

# **Prioritizing Energy Efficiency in Municipalities**

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## **ABSTRACT**

Local governments often hold a wide range of facilities in their portfolio, all with unique and different end uses. The list of facilities for city or county governments can include swimming pools, office buildings, educational facilities, and water and wastewater treatment plants. There is great potential to reduce energy costs in these facilities by focusing on retrofitting inefficient systems, instituting behavioral and operational policies, and creatively encouraging energy efficiency in building occupants.

Even with this immense opportunity to save energy and other resources, municipalities often lack the budget, staff and focus to make energy conservation a priority. Facilities managers are frequently occupied with day-to-day building operations and are unavailable to focus on capital improvements until a system failure occurs. Tight municipal budgets discourage early replacement of energy-intensive systems and often limit the ability to implement more efficient products when replacement is necessary. Life-cycle cost considerations are trumped by immediate budget shortfalls.

Behavioral and operational-based energy consumption is often ignored by facilities operators due to the level of attention that tracking this consumption requires. Also, municipal staff often lacks an understanding of how to best achieve meaningful behavioral and operational changes. Puget Sound Energy's Resource Conservation Manager (RCM) Program is designed to provide coordination and leadership for effective and efficient management of all utility resources and focus on energy efficiency through behavioral changes, operational improvements, maintenance activities and capital improvements. Through the combined use of these programs, cities and counties can invest in energy-efficient improvements across the spectrum of their facilities. It is the intent of this paper to explore a specific case study, the City of Bellingham, WA, to provide an example of how a city-utility partnership can gain the budget, staff and focus necessary to make energy efficiency a priority.

## **Introduction**

The City of Bellingham is located in the northwest corner of the Puget Sound region in Washington State. With a population of approximately 76,000 residents, the city operates a variety of facilities serving the population and outlying areas.

The City delivers municipal water, wastewater, and storm water utilities to over 90,000 customers. Operating these utilities is a primary responsibility of the jurisdiction. As for other utility commodities, all of the electricity and most of the natural gas provided to the municipality is supplied by two investor-owned utilities, Puget Sound Energy and Cascade Natural Gas. The City of Bellingham also purchases natural gas for its wastewater treatment plant and recreational aquatic center on the open market through an independent natural gas brokerage firm. Water and wastewater treatment account for a large majority of the overall municipal utility budget and provide essential services, so it is imperative that the systems are operated as efficiently as possible.

Bellingham's 2009 electricity and natural gas utility budget has been set at \$4.65 million, representing 5.8% of Bellingham's total \$80.01 million 2009 budget. Although utility costs account for less than 6% of the overall budget, this is one of the likeliest places to achieve significant savings through conservation. Consistent implementation of efficiency measures yields significant energy savings. Focusing on energy conservation retrofit projects and making energy efficiency a priority of new construction, renovation, and life cycle equipment replacement is paramount to achieving these savings. Further, the City of Bellingham has established policies ensuring that this focus on prudent energy management is addressed internally.

This paper will explore the reasons that this municipality has embraced efficiency, the model that the City used to achieve their goals and select projects that demonstrate Bellingham's successes with energy efficiency.

## **Catalysts for Conservation**

There are many reasons that a municipality might be moved to make conservation a priority. Financial benefits, availability and access to utility incentives and raising staff awareness about smart energy use choices are all necessary components to the proposition of prioritizing conservation. For Bellingham however, the driving force and willpower came out of a commitment to environmental sustainability. But, these collateral catalysts were essential to enabling the City's success in their environmental pursuits.

