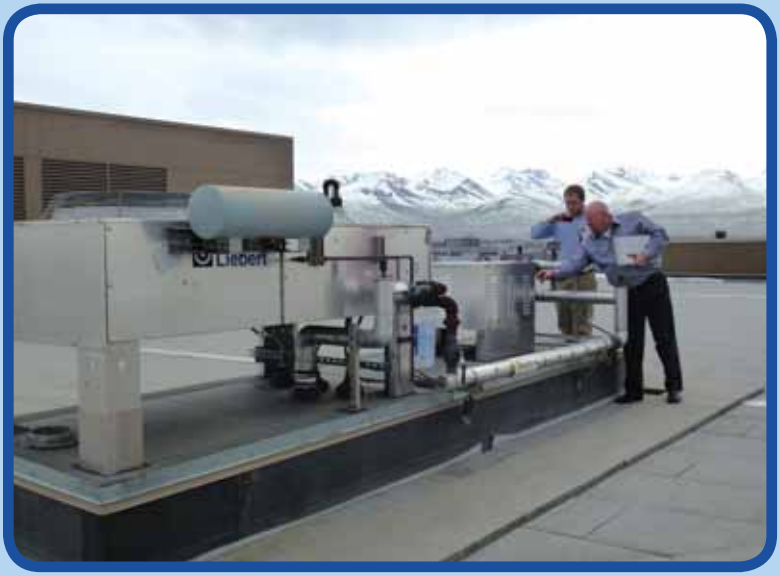
2013

Introduction to Energy Efficiency



A Guide to **Managing Energy Use** In **Public & Commercial Facilities**

Alaska Housing FINANCE CORPORATION

Background

Alaska Housing Finance Corporation (AHFC) is a public corporation that provides housing, finance and energy programs. In 2010 AHFC developed the **Alaska Energy Efficiency Revolving Loan Program** (AEERLP), which provides financing for permanent energy efficient improvements to publically owned buildings statewide. Since that time, AHFC has dedicated resources to understanding energy use and targeting energy efficiency in public facilities. AHFC created the **Retrofit Energy Assessment for Loan Program** (REAL), and benchmarked more than 1,200 public facilities to begin a statewide building inventory. Through the REAL Program, AHFC contracted with technical service providers, Certified Energy Auditors and Certified Energy Managers to complete more than 300 ASHRAE Level II Energy Audits. The results of this effort are summarized in ***A White Paper on Energy Use in Alaska's Public Facilities***. Most of the content in this guide is derived from overall audit project findings and observations. *For more information about the white paper see page 4*.

Alaska Retrofit Information System (ARIS)
ARIS has become the clearinghouse for information on Alaska buildings where multiple state agencies and organizations contribute data. AHFC created and maintains ARIS.

Glossary

The definition for words in **bold** can be found on page 30.

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Front Photo: Jerry Herring and Merrick Jackinsky from Central Alaska Engineering Company auditing the Loussac Library in Anchorage, AK.

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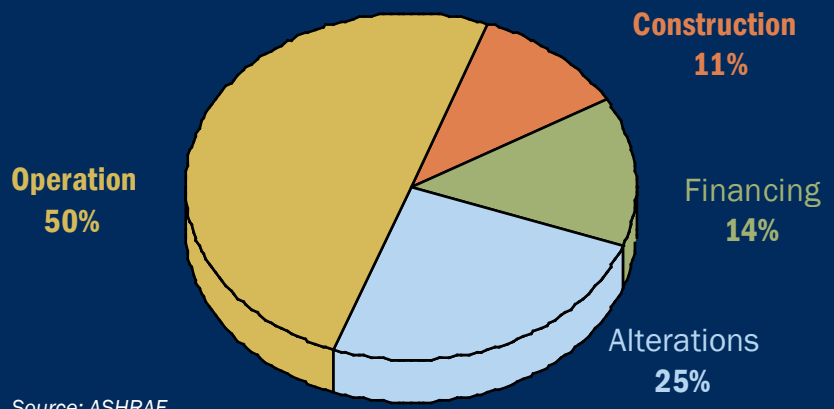
Introduction

Public and commercial buildings have the potential to reduce energy use by 30 percent on average.

It is estimated that more than 20,000 commercial and public facilities exist in the state of Alaska*. Based on two independent programs in Alaska, findings show that **facility owners could save an average of 30 percent on energy related costs each year by getting an audit and implementing identified energy efficiency measures.**

The purpose of this guide is to provide public facility, commercial building, and small business owners with a starting point for addressing energy use in existing facilities and recognizing energy efficiency as an energy source. Managing a facility from an energy standpoint allows owners to have more control over operations and costs. As shown in the chart below, over the life of a building 50 percent of costs go to operating the facility, including energy costs, maintenance and repairs. This guide addresses target savings that can be captured through routine maintenance, energy policy creation, energy assessments and project for implementation.

Lifecycle Costing: Over a buildings' lifetime



Source: ASHRAE

**Alaska Energy Authority (AEA) estimates that 15,700 private commercial buildings exist; AHFC estimates that 5,000 publicly-owned buildings exist (White Paper).*

Key Saving Strategies

Start with an Energy Audit - An energy audit identifies **energy efficiency measures (EEMs)** that can save an average of 30 percent on energy related costs each year. The audit can also be used as a tool for prioritizing capital improvements and budgets. By implementing **EEMs,** owners will purchase and use less fuel and electricity, provide improved thermal control and comfort, improved light quality and ensure healthy indoor air quality. *See page 16.*

Implement Routine Maintenance - Tune-ups and proper maintenance allows building systems to operate at peak efficiency. Operating systems such as control strategies, outside air dampers, boilers, furnaces, pumps and flow dampers as designed can significantly reduce a building's energy use as well as enable the building to serve for its anticipated useful life expectancy. *See page 7.*

Ventilation: Maximum Occupancy vs Actual - Assess actual ventilation needs and compare to the designed ventilation strategy. If a building has fewer people than the design called for, a facility owner can save money by adjusting the outside air ventilation rates to serve actual occupancy loads.

