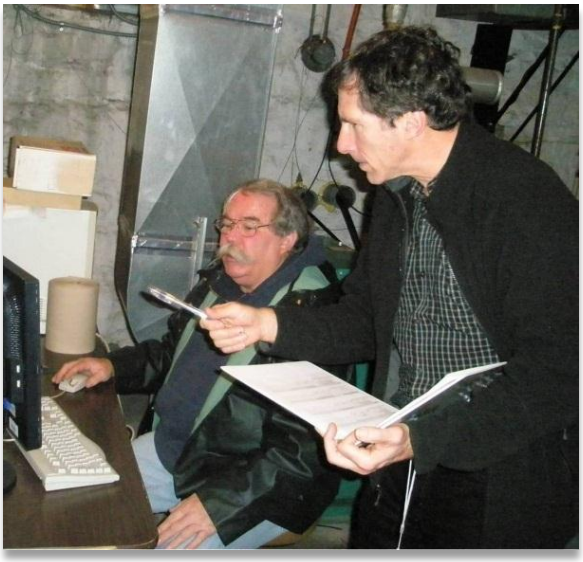
Shared Resource Conservation Manager Program Final Report



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Prepared by

WASHINGTON STATE UNIVERSITY
EXTENSION ENERGY PROGRAM

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Executive Summary

Background of the Shared Resource Conservation Manager Program

In 2009, Washington State University (WSU) Energy Program and Washington State Department of Commerce created a grant-funded program called the Shared Resource Conservation Manager (Shared RCM) Program. Funds originated from the American Recovery and Reinvestment Act (ARRA). Commerce contracted with the WSU Energy Program to provide program and technical support for the local government grantees of the program.

Seven partnerships were formed and granted $75,000 each over two years to support start-up of a Shared RCM Partnership program and hire a Shared RCM. In addition, an existing partnership was granted funding to support their ongoing program. These eight partnerships consisted of 35 entities, mostly cities, counties, school districts and ports. The average number of partners was four.

An RCM works to reduce use and costs of electricity, natural gas and other fossil fuels, water, solid waste and recycling within an organization. This is done by measuring, tracking and comparing usage data; assessing buildings to identify potential energy efficient no- and low-cost actions; paying attention to utility billing and rates; optimizing maintenance and operating procedures; and getting support from staff and managers to implement recommended measures.

A Shared RCM serves a minimum of two partners. This is an efficient use of the RCM for small public organizations that do not spend enough on utilities to be able to afford a full-time RCM.

Puget Sound Energy (PSE), an investor-owned utility, has an RCM program that five of the shared RCM partnerships joined.

This report summarizes the program as a whole. As supplementary information, detailed individual reports of each of the eight partnerships are available separately at: http://www.energy.wsu.edu/PublicFacilitiesSupport/ResourceConservation/SharedRCM.aspx.

The WSU Energy Program helped to form partnerships, assisted with initial grant applications and reporting, helped recruit RCMs, and provided program and technical support and training over the grant term.

Program Implementation

Implementing an RCM program involves entering and tracking data, performing building walk-throughs, identifying energy efficiency measures, writing reports and presentations to educate managers and staff, researching utility rebates and incentives, and working to get the measures implemented. Energy-efficiency measures that cost very little can include optimizing the start-up times of heating units, making temperature controls more efficient, identifying equipment that is not working optimally, and encouraging staff to unplug machines when not in use.

Measuring Results

According to data summarized for this report, electricity use for five of the partnerships dropped by over 2.5 percent during the first year of the Shared RCM program and dropped by over 6 percent during the second year. The cumulative two-year electricity use reduction was almost 9 percent. This equates to an energy-use decrease of over 3.7 million kWh and a reduction in carbon dioxide emissions of over 5.2 million pounds.

The results summarized here are conservative. Because of inconsistent or incomplete data, the totals show only the simple pay-back level of savings. The program had a small number of participants and only two years of data. Results indicate that first-year savings are smaller than previous estimates for RCM programs. The larger savings in the second year indicate that it can take some time for a new program such as this to "hit its stride."

Challenges and Insights

This report discusses WSU Energy Program staff insights and results from interviews with partners and RCMs about the program.

Challenges faced by the partners and RCMs included the lengthy time it took to form the partnerships and hire the RCM. In some cases, a full two years-worth of data was not available because the lengthy start-up time limited the total length of the program. Maintaining effective communication was also a challenge, especially in partnerships with many members. In addition, resource accounting programs were challenging and data entry proved time consuming.

The shared nature of these RCM partnerships added a layer of complexity that increased the time it took to demonstrate results. RCMs during the first year were busy with data collection and entry, building relationships with staff and management, making site assessments and writing reports. The additional time needed for building relationships lengthened the time before measures could be implemented. As indicated by the data evaluated in this report, greater reductions in resource use were visible during the second year of the program than during the first year, which indicates that even more reductions and savings can be expected in future years if RCM efforts continue.

When evaluating this Shared RCM Program, it is important to ask the following questions: What is success? How do you measure success? Was the program successful? The goals of the Shared RCM Program were to reduce energy use among the program partners and to learn what worked and what did not work so program successes could be replicated. Because the program was funded with an ARRA grant, it was also hoped that jobs created through the program would continue after the Shared RCM Program was completed.

The Shared RCMs did reduce energy use and costs among the partners, as discussed in this report. Can this program be replicated successfully? Possibly – with some changes.

Anecdotal evidence indicates that an RCM can save up to 8 to 10 percent in resource costs during the first year on the job. That number influenced the grant requirement that each partnership have a

minimum $1.5 million in annual resource expenses. An 8 to 10 percent savings on $1.5 million could cover the cost and expenses of an RCM position.

One of the lessons learned from a shared partnership approach is how much longer things take with more partners. Savings this big seem unrealistic in a shared partnership, where much of a Shared RCM's time during the first year is spent cultivating relationships with each partner and collecting baseline data. Perhaps smaller partnerships of two or three partners are optimal. Or perhaps greater minimum annual resource expenses should be required to cover the cost of the RCM position.

Key elements that will help a shared RCM program be more successful include a strong policy highlighting management's commitment to the program, a firm understanding of RCM concepts among management and staff, and a realistic expectation of resources and staff time needed to implement the program.

Hiring a qualified RCM is crucial, as is having a "champion" of the program in at least one of the partner organizations to influence decisions and advocate actions. There are a variety of ways for an organization to prepare itself so it is ready for an RCM and can help the RCM successfully transition into this new position.

At the time of the local grant end date (June 2012), all but one of the RCMs was still employed by their partnership. At this report date, five of the eight are still employed.

Looking Ahead

Each of the Shared RCM partnerships created something positive during this program. Resource use and associated costs decreased overall in most of the partnerships. Most partners describe a shift in how staff and management view energy use and an increase in resource use awareness among their staff. Perhaps visits to these partners in a few years can provide more insight about how we define the success of an RCM program, such as cultivating new skills for the RCMs, reducing energy use, having written documents that spell out how to achieve resource use reductions in the future, and initiating a culture change in the day-to-day use of energy and resources.

