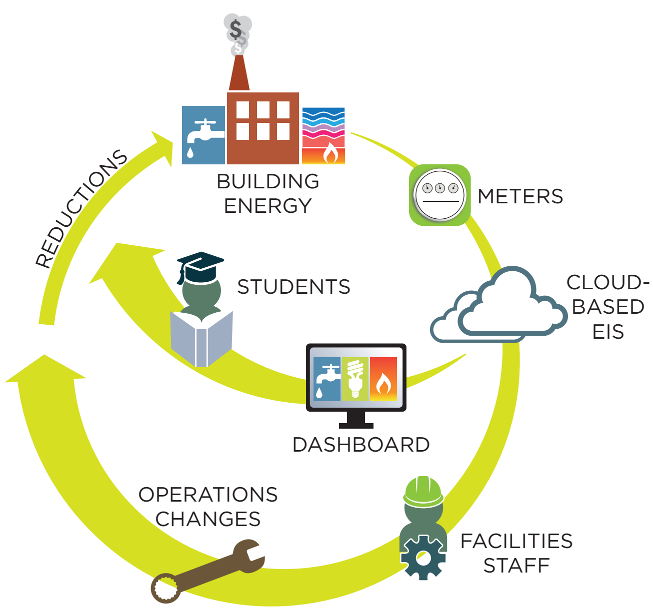

Figure 2: **Utililty data communication loop**
Data gathered from building meters and sub-meters is sent to an Energy Information System (EIS) to be analyzed. This data can then be used by facilities staff to identify operational changes, implement efficiency measures, plan for and implement capital improvements or respond to system failures. With the use of building energy dashboards, interval data also becomes visible to students and staff, who can modify behavior and implement personal efficiency measures such as unplugging unused equipment and turning off lights.

The Importance of Sub-Metering Energy Usage

Your campus may be equipped with meters serving multiple buildings. This set-up does not allow for in-depth energy and water consumption analysis. In order to track the energy usage of individual buildings on your campus, it is important to have each building separately metered for energy and water usage. For more information about submetering options for your campus, please review *Measuring Campus Performance*.

Building Upgrades – What to Expect

Although campuses are comprised of buildings spanning a wide range of uses and property types, just a handful of critical systems are responsible for the majority of energy and water usage, thus the bulk of efficiency improvements will involve the following system upgrades:

Energy

- Heating, cooling and ventilation control programming and equipment efficiency upgrades
- Lighting efficiency and controls upgrades
- Building envelope efficiency upgrades
- Water heating efficiency upgrades[4]
- Appliance efficiency upgrades

Water

- Water efficient toilets, urinals, faucets and shower heads
- Irrigation/landscaping efficiency upgrades
- Dishwashing and laundry efficiency upgrades[5]

By incorporating the campus benchmarking guide into a sustainability initiative, facilities staff will be able to develop an energy and water management plan developed around the institution's unique resource conservation goals, saving operational costs that can be reinvested elsewhere.

Case Study: Oglethorpe University

Oglethorpe University is a 180 year old liberal arts and sciences institution located in Atlanta, GA. The 100-acre campus has 28 individual building structures with a total of 548,514 sq. ft. of built space for staff and student use.

As a Grants to Green Campus Assessment Grantee, Oglethorpe began benchmarking utility data in preparation for the assessment and ongoing monitoring of resource consumption on campus. The Oglethorpe facilities team and Southface used the approach outlined in the campus benchmarking guide to identify a project team and set up the ENERGY STAR Portfolio Manager (ESPM) account. Similar to many university campuses, energy and water data was not available for the majority of Oglethorpe's individual buildings due to the utility meter configuration. The ESPM campus account was structured to benchmark the buildings to the extent possible by existing meters. Buildings were grouped by building type and source energy use intensity (EUI) metrics were determined for each group. These groups included dormitory buildings, academic buildings and the dining hall. National and local median energy and water consumption data were compared to each of Oglethorpe's building groups to help identify the highest savings opportunities. Benchmarking the campus also helped confirm the utility service layout, and prioritize opportunities for further submetering. Benchmarking results guided the building assessment surveys and analyses.

The Oglethorpe staff, students and administration expressed a goal to create student educational opportunities supporting the Grants to Green process through sustainability initiatives. Students are now assisting with tracking utility data in ENERGY STAR Portfolio Manager. Student participation may expand to include the analysis and reporting of energy and water consumption data to be used to engage the student body, faculty and staff in competitions to lower resource use in buildings through behavior change.

Better Buildings Challenge | *energy.gov/betterbuildings/solutioncenter*
Atlanta Better Buildings Challenge | *atlantabbc.com*
Southface | *southface.org*

The **Better Buildings Challenge** is an initiative of the U.S. Department of Energy designed to make commercial buildings, industrial plants and homes 20 percent more energy efficient by the year 2020. Free to join, the Better Buildings Challenge shares ideas and lessons learned from private and public sector partners to advance investments in resource efficiency. Local Government Partner programs like the **Atlanta Better Buildings Challenge**, provide additional technical assistance and marketing support and recognition to help program participants meet their efficiency goals. The Atlanta Better Buildings Challenge (ABBC) is a nation leading public/ private partnership. This community-wide effort is led by City of Atlanta Mayor's Office of Sustainability, **Central Atlanta Progress**, **Midtown Alliance**, **Livable Buckhead** and **Southface**.

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Prepared by:	Juliette Apicella, Laura Capps, Cody David, Sydney Roberts, Shane Totten, Gray Vickery
Contributors:	Jennifer Asman, Georgia State Vic Clements, The University Financing Foundation Robyn Furness-Fallin, Oglethorpe University Joan Kowal, Emory University Susan Kidd, Agnes Scott College
Design:	Greg Brough, Southface Energy Institute

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5. *www3.epa.gov/watersense/commercial/types.html*

Phase 1: Planning

Organizational Mapping

The benchmarking and energy and water management approach for your campus should align with your institution's energy and water utility data tracking capabilities, cost reduction targets and existing sustainability initiatives. To set the foundation for a robust sustainability strategy, campus-wide collaboration and communication is critically important. **The first step is to establish lines of communication, divisions of labor and accountability frameworks as they relate to energy and water management.** Mapping your organization's current utility management system and sustainability targets requires the following questions be addressed:

- Who receives/pays for the bills?
- Which budgets cover the bills? Are individual departments accountable for energy and water use expenses?
- What energy and water tracking tools are already in use?
- Are buildings individually or centrally metered? Are individual systems within buildings metered? [See *Measuring Campus Performance, A Case Study Analysis for information on submetering.*]
- How is energy and water use communicated to students or staff? Is there an information feedback system or communication loop (*Figure 2 in Overview Section*) in place?