Stagger Start Times - Demand charges can be more expensive than actual electric use. Stagger start times for major equipment and lighting loads to reduce **demand charges**. Ask the local electric utility account manager for assistance in determining how peak demand loads are calculated.

Temperature Setbacks - Buildings often have significant energy savings potential when they implement relatively low cost measures such as setback thermostats and optimizing automated controls.

A White Paper on Energy Use in Alaska's Public Facilities

Content in this guide is derived from the overall AHFC REAL program findings and observations. Some of these have been published in *A White Paper on Energy Use in Alaska's Public Facilities*, the first in-depth report on energy use in public facilities in Alaska. This publication can be found at: *www.ahfc.us/pros/energy-programs/energy-programs/energy-efficiency-public-facilities/*

Energy Management

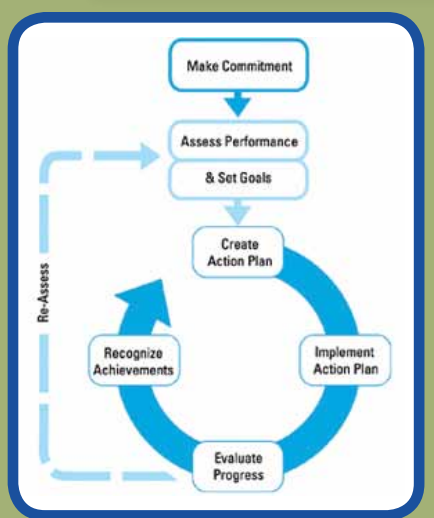
Proactively managing energy use through the proper application of internal policy, maintenance schedules and energy management plans can save thousands of dollars a year.

Effective energy management takes into consideration energy-related impacts and interactions of building components, including building site; envelope (walls, windows, doors and roof); heating, ventilation and air-conditioning (HVAC) systems; lighting; controls; equipment; occupant satisfaction and productivity; and maintenance schedules.

In managing a facility, energy efficiency should be considered on all levels, from routine operations and maintenance to major renovations and system upgrades. Effective energy management also maintains and enhances occupant comfort by looking at indoor environmental quality, ventilation and lighting levels, etc.

Facility Operation

The way a facility is operated can greatly effect energy costs. For example, in Southeast Alaska there are two prototype schools in the same climate zone with very similar student populations. One school spends $304,000 less per year for energy than the other. The primary difference is the way the building is operated. The school with the lower costs has optimized and automated system schedules, while the school with the higher costs is operated manually.



Energy Management Checklist
Energy Star offers guidelines for improving (or beginning) energy management. This graph outlines that process.
www.energystar.gov/index.cfm?c=guidelines.guidelines_index

Facility Maintenance

One observation from audit findings reported that many buildings did not implementing routine or preventative maintenance. Instead they were found operating reactively, addressing problems only as they arose. This resulted in systems working less efficiently and having to be repaired or replaced more often. By implementing proactive maintenance, equipment functions more effectively and minimizes fuel waste. This is done by creating a maintenance plan that outlines schedules following manufacturer recommendations and creating logs and schedules.

Routine Maintenance Can Keep Costs Down and Result in:

- Longer life of equipment
- Facilities running smoothly and efficiently
- Identification of damaged equipment to be repaired or replaced before it affects other equipment
- Reduce costs associated with repairs and replacements
- Prevention of accidents

Training for Staff

Systems in larger facilities are often complex. Underutilized or bypassed control systems were commonly found during the audit process. If staff do not have the appropriate skills or training, it is difficult to operate systems to their full potential. Knowledgeable personnel are essential to operating an energy efficient building. This could be a difference of hundreds of thousands of dollars each year, as shown on *page 6*.

For information on training programs and resources, visit:
www.akenergyefficiency.org/training_resources

Energy Conservation Manager

Through the audits completed in public buildings, agencies and organizations that employed an energy manager showed lower energy use than comparable buildings. It was found that hiring an energy conservation manager or Energy manager is one way to manage costs, monitor use, set maintenance and operating schedules and implement policy initiatives across multiple facilities. In many cases, the energy saved by the position more than paid for the position. If funding, capacity or resources are not available, these roles can be incorporated into existing staff duties. Provide training where necessary. In some cases, multiple small building owners could pool resources and hire an energy manager to serve several facilities, smaller communities or school districts.

The Role of the Energy Conservation Manager is to:

- Develop an energy policy for the entire organization
- Manage and track energy use and costs
- Prioritize improvements to reduce energy consumption starting with worst performers
- Assist facility personnel with optimizing operation of Direct Digi tal Control (DDC) systems
- Maintain maintenance and operation schedules
- Reduce energy use during unoccupied hours
- Educate building occupants on the reduction effort
- Help owners and facility managers make informed decisions about operating schedules and facility usage
- Be an integral member of the planning process for renovations
- Provide reports about building use and costs
- Review incoming bills for errors or discrepancies

Case Study: School District Results

Having a position dedicated to tracking energy use and detecting inefficiencies can have huge pay-offs. After AHFC published *A White Paper on Energy Use in Alaska's Public Facilities*, Cold Climate Housing Research Center interviewed six of the school districts with energy managers. They found that all had significant energy cost savings.

More than one energy conservation manager pointed to instances in which they saved significant amounts of money simply by identifying cases of overbilling by utilities. Specifically, one energy conservation manager saved approximately $250,000 per year by uncovering a billing oversight.