Background of the Shared RCM Program

A Resource Conservation Manager (RCM) works within an organization to reduce facility expenses for electricity, water, natural gas, fuel oil, solid waste, and recycling through low-cost and no-cost methods. This is done by implementing improved operating and maintenance practices, paying greater attention to utility billings and rate structures, and using specialized software to monitor and analyze utility consumption and expenditures.

The benefits of having an RCM dedicated to the task of saving resources and money are immediate and highly visible. RCM programs have been used in large and small organizations, even as public-sector budgets shrink. This is because RCMs have documented quantifiable results within the first six months once a comprehensive program is in place, and are able to sustain reductions in resource use and savings through the years. Anecdotal evidence points to RCM programs able to achieve savings of 8 to 10 percent on utility bills after the first year – often enough to cover the salary of the RCM.

However, many public facilities – such as school districts, local governments and universities – do not have staff with the time and expertise to systematically investigate and capitalize on energy efficiency opportunities, even though they often have large expenses for resources such as energy and solid waste. In addition, many smaller organizations feel unable to justify the expense of hiring someone dedicated to manage these resources.

The Shared RCM Concept

The WSU Energy Program had no models for this approach except the Skagit Regional Planning Council RCM. In that program, one full-time RCM served nine agencies.

The Skagit RCM reported that nine agencies were too many to juggle. He found it difficult to provide comprehensive service for any of the agencies. Simply establishing data management and relationships exceeded the time available.

We set a limit of five agencies in a partnership, with the knowledge that even that number of partners may be complex.

A grant of $75,000 was provided by Commerce to each partnership to encourage participation and help fund the start-up costs for the RCM program. The programs served by Puget Sound Energy also received support to cover start-up costs.

The cost to sustain each three-year shared RCM program was approximately $75,000 - $100,000 per year. The local agencies agreed to a funding formula that provided the remainder of the costs for each partnership.

To address this need to provide qualified staff to enhance resource use efficiency, the partners in the Shared RCM Program made a plan to support full-time RCMs who would work for several small jurisdictions at the same time. We were not aware of any other programs of this type in other states. A factsheet the WSU Energy Program developed as this Shared RCM Program got underway is provided as an attachment.

Roles of WSU and Commerce in the Shared RCM Program

The Shared RCM Program was the product of a combined effort of the Washington State University (WSU) Energy Program and the Washington State Department of Commerce (Commerce), with funding from the American Recovery and Reinvestment Act (ARRA). As such, specific expectations for those participating in the Shared RCM Program were carefully defined, as specified in the attachment.

Commerce offered an ARRA-funded program that included grant funding from Commerce and program and technical support from the WSU Energy Program. Commerce contracted with the WSU Energy Program to provide program and technical support to the local government entities that received the ARRA-funded grants. Funding was available to form ten Shared RCM partnerships. The partnerships needed to be formed before grant assistance could be provided.

Commerce and the WSU Energy Program developed grant application criteria and guidelines (provided as an attachment). Criteria stipulated that each partnership must be comprised of at least two jurisdictions, the partnerships must include at least two cities and/or counties, and the minimum annual resource expenditures of all partners combined must be $1.5 million. Other key provisions for the grant application included the approval of an inter-local agreement by all of the partners that defines their commitment to the Shared RCM Program and their financial and program management expectations.

The open application period for the grant, in which partnerships filed an initial application, was from October 1, 2009 to January 15, 2010. The deadline was extended to February 15, 2010 for eastern Washington applicants to try to achieve a more equitable geographical balance of programs in the state because most interest was among the more heavily populated counties in western Washington.

WSU Energy Program

The role of the WSU Energy Program was to promote and support energy efficiency improvements at public facilities through the Shared RCM Program. The WSU Energy Program focused on four primary tasks:

- Recruit and help form partnerships among public agencies,
- Assist with program grant applications,
- Help recruit RCM staff, and
- Provide program and technical support and training.

Form Partnerships

Commerce conducted extensive outreach for several ARRA funding programs that they administered, including the Shared RCM Program. WSU Energy Program staff followed up on inquiries and worked with interested agencies to identify potential partnerships. This included contacts with Puget Sound Energy (PSE) and Avista Utilities to identify agencies that had previously expressed interest in RCM.

Interested agencies typically had at least one staff person who understood the RCM concept and acted as a champion to recruit other local agencies to join in a partnership. As potential partnerships took shape, the WSU Energy Program encouraged all agencies within a partnership to come together for a partnership formation meeting. WSU Energy Program staff attended all of these meetings to help clarify program goals and answer questions.

At these partnership formation meetings, discussions centered on the value of RCMs, services they might provide, possible savings, costs to each agency and shared costs. The partners also discussed the logistics of the shared program, who would administer it and how the RCM's time would be shared.

These details were then included in an inter-local agreement for each partnership, which was required for the grant to be awarded.

At some meetings, more than enough potential participants attended to form a partnership so if one or two decided not to commit, there were still enough to create a partnership.

In some cases, agency partnerships were explored but did not solidify. These included agencies in the Pullman, Walla Walla, Wenatchee, Mill Creek and Tukwila areas. In Pullman, Walla Walla and Wenatchee, a meeting of partners was held but no partnership formed. In Mill Creek and Tukwila, inquiries were received from a number of agencies but the lead was not able to establish enough interest to call a meeting of potential partners. Unfavorable budget conditions, lack of staff time and incomplete understanding of the RCM concept were why some partnerships did not coalesce.

Once marketing efforts had been exhausted and there were still fewer than 10 partnerships (as was the goal), WSU Energy Program staff approached Skagit Council of Governments to offer support to their shared RCM program. That program was having difficulty sustaining the funding and effort of its RCM for the nine partner agencies. The Commerce grant support helped the Skagit program survive.

Eight partnerships were funded – seven new ones plus the Skagit program. The seven new programs, identified by lead agency with all partners, were:

1. City of Bonney Lake
    - City of Bonney Lake
    - City of Buckley
    - City of Sumner
    - Sumner School District
2. City of Bremerton
    - City of Bainbridge Island
    - City of Bremerton
    - City of Poulsbo
    - Port of Bremerton
3. City of Federal Way
    - City of Auburn
    - City of Federal Way
4. City of Vancouver
    - City of Camas
    - City of Vancouver
    - City of Washougal
5. Clallam County
    - City of Port Angeles
    - City of Sequim
    - Clallam County
    - Clallam Transit
    - Olympic Medical Center

6. Jefferson County
    - Chimacum School District
    - City of Port Townsend
    - Fort Worden State Park
    - Jefferson County
    - Port Townsend School District
7. Skagit County (see individual report for previous partners)
    - Port of Skagit
    - Skagit County
8. Spokane County
    - Central Valley School District
    - City of Ritzville
    - Spokane County

Assist with Program Grant Application

The initial program application demonstrated interest and the minimum requirements. It required agencies forming a partnership to show their usage and expenses for energy, solid waste and water. The difficulty of collecting resource cost data for the application helped the agencies understand how an RCM could be useful. This resource usage and expense information was used to assure a minimum scale for the overall program, estimate shared contributions by partners, and show the impact of possible savings. Combined resource expenses for all members in a partnership needed to be a minimum of $1.5 million. Ideally, if an RCM was able to reduce this annual cost by 8 to 10 percent in energy and other resource reductions, the savings would cover the RCM's salary.

