Recreation Center Efficiency Solutions Package

The Recreation Center Efficiency Solutions Package aims to support municipalities nationwide with selecting efficiency improvements to reduce energy and water use at existing recreation centers by at least 20%. This toolkit is a product of a collaboration of the City of Atlanta (CoA) and Southface Energy Institute through the Advanced Commercial Buildings Initiative in partnership with the U.S. Department of Energy. The majority of the CoA recreation center portfolio was benchmarked in ENERGY STAR® Portfolio Manager, and select centers received ASHRAE Level II audits. This package intends to inform local municipalities on how to approach conserving energy and water, and implementing institutional efficiency policies across a portfolio of recreation centers.

Background

The Advanced Commercial Buildings Initiative (ACBI) is a three-year project led by Southface Energy Institute and sponsored by the U.S. Department of Energy to increase energy and water efficiency in small commercial buildings. One ACBI project goal is to create a pathway to 20% energy reduction in recreation centers through a collaboration with the City of Atlanta.

Across the nation there are approximately 26,300 municipally owned recreation centers, the majority of which are smaller than 50,000 square feet[1]. The Department of Parks & Recreation of Atlanta manages 28 recreation centers. Recreation centers have long operating hours and offer a range of fitness and education activities.

Problem Statement and Barriers

Below, barriers to implementing energy efficiency projects at municipal recreation centers are listed:

- Limited access to financing and higher priority upgrades (Americans with Disabilities Act (ADA), life safety)
- Gaps in utility data and lack of verification protocol
- Lack of training around best practices regarding energy efficiency

This solutions package aims to address the last two barriers listed above.

Goals

Broadly speaking, the CoA sustainability plan sets targets to reduce its greenhouse gas emissions by 20% by 2020 and 40% by 2030, with 2009 as the baseline[2]. Goals specific to recreation center upgrades are as follows:

- Track utility consumption for all recreation centers in ENERGY STAR Portfolio Manager
- Exceed the 20% energy and water reduction goals of the Atlanta Better Buildings Challenge
- Pursue upgrades with a payback of 5 years or less
- Verify and track savings

[1] http://buildingsdatabook.eren.doe.gov/CBECS.aspx
[2] http://p2catl.com/climate-action/ghg-emissions-and-reduction-targets/

BENCHMARKING

OVERVIEW

Recreation center energy usage cannot be managed until it is measured. Benchmarking recreation centers involves tracking and evaluating recreation center energy usage and comparing performance to other recreation centers.

Why benchmark a portfolio of recreation centers?

- Compare energy performance and prioritize upgrade efforts
- Set energy reduction goals and measure progress
- Identify and cease payment for un-used meters in building portfolio
- Meet city benchmarking requirements

What tools can help benchmark utility data?

ENERGY STAR Portfolio Manager is a free online tool used nationally to benchmark buildings.

What data is needed to benchmark a building?

A common metric used in benchmarking is Energy Use Intensity (EUI). To calculate EUI, the following data points are needed:

- Building square footage
- 12 months of consecutive building energy use data

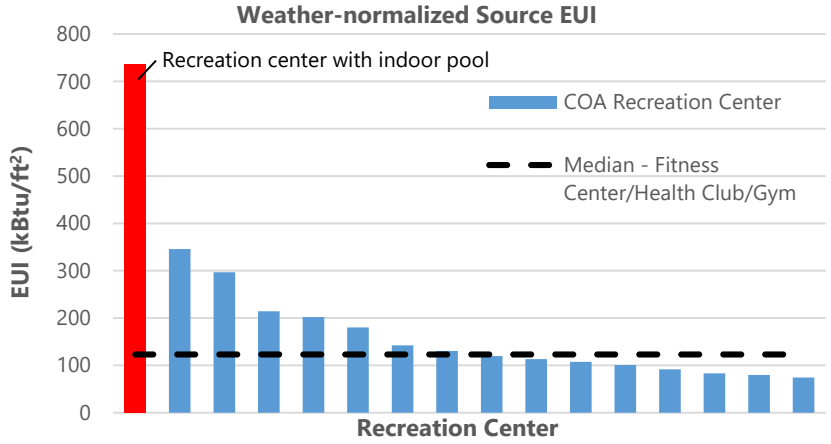
BARRIERS

The CoA Office of Sustainability took the lead for benchmarking utility data in Energy Star Portfolio Manager. Below outlines obstacles encountered during this process:

- Education
  - ➔ Staff training budget limitations, technical experience in efficiency, and staff turnover
- Documentation
  - ➔ Staff time burden in identifying hundreds of decades-old utility meters
  - ➔ Conflicting records for building floor area
- Process
  - ➔ Difficult to obtain building documentation or utility account information
  - ➔ Lack of process for data verification

DATA & SOLUTIONS

How are CoA recreation centers performing compared to each other and the national average recreation center? The results of benchmarking CoA recreation centers is shown in the graph below. Each bar represents the weather-normalized source EUI of a CoA recreation center; the higher the source EUI, the more energy the recreation center consumes. A more detailed explanation of source EUI can be found here*. The CoA recreation center portfolio's median source EUI is 124.8 kBtu/ft2, very similar to the national median source EUI of 123.1 kBtu/ft2.



Compared against the median Fitness Center/Health Club/Gym facility, half of Atlanta's recreation center portfolio is performing better than the national median, while the other half is performing worse. The disparity in building performance is caused by a variety of factors. The presence of an indoor pool significantly increases energy use. The natatorium (shaded in red) alone accounts for 42% of the annual source energy consumption for this portfolio of 16 recreation centers!

To address the barriers related to energy benchmarking, Southface developed a data verification protocol. The protocol aims to standardize the process for verifying data already inputted into ENERGY STAR Portfolio Manager, as well as provide a reference to those with limited technical experience. The Protocol for Verifying Utility Data may be found on page 7.

* https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager/understand-metrics/difference

RECREATION CENTER CHARACTERISTICS

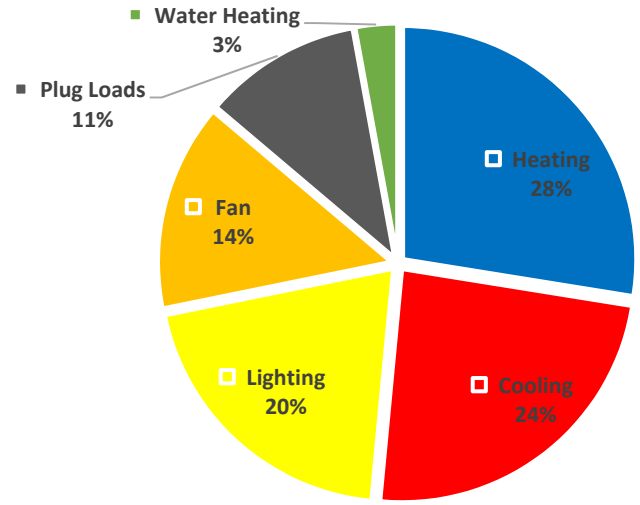
OVERVIEW

Recreation centers have long operating hours with a variety of different amenities and activities. Recreation centers are used by many different age groups, ranging from children attending afterschool programs to seniors participating in arts and crafts workshops. In the CoA recreation center portfolio, the average building area is 22,900 ft^2. The system characteristics of a typical CoA recreation center are outlined below:

- ***Mechanical System*:** Constant volume packaged units or split systems with gas-fired furnaces. HVAC equipment is controlled with programmable thermostats. Natatorium had pool dehumidification unit, pool pumps, and filtration equipment.
- ***Interior Lighting*:** Mostly linear fluorescent T8, T5, and T12. Less than 15% of interior lighting power consisted of incandescent, CFL, and metal halide fixtures. Lighting controls were predominantly manual toggle switches, with motion sensor controls in a few spaces.
- ***Exterior Lighting*:** HID (metal halide or sodium vapor) wall packs and pole-mounted fixtures. Fixtures illuminating outdoor pools, tennis courts, and sports fields were controlled manually. Other exterior lighting is controlled with photosensor or timer switches.
- ***Appliances*:** Most centers had 2 refrigerators, 1 freezer, 1 ice machine, and 1 dishwasher. Laundry equipment was reported to be used infrequently. Computer labs had between 10 and 20 desktop computers with LCD monitors. Printers and copiers were present in some recreation centers.
- ***Miscellaneous*:** Hydraulic elevators and electric kilns were present in some recreation centers.
- ***Water Heating*:** Gas-fired, storage water heaters with condensing burners. Water heating energy use was extremely low, even for facilities with showers and pools.
- ***Envelope*:** Walls: masonry (CMU); Roof: flat with built-up membrane; Floor: slab-on-grade.

DATA

Where is energy being used at a recreation center? The figure below displays the source energy breakdown of a typical CoA recreation center.



SOLUTIONS

The following should be kept in mind for successful implementation of energy efficiency projects at recreation centers:

- Invest in high quality, durable equipment to save money in the long run by reducing replacement costs and complaints.
- Engage recreation center personnel early in the design process to understand and address the particular needs of the station.
- Always remember to take a systems approach when assessing and upgrading recreation centers. A resource overviewing a building as a system can be found online at: www.southface.org/programs/acbi

OVERVIEW

Many municipalities have at least one recreation center with a heated indoor pool. Pools are a great asset, but they consume enormous amounts of energy and water. Pool water treatment and equipment maintenance are also very expensive. Improving the operations of pools through cost-effective measures and operational adjustments can result in significant reductions in energy use and operating costs.

POOL THERMAL BLANKET

Pool evaporation is a significant driver of natatorium (indoor pool) energy and water use. Water is constantly evaporating from the surface of the pool, simultaneously removing water and thermal energy from the pool while adding humidity to the air. Humidity in the air is removed using energy intensive mechanical processes.

Drastic reductions in natatorium energy use of up to 30% can be achieved by using a thermal blanket (an impermeable pool cover) to prevent evaporation when the pool is not in use. Despite the huge savings, only 5% of natatoriums use a thermal blanket.*

Retractable thermal blankets can be wound onto a storage reel. This type of pool cover is designed to be deployed and retracted quickly, on a daily basis. Typical costs for a blanket and storage reel are $1.65 per square foot. Source energy savings may exceed 200 kBtu/ft^2 of pool surface area. The payback is often less than 1.5 years. In addition to energy savings, pool blankets reduce water use, reduce pool treatment chemicals, improve indoor air quality, and prolong equipment life.

POOL PUMP VFD AND CONTROLS

Pool water must be recirculated to filter particles from the water and distribute treatment chemicals. Health codes typically require pool water to be turned over once every 6 hours. If a timing device is used to operate the pump, then pool water must be turned over once immediately prior to the pool reopening.[3] Pools are typically closed for 12 hours per day, which allows the pump to shut off or slow down.

Install a Programmable Timer Switch

Program the timer switch to start the pump 6 hours prior to pool opening time. A pool that is open for 12 hours per day can reduce pump operating energy by 25% with timer switch controls.

Install a Variable Frequency Drive and Controls

A Variable Frequency Drive (VFD) can be installed to reduce pump speed to maintain the minimum flow rate permitted by local health codes. A 20% reduction in pump speed results in a 50% reduction in pump power.

POOL BEST PRACTICES

- Maintain water temperature between 82 to 86 °F
- Ensure the setpoint for the dehumidification unit is between 50 to 60% RH
- For indoor pools, avoid stabilized chlorine containing trichloroisocyanuric acid (trichlor) to prevent cyanuric acid accumulation
- Install automated chemical feed system to ensure water quality while reducing maintenance difficulty

*http://www.usaswimming.org/ViewMiscArticle.aspx?TabId=1755&Alias=rainbow&Lang=en&mid=7715&ItemId=3633

3 Georgia Department of Public Health Rules and Regulations https://dph.georgia.gov/sites/dph.georgia.gov/files/related_files/site_page/EnvHealthPoolsChapter511-3-5.pdf. Verify local pool rules.