## **Environmental Concerns**

In 2005, the City of Bellingham signed onto the Mayor's Climate Protection Agreement, stating that signatories will, "Strive to meet or exceed Kyoto Protocol targets for reducing global warming pollution by taking actions in our own operations and communities." In 2006 and 2007, a comprehensive greenhouse gas inventory was compiled for Bellingham's municipal operations and community as a whole. Upon completion, the City adopted specific emissions reduction targets for municipal operations and the greater Bellingham community. To meet these commitments, Bellingham established a Resource Conservation Manager (RCM) program to address the reduction of greenhouse gas emissions resulting from municipal operations and to track progress. Hence, Bellingham's RCM was tasked both as the individual who would help to implement a program that would reduce emissions from public Bellingham operations and as the employee who would be able to quantify and report these emissions over time. The RCM was able to use energy management software to compute greenhouse gas emissions making the measurement and reporting straightforward.

It is the City of Bellingham's goal to be a national leader in social and environmental stewardship and responsibility. This desire has helped develop internal and external policies which strive to ensure that Bellingham's practices are living up to its goals. The RCM partnership with Puget Sound Energy not only helps the City manage its utility costs and corresponding environmental impact, but also provides the mechanism through which measurement, verification, and reporting of its ongoing greenhouse gas emissions can be easily achieved.

## **Awareness of EE Options**

The general awareness of energy efficient options for projects and policies can introduce a meaningful discussion about these alternatives when a project is being considered. Often, decision makers are under pressure to make timely decisions and may not consider energy efficiency options if they lack awareness and information is not on hand. If a major mechanical system fails, the timeline to address the failure and find a replacement can inhibit careful research of the energy efficient options available. Conversely, projects on systems that have not failed may not be prioritized because the existing system functions adequately. Yet, the existing system consumes more energy than more modern and efficient systems available on the market. With resource-minded staff informing these decisions, energy efficiency can be presented as a consideration and cost avoidance mechanism. When staff members are prepared with information on cost-effective, efficient system replacements, municipalities can think about life-cycle costs, return on investment, and environmental impacts inline with rapid decision making. Bellingham's RCM was prepared to discuss these points and make the case for energy efficient replacement options. For Bellingham, the RCM is instrumental to implementing efficiency projects for both system failure replacement as well as retrofits for the sake of energy efficiency.

## **Utility Incentives**

Puget Sound Energy (PSE), Bellingham's electric utility, offers a variety of incentives to encourage conservation amongst their customers. There are two major sectors that are serviced through the PSE energy efficiency programs: Commercial/Industrial and Residential. Most of the projects that a municipality would pursue would be serviced through the Commercial/Industrial programs at PSE. Within the Commercial/Industrial sector, PSE offers a program for Resource Conservation Management (RCM) as well as rebates for common efficiency solutions and custom grants for unique retrofit and new construction projects. Forward thinking customers use these incentives to help finance their energy-efficiency projects.

Regulations on efficiency programs governed by the Washington Utilities & Transportation Commission require that energy efficiency projects sponsored by utilities be cost effective. Cost effectiveness is the concept that the benefit from the project outweighs the cost of the project, when viewed from a lifecycle operating perspective. The benefit is typically characterized by the value to the utility of the energy conserved by the project over its useful life. This value can be stated in dollars per Therm or kWh. The cost of the project includes both the cost to the customer as well as the cost to the utility and includes the administrative expenses of running the energy efficiency program. This holistic approach guarantees that energy efficient projects are smart and effective regardless of who pays for them.

When a municipality evaluates projects for consideration in capital or operating budgets, payback periods are typically part of the analysis. Partnering with PSE, the city of Bellingham has been able to target and complete projects that pay for themselves through energy savings over the course of their useful life, sometimes many times over. These projects are cost effective without any incentives from PSE. However, with the added monetary contribution from the utility, municipal officials can demonstrate that the payback period is far shorter and the overall return on investment much more significant than would have been expected. Using utility incentives to realize a shorter payback period and decrease the out-of-pocket cost of the project enables Bellingham to pursue efficiency projects that otherwise would not be considered.