The second phase of the application process involved the actual grant application to Commerce. The WSU Energy Program was instrumental in assisting partnerships at this stage by providing an inter-local agreement template, answering fundamental questions about the concept of RCM, and making sure all the paperwork was properly signed and submitted. As the grant process was not competitive, each partnership applied as it was ready, but before the final deadline of March 1, 2010 (March 12, 2010 for eastern Washington counties).

Help Recruit RCM Staff

Once the grant award was in place, WSU Energy Program staff provided support for hiring the RCM by:

- Preparing a model job description, qualifications list and interview questions;
- Reviewing resumes; and
- Participating in the interview process for all of the RCMs.

WSU Energy Program staff identified the key tasks the Shared RCMs would be required to perform to identify qualifications needed by those applying for Shared RCM positions. As RCMs are sometimes misunderstood as purely technical positions, WSU Energy Program staff advised partners on the importance of including good interpersonal skills as part of the desired skill set.

RCMs were hired either as staff at the lead agency or as a contractor, as some agencies were uncomfortable with a regular hire during a difficult budget time when other staff were being laid off.

More information about the individual hiring processes is available in the supplemental partnership reports.

Key Tasks of Shared RCMs

Itemize and track resource use in all aspects of the organization

One of the first tasks of an RCM is to collect all resource use and cost data. Because individual departments often pay their utility bills separately, it can be difficult to gather utility invoices and billing information. In addition, the types of resource accounts (solid waste, electricity, etc.) are often managed in different departments or by different people.

Use and cost data is tracked in a resource accounting database. The five Shared RCMs in PSE territory used Utility Manager software. The other three used EnergyCAP. Larger utilities serving the agencies were able to provide past electricity and natural gas use and cost data and in some cases directly download data to the energy management software. PSE provides assistance for the agencies it serves by providing software, training and data download.

Resource accounting is a key ingredient of resource conservation management. With it, an RCM can analyze billing data to identify billing errors, select better rate schedules, identify inefficient facilities, locate water leaks, institute efficient operational procedures and more. Once established, resource accounting can be used to set savings goals for the organization and forecast resource budgets. Different types of cost and use graphs and reports can be produced to convey information to everyone from management to facilities staff to occupants.

Stimulate resource efficiency interest among staff and occupants

Efficiency thrives on good communication. RCMs use proven in-house communication and education strategies to heighten efficiency awareness among operations staff, management and occupants.

With changes in staff, building use, and technology, the RCM role continues to have ongoing importance. Renewal of occupant and management encouragement and training programs is crucial throughout the life of the RCM program, as is recognition for continued or maintained improvements.

Identify cost-effective no-cost, low-cost and capital projects

An RCM identifies cost-effective projects through resource tracking, facility audits and understanding a facility's operations. RCMs can also simplify budget forecasting because anticipated savings can be calculated in advance and documented during post-project operations.

Demonstrate responsible resource use to the public

The RCM documents the progress of efficiency efforts and demonstrates that the organization is carefully and successfully managing resources.

Provide Program and Technical Support and Training

Over the course of the Shared RCM Program, from before the grant application process to its end, WSU Energy Program staff members were engaged with the RCMs and their partnerships to help them make their programs successful. This involved phone consultations, conducting research, facilitating networking, convening meetings and making on-site visits.

The main areas of support are listed here.

Kick-Off Meetings

WSU Energy Program staff members conducted kick-off meetings for each partnership soon after each RCM was hired. At this meeting, program expectations and required activities were reviewed by all partners and integral staff. WSU staff presence was important to answer questions about how the program would proceed.

Resource Accounting Software Assistance

WSU Energy Program provided extensive assistance to Shared RCMs on the use of their resource accounting programs. PSE provided assistance with Utility Manager to those Shared RCMs working with a PSE RCM grant, and WSU staff learned how to use Utility Manager in order to better assist those RCMs in general. WSU staff became proficient in EnergyCAP in order to assist the three RCMs who used that program. Further discussion about use of the software programs is provided later in this report.

On-Site Visits

Once the RCM program was started, specific technical support was provided to assist each RCM, including a number of on-site visits by WSU Energy Program technical staff. These visits involved working with the RCMs to conduct and complete their building assessments and trouble-shooting with them to identify areas of concern, such as facilities that used an inordinate amount of energy without an apparent reason. Approximately 40 on-site visits were made, some with additional WSU Energy Program staff such as engineers.

During the first site visit, each RCM was provided with a tool kit containing typical measurement instruments and other tools that they might need in the field. Standard reference materials were also provided, and each RCM was trained on use of the tools, if needed. See the appendix for a list of tools provided.

The site visits enabled WSU Energy Program staff to assess the RCM's expertise and provide further assistance where needed. Potential solutions and next steps were discussed, and this was often supplemented with in-house WSU research and support.

Some site visit activities include:

- Looking at temperature controls,
- Looking at lights in unoccupied areas,
- Identifying air leaks and clogged air intake and return ducts, and

- Identifying lighting upgrade and occupancy sensor opportunities.

Listed below is a sampling of what took place during these visits:

- With thermal imaging, WSU Energy Program staff and the Spokane County RCM found hot spots underground that proved that steam lines and valves from the Court House Complex central steam plant were leaking.
- A motorized damper for the Sumner City Hall was found to be open during unoccupied hours. The RCM worked with the city to provide a time controller for the unit.
- The police department evidence area at the City of Auburn had problems with humidity. Upon inspection, WSU Energy Program staff and the RCM discovered plugged outside-air intake screens, compressors that were not working and leaking rooftop units. WSU Energy Program staff helped the RCM plan further investigations and research to solve the problem.
- Site visits at eight buildings at Fort Worden State Park focused on re-vamping control sequences for heating, mechanical systems, lighting, ventilation and air leakage.

Research Support

The bulk of the WSU Energy Program's in-house support involved answering questions posed by the Shared RCMs, troubleshooting problems and carrying out research on specific issues. The list of topics discussed via email and on the phone among the RCMs and WSU staff was extensive and the sharing of information was invaluable. Topics included computer energy management, meters and monitoring, energy use comparisons of county and city prison facilities, wireless pneumatic thermostat controls, best energy policy templates, and driving factors for getting recommended measures implemented.

The WSU Energy Library provided research on energy efficiency programs that involved behavior changes, resources for implementing water conservation measures in schools, articles on heat-loss issues and guidance on calculating savings with window film installation.

Shared RCM Networking

The WSU Energy Program provided numerous opportunities for the Shared RCMs to learn from each other. Three face-to-face meetings were held with the RCMs – one at the WSU Energy Program offices in November 2010, and two prior to the Energy/Facilities Connections conferences (hosted by the WSU Energy Program's Plant Operations Support Consortium) in May of 2011 and 2012. In addition, a phone meeting was held in March 2011 and a webinar meeting in October 2011.

At these meetings, WSU Energy Program staff and some of the RCMs gave presentations and discussed current issues of concern. For example, early meeting topics included working with multiple partners, best use of tools and an introduction to Commerce staff. At later meetings, there was time to share success stories, give program updates, and discuss how to get measures implemented into facility staff's workflow. RCMs shared insights on everything from how to write resource conservation plans to technical issues such as submetering, solid waste contracts and pneumatic controls.