Snapshot: Anchorage School District Policy*

Bullet Points for Energy Policy

- Energy usage is a cornerstone of how well our facilities are managed
- Energy is one of the largest controllable non-personnel costs
- Rising utility costs are expected to continue

Operate Efficient Facilities

- Purchase energy efficient equipment when upgrading
- Upgrade exterior lighting with sensor control
- Analyze and calibrate systems and controls
- Commission new equipment
- Eliminate classroom appliances (such as small refrigerators)

Data Needs

- Measure current usage for accurate and timely data
- Determine performance metrics and benchmark facilities
- Standardize process using data tracking software

Facility Planning

- Seventy-five percent of building cost comes after construction
- Design and operate to ASHRAE standards
- Work closely with architects and engineering team

Recommended Tool: ASHRAE Guideline 32-2012
Sustainable, High Performance Operations and Maintenance.

Photo: Paul Kapinos, Head of Anchorage School District Resource Conservation
**Source: Selection from the ASD Policy http://www.akenergyefficiency.org/energy_policies*

Energy Policy

Developing an internal policy is the first step to addressing energy efficiency and conservation.

An internal energy policy allows facility owners and operators to formalize how energy is used while outlining goals and expectations. It also adds standardization to building operation which makes it easier to determine from energy use data which buildings are operating inefficiently. A policy allows facilities to establish a process to efficiently manage energy use while maintaining occupant comfort and indoor air quality. A policy does this by addressing accountability, operation schedules and setback temperatures, procedures for variable occupancy and energy management education for operators and occupants.

Getting Started:

Collect Benchmark Data
Before developing a policy, it is important to know the starting point and evaluate current conditions, costs and trends. This is done by collecting and analyzing facility benchmark data. Benchmark data is the basic building information, including at least two years of utility data, square footage, year built, etc. This information can be used to analyze trends and identify abnormalities. *See page 17.*

Approach
Policies are proven most effective when they are implemented through a top down approach with management's full support. Staff participation in the development process establishes an even higher level of buy-in.

Components of a Policy

Mission Statement, Purpose, Statement of Concern
An internal energy policy should state why the organization is committed to conserving energy and/or using it efficiently. Usually in the form of a paragraph, this piece outlines the purpose of the document, such as conserving energy in the workplace, using energy more efficiently, reducing costs, reducing emissions or showing environmental stewardship. Typically this section also articulates areas of concern such as high and increasing energy costs, community sustainability, etc.

Roles and Responsibilities
The most well formulated policy is ineffective without accountability. Define who is responsible for tracking energy use, general implementation, enforcement, etc. For example, the maintenance or custodial personnel may be responsible for managing setback timers, while employees or maybe students are responsible for turning off monitors and lights. The construction department may be responsible for setting efficiency standards while the purchasing department enforces the standards set by construction.

Occupant Comfort, Health and Safety
Energy efficiency and conservation should never come at the cost of occupant comfort, health, or safety.

Energy Accounting
Not only is the initial benchmarking important (which can be done through an audit), but continuous energy accounting is also vital. A policy should outline a plan for continuous energy accounting, which helps a facility determine how effective its energy use is over time.

Implement Energy Efficiency Measures
Make a commitment to implement all **EEMs** with **SIR** greater than 1.25 and **simple payback** less than seven years, or similar. *See page 30.*

Commitment to Policy
Some organizations have employees sign an agreement to follow the policy; others post it in a visible location such as a bulletin board or website.

Make It Official
Have a governing board, executive office or council officially adopt it. Then, throw a kick-off party and get support and enthusiasm from all.

Operations Measures:

Preventative Maintenance Schedules - Establish a routine maintenance program. Outline responsibilities such as who should manage, maintain, update and implement in job descriptions.

Ventilation Levels - Establish appropriate ventilation levels for existing occupancy. Ventilation levels are often set for maximum code occupancy rather than actual occupancy use.

Manage Peak Demand - Stagger start times for large equipment. See *page 30 for* ***Peak Demand***.

Vending Machines, Refrigerators and Freezers - Consider building use during unoccupied hours and during seasonal shutdown periods.

Temperature Setbacks - The policy should establish both occupied and unoccupied temperature settings. This relieves the operating personnel from having to satisfy individual requests that add to energy costs.

Consider Community Use and After Hours Use of Facility - Auditors often found school facilities running at full capacity with only a few people utilizing the gym or a single teacher in a classroom on a weekend or during summer hours. Controls and zones for HVAC systems should be optimized when occupancy is low. Additionally, a facility may consider hosting open gym on designated evenings only.

Replacements and Renovations - Incorporate energy efficiency into future decision making. When replacing equipment, use a **life cycle cost analysis**. For renovations or additions, consider including minimum energy efficiency code requirements, such as BEES, IECC or ASHRAE*.

*Building Energy Efficiency Standards (BEES), International Energy Conservation Code (IECC), American Society of Heating, Refrigerating, and Air-Conditioning (ASHRAE) Engineers.

Photo: Jeremy Spargur, Nortech

Occupant Measures:

Computers, Printers, Copiers, Fax Machines, Coffee Pots, etc - Leaving electronics on overnight and on weekends can add up. An energy policy should address whether these should be turned off and when and who is responsible. Incorporate the use of power management software. Energy Star has a free power management software. *See page 29.*

Operation of Space Heaters and Fans - Individual heaters and fans carry large electric loads and can indicate that larger systems are not working appropriately. Consider limiting or eliminating use.

Windows and Window Coverings - Leaving windows open during certain seasons wastes energy. Additionally, shades can be used to maximize heat gain and heat loss.

Interior and Exterior Lighting - If not automated, lights should be shut off when the building is unoccupied.