Once you have an idea of who sees the bills, how the bills are paid, whether any utility tracking systems are in place and how communication regarding utility consumption flows, you will be able to determine who needs to be engaged in establishing a successful project team.

Establishing a Project Team

Teamwork is an essential component to a viable and organized building efficiency program. To streamline the process of measuring and tracking utility billing data, it is recommended that a project team be established at the onset. Assigning tasks to specific staff members will increase staff exposure to utility information while distributing the workload. Below is a list of common roles and responsibilities that are critical to a successful energy and water management program:[6]

- Utility bill management – Receives and pays for utility bills; may also be responsible for assigning fiscal accountability to individuals or departments for energy and water use.
- Utility data management and analysis – Responsible for managing utility data. When handling large quantities of data, interns can help log data and generate energy consumption reports.
- Systems response coordination and operations management – Oversees building operations to ensure that systems are operating efficiently and to routinely perform preventative maintenance.
- Progress reporting – Communicates energy and water consumption information and progress towards conservation goals to students, staff and management in a clear and concise format to increase awareness and drive behavioral change. Typically uses a digital dashboard or web-interface.

It is important that in addition to meeting the suggested roles described above the project team represents the following departments on campus:

- Administration – Sustainability division; ideally reporting to the VP of Finance
- Facilities – capital improvements
- Facilities – maintenance and operations
- Staff and faculty
- Student body
- Local community

As individuals join or leave the project team, knowledge transfer will be critical to long-term program success. Allowing ample time for documentation of the process and lessons learned will alleviate loss of this institutional knowledge.

Once the project team is identified, regular meetings will be necessary to plan, initiate and maintain the program according to the following process steps.

Setting Performance Goals

Whether your campus is striving to be best in class in the higher education sector, or you just want to reduce energy and water waste, establishing clearly defined energy and water reduction goals at the onset will serve to continually motivate the project team throughout the building improvement process. The goals should be realistic and align with the organization's strategic plan, policies and/or reduction goals required for participation in voluntary energy and water reduction programs. Setting measurable goals helps to:

- Verify the success of energy and water improvements
- Foster ownership of resource management responsibilities
- Demonstrate commitment to environmental stewardship
- Develop a project timeline
- Raise awareness across campus[7]

Incorporating resource efficiency and other sustainability goals into your organization's strategic plans will support the long term success of these efforts.

6. Parker, S., Boyd, B., Fowler, K., Hunt, W., Koehler, T., Stoughton, K., Pugh, R., Sandusky, W., Sullivan, G. (2015). *Metering Best Practices: A Guide to Achieving Utility Resource Efficiency, Release 3.0*
7. U.S. Environmental Protection Agency, ENERGY STAR Program. (2013). Guidelines for Energy Management.

Phase 2: Benchmark

Benchmark Campus Buildings

Benchmarking is the process of evaluating the energy and water performance of a building relative to key indicators, including the performance of peers and the historic performance of the building itself. Performance is measured over at least a 12-month period.

Establish a Baseline Year

Before benchmarking can begin, a baseline year must be selected. The baseline year will be used to compare annual consumption (12 months of utility data) to subsequent and current years, allowing progress to be tracked over time. Select a baseline year (or an average of several historical years) that best represents a typical year of energy and water consumption history and is free of any major gaps or anomalies. Baseline years can differ for specific buildings if some were recently constructed or missing essential data for the preferred year or have other specific needs warranting an alternate baseline.

Benchmark

ENERGY STAR Portfolio Manager developed by the U.S. EPA is a free online tool to track and measure building energy, water, waste and greenhouse gas emmisions. The first step in benchmarking is to gather and enter utility consumption and cost information into a data tracking tool, such as Portfolio Manager or other utility management software. This allows performance analysis and comparison with other buildings.

Benchmarking individual buildings requires that each participating building be equipped with a utility meter or sub-meter to track its energy usage. Review *Measuring Campus Performance* to learn more about submetering options for your campus.

A successful benchmarking program does not require the involvement of every building on your campus and can even be accomplished at the campus level if you do not have the benefit of sub-meters at this time. **Do not be discouraged if some of your buildings have incomplete utility bill histories, or data is unavailable. To start benchmarking, all you need is 12 months of energy and water data for at least one campus building.** Begin with realistic benchmarking goals and then scale up the project.

When entering buildings into Portfolio Manager, it is important that the most appropriate property use-type be selected for each building in order to provide the most useful comparison with other buildings (i.e., do not select College/University for every building on campus; instead select a use-type that more specifically represents the use of the space). **ENERGY STAR has identified 80 property types** and corresponding national average energy use metrics for comparisons to individual commercial buildings including those commonly found on college and university campuses. Property types found commonly on campuses are listed in *Table 1*; for a full list of property types defined by ENERGY STAR, review the National Median Table.

Table 1: **25 of the most common commercial building types located on college and university campuses**

Property Type - Primary Function	Source EUI** (kBtu/ft²)	Site EUI** (kBtu/ft²)	ENERGY - Reference Data Source - Peer Group Comparison**
College/University	262.6	130.7	CBECS - College/University
Fitness Center/Health Club/ Gym	96.8	41.2	CBECS - Recreation
Hotel*	162.1	73.4	CBECS - Hotel & Motel/Inn
Laboratory	123.1	78.8	CBECS - Other
Library	235.6	91.6	CBECS - Library
Multifamily Housing*	127.9	78.8	Fannie Mae Industry Survey
Museum	85.1	45.3	CBECS - Public Assembly
Non-Refrigerated Warehouse*	60.0	28.5	CBECS - Non-refrigerated Warehouse & Distribution Center
Office*	148.1	67.3	CBECS - Office & Bank/Financial
Other - Restaurant/ Bar	432.0	223.8	CBECS - Restaurant/Cafeteria
Other - Technology/ Science	123.1	78.8	CBECS - Other
Other Lodging Residential	155.5	73.4	CBECS - Lodging
Outpatient Rehabilitation/Physical Therapy	155.2	63.0	CBECS - Outpatient Healthcare
Parking	N/A	N/A	Non available
Performing Arts	85.1	45.3	CBECS - Public Assembly
Pre-school/Daycare	145.7	70.9	CBECS - Preschool
Repair Services (Vehicle, Shoe, Locksmith, etc.)	100.4	49.6	CBECS - Service
Residence Hall/Dormitory*	114.9	73.9	CBECS - Dormitory
Retail Store*	114.4	47.1	CBECS - Retail Store
Social/ Meeting Hall	69.8	45.3	CBECS - Social/ Meeting
Stadium (Closed)	85.1	45.3	CBECS - Public Assembly
Stadium (Open)	85.1	45.3	CBECS - Public Assembly
Swimming Pool	96.8	41.2	CBECS - Recreation
Urgent Care/ Clinic/ Other Outpatient	182.7	66.8	CBECS - Clinic/ Outpatient
Worship Facility*	70.7	36.8	CBECS - Religious Worship

*Property Type will have a 1-100 ENERGY STAR Score
** ESPM Technical Reference US Energy Intensity by Property Type (March 2016)

Twenty of these 80 property types are eligible to receive an ENERGY STAR Score, which ranges from 1-100. The score is based on national peer group survey data from sources such as the [Commercial Building Energy Consumption Survey (CBECS)] which is conducted every five to seven years by the US Department of Energy. Eligible buildings with ENERGY STAR scores of 75 or higher can apply for ENERGY STAR certification. To see if your building is eligible to receive an ENERGY STAR score and to take advantage of valuable marketing associated with ENERGY STAR visit [ENERGY STAR's eligibility page].