A networking site was set up on SharePoint on the WSU Energy Program website for use by the Shared RCMs to post documents and links to pertinent information in a central location. Unfortunately, the website was slow and bulky to use so only a couple of RCMs used it regularly.

RCM Equipment Loan Program

The WSU Energy Program established an RCM equipment loan program for tools that might be used on a more intermittent or one-time basis by the RCMs. These tools included various types of data loggers and several infrared cameras. WSU technical staff trained the RCMs to use these tools as part of site visits. The RCMs have continued to borrow and use the tools. Guidelines for this loan program and a list of available tools are provided as an attachment to this report. When funds are available to administer it, this loan program will be continued for local government RCMs and energy managers.

Additional Resources

WSU Energy Program staff members also:

- Provide the online **RCM Exchange (RCMx)** guidebook for RCMs and others who want specific information about how to build, implement and/or sustain a successful RCM program. RCMx offers guidance, checklists, report templates, policy statements and other tools, as well as success stories and profiles of RCMs in Washington state.
- Prepare ***RCM Newsbriefs,*** a monthly email newsletter highlighting articles, information and training opportunities pertinent to the RCM field. Public-sector RCMs and staff and contractors who work in that capacity for public agencies may join the RCM electronic mailing list and subscribe to the newsletter.

PSE's RCM Program

PSE's RCM program provided invaluable insights and supplemental financial assistance for some of the partnerships. PSE's RCM program that operates in parallel with the Shared RCM program is described here. Realizing that the Shared RCM program could inspire additional participation in their RCM program, PSE provided the following:

- Helped to create new partnerships in their utility territory (four of the new partnerships and the existing Skagit program are within PSE territory),
- Committed PSE resources to augment the grant funds distributed by Commerce,
- Provided software, training and technical support, and
- Provided baseline utility data to the Shared RCMs.

Each of the Shared RCM programs in PSE service area signed agreements to participate in the PSE RCM program.

Additional details about PSE's RCM program are provided as an attachment to this report.

Department of Commerce

The Washington State Department of Commerce conducted outreach for the Shared RCM Program, as they did for all of their grant programs funded by ARRA. They accomplished this by providing information via the web and email and holding grant workshops throughout the state. The Shared RCM Program was separately promoted at these workshops with a staff presentation and conversations with interested attendees.

Specifically, Commerce:

- Provided the grant contract for $75,000 in agreement with the lead agency of each partnership,
- Established milestones for the contractual agreement so they could monitor each partnership's progress for reimbursement payments,
- Provided input about the overall design and evolution of the program as grants were awarded, and
- Provided funding and oversight of contractual obligations.

Program Implementation

The goals of an RCM Program are typically to reduce energy and other resource use, save on utility bills, and reduce the volume of greenhouse gas emissions. To achieve the goals established for this Shared RCM Program, the RCM must enter and track resource use and expense data, gather facility information such as meters and building systems, perform energy assessments of the facilities, identify conservation measures, and work to implement those measures. Conservation measures are no-cost, low-cost or capital projects. Generally, RCMs concentrate on no- and low-cost measures, although they often identify potential capital projects and may manage or assist companies who are installing large-scale projects.

Facility assessments and data reports can be used to identify the need for improvements such as retrofitting lighting systems, optimizing heating systems, changing solid waste and irrigation practices, and calculating when it is cost effective to upgrade equipment.

Implementing these measures involves creating reports and presentations to get appropriate staff and manager buy-in, working with utilities on incentive funding, working with staff to purchase and implement measures if needed, and then tracking to measure results. Many no-cost measures are implemented through behavior change, such as turning off lights and computers, and reducing use of electronics that plug into walls (plug load).

To track data, the RCMs in PSE territory used Utility Manager Pro because PSE offered the software and training as part of their RCM grant. The other RCMs used EnergyCAP software provided by the WSU Energy Program. All RCMs used Microsoft Excel® to manipulate data as necessary.

A separate data tool offered by PSE and some of the larger utilities is meter readings at 15-minute intervals. This real-time data enables the RCM to determine how much energy is used at system startup in the morning and if equipment is left on at night and weekends when not in use.

Common ways to reduce energy bills include aligning building operation with occupancy (such as not turning heat on until necessary and then only where there are occupants); reducing ventilation flows; reducing lighting levels as appropriate; and installing lighting retrofits, lighting occupancy sensors, and other building controls.

Partnership Reporting Requirements

Each partnership was obligated to meet specific milestones and submit reports as stipulated in the grant contract. Their purpose was to assure the success of the program by making sure there was forward movement and to ascertain if a partnership needed extra support from the WSU Energy Program.

These reports included:

- Facility assessments and facility action plans completed for at least each primary facility
- Resource Conservation Management Plans for each agency
- Resource use and cost data entered into a resource accounting database, including historical data going back at least two years
- Monthly summary reports of activities
- Quarterly reports to Commerce (required of all ARRA grants)

Optimizing pump motors at waste and water treatment facilities is a very important way to reduce energy use. This includes pumps that are not working well, not sized properly or need adjustment.

Technical assistance is usually needed for these assessments, although facility staff can often implement the recommendations, which may include a multi-year schedule for decommissioning and replacing motors with more efficient ones. Even though these measures may take years to show evidence of decreased energy use, the RCM's plan and projections of savings are important.

In addition to these conservation measures, it is important for RCMs to audit utility bills. The Shared RCMs in this program found billing errors, inaccurate meters and irrigation meters that needed to be de-activated during non-summer months, among others.

The eight partnerships implemented their programs in the manner best suited to their situations. This depended on how many partners they had, how many champions supported those partnerships, if they were in PSE territory, and their own experience and skills as RCMs. All of these factors affected the results of their programs. More information on the partnership programs is available in the individual partnership reports.

Measuring Results

One of the typical ways to assess progress of an RCM program is to measure data such as resource use and cost. How much electricity or water a facility uses in a given period compared to the same time period in an earlier year can indicate if a conservation measure or behavioral change is making an impact. These measurements, taken on an individual agency basis, can provide useful information.

However, measuring the Shared RCM Program success across different partners and RCMs is a challenge for a variety of reasons. Jurisdictions may use different resources or different resource accounting software, utility companies may track data differently, data may be incomplete, buildings may be remodeled or vacated, new facilities may be built, occupancy levels may change, or RCMs may use different results in reporting to their partners.

In most partnerships, the Shared RCMs identified a base year, or baseline year, that was the year before they began work as the RCM or the year prior to the PSE contract being signed, if applicable. Resource use and costs during the RCM program were compared with the base year to determine savings and/or reductions. Some RCMs use raw data to calculate savings; others use avoided cost.

How data results from the Shared RCM program are articulated in this report requires explanation. Five of the eight partnerships also had a grant agreement with PSE, which measured results using a different method. Because the PSE methodology is not comparable for all of the programs, it is not used to aggregate the data.

Estimates of Energy Use, Energy Savings and Greenhouse Gas Reductions

The table below shows two-year program data for five partnerships; Clallam County, Spokane County and the City of Vancouver partnerships did not have enough complete data to include in the table. Changes that are a negative number or percentage indicate a reduction in use.

Cost savings are not included in this table because the rapid rise in some fossil fuel rates, and differences across the partnerships' utility rates, prevent clear comparisons. The percentage of resource **cost** reduced may be higher than the percentage of resource **use** reduced.