LED LIGHTING RETROFIT AND CONTROLS

OVERVIEW

Lighting accounts for 20% of the annual energy consumed by a recreation center. Light emitting diode (LED) lighting is quickly becoming an affordable lighting solution with superior efficiency, light quality, controllability, equipment life, and environmental footprint (no mercury). Retrofitting or replacing lighting fixtures with LED is one of the most cost effective ways to reduce energy consumption.

LED LINEAR FLUORESCENT T12/T8/T5 RETROFIT

Retrofitting or replacing linear fluorescent fixtures with LED can reduce lighting energy by more than 40% with a 6 year payback.

Option 1: New LED Troffer
Excellent efficiency, full dimming, long lifespan, and great aesthetics. High installation cost (typically $250 per fixture or more) extends payback.

Option 2: LED Door Retrofit Kit
Good efficiency, full dimming, long lifespan, and looks similar to new LED troffer. Existing fixture housing is retained, making installation easy and minimizing disruption. Medium installation cost (typically $165 per fixture) results in better payback than replacing the entire fixture.

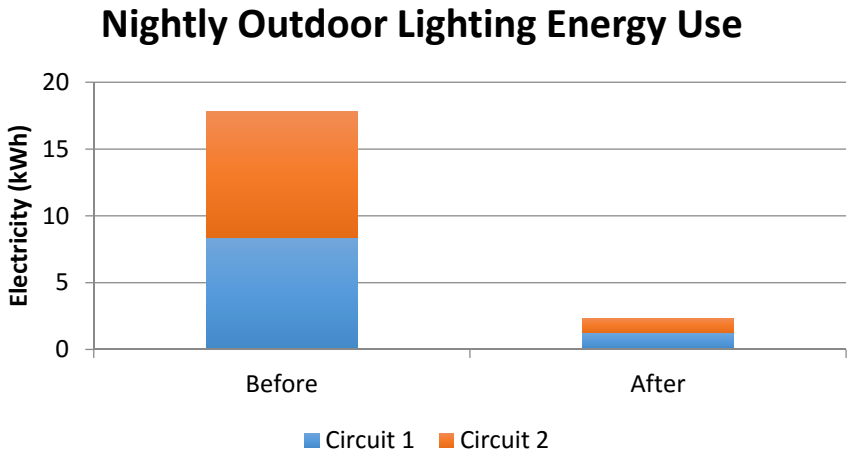
Option 3: LED Retrofit Tubes
Good efficiency, no dimming, medium lifespan, and looks like fluorescent. Plug-and-play installation for compatible ballasts with the lowest installation cost (approximately $20 per lamp), which provides the best payback. Consider replacing ballasts to ensure compatibility and avoid maintenance for ballast replacement.

LED HIGH-BAY FIXTURES

Replacing high-bay metal halide fixtures in gymnasiums and other high-bay spaces with LED fixtures can reduce lighting power by 55%, while eliminating routine maintenance cost and improving light quality. Unlike metal halide, LED lighting requires no warm-up time and works great with motion sensors controls. LED fixtures are fully dimmable and work great with photosensor controls for daylight harvesting applications.

LED OUTDOOR FIXTURES

Replacing HID outdoor lighting with LED fixtures will drastically reduce energy use, while providing better illumination and lowering maintenance costs. For maximum energy savings, install bi-level LED fixtures integrated motion sensor and photocell controls. Bi-level fixtures dim when no occupancy is detected, saving energy without compromising security. Bi-level LED outdoor fixtures can reduce lighting energy by up to 88%.