For detailed instruction on how to benchmark in Portfolio Manager, review [How to Benchmark a Campus in Portfolio Manager.]

Phase 3: Identify Underperforming Buildings

Evaluate Results to Identify Underperforming Buildings

Essential Performance Comparison Metrics

Once your building's historical performance data has been entered into Portfolio Manager or a comparable utility management software, you can begin to analyze performance using the following methods of comparison. The purpose of this step is to identify poor performing buildings that may be good candidates to receive assessments in *Phase 4*:

1. **Compare Current Performance to Past Performance** - Compare current weather normalized EUI and water use intensity (WUI) to the same metrics during the baseline year(s) to identify any changes in building performance over time. EUI and WUI represent the energy and water performance of your building, respectively, and are important comparison metrics for identifying underperforming buildings. Buildings with current EUIs or WUIs higher than their baselines without a specific cause, such as an increase in operation hours or services, are demonstrating poor performance and will likely benefit from energy and water efficiency upgrades.
2. **Compare Current Performance to the Performance of Other Buildings** - Comparing your building's weather normalized EUI and WUI to other campus buildings of the same use-type, as well as to national medians, helps identify abnormally high energy and water users. It may be helpful to create a spreadsheet to organize and compare the data (*Table 2*).
   - **EUI** – Compare source EUIs of all buildings on your campus to identify the highest energy consumers. Then compare each building's source EUIs to national medians in chart (Table 2). If the primary function is not listed on the chart, reference the full listing of more than 80 property types in [U.S. Energy Use Intensity by Property Type.]
   - **WUI** – Compare WUI of each campus building to determine the highest water users on your campus.

Calculating EUI and WUI

Energy Usage Intensity (EUI) is calculated by dividing the total energy (e.g. electric, natural gas, district steam, chilled water) consumed by the building in one year (measured in kBtu) by the total gross floor area (sq. ft.) of the building(s). **Water Usage Intensity (WUI)** is calculated in the same manner - total gallons consumed in one year divided by total gross floor area[1]. Thus, it is essential that the floor area calculations for the buildings be accurate.

Source or Site?

"Source Energy is the total amount of raw fuel that is required to operate your property. In addition to what the property consumes on-site, source energy includes losses that take place during generation, transmission, and distribution of the energy, thereby enabling a complete assessment of energy consumption resulting from building operations."[10]

"Site Energy is the total amount of energy your property consumes onsite, as reported on your utility bills."[10]

The **national median source EUI** is the recommended metric to benchmark buildings, representing the middle of the national peer building group's energy use (half use more, half use less) and serves as a reference to compare energy performance. For properties receiving an ENERGY STAR Score, the national median is adjusted for Gross Floor Area, use details, weather, climate and fuel mix. The national median is the actual Source EUI that would give your property a score of 50. For properties receiving a Weather-Normalized Source EUI instead of an ENERGY STAR Score, the national median Source EUI is the best source of comparison with like properties and is adjusted for Gross Floor Area and fuel mix but not adjusted for use details, weather or climate. (U.S. EPA, ENERGY STAR Portfolio Manager, 2016)

Weather Normalization

Weather normalization accounts for the difference between the building's performance under average weather conditions "climate normal" and a year of unusual weather conditions. Weather normalization supports comparisons of annual consumption changes by removing weather-related penalties. ENERGY STAR Portfolio Manager automatically weather normalizes your EUIs; to learn more, visit the [Portfolio Manager Technical Reference: Climate and Weather]

Additional Performance Comparison Metrics

While EUI and WUI are the most important metrics for comparing building performance, there are other metrics that may be helpful in identifying buildings with maximum potential for energy savings. Just because a building has a low source EUI or WUI, doesn't mean it is performing at maximum efficiency. The following comparison metrics can be used in conjunction with EUI/WUI comparisons to provide a more detailed picture of energy consumption and energy cost allocation on your campus.

1. **Weighted Percentage** - Compare each building's annual energy and water consumption as a percentage of the total campus consumption, or as a percentage of a subset of total campus consumption (i.e., as a percentage of total campus consumption for buildings ≤50,000 sq. ft.) for current year. This will indicate which buildings are consuming the largest amount of energy on your campus regardless of EUI.

   Just because a building is consuming a large percentage of your campus' total energy does not automatically mean that it will benefit from energy improvements. Some buildings, especially those with energy intensive systems or processes, are expected to consume large amounts of energy. Efficiency of existing building systems and potential for improvement should ultimately be the deciding factor to prioritize retrofits. For example, a large chemistry building may be the leading consumer of energy on your campus, yet its performance is better than that of its national average counterpart and it contains the most efficient equipment available; thus energy improvements will not result in substantial savings at this time.

2. **Energy Cost Index** - Calculate and compare the energy cost index (ECI) and water cost index (WCI) for each campus property. ECI and WCI are calculated as annual utility costs for energy or water divided by the gross floor area (GFA), respectively. ECI/WCI helps determine which buildings have the highest operating costs based on the cost of fuel/water being consumed. Comparing cost indexes of campus buildings will reveal which buildings are the most expensive to operate. Because utility costs vary by fuel type, ECI does not necessarily indicate the highest energy usage, rather the highest fuel costs. For example, a chemistry building that consumes large amounts of natural gas may have a lower ECI than a similarly sized computer lab that consumes a comparable amount of energy via electricity because the cost of electricity per Btu is higher than the cost of gas in that particular region.