## **Return on Investment**

Municipalities are uniquely positioned to undertake energy efficiency projects because, unlike many private enterprises, municipalities can accept lengthier returns on investments. While some efficiency projects pay for themselves in avoided costs almost immediately, many worthwhile projects have longer payback periods. Private enterprises historically view longer payback periods as risky and thus are not as likely to pursue those projects with lengthy payback periods due to future uncertainties. Conversely, municipalities are generally more willing to view these efficiency projects as feasible and financially viable. Bellingham recognizes that energy efficiency is a service that provides a return that can be defined and depended upon while addressing the concern of delivering reliable service to the city's residents. In the current economic environment, moving forward on even low-risk projects with timely positive returns can be difficult. With energy efficiency investments, the risk is very low and the returns are remarkable: often greater than other investments that a municipality might otherwise consider. Making this case to the committees that define the capital and operating budgets for the City can escalate the focus on energy efficiency.

In this economic climate, the City of Bellingham faced budget deficits due primarily to a decrease in development and sales tax-generated revenue. The City opted to freeze hiring for all vacant positions, and ultimately decided to lay off some employees, to mitigate budgetary constraints. The RCM position had recently been vacated, and due to the hiring restrictions, would not have been filled. Although demonstrable savings were already apparent, the case was made to City management that the bulk of the potential benefit would not be realized if the program did not continue. Bellingham decided to open the application for the RCM position initially to employees receiving pink slips and was able to place a terminated employee into the position. Interestingly, although the RCM program was developed in order to meet climate program objectives, the main reason it has continued to be supported by City management during the economic downturn is because of the potential for financial savings. The City recognizes that an RCM can return money to the city coffers through smart management of utility resources.

## **Bellingham's Model for Efficiency Prioritization**

Although the City of Bellingham completed a number of significant energy efficiency projects previously, it was not until late 2007 that City officials began to address comprehensive energy management. In November 2007, the Bellingham City Council passed a resolution establishing an RCM position with the support of PSE including a \$15,000 grant from PSE to initiate the program. The person hired for the position used the PSE provided framework to create a model tailored to the organizational needs of the City.

The PSE RCM program is set up to provide both monetary incentives for establishing an RCM program at a site and also to provide utility customers with tools and expertise to succeed in resource conservation. PSE staff provides consultation in RCM program implementation as well as offers training and a suite of tools useful in implementing conservation management. Using the PSE framework, the RCM was able to develop a plan for conservation success.

Although RCM programs do not look the same in every organization, there are common elements that must be present in order for the program to be successful. These include: utilizing energy management and utility accounting software to aid in identifying problem buildings and

equipment, significantly influencing occupant behavior comprehensively and on an ongoing basis within the organization, clearly communicating and mandating the objectives of the program, and reporting energy savings attributed to the RCM program both internally and externally.

The first priority of Bellingham's RCM program was to establish and populate a comprehensive utility accounting database tracking all municipal electricity, natural gas, water, wastewater, solid waste, and recycling accounts. Through the partnership with PSE's RCM program, PSE provided the City with a software tool, LPB Energy Management's Utility Manager Pro resource accounting software. This program allows for detailed tracking of utility resource consumption and cost info and for easy uploading of the utility billing history. Although some manual data entry was required, the bulk of Bellingham's municipal utility accounts are electrical and Puget Sound Energy was able to provide data that could be directly imported into the Utility Manager program.

An important web-based analytical tool that proved critical to Bellingham's RCM program is PSE's Energy Interval Service (EIS). EIS provides online access to 15 minute intervals of energy usage. This trend and profile data is useful when addressing site specific energy management objectives. Through the effective implementation of EIS reporting, Bellingham's RCM was able to identify facilities that were using too much energy during unoccupied periods, quantify the impact of operating energy intensive equipment, and develop reports that facilities management staff used to enhance facility operational energy efficiency. Puget Sound Energy provides EIS to all RCM program participants free of charge.