Assumptions

- Data is stored in the WSU Energy Program Utility Manager database
    - The RCMs provided the partnership data to the WSU Energy Program
    - EnergyCAP data from Clallam County was converted to Utility Manager
- The WSU Energy Program Utility Manager database used only data from facilities that had data from all two years of the Shared RCM Program, plus the base year. For example, if natural gas use was listed for base year and year one, but not for year two, the facility data was omitted from the report.
- Total changes include reductions and increases in energy use. (PSE only counts energy use reductions for their grant.)

- Sites with highly unusual increases or decreases in energy use were omitted because these anomalies may have been for sites that were new or taken out of commission.
- Facilities such as wastewater treatment plants, well houses, and pump and lift stations that use pump motors were omitted because measures have not yet been implemented. It often takes years for these changes to demonstrate savings.
- The avoided cost approach, which PSE uses, was not used in the table below. The avoided costs measurement is a valid way to show savings, but summarizing the results across many complex sets of data would not represent an accurate result.

Explanation of Avoided Costs

The avoided cost approach is a way to project expected expenses by taking into account statistically significant annual changes due to cold or hot weather, changes in occupancy numbers, or other changes. Without these changes or conservation measures, energy use is expected to stay the same year after year (although not energy cost because of ever-increasing rates). During a colder year, for example, energy use would increase because of increased heating. A calculation can be made to project the expected rise in energy use due to the colder temperatures. If energy efficiency measures were implemented and the increase in energy use is lower than expected, the difference in the actual use vs. projected use is the amount of energy use that was avoided. This avoided amount multiplied by the current utility rate is the avoided cost.

Utility Manager has a module that can calculate avoided cost and energy use. Some of the data reported by PSE RCMs takes into account avoided costs. Yet, as mentioned above, summarizing complex sets of data – only some of which use avoided costs – would not accurately represent the results.

Results

Cumulative reductions in electricity use for all five partnerships with valid data were 8.8 percent, with over two-thirds of that reduction occurring in year two. The total kWh of electricity saved equals over 5.2 million pounds of carbon dioxide emissions that were prevented from entering the atmosphere.

While these data show reductions in electricity use for both years of the Shared RCM Program, the second year of the RCM's employment was when changes were most apparent.

Looking at just electricity data, which is the most complete, there is a substantial difference between year two changes and year one changes. As discussed further below, greater reductions in usage are expected in year three and beyond.

Estimates of Energy Use, Energy Savings and Greenhouse Gas Reductions for the Shared RCM Program Partnerships

	Bonney Lake	Bremerton	Federal Way	Jefferson	Skagit	Totals
Electricity Use (Kwh)						
Base year	10,210,490	5,605,485	8,464,605	12,594,764	5,240,449	42,115,793
Year 1	9,922,683	5,451,240	8,282,960	12,427,971	4,925,047	41,009,901
Year 2	9,695,768	5,023,059	8,018,222	11,987,477	4,790,818	39,515,344
% Change Year 1	-2.8%	-2.8%	-2.1%	-1.3%	-6.0%	-2.6%
% Change Year 2	-5.0%	-10.4%	-5.3%	-4.8%	-8.6%	-6.2%
Cumulative change	-802,529	-736,671	-628,028	-774,080	-765,033	-3,706,341
Cumulative 2-year % change	-7.9%	-13.1%	-7.4%	-6.1%	-14.6%	-8.8%
CO_2 savings (lbs)	1,127,192	1,034,691	882,097	1,087,234	1,074,527	5,205,741
Methane (lbs)	31	28	24	30	29	143
N_2O (lbs)	15	14	12	15	14	70
Fossil Fuel Use (therms)						
Base year	283,995	57,418	176,532	181,527		699,472
Year 1	273,226	59,512	159,773	204,301		696,812
Year 2	263,715	57,641	183,667	184,481		689,504
% Change Year 1	-3.8%	3.6%	-9.5%	12.5%		-0.4%
% Change Year 2	-7.1%	0.4%	4.0%	1.6%		-1.4%
Cumulative change	-31,049	2,317	-9,624	25,729		-12,627
Cumulative 2-year % change	-10.9%	4.0%	-5.5%	14.2%		-1.8%
Energy Use (Mbtu)						
Base year	62,549	24,956	46,535	61,158	17,886	213,084
Year 1	60,549	24,603	44,239	63,571	16,809	209,771
Year 2	58,838	22,917	45,724	59,380	16,351	203,210
% Change Year 1	-3.2%	-1.4%	-4.9%	3.9%	-6.0%	-1.6%
% Change Year 2	-5.9%	-8.2%	-1.7%	-2.9%	-8.6%	-4.6%
Cumulative change	-5,711	-2,392	-3,107	634	-2,611	-13,187
Cumulative 2-year % change	-9.1%	-9.6%	-6.7%	1.0%	-14.6%	-6.2%

These numbers are from the Utility Manager database, comparing the baseline year of the partnership with the following two years. Cumulative changes are the difference in use of year one compared to the baseline plus the difference in use of year two compared to the baseline.

Facilities included are the primary non-water utility sites with complete data for all three years.
Blank cells, as with Skagit fossil fuel, indicate that the WSU Energy Program did not have enough data for all three years to analyze results.

Challenges and Insights

Results and findings of the Shared RCM Program incorporate insights from WSU Energy Program staff and feedback gleaned during interviews as the Shared RCM Program ended.

- WSU Energy Program staff worked closely with the RCMs and partnerships for nearly three years and gained significant understanding of many aspects of the programs.
- WSU Energy Program staff interviewed the key contacts for many of the partnership members and the RCMs during fall 2012. Each interview focused on the expectations for the program, satisfaction with the program and plans for future efforts. There were additional insights shared during these interviews, as well as confirmation of WSU Energy Program staff insights.

Organizations decided to join a partnership for similar reasons: they were all looking for savings, wanted to be energy efficient, and knew a Shared RCM was a solid approach that fit with other organizational goals. The organizations appreciated that the RCMs:

- Provided billing analysis,
- Pursued grant opportunities and specific maintenance savings opportunities to help cut costs, and
- Helped educate staff on reducing resource use.

Challenges encountered by the Shared RCMs varied widely, from getting historical data from the utility to developing strong working relationships among the partners. Sharing an RCM was difficult for many of the smaller partners. With limited time to get to know the partners' buildings and staff, the RCM was challenged to define promising energy efficiency actions and measures.

This discussion is organized into the following sections:

- Program start-up
- Communication
- Hiring qualified RCMs
- Managing utility data
- Timeline
- Savings and reductions
- Key elements for success

Program Start-Up

Program start-up took longer than originally planned for a variety of reasons:

- During formation of the partnerships, partners needed to be educated about the Shared RCM concept before they would commit.
- Adopting the inter-local agreements took additional time due to the timing of board and council meetings and winter holiday schedules. In addition, legal departments needed time to review the agreements.

- In one case, a board unexpectedly voted to reject program adoption, which necessitated waiting until the next board meeting to get the proposal passed (which it did).
- Key staff turnover among some proposed partners caused delay.
- Lack of understanding of program requirements led to concerns regarding the preparation of facility action plans and the performance of resource accounting.