Table 2: **Example building comparison chart**

Building Name	Building Type	Gross Floor Area (GFA) [sf]	Weather-normalized source EUI [kBtu/sf]	National median source EUI [kBtu/sf]	Percent above or below national median	Building percentage of total campus energy use	Energy cost index (ECI) [$/sf/year]	WUI [gal/sf]	Building percentate of total campus water use	Water cost index (WCI) [$/sf/year]
Capps Museum	Museum	34,932	210.5	85.1	147%	3%	$1.80	2.8	1%	$0.31
Vickery Fitness Center	Fitness Center/ Health Club/ Gym	281,205	223.8	96.8	131%	8%	$3.10	8.7	10%	$0.26
Barcik Hall	Residence Hall/ Dormitory	29,864	239.8	114.9	108%	3%	$3.50	15.89	5%	$3.50
Culver Library	Library	304,172	486.9	235.6	107%	8%	$2.80	7.12	5%	$0.33
Lindsley Academic Building	College/University	33,242	356.4	262.6	36%	5%	$2.90	8.16	4%	$0.22
Godfrey Dining Hall	Restaurant	80,774	549.9	432	27%	9%	$5.50	44.44	12%	$4.20
Herman Admin. Building	Office	44,646	110.2	148.1	- 26%	1%	$1.10	5.85	2%	$0.31
Math Building	College/University	31,626	194.9	262.6	- 26%	1%	$1.50	2.39	3%	$0.20
Summary for Reporting Properties	All	Total: 840,461 sf	Average Weather-Normalized Source EUI: 296.6 kBtu/sf	N/A	N/A	Total Percentage of Campus Energy Use: 38%	Average ECI: $2.78 $/sf/year	Average WUI: 11.9 gal/sf	Total Percentage of Campus Water Use: 42%	Average WCI: $1.17 $/sf/year

The above table (*Table 2*) represents a suggested method of comparing buildings on a typical college campus using source EUI, national median source EUI, weighted energy and water consumption, water use intensity (WUI), energy cost intensity (ECI), and water cost intensity (WCI) metrics to determine which buildings may yield the highest energy savings as a result of energy improvements. Six of the eight buildings are below 50,000 square feet, representing a typical ratio of small to large buildings on campuses..

- The first step compared each building's EUI against the national average EUI for similar building types by calculating the percentage above or below the national average to identify the poorest performing buildings (represented in blue above).
- Next, the percentage of total campus energy and water consumption consumed by each building was calculated. Buildings that are consuming a large percentage of total campus energy and/or water and have high EUIs/WUIs are perfect candidates for energy and/or water efficiency improvements.
- Finally, ECI and WCI were compared for each building to determine which buildings have the highest energy and water costs.

Once you have calculated the comparison metrics, compare them side by side for each building to determine which buildings will likely produce the most substantial energy/water savings. The ideal candidates will score high in all categories. However, buildings that score high in only one or two categories should still be considered based on building use and performance.

In the above example (*Table 2)*, Vickery Fitness Center, Culver Library, Barcik Hall and Capps Museum have EUIs much higher than the national average for similar buildings. Of the three, Capps museum has the lowest ECI and WUI, and accounts for the smallest percentage of total campus consumption, thus it will be prioritized as the lowest of the three, despite having the highest EUI. In contrast, Godfrey dining has an EUI only 27 percent higher than the national average, yet its WUI far exceeds any other building, and it accounts for the largest percentage of total energy usage. Thus it will likely benefit from energy and water efficiency measures. A quick walkthrough of the buildings, as described in Phase 4, can confirm potential for savings and the need for a full energy and water assessment.

Qualitative Benchmarking

Data analysis alone may not reveal important energy and water consumption drivers such as water leaks, envelope leakage and unnecessary equipment operation. For this reason, it may be helpful to gather opinions from building occupants and facilities managers about any energy-related issues they may have experienced while in the building, including specific anecdotes, persistent comfort problems, indoor air quality (IAQ) issues or system-specific issues that may be contributing to excessive energy use. This can be accomplished either by conducting interviews with key occupants, or creating a building-wide survey to gather information.[8]

8. U.S. Environmental Protection Agency, ENERGY STAR Program. (2013). Guidelines for Energy Management.

Phase 4: Perform Assessments and Identify Efficiency Measures

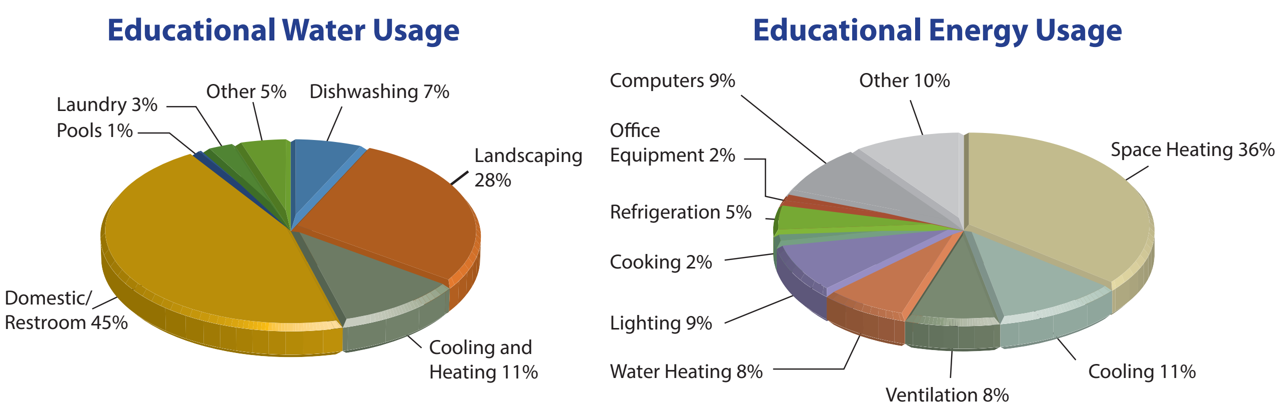
Understanding Consumption Drivers on Your Campus

Before developing a strategy to improve building efficiency it is important to understand what systems are responsible for energy and water consumption on your campus. The biggest drivers of energy and water usage on college campuses vary on a building to building basis due to differences in primary building activity and occupancy schedules. For example, a typical office building uses 12 percent of its total energy on interior lighting, while stadiums and public assembly buildings use less than 7 percent of their total energy on interior lighting.[9] Similarly, residence halls consume large quantities of water due to domestic/restroom and laundry equipment while classroom facilities often use much less.[10]

Systems such as heating and lighting tend to be consistently high energy consumers across most building types. On the other hand, plug and process loads (PPLs) including computer and food service equipment are much more variable and can account for 30 percent or more of the energy use in a building.[11] **Understanding your building's use details (e.g., primary building activity, occupancy schedule and peak demand hours) is the first step to creating an accurate picture of energy and water consumption**.

The pie charts below illustrate the breakdown of energy and water consuming systems for educational facilities defined by CBECS as buildings used for academic or technical classroom instruction. Note that end-uses are dependent on building activity and occupancy schedule and therefore will vary across building types. Upgrading these consumption driving systems will yield significant energy and water savings and should be targeted for efficiency projects.