Incentivizing Energy Efficiency

*In analyzing incentives for school districts, it was found that these programs were a driving force behind successful energy efficiency implementation**

The **Fairbanks Northstar Borough School District** incentivizes individual schools to lower costs by putting 100 percent of energy savings back into the facility and maintenance budget.

An Alaskan business, **Automated Laundry Systems**, provides a $50 reward to staff who present innovative ideas for reducing energy use in the building.

Friendly competition is a successful way to motivate people to reduce use. Design your own or sign up for the **Great Alaska Energy Challenge** and compete with other facilities statewide to see who can reduce energy use the most! For details visit:

www.akenergyefficiency.org/energychallenge

*Source: *Energy Efficiency of State, Municipal, and Tribal Buildings in Alaska: Metrics and Analysis*

Lead by Example: The City of Homer

The City of Homer created *Money, Energy and Sustainability; A policy guide for City of Homer employees on reducing energy use and waste in local government operations.* It comprehensively addresses a majority of the recommended components.

Policy Format:

The City of Homer energy policy is broken into seven sections including office, computer equipment and appliances; lighting; heating and cooling; vehicle use; recycling and waste reduction; water use; and procurement. The section on heating and cooling is reprinted on the following page as an example.

Policy Strengths:

- Sections establish official policies for use and reduction
- Responsibilities are assigned to designated staff from city employees to the city manager
- Each section highlights facts, costs and tips
- Engages employees with photos and feedback requests

Examples of Existing Policies

The entire City of Homer policy, as well as other policies created and used by Alaskan businesses, schools, and public facilities can be found at: *www.akenergyefficiency.org/energy_policies*

Policy Snapshot: City of Homer

PART 3: HEATING AND COOLING

POLICIES: The City of Homer will utilize the following strategies to reduce energy use relating to heating and cooling:

> Invest in all energy-efficiency measures pertaining to heating and cooling with payback periods of 10 years or less.

> Conduct energy audits within two years for all City buildings and implement recommendations for weatherization and other measures to reduce energy use.

> Ensure that all new and renovated City buildings are constructed with energy efficiency and other conservation goals in mind.

Did you know...?

Building operation and maintenance programs specifically designed to enhance operating efficiency of HVAC and lighting systems can save 5% to 20% of the energy bills without significant capital investment.

Source: energystar.gov

RESPONSIBILITIES: All City employees are responsible for utilizing City buildings in a manner that will ensure maximum energy-efficiency without unduly impacting work performance, safety, or security. Within this framework, the following strategies will be practiced:

> Set heating thermostat setpoints to 68 degrees F and cooling thermostat setpoints to 75 degrees F in offices and work areas.

> Keep air registers and vents clear to allow air to flow freely throughout the room.

> Keep all windows closed in City buildings during periods when indoor heating or cooling systems are operating.

> Do not use individual space heaters or air conditioners for heating and cooling.

CITY MANAGER/DEPARTMENT DIRECTOR RESPONSIBILITIES:

> Provide adequate maintenance staff, adequate training for staff, and adequate resources to maintain City buildings for maximum efficiency.

BUILDING MAINTENANCE STAFF RESPONSIBILITIES:

> Maximize the use of energy management systems to reduce energy consumption by scheduling shut-down of appropriate HVAC equipment during times when the space served is unoccupied.

> Ensure that up do date operational procedures and manuals are available.

> Implement preventive maintenance programs complete with maintenance schedules and records of all maintenance performed for all building equipment and systems.

> Implement a monitoring program that tracks and documents building systems performance to help identify and diagnose potential problems and track the effectiveness of the O&M program. Include cost and performance tracking in this analysis.

Source: City of Homer's *Money, Energy and Sustainability; A Policy guide for City of Homer employees on reducing energy use and waste in local government relations*

Energy Assessments

Energy assessments pay for themselves with reductions in facility operation costs and increased facility productivity.

In addition to collecting benchmark data, there are three common audit levels established by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) which are outlined in this section. Because audits and auditor styles can vary, expectations for targeted **EEMs**, calculations and payback periods should be discussed with the auditor upfront. Even though common **EEMs** are often recommended, each building must be evaluated individually to account for building type, system complexity, climate zone, etc.

Energy Audits Identify:
- Cost effective **EEMs**
- Potential waste, leaks and misuse of fuel
- Equipment that needs to be replaced or commissioned
- Potential cost saving through utility rate analysis
- Low/no cost energy efficiency and conservation mesures
- Operational, maintenance or other inefficiencies

Find an Auditor

AK Energy Efficiency - Browse the descriptions and qualifications of different firms and auditors. Also see other customer reviews.
www.akenergyefficiency.org/auditors

Association of Energy Engineers - Certified Professionals Directory
www.aeecenter.org/custom/cpdirectory/index.cfm

Left Photo: Jerry Herring, Central Alaska Engineering Company;
Right Photo: Jim Rehfeldt, Alaska Energy Engineering

Benchmarking

Benchmarking is the preliminary data collection and analysis that takes place before the audit. Typical benchmark data consists of building age, square footage, occupancy, building drawings (original and additions), historical energy use including a minimum of two years of fuel and electric bills, etc. Facility staff is responsible for collecting this data and can use it to determine the level of audit needed or if retro-commissioning should be undertaken.

Collection and Analysis Tools
Benchmark data can be analyzed using an energy management tool such as the Retrofit Energy Assessment for Loan (REAL) Excel form or Energy Star's Portfolio Manager. These tools generate the **Energy Use Index (EUI)** and **Energy Cost Index (ECI)** for a building. ARIS can be used to compare buildings of similar EUI/ECI, size, age, climate, etc, in Alaska. If a building owner has multiple buildings, comparing benchmarks across buildings is possible. Both tools can track energy use and compare trends on a monthly or yearly basis.