Once utility resource consumption and cost was quantified, and initial relationships were formed with key participants, Bellingham's RCM shifted gears and began focusing primarily on the implementation of the behavioral and operations and maintenance energy efficiency campaign. This is no small task, and it must be taken seriously as it is a primary function of an RCM program.

Within the City of Bellingham's business structure, there are many disparate departments and facilities that seldom, if ever, communicate holistically. An RCM can have great influence if he or she is able to break down some of these communication barriers and implement a comprehensive, organization-wide energy efficiency campaign. Bellingham's RCM took every opportunity to spread the RCM campaign message within the organization. This involved utilizing existing and developing new routes of communication. Through brief but clear presentations at large staff and small work group meetings, the RCM was able to spread a compelling message of energy efficiency to all staff members.

It was of primary importance to put tools in the hands of folks willing to help implement change within the organization. Numerous staff members offered to help police workspaces and encourage staff to use less energy in their offices, and the RCM gave these eager energy stewards calculators, checklists, and reminder tools that helped to quantify and promote the changes they were encouraging. This concept turned a single RCM into many energy stewards helping to achieve behavioral changes.

Facility operations presented the RCM a large opportunity for conservation. The RCM worked first to analyze the relative energy efficiency of each facility within Bellingham's portfolio using the Utility Manager resource accounting database and EIS. Although the least efficient facilities presented real opportunity for large savings, there were significant opportunities even in the most efficient Bellingham facilities. As many intelligent folks have lamented, "You can't fix what you can't measure." Once baseline consumption data was

established for all facilities, the RCM worked with facilities staff to develop new and enhance existing operating procedures leading to increased overall efficiency. Efficiency measures ranged from implementation of advanced HVAC and electrical system control sequences to installing weather stripping on exterior doors and implementing energy efficient light bulbs in all sockets.

As PSE's RCM program dictates, all of these behavioral and operations and maintenance measures were qualified and compiled into specific facility action plans for each site. Within these action plans, Bellingham's RCM organized all measures from highest to lowest potential energy reduction and from highest to lowest overall cost. For each specific measure, notes were made detailing staff required for specific action, the proposed timeline for implementation, and potential budget impact. Equally as important was a "notes" section where staff could detail the success of implementation. The Facility Action Plans (FAP) were meant to be used as worksheets for continued effective resource management.

No matter how aggressive an energy management campaign is, there often comes a time when policies and enforcement are necessary. The City of Bellingham's RCM program was not an exception to this rule. Despite all of the positive efforts of Bellingham's RCM, there were still employees who insisted upon using their own personal refrigerators; thermostats were being mysteriously and inappropriately adjusted, etc. The decision was made to draft a Resource Management Policy that would be officially adopted by Bellingham City Council and enforced by staff members. This policy addresses electrical and HVAC systems and operation, water supply and management, water and wastewater treatment, and solid waste and recycling practices. All of the measures adopted must be adhered to by staff members. The policy eliminated many arguments.

Again, one of the cornerstones of the RCM program is comprehensive utility accounting, and the Utility Manager software provided as an aspect of the RCM grant makes this possible. As the City of Bellingham learned through careful tracking and analysis of energy usage and cost data, there are many easily identifiable and quantifiable benefits of holistically monitoring energy consumption and increasing energy efficiency, including measurement and verification of efficiency projects developed and implemented within the agency. The RCM also helped identify and champion projects which qualify for additional utility incentives such as: Lighting system improvements, HVAC systems and controls, water heating system improvements, retro commissioning, and building thermal improvements.

This model for efficiency prioritization has been a success for Bellingham because it has streamlined project decisions, identified wasted resources, and provided opportunities to improve the efficiency of Bellingham's municipal operations. Establishing detailed plans and policies and communicating the conservation message to the stakeholders has resulted in reduced waste and improved efficiency for the City of Bellingham.