Figure 4: **Primary energy[12] and water[13] end-use for educational facilities**



Performing Assessments

Buildings identified as leading candidates for efficiency improvements should receive an ASHRAE Level 1 building audit involving an analysis of utility bill histories and a walk-through evaluation. The building walk-through identifies low cost/no cost measures for improving performance and generates a list of potential capital improvements and estimated costs and savings. This level of analysis helps to determine the potential energy and water savings for evaluated buildings and helps to identify and prioritize those buildings with the highest potential for savings on campus.

Buildings identified during the Level 1 audit as having the highest potential savings may require additional evaluation and should receive an ASHRAE Level 2 or 3 building audit. A level 2 assessment involves a more detailed building survey to determine energy and water end uses within the building, costs and savings for capital improvements, proposed changes to operations and maintenance (O&M) procedures[14] and opportunitites for recommissioning or retrocommissioning.

Some buildings may also benefit from a Level 3 audit. Level 3 audits, often referred to as investment-grade audits, provide an in-depth evaluation of the proposed capital improvements including energy modeling, detailed project costs and savings analyses, such as a life-cycle cost analysis. While appropriate for some projects, many upgrades can move forward without a Level 3 analysis and associated expenses.

Engaging local and online assessment resources can help to offset auditing fees. Below are some examples:

- Implement a student-led assessment program like the Penn State program [see Case Study], using the *Small Commercial Energy and Water Assessment Toolkit*.
- Utility provided no-cost or subsidized assessments.
- Utilize the U.S. Department of Energy's Building Energy Asset Score. A free, standardized tool for assessing the energy performance of a commercial building, the Asset Score generates a simple energy efficiency rating and provides recommendations for improvement.
- Utilize the Retrofit Savings Estimator from the New Buildings Institute and determine how much energy you can save by implementing suggested energy efficiency measures.
- Engage with local efficiency programs offering free or subsidized assessments. Examples include the Grants to Green program serving the non-profit communities in Metro Atlanta, Dubuque, Iowa, and Maine, and Interfaith Power and Light working with faith-based organizations nationally.

Levels of Assessment

ASHRAE Level 1:
Walk-Through Analysis

ASHRAE Level 2:
Energy Survey Analysis

ASHRAE Level 3:
Detailed Analysis of Capital Improvements

Source: ASHRAE 2011

Full Citation: ASHRAE. Procedures for Commercial Building Energy Audits, 2nd Edition. January 2011

Case Study: Penn State

"Student engagement is emerging as a powerful strategy in the pursuit of a sustainable future. Here at Pennsylvania State's Architectural Engineering Department we have added to our curriculum a 'Building Retuning' course to educate graduate students on assessing energy consumption in commercial buildings and identifying operational improvements. This presents a unique energy management opportunity, wherein student coursework is fed back into the University's sustainability efforts, helping facilities staff identify and implement energy efficiency measures on campus. The terrific success of this pilot course has proven that students have the capability to act as multipliers to the work of energy efficiency professionals, gaining valuable experience while also adding value in energy efficiency efforts on their campus. The course is available for other colleges to adopt and teach at their campus"
–*Mahsa Safari, Penn State Graduate Assistant.*
Full Citation: *Safari, M., Riley, D., Asadi, S., Delgoshaei, P., Shulock, L. Advanced Building Energy Efficiency through Engaged Scholarship. Pennsylvania State University Architectural Engineering Department.*

Calculating Financial Benefits of Energy and Water Investments

Organizations evaluate efficiency projects based on the positive cash flow projections achieved by estimated utility savings. Building assesssment reports developed by a consulting auditor should include these economic metrics. If your organization uses internal staff resources to conduct building assesssments and prepare recommendations, economic metrics will need to be calculated. Organizations often have a preferred method to analyse these investment decisions. Be familiar with the method used and the internal process for developing the financial analysis. There are multiple methods available to determine the value of an investment ranging from simple to more complex. Two methods used are simple payback period (SPP) and simple return on investment (SROI). These methods do not account for the time value of money or other aspects often included in an financial analysis.

- Simple Payback Period (SPP) – Determines the time period needed to pay back a capital investment. To calculate the SPP (years), divide the initial capital costs by the annual cost savings. Example calculation for the installation of lighting sensors: Project capital cost of $1,889 divided by annual savings of $1,384 will yield a simple payback period of 1.36 years.
- Simple Return on Investment (SROI) – Calculates the financial return of an investment such as an energy or water efficiency project. To calculate the SROI, divide the annual cost savings by the initial capital costs. Example calculation for the installation of lighting sensors: Project annual cost savings of $1,384 divided by initial capital costs of $1,889 will have a 73% simple return on investment.

Net Present value (NPV) – Calculates the financial return of an investment accounting for the time value of money. The value of money is discounted placing a higher value on near-term cash flow and a declining value on future cash flow. For more information on NPV see referenced Upgrade Manual and table (*Figure 5*) below from the [ENERGY STAR Upgrade Manual, Section 3. Investment Analysis.]

Figure 5. **Calculation of net present value (NPV)**

Year	Initial investment ($)	Energy savings ($)	Present value factor (1 / (1+r)t)	Present value of cash flow ($)
0	-20,000	–	1	-20,000
1	–	4,000	0.909	3,636
2	–	4,000	0.826	3,306
3	–	4,000	0.751	3,005
4	–	4,000	0.683	2,732
5	–	4,000	0.621	2,484
6	–	4,000	0.564	2,258
7	–	4,000	0.513	2,053
8	–	4,000	0.467	1,866
9	–	4,000	0.424	1,696
10	–	4,000	0.386	1,542
NPV				**4,578**

Note: r=the discount rate; t=the elapsed time in years.

9. U.S. Energy Information Administration. (2012). 2012 CBECS Survey Data, Table E1.
10. www3.epa.gov/watersense/commercial/types.html
11. www4.eere.energy.gov/alliance/activities/technology-solutions-teams/plug-process-loads
12. U.S. Energy Information Administration. (2012). 2012 CBECS Survey Data, Table E1
13. www3.epa.gov/watersense/commercial/types.html
14. American Society of Heating, Refrigerating, and Air Conditioning Engineers. (2011). *Procedures for Commercial Building Energy Audits, 2nd Edition.*

Phase 5: Implementation

Measures identified during the assessment phase as having the highest potential for energy and water savings should be scheduled for implementation. Energy reduction measures will fall into one of the following categories:

- Low cost/not cost improvements
- Behavioral changes
- Capital improvements

The most effective implementation strategy will incorporate measures from each category. Southface has developed a series of resources detailing small commercial energy and water efficiency measures for various critical building systems including building envelope and water heating. These resources are available at www.southface.org/programs/acbi.