REAL Benchmark Form – Accessed through an account with AHFC, the ARIS database has more than a thousand Alaska commercial buildings. An Excel version of the benchmark form can be found at:
www.ahfc.us/pros/energy-programs/energy-programs/energy-efficiency-public-facilities/

Energy Star's Portfolio Manager - Accessed by establishing an account through Energy Star. The data entered is compared on the national level. More information can be found at:
www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager

Graph: Chart example generated from the REAL Benchmark Form

ASHRAE Audits

Level I

Walk-through Analysis/Audit

An ASHRAE Level 1 audit is a visual assessment of energy systems and components in a building. A thorough analysis of benchmark data is done by the auditor, and the building is compared to industry standards. This level involves refining systems and structure assumptions that were based on as-built drawings and utility data to identify low-cost or no-cost **EEMs** for immediate savings. The visual inspection can often identify other items that should be further investigated. Energy management and operations and maintenance recommendations may also be identified. This is a preliminary audit used to gather additional information that can be used for more in depth audits; it is in no way comprehensive. Level I is the lowest cost audit and first step to improving efficiency.

Level II

Energy Survey & Engineering Analysis

This is a standard audit that evaluates how and where energy is used. It includes a detailed look at all building components. It takes into consideration occupants' impact on the facility and often includes conservation, behavioral and O&M procedure recommendations. In depth onsite measurement and testing is done to verify efficiencies and calculate energy costs and savings. Energy modeling is also typically done. This audit provides energy calculations and financial analysis of proposed **EEMs**. The financial analysis or **Life Cycle Cost Analysis** allows the facility owner to truly understand the financial benefits of installing recommended **EEMs** listed in the audit.

Level III

Detailed Analysis or Investment Grade Audit

Level III is an expansion of the previous audit levels and is based on the facility representative's selection of measures to analyze further. Typically, firm contractor and material prices are incorporated so this audit provides a more accurate estimate of implementation costs. Energy savings calculations are more certain because they usually include actual building data. These savings combined with real construction costs result in reliable payback estimates for the targeted energy improvements.

Case Study: Goldbelt, Juneau

Written By: Cady Lister, Energy Efficiency & Conservation Program Manager at Alaska Energy Authority

The Goldbelt Hotel in Juneau received a Level II energy audit through AEA's Alaska Commercial Energy Audit program. The audit identified a number of measures to reduce energy consumption; measures included both efficiency technology and recommendations regarding operations and behaviors that reduce energy consumption for little to no additional cost to the hotel.

The Goldbelt is a 71,560 sq. ft. hotel with 106 rooms and operates year round. Built in 1969, the building is a seven story cast-in-place structure with large windows throughout. A new roof in 2006 and installation of a Siemens Direct Digital Control (DDC) system are the two examples of major renovations in the last 40-plus years.
The Goldbelt hotel was paying $223,787 per year in utility costs, roughly $2.66 per square foot. **The energy auditor was able to identify actions that would save the hotel an estimated $61,411 per year, or a little more than 27 percent, on measures with payback periods of less than one month to a little over two years.**

The largest savings were found through changes to the ventilation system that reduced the amount of air exchanged in the building by installing occupancy controls to limit air flow unless called for ($30K annual savings) and through changes to the domestic hot water system by replacing inefficient boilers, reducing the hot water temperature setting, reducing use by replacing kitchen sink aerators and installing flow reducers in bathroom sinks ($20K annual savings). Surprisingly, the most cost effective measure was to simply have housekeeping draw the drapes in each room they visited and in every unoccupied room. **This change is practically free and is estimated to result in more than $13,000 savings per year.**
Total cost for all recommended improvements was just greater than $106K for a **simple payback** of about one year and eight months. Even assuming a very conservative lifespan of seven years for these measures, the savings to the hotel after the cost of the improvements is well over $300K.

Retro-Commissioning

Just because a facility has energy efficient technology doesn't mean that it functions as intended over time. Retro-commissioning essentially is a holistic building tune-up performed by firms with certified commissioning professionals. It is the systematic process of ensuring that an existing building's energy systems and equipment operate in an optimal manner. Retrocommissioning is a step beyond routine internal **O&M** procedures and requires the involvement of experienced firms.

Retro-commissioning can identify areas where the operating staff needs remedial training and this staff training can be included in the in project scope. For new construction, this process is simply called Commissioning. **Building owners should consider combining retro-commissioning with an audit to maximize savings potential.**

A typical retro-commissioning project involves:

- Evaluating lighting systems and controls performance
- Evaluating the building envelope and outside air infiltration
- Evaluating the energy management system and controls
- Balancing the HVAC system
- Tuning the heat exchange equipment
- Tuning the heating and cooling system

Benefits:

A typical project provides savings of 5-15 percent with a payback of two years or fewer. Scope of the project, building size, age of equipment and degree of current dysfunction affect the energy savings percentage. A majority of energy savings come from adjusting energy management system/controls. While not as easily quantified, increases in productivity due to improved work environment can overshadow savings in energy. Payroll cost can be $200 per square foot or greater.

Source:www.naseo.org/committees/buildings/documents/NASEO_Public_Buildings_Manual.pdf

Case Study: Research Facility, Kodiak

Written By: Bob Tucker, Maintenance Coordinator
Kodiak Island Borough

While working with their local direct digital controls (DDC) technician, Kodiak Island Borough staff found that over the last 13 years their main air intake dampers in the Research Facility had been programed to maintain 100 percent outside air for no apparent code reason. This meant that all air brought into the building had to be heated 24/7 causing the heating coils to operate wide open in the colder months, consuming an enormous amount of fuel. Normal operations would have these go into night time shutdown for economic savings.