Communication

In some partnerships, RCM communication with the partners was ineffective. Some partners did not have a clear understanding of the contractual obligations or expectations of the Shared RCM Program. Partners who had a better understanding of the program had more opportunities to benefit from it. One way to remedy this may be for the RCMs to meet with each partner more often.

Good communication also means having a clear understanding of what to expect as a Shared RCM program gets underway. When the RCM is new and unfamiliar with the partners, it is especially important to set clear expectations about:

- How much time the RCM will spend with each partner,
- How much staff time is available from the partner organizations to support the RCM's efforts, and
- Realistic resource use reductions and cost savings, especially early in the program.

How the RCM communicates with facility staff, managers and building occupants is also very important, and can create difficulties if it is not done well. RCMs were short-term outsiders working within the partner organizations, which was not always the most constructive framework. Some RCMs were resented by maintenance or facility staff. In one case, the RCM created a tense divide between maintenance staff and building occupants by acting independently to address occupants' complaints about internal temperatures.

Hiring Qualified RCMs

Some partnerships had difficulty finding qualified RCM candidates. Finding a person with the right mix of experience, technical knowledge and capacity for learning about buildings and energy systems – in addition to having good interpersonal and communication skills and the ability to work in the public sector – was challenging.

Especially outside of the Puget Sound area, job announcements produced only a small number of applicants who were fully qualified to be RCMs. This presented challenges during program startup as new RCMs learned their role and established an understanding of RCM activities.

Managing Utility Data

Resource accounting is crucial to track, assess and analyze utility use and costs in buildings and identify potential savings measures. Because of the potential savings, electricity and natural gas were the

primary focus of the RCMs' resource accounting efforts. Utilities such as water and solid waste were often not entered completely – or at all – reflecting constraints on the RCMs' time.

The resource accounting tools used in the Shared RCM program were not always adequate and often fraught with challenges.

- **EnergyCAP** is a SQL-based software application with great capacity for looking at reports and data in different ways. However, it is difficult to use and requires a very long learning curve. The company offers a service to set up and maintain an agency's database, but at a price that can be prohibitive.
- **Utility Manager Pro** is Microsoft Access-based and, while it is easier to use, it has more limited functions and built-in reporting features.
- **ENERGY STAR® Portfolio Manager** is a free tool offered by the U.S. Environmental Protection Agency that tracks and assesses energy consumption. However, it is extremely limited compared to the other two programs. Portfolio Manager does not track energy costs or normalize for weather or occupancy, nor does it allow for electronic importing of billing data. For these reasons, the RCMs did not rely on it for robust resource accounting.

From a program planning perspective, the WSU Energy Program and the RCMs underestimated the time involved to collect and enter data and maintain the resource accounting system. Some partnerships were able to automatically upload data from utilities. But non-PSE utility data generally needed to be entered into the databases manually. The exception to this was Avista Utilities in the Spokane region, which directly downloaded their data into the Utility Manager database.

EnergyCAP

The WSU Energy Program purchased EnergyCAP resource accounting software for use by the three Shared RCM programs who worked in partnerships that were not served by PSE. This purchase was made through a competitive bid process, where the aim was to find accounting software that would meet RCM program needs. In-person training was also purchased, which was provided to the non-PSE RCMs at a multi-day event soon after they were hired.

Difficulties with EnergyCAP included:

- The complexity of software overwhelmed the RCMs' capability.
- The EnergyCAP trainer was not a good fit for the training event we held.
- The Shared RCM Program structure and needs were different from those of the usual EnergyCAP users, which created a challenge for adapting the training.
- WSU Energy Program staff had limited knowledge of resource accounting at the time of the training.
- The training event could have benefitted from advanced preparation – for the RCMs and the trainer.
- The WSU Energy Program did not purchase the capacity for EnergyCAP Inc. to download historical data. Without direct data download, the complex process needed for spreadsheet or manual entry

bogged down the ability of the RCMs to begin to use the data. In retrospect, it may have been more efficient to pay EnergyCAP to download historical data.

- The RCMs encountered difficulty working with EnergyCAP and the utilities to establish data download. EnergyCAP is able to upload historical data from spreadsheets given a precise format and if accounts are set up beforehand in the database. Because the utilities either could not generate spreadsheets or could not make them compatible with the formatting requirements of EnergyCAP, the RCMs spent a lot of time to make them work.

Two of the three EnergyCAP users eventually switched to Utility Manager software. The third partnership using EnergyCAP discontinued use of the program when the RCM grant ended.

Utility Manager

There were also difficulties with Utility Manager. While PSE provided the software and training for Utility Manager to the RCMs in its territory, it took much longer than expected for historical data to be uploaded, mostly due to a backlog at PSE. This, in turn, affected the RCMs' ability to produce facility action plans and identify priority areas in a timely fashion.

One of the RCMs was given the beta version of a new web-based Utility Manager, but needed to switch over to the regular software some months into the program, further delaying data entry.

Other difficulties with Utility Manager included slow response from customer support (possibly influenced by change of owners of the software company) and the inconvenience of limited report capabilities, which necessitated that the RCMs export their data to Microsoft Excel in order to create many of their reports and graphs.

Changes in the Vancouver and Spokane partnerships resulted in a switch from EnergyCAP to Utility Manager. These RCMs also had some trouble collecting data for use in Utility Manager.

Timeline

Two years was not enough time to generate and measure the program results. The first year of any RCM program involves populating the database (and, in some cases, learning how to use it); building relationships with staff, managers, the utilities and other key players; visiting and assessing the facilities; identifying measures; and recommending how to get them implemented. For a Shared RCM, working with anywhere from two to five jurisdictions amplifies the time it takes to accomplish these tasks.

Although conservation measures implemented during the first year may not show up in savings until the following year, many first-year savings come from identifying one-time savings through analyzing bills for billing errors, water leaks, sewer charges for irrigation water and inaccurate meters. In fact, some partners saw a small increase in energy use or costs during the first year. In most cases, the second year resource use dropped accordingly. Many of the partner staff who were interviewed felt that an additional year would allow them to implement more measures so increases in energy efficiency would be more apparent.

There is often a progression of activities the RCM attempts to tackle. The RCM usually first focuses on low- and no-cost measures that affect occupied facilities that are heated or cooled. Water and waste facilities are usually dealt with later, due to the added complexity and technical resources needed to fully assess these processes.

Wastewater treatment facilities, lift stations, well pump houses, and other sites with pumps and motors that move waste and liquids are even more complicated to assess, requiring more technical knowledge and equipment than an RCM usually has. In these situations, an engineer is often called in to complete the assessment. Five RCMs requested assistance from the WSU Energy Program to measure motor and pump efficiencies. WSU Energy Program engineers visited the sites, discussed pump maintenance management with the RCM and other facility staff, made measurements and wrote up findings, such as suggested motor replacement schedules.

While savings from these in-depth facility assessments may not be evident after the two years of the Shared RCM Program, the stage has been set for substantial savings if the recommendations are implemented.

Savings and Energy Use Reductions

The Shared RCM program was set up with the assumption that cost savings of 8 to 10 percent may be achievable and that amount would cover the RCM's salary, allowing the program to pay for itself. However, as indicated in the energy use and savings table, that was not the case. First-year reductions in electricity use averaged around 2.5 percent. Second-year reductions compared to the base year were more than twice as much as the first year, but still averaged reductions of 6.2 percent.