Low Cost/No Cost Improvements You Can Do Now

Energy and water reductions can be achieved with the investment of staff time. These changes range from minor operational improvements such as thermostat setbacks, to minor efficiency upgrades such as installing faucet aerators. The U.S. Department of Energy and Pacific Northwest National Laboratory (PNNL) offer an online self-paced building retuning course for facility engineering staff covering the skills needed to analyse data from building automation systems and implement operational improvements to reduce energy consumption. Follow this link to begin the no-cost training: retuningtraining.labworks.org/training/lms. The following table displays some low cost improvements you can do now:

Table 3: **Low cost/no cost improvements campuses can do now**

Energy Conservation Project	Typical Simple Payback Period (SPP)Range (Years)		Efficiency Metric
	Best Case	Worst Case	
Replace Screw-In Incandescent/Halogen Lamps with LED	0.1	3	83% reduction in energy
Replace Incandescent/CFL Exit Signs with LED	0.1	3.5	80% reduction in energy
Implement Temperature Setbacks/Setups for HVAC	0.1	10	5% reduction in runtime
Install 1.5 GPM Showerheads in Dormitories	0.1	3.5	40% reduction in water flowrate
Install 0.5 GPM faucet aerators	0.5	0.3	66% reduction in water flowrate

Improving Operations and Maintenance through Behavioral Change

ENERGY STAR has demonstrated that **it is possible to reduce energy and water consumption by 10 percent or more through occupant education and collective behavioral change.**[15] Behavioral change is a top-down process that begins with campus leadership and facilities management and extends all the way to building occupants. Below are some simple ways to maximize the performance of your building through coordinated behavioral change:

- Provide adaptive comfort controls. (e.g., multi-level lighting controls, operable windows and accessible thermostats with defined temperature ranges).[16]
- Use visual aids to encourage occupants to conserve through behavior change (*Figure 5*).[17]
- Incentivize smart building usage through campus competitions.
- Provide occupants with easy-to-understand energy and water metrics and a means to communicate feedback to building managers.

Figure 5: **Behavior change visual aid**

Capital Building Upgrades

What to Expect

Based on the typical breakdown of energy and water usage in most commercial buildings, **the bulk of building upgrades will fall into the following categories:**

Energy

- HVAC efficiency upgrades including improving blower motor efficiency, equipment replacement and utilizing HVAC controls for scheduling runtime, temperature setback and demand-based ventilation
- Lighting efficiency upgrades including LED lighting retrofits, daylighting and lighting controls such as vacancy sensors. Note that the bright nature of LEDs can result in over lighting. Design lighting retrofits based on foot candle output to determine the optimum layout and quantity of fixtures.
- Building envelope upgrades including air sealing, insulation, window upgrades and shading solutions to reduce solar gain.
- Water heating efficiency upgrades including equipment replacement and hot water distribution efficiency such as pipe insulation and recirculation pump timers.

Water

- Domestic water use reduction measures including the installation of high efficiency toilets, urinals, sink faucets and shower heads; and the installation of 0.5 GPM aerators on existing sink faucets.
- Irrigation/landscaping efficiency upgrades including soil moisture sensors, spigot timers and the use of alternative water sources from condensate capture and rainwater harvesting for irrigation.
- Dishwashing and laundry equipment efficiency upgrades.[18]

Implementation Success: Emory University

Emory exceeded their aggressive goal to reduce energy use by 25 percent per square foot by 2015 from 2005 levels ahead of schedule. "Achieving the goal required extensive engagement across all levels of the university – from administrators who saw the wisdom of investing in energy efficient systems for both new and old buildings to every individual who turned off a light or appliance." Emory's efficiency and conservation strategies implemented include:

- Energy reduction projects including lighting retrofits, weatherization and HVAC upgrades
- Established a temperature policy to keep building thermostats between a range of 68 and 76 degrees
- Recommisioning program to bring building performance in alignment with efficient design and operation.
- The Sustainable Performance Program (SPP), an ongoing commissioning program designed to maintain optimal performance of building HVAC systems.
- Standards for new construction to achieve LEED Silver or higher

Source: Emory FY2015 Annual Energy Report

Planning and Bundling Capitial Improvements

Often the upgrades recommended during building assessments correspond with planned capital improvements. For example, a malfunctioning air conditioner scheduled for routine replacement can be replaced with a more efficient unit, improving occupant comfort with the added benefit of energy efficiency. Additionally, **planning for upgrades and replacing equipment before it fails allows time to design a more efficient system**; emergency replacements can result in less efficient equipment due to forgoing the planning and design process and product availability.

Bundling improvements is best practice to ensure optimal system performance and lower installation costs. For example, combining the air conditioner replacement project with building automation system controls or sub-meters will support energy management and enable ongoing energy tracking while verifying the performance of the upgrades.

Further, completing an LED lighting retrofit and lighting control upgrades with an air conditioner replacement will lower the building cooling load, potentially reduce new cooling equipment size requirements and lower up-front equipment costs. Combined these projects together optimize energy and cost savings, and occupant experience with thermal comfort and higher quality lighting. The bundling approach requires advance planning. Replacing building systems on a need-by-need basis without evaluating a higher performing, integrated solution should be avoided.

Implementation Funding Opportunities

Many institutions are reluctant to commit to efficiency projects because the perceived costs of project implementation do not fit into their budget. They are not evaluating true maintenance costs of current vs. improved equipment, and they are not viewing energy and water efficiency improvements as an investment. **For a complete picture of cost impact, maintenance and operating costs of current and new equipment must be compared**. For example, conventional lighting maintenance expenses for high-bay applications (e.g. gyms and natatoriums) alone can outweigh the expenses to purchase and install new LED fixtures. **Many efficiency measures have a return on investment exceeding 5 percent, with several exceeding 15 percent, providing a very favorable investment strategy for the school**.

Cost savings identified through the assessment process are compelling, but even so, many campuses are hesitant to fund initial efficiency projects. A number of resources are available to help mitigate the upfront cost barrier and to help schools establish ongoing efficiency programming:

- Incentives – Many utilities and government agencies offer a variety of rebates, tax credits and other financial incentives for efficiency. To find incentives in your state, visit: www.dsireusa.org.
- Green Revolving Funds (GRF) – GRFs provide institutions with capital for energy efficiency improvements. The resulting cost savings are tracked and used to replenish the fund allowing it to break even or grow. Once the project costs have been met through energy savings any remaining savings can be reinvested into campus budgets. Funding for GRFs can come from operating budgets, endowments, rebates, grants, government funding, and/ or student fees.[19] The Billion Dollar Green Challenge, launched by The Sustainable Endowment Institute in collaboration with 16 partner organizations offers resources to help your institution develop a GRF.
- The University Financing Foundation (TUFF) – TUFF is a non-profit organization offering resources for the assessment, planning and implementation of cost-saving energy efficiency measures. With years of experience TUFF's staff help to engage the right professionals to perform assessments and outline a project plan using low-cost financial resources (tax-exempt capital). This approach provides colleges with the ability to reduce implementation costs for any type of sustainability project from simple lighting replacements to utility plant retrofits and campus infrastructure.
- Grant programs –Grants to Green provides building assessments, technical assistance and funding to implement energy and water efficiency projects to strengthen nonprofits. The reduced operational costs allow the organization to invest the cost savings back into mission work. Grant programs vary by location and are available in Metro Atlanta, Dubuque, Iowa, and Maine.