After this programming error was identified, KIB changed the outside air setting to 25 percent which is still more than what is usually required. KIB then worked with an auditor and had the entire facility retro-commissioned including checking the programming against the sequence of operations. The change in the programming alone saved 10,500 gallons of fuel in 7 months over the same period last year. This reduction in fuel use is equal to a savings of $39,900.

KIB recognizes that retro-commissioning and the review of the system's sequence of operation and programming are extremely important and has since completed audits on other borough owned facilities.

More info:

A Retrocommissioning Guide for Building Owners
www.peci.org/sites/default/files/epaguide_0.pdf

Public Buildings Manual
www.naseo.org/committees/buildings/documents/NASEO_Public_Buildings_Manual.pdf

ACG Energy Management Guideline
www.commissioning.org/energyprogram/energy.aspx

Energy Star Guide: Building Upgrade Manual
www.energystar.gov/ia/business/EPA_BUM_Full.pdf

> Not implementing an EEM can be more costly than implementing it in the long run. Choosing to not implement is a decision to pay the increased energy use cost for the remainder of the building's anticipated life.

A level II audit or higher should not only provide the owner with a list of **energy efficiency measures** that are cost effective but also include estimates of total cost and payback. In moving forward there are multiple factors to consider: What are the benefits of investing in energy efficiency; what **EEMs** should be done; who will manage the implementation of the project (internal staff or a contractor); and how will the project be financed (capital budget, grants, loans)? This section will begin to address those issues.

Benefits of Investing in EEMs

Energy Reduction and Cost Benefits:
- Reduce energy and maintenance costs
- Reduce financial risks associated with future fuel price increases
- Improved reliability and higher quality performance

Building Occupant Benefits:
- Improved thermal control and comfort
- Improved productivity
- Improved light quality
- Healthy indoor air quality
- Improved safety

Community Benefits:
- Creation of local jobs
- Reduced environmental impacts
- Increases building longevity
- Long-term community sustainability
- Reduction of building pollution and emissions
- Efficient use of local energy resources (hydro, wind, biomass, etc.)

Case Study: University of Alaska Fairbanks

Written By: Amber McDonough, PE, Energy & Environmental Solutions, SIEMENS INDUSTRY, INC.

The University of Alaska Fairbanks (UAF) used Siemens Industry, Inc. Building Technologies Division – Energy & Environmental Solutions (Siemens) to perform Investment Grade Energy Audits for 14 buildings on their main campus in Fairbanks. UAF had Siemens develop a performance contracting project that identified energy efficiency improvements with less than a 15-year **simple payback.**

Siemens worked closely with UAF facilities personnel to investigate and analyze the operations of the buildings in order to develop **Energy Efficiency Measures (EEMs)** that could be combined to form a cost-effective energy performance contracting project solution. The project required an in-depth analysis, since UAF has already been proactive with managing and implementing typical **EEMs**.

The facilities included a variety of uses: classrooms, laboratories, research areas, a gymnasium, an ice rink, recreation areas, conference halls, large atriums, a cafeteria, a dormitory, art workshops, theaters, and a library. In total, more than one million square feet of space with a total electrical, steam, and water utility expenditure of more than $4.6 million per year received energy audits.

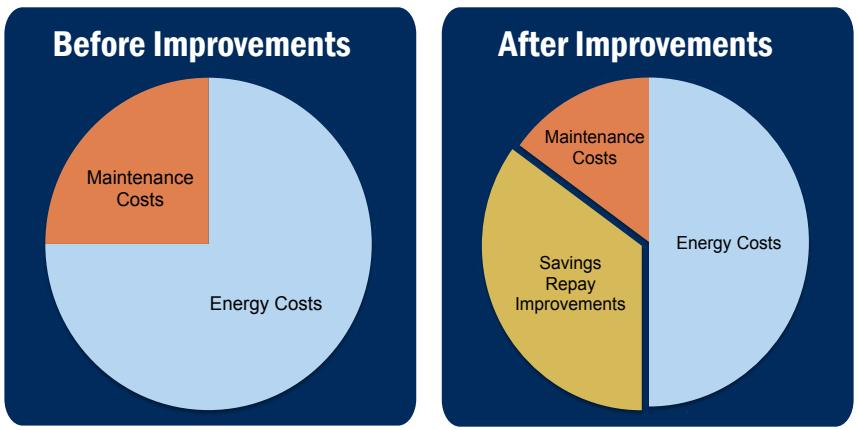
UAF awarded Siemens a $5,164,000 energy performance contract to implement **EEMs** that are expected to generate more than $524,000 per year in energy and operational savings for UAF. This contract includes a 10-year savings guarantee and results in a project with a 9.8 year **simple payback**, which reduces the buildings' annual energy consumption by more than 10 percent. The recommended **EEMs** include extensive lighting retrofits, ventilation and exhaust system improvements, control system enhancements with demand-based ventilation and unoccupied temperature resets, water cooling improvements, motor upgrades, variable frequency drives, and envelope improvements for windows and doors.

Approaches to Project Implementation

Energy Performance Contracting (EPC)

EPC provides a turn-key process for comprehensive energy efficiency projects. EPC allows building owners to improve their facilities, using savings from their energy and operational budgets, to fund projects with guaranteed results. An EPC can be provided by an Energy Service Company (ESCO) which specializes in providing EPC services from concept design through the post-construction performance guarantee period. The ESCO guarantees the owner will achieve the energy savings from the implemented energy efficiency measures.

The State of Alaska and Department of Transportation and Public Facilities have managed EPCs in more than 40 public facilities, generating energy cost savings in excess of $1.8M per year.