Although individual program results may be higher than summarized in the table, they do not reach the 8 to 10 percent mark, even using the PSE methodology, which tends toward higher savings numbers. It should be noted that the 8 to 10 percent figure is not based on statistical research, but rather on anecdotal evidence.

Explanations for why these savings are lower than expected are provided throughout this report. Typical start-up activities combined with inexperienced RCMs, difficulties getting the resource accounting systems up and running, changes in key partner staff, and the need to develop multiple relationships are just some of the contributing factors.

Some of this complexity does not exist for an RCM program in a single organization. Expectations for early results need to be tempered as the complexity of a shared RCM program increases.

Key Elements for Success

Key elements for success revealed themselves as the RCM program evolved. Some of these are characteristics that could be defined as organizational readiness – elements that help with RCM program start up and can sustain a program if problems arise, as described below.

- A strong policy outlining RCM goals and responsibilities and highlighting management's commitment to the RCM program.
- A firm understanding of the RCM concept and realistic expectations of how much staff time and funds the program will need. Sage advice from one of the partners: even if you know how to make a change, it's not always possible.
- A qualified person who is properly equipped to act as the RCM. In this program, three of the most effective RCMs had previous experience in the field.
- An administrator or manager who helps navigate the RCM program through policy/management channels – a "champion" for the program.
- Patience by all to allow the work to be done correctly and consistently.

The following elements were cited by program participants as features that are part of the RCM's role, but can be influenced by the existence of the elements listed above.

- Buy-in and support by facilities and maintenance staff and occupants.
- A data management system to track resource use and costs, which can be used to help set priorities and show progress when energy efficiency actions are implemented.
- A recognition program with awards for occupants and staff who help achieve RCM goals.
- Ability to communicate progress and highlight successes to organization staff and management.

Looking Ahead

While each of the partnerships described here faced unique challenges and produced different results, several common themes emerged that can be useful as other agencies consider implementing an RCM program:

- Does a shared RCM program have value?
- Can this Shared RCM Program model be replicated?
- Advice for public agencies considering an RCM program
- Advice for small local agencies that do not pursue an RCM
- How do we evaluate success?

Does a Shared RCM Program Have Value?

While the WSU Energy Program was able to collect savings data for these Shared RCM programs and observed some correlations, this small number of programs cannot be used for any type of data-driven evaluation. The complex differences among these programs should caution against drawing conclusions beyond general observations.

During interviews with project participants, WSU Energy Program staff asked if they derived value from the Shared RCM Program. Most said they gained value from the program. Some indicated that they would continue with a revised set of program parameters. In fact, one small city that was not in the Shared RCM Program has contracted for services from the RCM because of recommendations from one of the participating agencies.

At two of the partnerships, the Shared RCM is training a replacement who is already employed by one of the agencies. That person will assume RCM duties just at that one agency, and it is unclear how much of their job responsibility will be related to RCM work.

PSE's RCM program has been in place for a number of years and has data for many of the RCM programs that they have funded. Using the PSE data, it might be possible to make correlations about successful RCM activities, skills and agency support.

Can This Shared RCM Program Model be Replicated?

Participating agencies felt that the Shared RCM Program could be replicated, but they stressed that some elements of a shared program should be re-evaluated. These elements are discussed below.

Number of Partners

The programs in the Shared RCM Program ranged from two partners (Federal Way and Auburn) to five partners. RCMs in the larger partnerships reported difficulties with establishing momentum due to so many relationships to establish and maintain. Data management was also a larger and more complex task, which tested the patience of partners as they waited for the entire program to establish some momentum and realize resource use reductions and cost savings.

Looking ahead, it is helpful to acknowledge that a smaller number of participating agencies in a partnership makes it less complex, requires less juggling by the RCM, and simplifies data collection and management.

Level of Commitment by Partners

Commitment by the partners to the Shared RCM Program goals was the key to the success of each partnership. In the case of the Spokane partnership, the lead staff person at the county persisted with the program beyond the bumpy experience with their first RCM, who left the program for other work before momentum was established. This caused the program to fall many months behind the original schedule. Because of the lead staff person's commitment to the program, the partners realized the importance of hiring another RCM. With the second RCM, the partnership is seeing success.

Commitment was especially important for the lead agencies because they were responsible for administering the funding agreement with Commerce. They also acted as lead in communicating about program activities.

Training is Essential

Many RCMs are not engineers and they may not come to the job with all of the technical training they may need. The WSU Energy Program provided training in using key measurement tools and taught incoming RCMs about terms and equipment they would encounter on the job, such as pump demands and flow sensors. Several organizations offer technical training that would benefit RCMs (these are listed in the attachments).

Advice for Public Agencies Considering an RCM Program

Public agencies that are thinking about starting an RCM program (not necessarily a shared program) need to make sure they are ready and able to commit the time and resources required to ensure the program is a success.

Many of these recommendations can apply to an RCM program with a single agency or as a shared program. A shared RCM program may help small organizations that might otherwise not have staff available to work on energy efficiency projects.

Organizational Readiness

Organizational readiness means that there is top-level management and policy support for the RCM program, as well as an understanding of the RCM approach. This support needs to be conveyed to the organization so staff members who work directly with the RCM are open to that engagement.

When a public agency is preparing to start an RCM program, it is important that the managers:

- **Accept that RCM programs are a multi-year commitment – savings results may not be apparent until after the first year**. Start-up activities such as data collection take time. Staff time is needed to get the program started, and the RCM needs time to establish baselines and show resource use and

costs, which builds the foundation for proposing energy-saving activities and prioritizing those activities and investments. Patience is necessary to allow time for the RCM approach to work.

- **Establish policy commitments to saving energy, reducing greenhouse gas emissions and reducing waste.** These top-level commitments help ensure that an RCM program can achieve measureable success. They can also communicate the importance of the program to internal staff as well as policy makers and the public. Restating commitments periodically help maintain the program as well as informing new staff.
- **Understand the RCM concept thoroughly before hiring an RCM to ensure the RCM is a good fit.** This also helps staff understand what the RCM is doing and why, as well as RCM oversight if needed.
- **Commit to measure resource usage.** Decide what level of analysis is needed to track and assess impacts and provide adequate time and funds to make it happen.
- **Communicate clearly with staff, decision makers, managers, facility operators and the public.** Understand how managers and staff work and pay attention to situations that may create resentment with the RCM.
- **Understand what it takes to implement energy efficiency improvements**. Even if a project is "no cost," it will still take some funds and staff time to implement.
- **Commit to long-term assessment of maintenance and operations changes**. It has been shown that when an RCM program ends, energy use begins to increase again. With or without an RCM, be aware that diligence is necessary to maintain energy savings.
- **Build a good relationship with utility providers so you can ask them for technical help, funding assistance and data.**

Essential RCM Attributes

There is currently no certification that identifies someone as an RCM. Skills and abilities of existing RCMs vary, yet there is general consensus about key skills and topical areas of knowledge that an RCM needs to be successful.