Case Study: Agnes Scott

Agnes Scott, a private liberal-arts college in Decatur, GA, set up a green revolving fund in 2012 with the help of donations to fund energy efficiency projects by investing the utility cost savings of each efficiency measure back into the fund for future efficiency projects.

"We weren't satisfied with the solution of having an outside company come in and tell us how we should be sustainable," John Hegman, vice president of business and finance for Agnes Scott says. "Someone else would profit from our savings. If we borrowed from the endowment, the funds would have to be repaid, so we created a donor-based fund that generates returns from projected utility cost savings. The savings go back into the fund to pay for future projects."

Not all projects give immediate return on investment, and that's okay, says Hegman. "We can't focus solely on easy or quick return projects, then the fund would not keep revolving. We have to blend the length of projects. We won't see returns on our Campbell geothermal project for six to seven years, and some projects may have even longer payback periods. But I don't think we'll run out of sustainability projects for a long time."

15. www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/save-energy/engage-occupants
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Phase 6: Tracking, Reporting and Sharing

Measurement and Verification

Measurement and verification (M&V) of efficiency measures allows for the documentation and reporting of actual savings and ensures savings are maintained overtime. As with any investment, schools will want to know the utility savings, performance improvements and reduced maintenance expenses from efficiency improvement projects and communicate the results to donors, staff/faculty, students and other campus stakeholders.

Effective measurement and verification plans are designed during the project design phase, prior to project implementation, and will have the following benefits:

- Improve energy savings through accurate projections and greater persistence of project performance;
- Reduce cost of project financing through demonstrated past performance;
- Improve project engineering as detailed front-end design is a prerequisite for effective M&V planning;
- Demonstrate and capture the value of reduced greenhouse gas emissions; and
- Increase understanding of energy management as a public policy tool.[20]

Tracking and verification is important for measuring project success and demonstrating progress towards savings goals, or in the case of a green revolving fund, accounting for project cost savings to be reinvested. The International Performance Measurement & Verification Protocol provides detailed guidelines for M&V planning.

Buildings that undergo energy and water efficiency projects should continue benchmarking to the extent allowed by the meters as part of M&V. The data should be tracked and evaluated to monitor the impact of the investment on operational cost savings, reduction in utility use, maintenance, increase in occupant comfort and to compare the results to the projected performance.

Measurement and verification of energy and water performance data for individual buildings, as well as the campus as a whole, is a critical component of an effective campus-wide energy and water management program and cannot be understated in importance. Reporting the positive impact of efficiency projects towards operational savings and meeting institutional goals can build support for future investments. Even simplified M&V plans that only track and report actual building energy and water consumption compared to baseline can have a big impact on ensuring persistent savings.

Using Building Energy Dashboards to Promote Awareness

Building energy dashboards (*Figure 6*) track and display interval building performance data, and enable facility managers and building occupants to make data-driven decisions about sustainable building use. Data can be displayed using a lobby dashboard or a publicly accessible website. Building dashboards also support energy and water reduction challenges between various buildings on campus, fostering competition and increasing occupant awareness. **By integrating these technologies into your campus's energy and water management program, the data gathered during the measurement and verification process can serve to educate students and staff about the role they play in energy and water consumption.**

Figure 6: **Dashboard example by Lucid Building OS**

Engaging Students through Coursework

Valuable educational opportunitites are embedded within the energy reduction process. Data gathered through ongoing energy and water monitoring can supplement course curricula to educate students on energy and water usage and data management, as well as more specialized topics including energy modeling, assessing building performance and systems response. A number of schools have already taken advantage of these opportunities. For example, **at Georgia Tech Research Institute, mechanical and electrical engineering students are responsible for designing the energy and water dashboards which allow facilities managers to track energy and water usage across the campus.**[21] Faculty idea-sharing committees have proven valuable in supporting the integration of energy and water consumption data and related sustainability activities into course curricula.

ENERGY STAR® Commercial Buildings College Course

ENERGY STAR offers a college course, Introduction to Commercial Building Energy Efficiency Through EPA's ENERGY STAR Program, which introduces students to the benefits of and barriers to commercial building energy efficiency through an in-depth look into EPA's ENERGY STAR Program. In this course, students will learn about current trends in commercial building energy efficiency, occupant engagement/education, greenhouse gas reduction and transforming the market with ENERGY STAR among other topics. To add this course to your syllabus, check out the ENERGY STAR Commercial Buildings College Course Overview.

Sharing Data with the Better Buildings Challenge

The Better Buildings Challenge is an initiative of the U.S. Department of Energy that aims to make commercial, public, industrial and residential buildings 20 percent more energy efficient over the next decade. Through the Better Buildings Challenge, public and private sector organizations across the country are working together to share and replicate positive gains in energy efficiency. Expanding access to energy and water management best practices is a central objective of the Better Buildings Challenge. Participating organizations who commit to the challenge goals, also pledge to share project utility data, as well as information about the tools, technologies and processes that helped their campus reach sustainability goals. By joining this program, your can contribute information to help improve approaches to energy and water efficiency on college campuses across the nation.

Some cities sponsor local Better Buildings Challenge programs providing added technical assistance and marketing support.

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23. Bongiovi, Ross. (2016). Personal Interview.

Phase 7: Recognition

Recognition

Implementing a successful benchmarking and building efficiency improvement program on your campus is an excellent way to earn meaningful recognition in your local community, as well as within the higher education sustainability network as a leading-edge institution. A number of recognition programs exist to measure building efficiency and other sustainability metrics on campus.