Non Energy Performance Contract (Non EPC)

Many facilities have the capacity to develop a scope of work and manage project implementation internally. The facility manager or business owner can take on the responsibility of defining and implementing the scope of work through many forms of contracting. They can choose to lead the project or hire a project manager. The owner is responsible for managing the internal staff or hired contractors. Though there is no performance guarantee to insure a specific level of performance and/or energy savings, one hundred percent of the savings will go to the building.

Graph source: www.energyservicescoalition.org/resources/whatis.htm

Deep Building Energy Retrofit

Written By: James Diemer, Energy Specialist, Alaska Housing Finance Corporation

A comprehensive way to reduce energy use in buildings is through a deep retrofit. A deep retrofit considers the building and all integrated systems as a whole through a level II or III audit. The mechanical, electrical, and architectural components are evaluated as one, since an upgrade to one system will almost certainly affect the other systems in the building. When considering a systemic energy retrofit energy reduction can be maximized (in some cases by 40 percent or more) when implementing an **EEM** strategy which incorporates all systems in a holistic manner. Projects which address only shorter payback retrofits defeat the ability to incorporate longer payback retrofits such as heating system improvements, which are critical to the building.

Utilizing a **life cycle cost analysis** of all system retrofits can create more financial savings than analyzing each system separately. By implementing a 10 year plan for example, the savings from a lower cost quick payback upgrade can be used to offset the cost of more expensive and longer payback improvements. In this scenario, an expensive shell component retrofit may become cost effective when bundled with the other system upgrades.

The long term preservation and efficiency of the building are enhanced when the building is assessed as a whole. For example, efficient lights produce less heat. Less heat from lights create a larger heat load for the mechanical system. However, increased insulation levels decrease the heat load, and the deep building retrofit will determine if the mechanical system can now be replaced with a smaller unit.

Once all these factors are considered as a whole, future planning, capital improvements, reduced maintenance, and energy savings create a different financial picture than simply analyzing one system improvement independent of another.

More info:

Rocky Mountain Institute
www.rmi.org/retrofit_depot_101

Castle Square
www.castledeepenergy.com/?page_id=30

Making the Business Case for Energy Efficient Buildings; Jonathan Westeinde
www.youtube.com/watch?v=K9b6k7P20e4&feature=plcp

Project Financing

There are multiple funding resources for addressing energy efficiency upgrades and improvements.

The following financing options are available for small businesses, commercial and public facility owners.

Additional financing options are available at:
www.akenergyefficiency.org/workplace/find_financial_assistance

Alaska Energy Efficiency Revolving Loan Program

Administered by: AHFC
Eligible: Public Owned Facilities
Description: AEERLP, a 250 million dollar revolving loan fund, provides financing for permanent energy efficient improvements to buildings owned by regional educational attendance areas, by the University of Alaska, by the state, or by municipalities in the state. Savings from energy efficiency improvements are used to repay the loan. No minimum or maximum.
Web: www.ahfc.us/loans/akeerlf_loan.cfm

Alaska Commercial Energy Audit Program

Administered by: Alaska Energy Authority
Eligible: Private Commercial Facilities
Description: The program provides reimbursements of qualified commercial energy audits for privately owned commercial buildings. The maximum reimbursement is set by the building size and complexity and ranges from $1,800 to $7,000 with consideration for travel costs to remote locations.
Web: www.akenergyauthority.org/efficiencyaudits.html

Alternative Energy and Conservation Revolving Loan Fund

Administered by: DCCED
Eligible: Public and Private Facilities
Description: Loans may be made to purchase, construct and install alternative energy systems or energy conservation improvements in commercial buildings. Maximum amount is $50,000.
Web: www.commerce.alaska.gov/ded/fin/ae.cfml

Capital Improvement Projects

Administered by: DEED
Eligible: School District Owned Facilities
Description: Schools can apply for CIP project funding, including energy efficiency measures, from the Department of Education and Early Development. Project ranking/award is per the department's statutes.
Web: www.eed.state.ak.us/facilities/FacilitiesCIP.html

Federal Tax Deduction for Commercial Buildings

Administered by: Federal Government
Eligible: Commercial buildings and facilities
Description: A new deduction for expenses incurred for energy-efficient commercial building property. The deduction is equal to energy-efficient commercial building property expenditures made by the taxpayer.
Web: www.efficientbuildings.org/about_the_provision.html

Rural Energy for America Guaranteed Loan Program

Administered by: USDA RD
Eligible: Rural Small Business Facilities
Description: REAP Loans encourage the commercial financing of renewable energy and energy efficiency projects. Project developers will work with local lenders, who in turn can apply to USDA Rural Development for a loan guarantee up to 85 percent of the loan amount.
Web: www.rurdev.usda.gov/BCP_ReapLoans.html

Village Energy Efficiency Program

Administered by: AEA
Eligible: Public and community buildings and facilities
Description: Provides energy efficiency upgrades and improvements to public and community buildings in small, high energy cost communities. Measures include lighting, switch boxes, motion sensors, set back thermostats, improvements to the building envelope and low mass boilers. Community selection is through an application process and based on cost of energy, geographic distribution and potential savings.
Web: www.akenergyauthority.org/programsalternativeVEEP.html

Resources and Tools

These pages list additional tools for building owners to address energy efficiency.