LED UPGRADE – BEST PRACTICES

- Purchase LED products that are certified by ENERGY STAR, Design Lights Consortium, or Lighting Design Labs
- Test LED upgrades for a few fixtures at your recreation center before ordering a large quantity
- Ensure that upgraded fixtures deliver appropriate illumination levels (foot-candles); not too bright or too dim.
- Install occupancy/vacancy controls for rooms with intermittent occupancy
- Apply for utility rebates to reduce payback

OVERVIEW

Heating, cooling, and ventilation account for 66% of recreation center energy consumption. HVAC energy consumption is driven by building envelope performance, HVAC equipment efficiency, ventilation rate, internal heat generation, and equipment operating parameters. While all drivers of HVAC energy are important, adjusting equipment operating parameters through HVAC controls is by far the most cost effective strategy for reducing HVAC energy consumption.

THERMOSTAT SETBACKS

Small adjustments to the thermostat setpoint can result in large reductions in HVAC energy consumption. Resetting the thermostat setpoint while a building is not occupied, referred to as a setback, produces no comfort complaints while saving energy and reducing equipment wear. Many recreation centers are heated and cooled with unitary HVAC equipment that is controlled with programmable thermostats. While programmable thermostats can be used to implement thermostat setbacks, few recreation centers actually utilized the programming feature and instead hold a constant setpoint temperature.

Recommended cooling setback temperature: 85 °F

Recommended heating setback temperature: 60 °F

OPTIMUM START CONTROLS

Conventional HVAC controls start or stop equipment based on a pre-determined schedule, referred to as programmed start. Heating or cooling equipment is often programmed to start several hours before the building opens to ensure that the setpoint temperature is met when occupants arrive. Programmed start either leads to wasted energy when the equipment starts too early, or comfort complaints when equipment starts too late.

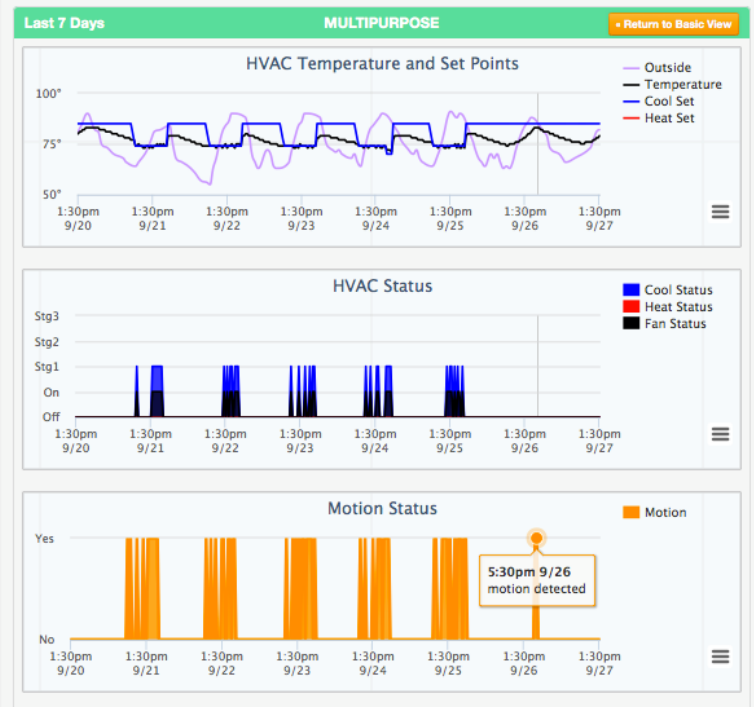
Optimal start, by contrast, uses control algorithms to calculate when the equipment needs to start in order to meet the setpoint when the building opens. The equipment starts just-in-time to meet the setpoint, resulting in no energy wasted conditioning an unoccupied building.

WEB-BASED THERMOSTATS

Web-based thermostats are a cost-effective way to implement thermostat setbacks with a payback of less than 3 years, while providing additional benefits. Web-based thermostats allow setpoints and schedules to be managed and monitored remotely from any device with an internet connection. Settings changes can be applied to single or multiple thermostats with a single click.

Web-based thermostats are capable of implementing optimum start to provide increased savings without compromising comfort.

Another benefit of web-based thermostats is the ability to monitor HVAC equipment operation to identify equipment failure and anticipate comfort issues.