## **Project Examples and Results**

The following section outlines three projects that Bellingham has implemented to save energy: Resource Conservation Management, a large lighting retrofit, and a wastewater treatment facility retrofit. These projects are selected to demonstrate the gamut of energy conservation approaches that the city is pursuing to meet their fiscal and pollution reduction goals. Specifically, the operations and behavioral-based RCM project is an ongoing conservation activity that is the cornerstone to the City's successes in energy conservation; the lighting retrofit

is a project that made great investment sense but only was seriously considered because utility rebates shortened the payback period; and the wastewater treatment facility retrofit is a project that was primarily required to meet growing population demands although facility managers opted to select efficiency improvements to meet their design criteria and simultaneously reduce future operating costs.

## **RCM Activity**

As we are writing this paper, Bellingham is still in the process of working through the implementation of their RCM program. Although PSE doesn't have a comprehensive savings analysis of Bellingham's program yet, initial reports are indicating that the efforts are making an impact.

A particular municipal facility that has achieved notable results through implementation of the RCM's FAP is the public Arne Hanna Aquatic Center. This 20,000 square foot public aquatic center consumes more energy than any other municipal facility, excluding the water and wastewater treatment facilities. Upon realization of this fact, Bellingham's RCM went to work identifying ways to cost effectively reduce energy consumption at the center. There was no shortage of opportunity.

The first major opportunity the RCM noted on the FAP related to the amount of outside air being brought into the facility. The air was being fully exchanged approximately ten times per hour, or once every six minutes. Although there is a significant need to bring fresh air into this space because of the presence of pool chemicals, including chlorine, this schedule was excessive. The first recommendation was, therefore, to reduce the amount of outside air entering the facility through recalibration of air handling equipment.

Second, although most of the facility remains over 80°F during operating hours, individuals in offices were still using space heaters to supplement heating in the winter. This is hazardous as well as inefficient, so the second recommendation was to do away with the space heaters.

Other significant measures indicated within the FAP included: Lowering heating and raising cooling set-points in restrooms and corridors whenever possible, utilize lock-outs on thermostats so that they can only be operated within a certain range, turn down thermostats serving domestic hot water heaters to 110°F, and turning off lighting when daylight was adequate. The implementation of these measures saved the Arne Hanna Aquatic Center over 25,000 kWh and \$2,500 in operating costs in 2008 compared to 2007.

It has been very important to the City of Bellingham that RCM program savings are quantified and reported internally. In fact, as noted above, savings attributed to Bellingham's RCM program are the main reason it is still being supported by the City in this difficult economic environment.

## **Lighting Retrofit**

A specific capital project identified and facilitated by Bellingham's RCM was a lighting retrofit involving four fire stations and six public works facilities. The project was a straightforward exchange of linear fluorescent fixtures. The existing equipment was comprised entirely of T12 fluorescent fixtures, mostly F40T12, many with magnetic ballasts. The

replacement equipment included efficient fluorescent T8 fixtures with electronic, low ballast factor, programmed start ballasts and 25W F32T8 bulbs.

The City of Bellingham's RCM served as the project manager for this efficiency retrofit. The bid specification indicated that all bidders were responsible for applying the appropriate utility grants and rebates to the project. Consequently, the bid specification contained all relevant information about the products that were being replaced, including wattage, ballast type and factor, total fixture count, and operating hours. All sealed bids came back with this incentive money applied, and PSE reimbursed the contractor directly once the work was performed. By requiring the contractor to process the utility incentive, the City of Bellingham was able to save significant time and effort. The contractor is a good entity to process the rebates and incentives because they have specific knowledge of the equipment being installed, and in this case, removed.

Because of the extended operating hours at the fire facilities and overall inefficiency of the existing system, the lighting upgrades were projected to achieve 103,913 kWh of annual energy savings compared to the existing equipment. The City pays approximately \$.08 per kWh for electricity, with green power surcharges, so at current rates, the total annual cost savings are estimated to be \$8313.