- Better Buildings Challenge, a national initiative of the U.S. Department of Energy aims to make commercial buildings, industrial plants and homes 20 percent more energy efficient over a ten year period through the sharing of success stories.
- Atlanta Better Buildings Challenge (ABBC) is a nation leading public/ private partnership in the Better Buildings Challenge. The goal of the challenge is to reduce energy and water consumption in Atlanta's commercial buildings by 20% by 2020. These community-wide efforts are led by City of Atlanta Mayor's Office of Sustainability, Central Atlanta Progress, Midtown Alliance, Livable Buckhead and Southface.
- Climate Leadership Commitment is a network of colleges and universities committed to reducing greenhouse gas emissions and advancing the research that is critical to increasing climate awareness.
- Sustainability Tracking, Assessment & Rating System (STARS) by the Association for the Advancement of Sustainability in Higher Education (AASHE) – STARS is a credit-based sustainability rating system that scores an institution's performance in areas ranging from building operations and transportation to curriculum design and public engagement.
- Sierra Magazine's "Cool Schools" - Every year, Sierra Magazine in partnership AASHE publishes its list of the most sustainable higher education facilities in the country based on data submitted through the STARS Reporting Tool.
- Princeton Review's Guide to Green Schools - Based on a review of over 2,000 colleges, Princeton Review selects schools that demonstrate excellence in sustainability through academics and green campus initiatives.

Final Thoughts

Planning for Future Growth

The previously outlined energy reduction process applies only to existing buildings. New construction represents an equally important opportunity to implement efficiency practices and should not be neglected. If adding new buildings is part of your campus's strategic plan, it is important to formulate a policy that upholds energy efficiency and sustainable building practices for all new construction. New construction policies should feed into the organization-wide energy reduction goals outlined in the campus strategic plan. Some key recommendations for sustainable new construction policies are:

- Create green certification or high performance requirements for all new buildings
- Require utility submetering and data tracking for all new buildings and perhaps their major systems
- Implement an on-site water recycling system, like Emory University's Water Hub
- Implement on-site renewable energy production such as solar power
- Develop a commissioning program for all new buildings
- Require new designs to be based on industry best practices for occupant well-being and holistic building performance

Contributing to the Bigger Picture

In taking the initiative to reduce energy and water consumption on your college campus, your organization is demonstrating excellence in environmental leadership and setting a positive example for the higher education industry at large. Furthermore, participating in this process gives your organization the unique opportunity to contribute to commercial building performance data for college and university building types. The industry needs more information and your anonymous contributions to the database supports future research and advances practices and technologies used in the design, construction and energy industries. The **Buildings Performance Database** is dedicated to creating a comprehensive and centralized resource to help increase confidence in energy investments. To learn more about contributing data, visit the Building Performance Database website: **energy.gov/eere/buildings/contributing-data**.

Definitions

ASHRAE Level 1 Assessment - Walk-Through Analysis/Preliminary Audit - A Simple building assessment involving brief interviews with operations staff, review of utility bills and operating data and a short walk through of the building to identify potential energy improvements.

ASHRAE Level 2 Assessment - Energy Survey and Analysis - A more detailed building assessment that uses the findings from the level 1 assessment to perform a in depth evaluation of building systems including HVAC, building envelope and plug loads to identify a variety of building improvements.

ASHRAE Level 3 Assessment - Detailed Analysis of Capital Improvements – A highly detailed building assessment that combines the findings from the level 1 and 2 assessments in combination with computer simulations and energy models to determine exactly what savings would result from energy improvements.

Baseline Year - A 12 month period of utility history that will be compared to subsequent years to track energy reduction progress. The baseline year should be representative of a typical year of energy consumption and be free of any gaps or anomalies.

Benchmarking - The process of comparing a building's current energy performance to its own historical performance or peer performance in order to assess energy performance and motivate improvements.

Building Automation System (BAS) - Centralized and automatic control of a building's systems including HVAC and lighting through computerized networking and web-based systems. The purpose of a BAS is to improve operations efficiency and occupant comfort, while reducing operations costs and staff workload.

Central Meter - A meter that measures the amount of energy going to several buildings at once. Central meters are typically used for aggregated utility billing on college campuses.

Recommissioning (Rx) - The process of verifying the performance, calibration and safety of building systems including HVAC, electrical, plumbing and building envelope.

Commercial Building Energy Consumption Survey (CBECS) - A national survey that gathers data on the U.S. commercial building stock with a focus on energy-related building characteristics and energy usage data.

Energy Cost Index (ECI) - A metric used to describe the operating cost of building, expressed as dollars per square foot per year.

Energy Information System - A type of energy data tracking software that allows for detailed energy analysis including benchmarking, utility tracking, load profiling, energy anomaly detection, data reporting, and data communication.

ENERGY STAR Portfolio Manager - An online tool that benchmarks and tracks a building's energy and water consumption and greenhouse gas emissions using utility data, as well as metered energy consumption data.

ENERGY STAR Score - A numerical score from 1-100 to measure the energy efficiency of a building with reference to similar buildings. A score of 60 means a building is performing better than 60 percent of similar buildings nationwide. Top performing buildings with a score of 75 or higher may be eligible for ENERGY STAR certification.

Energy Usage Intensity (EUI) - A metric used to describe a building's energy consumption, expressed as energy per square foot per year. Source EUI represents the total amount of raw energy, including energy used in transmission, delivery and processing, required for building operation. Site EUI represents the amount of energy consumed by your building according to utility bills.

Faucet Aerator - A screw on faucet head that restricts the amount of water flowing through a faucet to conserve water without compromising performance.

Gallons per minute (GPM) - used for rating consumption rates of faucets, shower heads, and other water fixtures.

Green Revolving Fund (GRF) - An internal fund that provides financing for energy efficiency and sustainability projects in which capital generated from utility cost savings as the result of improved efficiency is used to replenish the fund.

HVAC - Heating, Ventilation and Air Conditioning; refers to all components of the building comfort system.

Interval Data - High resolution energy data that records energy consumption for preset time interval, most commonly 15 minutes

kBtu - Unit of measuring energy consumption, defined as the amount of work needed to raise the temperature of one pound of water by one degree farenheit.

Light Emitting Diode (LED) - Solid state lighting technology with an efficiency and life-span several times better than traditional fluorescent and incandescent lights.

Simple Return on Investment (SROI) – An economic metric used to calculate the financial return of an investment such as an energy or water efficiency project. To calculate the SROI, divide the annual cost savings by the initial capital costs. Example calculation for installation of lighting sensors: Project annual cost savings of $1,384 divided by initial capital costs of $1,889 will have a 73% ROI.

Simple Payback Period (SPP) – An economic metric to determine the period time needed to pay back a capital investment. To calculate the SPP (years), divide the initial capital costs by the annual cost savings. Example calculation for installation of lighting sensors: Project capital costs of $1,889 divided by annual savings of $1,384 will have a payback period of 1.36 years.

Water Usage Intensity (WUI) - A metric used to describe a buildings water consumption, expressed as gallons per square foot per year.

Weatherization - The practice of designing or modifying a building's envelope to be resistant to natural elements, especially wind, sunlight and precipitation, in order to protect internal systems and reduce building envelope leakage.

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