Protocol for Verifying Utility Data

Goal: to provide a protocol for developing a to-do-list to verify and/or correct utility data already input into ENERGY STAR Portfolio Manager (ESPM). Three key pieces of information must be validated:

1. Year built
2. Gross Floor Area
3. Utilities (electricity, gas, and water)

Navigation: Return to Benchmarking Section

1. Year Built:

Definition: This is the year in which your property was constructed. If your property has undergone a complete renovation that included gutting and rebuilding the interior, then you can indicate the date of this renovation as the year built.

Verification: There are three ways to verify the year the property was built, and all three options should be employed for increased accuracy:

1. Compare with the bottom-right corner of as-built drawings
2. Site visit observations (including plaques and/or corner stones found in the property)
3. Site visit interviews with recreation center occupants

2. Gross Floor Area

Definition: Gross Floor Area should include all space within the building.

Verification: There are three ways to verify the property's gross floor area, and the all three options should be employed for accuracy:

1. Check property record data, if accessible online
2. Calculate using architectural plans
3. Use Google Maps Engine's measuring tool to get a rough estimate of roof area

3. Utilities

Definition: Utilities should include at least one electricity meter and one water meter (there may be a separate irrigation water meter, but it is unlikely). If gas is consumed onsite, there will also be a gas meter. The utilities should only pertain to the property's energy and water consumption. Do not include meters for tennis court lighting, sports field lighting, well pumps, or auxiliary buildings.

Before You Start: The following items should be gathered for each property before verifying any of the utility meters in ENERGY STAR Portfolio Manager:

1. Compile a list of all utility accounts attributed to the property, including:
   - Address
   - Account Number
   - Meter Numbers
     - It is recommended to conduct a site visit and obtain meter numbers from the physical meters onsite.
   - Annual total consumption and cost (from Step 2 below)

2. Download ENERGY STAR Portfolio Manager account into spreadsheet:
   - In the property's Summary tab, at the bottom of the page, click "Download Property to Excel" link
   - Create a separate sheet for each utility meter within the same Excel document
   - In the Meters Consumption Data, select and copy the rows pertaining to each utility and paste them into the appropriate newly created sheets (don't forget the header row)
   - Delete all columns for each utility, except the following:
     - Start Date
     - End Date
     - Usage/Quantity
     - Cost ($)

Utility Verification: To verify each utility, access to each utility's online account (either directly through the utility or through a utility management system) is required. Once login access is acquired, follow these steps:

1. Login to the utility account
2. Search for the property by its Account Number (from Step 1 above). Once identified:
    - Verify the listed property address matches the actual address (from Step 1 above)
    - Verify the listed Meter Number(s) match the actual Meter Number (from Step 1 above)
3. Compare the utility data available online to the data in ENERGY STAR Portfolio Manager (from Step 2 above)
    - Rather than comparing month to month, the annual consumption and cost should be compared. Sometimes, utility management systems may normalize bills to be evenly distributed across each month, which adjusts the monthly billed consumption slightly. Therefore, annual totals should be compared for accuracy. Be sure to check the Start Date and End State between both sets of data to ensure both annual totals are over the same date range.
        - Look for red flags, including zero consumption or cost.
4. Correct any errors in ENERGY STAR Portfolio Manager as appropriate
    - Error correction methodology will vary, but general guidance for correcting errors is as follows:
        - If you find an annual total in ENERGY STAR Portfolio Manager that doesn't match the data in the online utility account, overwrite the existing data in ENERGY STAR Portfolio Manager with the monthly bills from the online utility account.
        - After replacing ENERGY STAR Portfolio Manager entries with the correct data, ensure annual totals match.

Pathway to 20% Energy Savings Detailed Specifications

Goal: This document outlines detailed specifications for energy conservation measures to be implemented in recreation centers. Project numbers 1 – 4 are recommended to reach 20% energy savings. Project numbers 5 – 7 provide guidance on measures related to health and indoor air quality, or low-cost measures.