AHFC Research and Information Center (RIC)
The RIC is a library of books, fact sheets, videos, reports, catalogs and other resources that dive deeper into the topics addressed here. Topics range from energy efficiency, renewable energy and sustainable technology. Either visit the library in person or access resources online. *www.ahfc.us/energy/ric.cfm*

AHFC Audits Publically Available
For examples of ASHRAE Level II Energy Audits completed by multiple firms, check out the audits completed through the REAL program.
www.ahfc.us/energy/energy_eff_public_fac.cfm

Alaska Retrofit Information System (ARIS)
ARIS is a tool available for some public building owners/managers to track energy use. It provides a ranking of a portfolio of buildings by **EUI** or **ECI**, and can compare energy use of a building by type to others of the same type in similar climactic regions.
www.ahfc.us/energy/energy_eff_public_fac.cfm

akenergyefficiency.org

Visit www.akenergyefficiency.org

This site is a one stop shop for energy efficiency in Alaska, including listings of auditors, energy contractors, and other services. Check this site for updates on available state and federal programs, new funding opportunities, events, classes and other resources.

Also visit www.akenergyefficiencymap.org

This map shows multiple energy efficiency projects statewide. Login and enter your own energy efficiency project!

Source: ASHRAE

Energy Saving Tools

The Association of Energy Engineers
AEE has many energy related training programs available to the public. An institution's energy manager can become a CEM (Certified Energy Manager) through AEE.
www.aeecenter.org

The Building Owners and Managers Association (BOMA)
BOMA offers information on building management and operations, development, leasing, building operating costs, energy consumption patterns, local and national building codes, legislation, occupancy statistics, technological developments, etc.
www.boma.org

DOE Energy Star Financial Calculators
DOE offers multiple calculators to assist owners in evaluating next steps. Calculators including Financial Value, Building Upgrade Value, and Cash Flow Opportunity Calculator.
www.energystar.gov/index.cfm?c=assess_value.financial_tools

Energy Efficiency Tool Loan Kit Program
The Alaska Energy Authority offers tools for check-out by Alaskans seeking to assess opportunities for improved efficiency in their workplaces. For details check out:
www.akenergyauthority.org/eec-toolloankit.html

Energy Star
This is a hub for an array of tools from energy management, to assessing efficiency, improving performance, and much more.
www.energystar.gov/index.cfm?c=tools_resources.bus_energy_management_tools_resources

Green Star
An organization that encourages businesses to practice waste reduction, energy conservation and pollution prevention through education, technical assistance, and "green business" certification.
www.greenstarinc.org

U.S. Small Business Administration
Explore energy saving tips and learn how you and your business can be more energy efficient.
www.sba.gov/category/navigation-structure/starting-managing-business/managing-business/running-business/energy-e

Glossary

A **Demand Charge** is not the actual cost of the energy used, but the cost of providing a required capacity available at all times. The demand charge is determined by the maximum demand required of a user during a defined period or **Peak Demand**. Demand is usually the consumption over time integrated over 15 minute period. The five-second start surge doesn't affect the 15 minute integration period very much. Demand is best reduced by reducing loads.

Energy Cost Index or ECI is the annual amount of money spent per square foot for thermal and electrical energy. It should be noted that both the **energy use index (EUI)** as well as the ECI index will be influenced by the differences in climate and size between buildings, as well as local energy costs.

Energy Efficient Measure or EEM is an idea, concept or change that could provide a reduction in the energy costs and use.

Energy Use Index or EUI is a measure of the annual amount of energy used in BTUs per square foot. This is often used to compare the energy consumption of buildings within similar climate zones.

Life Cycle Cost is the total discounted dollar cost of owning, operating, maintaining, and disposing of a building or a building system over a period of time (National Institute of Standards and Technology)

Life Cycle Cost Analysis is an economic evaluation technique that determines the total cost of owning and operating a facility over a period of time.

O&M is the abbreviation for Operations and Maintenance.

Savings to Investment Ratio or SIR is the savings over the life of the EEM divided by investment capital cost. Savings includes the total discounted dollar savings considered over the life of the improvement. Investment in the SIR calculation includes the labor and materials required to install the measure.

Simple Payback is a cost analysis method whereby the investment cost of an EEM is divided by the first year's savings of the EEM to give the number of years required to recover the cost of the investment.

Sources and References

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www.commissioning.org

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www.akenergyauthority.org

Alaska Energy Efficiency Site
www.akenergyefficiency.org

Alaska Housing Finance Corporation
www.ahfc.us

American Society of Heating, Refrigerating, and Air-Conditioning Engineers
www.ashrae.org

Building Commissioning Association
www.bcxa.org

City of Homer
www.cityofhomer-ak.gov

Cold Climate Housing Research Center
www.cchrc.org

Energy Star
www.energystar.gov

Green Building Council of South Africa
www.gbcsa.org.za

Investment Grade Energy Audit: Making Smart Energy Choices
Shirley J. Hansen, James W. Brown

National Association of State Energy Officials
www.naseo.org

Natural Resource Council of Maine
www.nrcm.org/documents/ME_business_energy_efficiency_guide.pdf

U.S. Department of Energy
www.energy.gov

Additional sources cited throughout where appropriate.

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ALASKA ENERGY AUTHORITY

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Educating All Students for Success in Life

Alaska Housing FINANCE CORPORATION

AMERESCO
Green • Clean • Sustainable

Bristol Bay Native Association

Central Alaska ENGINEERING COMPANY

TRANSPORTATION & PUBLIC FACILITIES · STATE OF ALASKA ·

COFFMAN ENGINEERS

SIEMENS

NORTECH
ENVIRONMENT, ENERGY, HEALTH & SAFETY CONSULTANTS

SWAMC
Southwest Alaska Municipal Conference

REAP
Renewable Energy Alaska Project

UAF
UNIVERSITY OF ALASKA FAIRBANKS

Using the Project Energy Savers™, LLC template, this guide has been specifically created by Rebekah Lührs, Energy Specialist 1 at Alaska Housing Finance Corporation.

For more information about Project Energy Savers, visit www.projectenergysavers.org