The total cost of this project, per the lowest bidder, was \$39,990. Because of the relatively high potential energy reduction and low project cost, Puget Sound Energy provided \$20,837 in grant and rebate money. So, the City of Bellingham paid the contractor only \$19,153 total for all ten facilities. This is a prime example of the impact a dedicated staff member can make to energy efficiency and avoided costs. In this particular example, \$19,153 was spent on a project that saves \$8313 annually because of reduced operating costs. The project will pay for itself in raw energy savings, at today's rates, in 2.3 years.

Two specific things made this project happen: First, the City of Bellingham hired an RCM and established an RCM program. Without a holistic focus on energy efficiency, no one would have moved forward on this project. Second, Puget Sound Energy agreed to pay 53% of the total project cost. Without this additional funding, the project would not have happened. It really is as simple as that.

## **Wastewater Treatment Facility Retrofit**

The City of Bellingham operates a single waste water treatment plant with an average load of 11.6 million gallons per day. Efficiency in waste water treatment generally occurs in process modifications and use of efficiency pumps and motors. Bellingham has retrofitted pumps with variable frequency drives (VFDs) and replaced aerators with efficient impellers and VFDs. Further, the efficiency of their aeration process was improved by modifying the process for the first stage to anaerobic digestion. While these modifications improved energy efficiency, they also offered the added benefits of increased capacity and improved quality of the treatment. PSE participated in this major retrofit of Bellingham's waste water treatment facility.

Two separate projects addressed these waste water treatment plant retrofits. The first project retrofitted two 75 hp pumps with VFDs. The cost of this measure was \$52,765 of which PSE paid \$21,901 or 41.5%. The city estimated that the payback period for this project was 11.8 years but with the PSE grants, the payback was shortened to 6.8 years. PSE estimates that these measures save the city 85,000 kWh annually and should have a life of 15 years. Hence, savings of 1,275,000 kWh are estimated to be realized over the life of these measures.



The second project was more extensive with both process modification and equipment retrofits. The aerators tanks were modified to improve efficiency while prepare for capacity increase in the future. The project converted the first stage of the aerators into anaerobic, added VFDs to all the aerators to match the oxygen demand, replaced all the impellers in the aerators with high efficient impellers, and up-sized the second stage from 30 hp to 75 hp. The cost of these measures was \$669,298 of which PSE paid \$334,649 or 50%. The city estimated that the payback period for this project was 11.8 years but with the PSE grants, the payback was shortened to 5.9 years. PSE estimates that these measures save the city 1,039,000 kWh annually. Over a 15 year life, these measures should save as much as 15,585,000 kWh.

While this project was completed prior to the City hiring an RCM, Bellingham was fortunate to have employees that prioritized efficiency for this project. Waste water treatment engineers recognized that the pumps could be run more efficiently and that process modifications that save energy as well as provide for additional capacity could be installed to meet the growing demand in the municipality.

## **Conclusions**

Bellingham has created a workable model for energy conservation using a dedicated staff member focused on resource conservation and operational energy efficiency. It is critical that this employee obtain top-level commitment to policy implementation and policy changes and develop staff education to support this goal. While the driving force for implementing a Resource Conservation Management program in Bellingham was the adoption of greenhouse gas reduction targets, the economic benefits of resource conservation became an important motivator for continuing the RCM position during a period of downsizing and economic uncertainty.

Going forward, the City of Bellingham intends to follow through on their three year RCM grant agreement with PSE and anticipates greater annual energy reductions as their plans are implemented. Strengthening their commitment to this model, the city has formed a partnership with a non-profit network of small local businesses, Sustainable Connections. This agency has hired a community RCM to bring the same value to the small business community in Bellingham that the City of Bellingham's RCM has brought to the municipality. PSE is the key sponsor of this position for Sustainable Connections, and worked closely with the agency to create a customized RCM grant agreement and corresponding goals for the greater Bellingham business community. Public / private partnerships like these have the ability to transform the way energy is consumed in the future.