Navigation: Return to Pathway to 20% Savings Section

---

1. **Lighting Efficiency Measures**
   a. Interior Lighting & Controls
   - Upgrade all existing linear fluorescent T12/T8/T5 fixtures to LED.
   - Replace all existing incandescent and screw-in CFL bulbs with LED screw-in bulbs.
   - Replace all existing can lights with LED can lights.
   - Replace high-bay metal halide and T12 fixtures with high-bay LED fixtures with dimming capability
   - Install motion sensor switches for all interior lighting.
     - Offices, classrooms, and small rooms: Program controls to *vacancy mode* (manual-on, auto-off)
     - Gym and multipurpose rooms: Program controls to *occupancy* mode (auto-on, auto-off)
   - Provide dimming controls for gymnasium

   b. Exterior Lighting & Controls
   - Replace exterior metal halide wall packs and pole lights with LED fixtures. New fixtures should have integrated photocell and bi-level occupancy controls. Sports field lighting and lights that are not used can remain.

2. **HVAC Efficiency Measures**
   a. Replace programmable thermostats with web-based thermostat
   - Enable smart recovery/optimum start – system start time is determined algorithmically, such that the building reaches setpoint by the scheduled occupied time
   - Program temperature setpoints for occupied schedule
     - Occupied schedule should match the operating schedule for the building or zone. *System start time is determined automatically with smart recovery/optimum start enabled.*
   - Program temperature setpoints for unoccupied periods
     - Unoccupied cooling mode: 85 °F
     - Unoccupied heating mode: 60 °F
   - Set occupant adjustment range with passcode– occupants are able to alter the setpoint by a predetermined amount (e.g. 75 +/- 2 °F)
   - Set hold duration – occupants can turn on after-hours heating or cooling for a limited period of time (e.g. 1 hour, 2 hour, next schedule event)
   - Remote management – adjust thermostat schedules and setpoints as necessary from any location using a device with an internet connection
   - Schedule for events – override the default schedule and setpoints for holidays, rentals, or other events that are known in advance
   - Configure alerts – receive notifications for maintenance tasks (e.g. time to change filter), energy performance, or comfort issues

3. **Appliance Efficiency Measures**
    a. Unplug refrigerators and freezers that are not being used
    b. Replace existing refrigerators with ENERGY STAR® rated refrigerators.
    c. Replace existing ice machine with an ENERGY STAR® rated ice machine.
    d. Use computer management software to shut down all computers and monitors during unoccupied periods
4. **Water Heating**
    a. Install timer switch for hot water recirculation pumps
    b. Replace gas-fired atmospherically drafted water heaters with an ENERGY STAR® gas-fired storage water heater with condensing burner
5. **Indoor Pool**
    a. Install retractable thermal blanket with storage spool.
    - Deploy thermal blanket from the spool when the pool closes
    - Retract thermal blanket by rolling onto spool when pool opens
    - Train and monitor staff to ensure that blanket is used on a daily basis
    b. Install programmable timer controls and Variable Frequency Drive for controlling the operation and speed of pool pumps
    - Pool occupied: pump operates at nearly full speed to meet required turnover rate of 1 turnover per 6 hours
    - Pool closed: pump operates at reduced speed in accordance with local health code
    - Pool start-up (6 hours before opening): pump operates at nearly full speed to meet required turnover rate of 1 turnover per 6 hours
6. **Water Efficiency Measures**
    a. Replace existing shower aerators with WaterSense labeled 1.5 gallon per minute (GPM) aerators (*low cost*).
    b. Replace existing faucet aerators with WaterSense labeled 0.5 gallons per minute (GPM) faucet aerators (**low cost**).
    c. Retrofit the existing kitchen spray nozzle and faucet with a WaterSense labeled 1.28 GPM spray nozzle and 1.5 GPM faucet.
    d. Replace existing water closets with WaterSense labeled 1.28 gallon per flush units and manual flush (no automatic sensor).
    e. Replace existing urinals with WaterSense labeled 0.125 gallon per flush units and manual flush (no automatic sensor).