WSU Energy Program staff members who have helped to hire and worked closely with RCMs have identified common skills, training, aptitude and experience necessary for an RCM to be successful. While success may, in part, depend on the working environment, certain characteristics are particularly useful:

- **A friendly, relationship-building attitude is a must.** The position is in some ways more of a people position than a technical position. For example, at one agency a facility manager did not want to learn anything from the RCM, so the RCM did not press him to collaborate. Over time, this manager began to trust the RCM and they developed a good working relationship.
- **Diplomacy is very important.** The RCM must be astute in navigating political situations and understanding each agency's culture. Being a good listener is key, as is being sensitive to different situations and asking the right questions.
- **Database and spreadsheet skills are a must.** Even if the data entry work is done by others, the RCM must completely understand the underlying concepts in order to select or create the reports that will convey the best information to particular audiences.

- **Ability to teach people about what they need to know to help the organization be energy efficient.** Facility maintenance staff will need different information than facility occupants.
- **Good organizational skills are important** because of the many tasks the RCM is expected to juggle, whether the RCM is shared by several agencies or is dedicated to a single entity.

These attributes can be grouped into skills an RCM should possess before beginning work in an RCM program, skills they can learn on the job, and with additional training and skills development.

Fundamental Skills Best Obtained Before Becoming an RCM

To truly be successful, an RCM must "hit the ground running" to achieve savings and reductions as soon as possible. To this end, it is crucial the RCM candidate have certain skills and abilities at the time they begin their position. These include, but are not limited to, the following.

Technical Understanding

- Understanding of electric/gas/water/sewer utility meters and billing, including demand charges and solid waste billing
- Working knowledge of Microsoft Excel, including formulas and calculations
- Mathematics and basic engineering principles
- Calculations such as return on investment
- Proficient utilization of measurement tools and equipment used to assess buildings
- Energy accounting and utility bill auditing
- Conducting a facility assessment (different than an investment-grade audit)

Building Systems

- Basic understanding of operation and maintenance of building systems
- Basic knowledge of energy efficient measures in lighting systems, HVAC other mechanical systems
- Understanding of how to measure building system components, including lighting levels, CO_2 and other factors that affect building operation

Project Management and Communication

- Skills to communicate with different agencies and people, including good listening skills
- Understanding of utility incentive programs
- Good record keeping – must manage large amount of data, information and files
- Understanding of the organizational politics, resources and interests, which inform the preparation of building action plans
- Understanding of preventive maintenance programs ("breakdown maintenance" is common, resulting in inefficiencies)
- Understanding of RCM approach and how it fits into organizations
- Ability to build relationships with key staff and stakeholders
- Comprehension of language used to describe buildings, building systems and energy efficient measures (such as "optimize controls")

Supplementary or On-the-Job Training for Agency-Specific Needs

Additional Technical Understanding

- Energy interval service
- Energy accounting software
- Additional measuring and assessing tools and equipment
- Other resource topics, such as water efficiency, solid waste/recycling

Additional Building Systems

- Understanding of digital controls, such as EMS and BAS
- Deeper understanding of energy efficient systems, including lighting

Additional Project Management and Communication

- Understanding of how a specific type of agency works to get things done (learning the bureaucracy)
- Understanding of the roles of key players – ESCOs, contractors, utilities, operations and maintenance, and vendors
- Presentation skills
- Knowledge of how to disseminate information in different ways to different people, and in the simplest, most effective way

Further Thoughts on Training and Skills Development

These additional thoughts were offered by the Shared RCMs and reflect insights gleaned by WSU Energy Program RCM staff.

- Not all facility managers and staff have adequate, current training for the systems they are operating and maintaining. This can influence the potential impact of an RCM program.
- More training is needed for internal facility staff on new technologies. Training for new staff is also needed.
- Some vendor-provided training (for example, for EMS/BAS controls) is not adequate for the operators. As a result, systems are sometimes operated manually, which does not take advantage of the technology.
- Demand charges may increase if electrical technicians do not understand billing and demand charges.
- It has been suggested that RCM guidance documents and resources need to be clearer and better organized. The amount of overlapping resource documents can be confusing.
- Peer networking is useful, especially within similar agency types, such as a network of RCMs who work in government agencies.

Training Opportunities

WSU Energy Program staff reviewed currently available training opportunities in Washington state and the Northwest. A list of organizations and schools that provide training opportunities is provided in the attachments.

Advice for Small Local Agencies that Do Not Pursue an RCM

Small agencies that do not hire an RCM can still benefit from many facets of the RCM approach described in this report.

Resource Accounting

Measuring how resources are used and how much they cost is essential to establish a baseline against which future progress can be measured. These measurements alone can inspire action. Without measurement, there is no assurance that additional efforts are worthwhile.

ENERGY STAR Portfolio Manager benchmarking would be useful at a minimum, although this does not have the same level of detail and reporting capabilities as EnergyCAP or Utility Manager.

Staff Engagement

Staff in almost any assignment area can influence reduction of waste and achievement of savings. But to do so, they need to understand the goals and methods the agency is undertaking to meet those goals. To increase staff knowledge of energy and resource efficiency, the agency can support training programs, attendance at conferences, newsletters and staff participation in networking groups.

RCMs commonly say that they facilitate changes; they do not actually accomplish them on their own. RCMs provide a focused collection of data, information, experience and ideas for the organization, but it is the individual staff members who work in these facilities and who learn low- and no-cost techniques to achieve savings who actually facilitate change.

How Do We Evaluate Success?

Determining if an RCM program is successful poses interesting questions. Do we base success on resource usage and cost data alone? Can a program be successful without favorable numbers? Does culture change within a jurisdiction count as success?

WSU Energy Program staff identified additional overall ARRA program success measures as:

- How many programs continued past the grant's end,
- How many RCMs were employed in some capacity at the grant's end, and
- If the RCMs were still working as RCMs.

One of the goals of the ARRA grants was to increase employment. At the close of the local partnerships' grant on June 30, 2012, all but one RCM was still employed, most with the original slate of partners. This is perhaps partially attributed to PSE contracts with the partnerships that extended past the Commerce

dates. Six months later, at the end of 2012, five of the eight RCMs were still employed. While at least three of these will not be working at the partnership past 2013, two are training staff to continue with part of the RCM responsibilities.

WSU Energy Program staff members have heard that some of the RCMs plan to market RCM services to interested agencies after their employment ends. Data tracking, facility assessments, identifying energy efficient measures, ESCO management and report writing are just some of the skills that the RCMs can offer in varying degrees. Perhaps this can be referred to as "RCM Lite."

Each of the Shared RCM partnerships created something positive during this program. Resource use and associated costs decreased overall in most of the partnerships. Most partners describe a shift in how staff and management view energy use and an increase in resource use awareness among their staff. Perhaps visits to these partners in a few years can provide more insight about how we define the success of an RCM program, such as cultivating new skills for the RCMs, reducing energy use, having written documents that spell out how to achieve resource use reductions in the future, and initiating a culture change in the day-to-day use of energy and resources.

Attachments

Training Opportunities for RCMs

RCM Basic Toolkit Provided by the WSU Energy Program

RCM Equipment Loan Program Guidelines

Puget Sound Energy's RCM Program

RCM: A Tool for Public Facilities

Shared RCM Factsheet

Shared RCM Profiles

Ron Major

Deke Jones

Brian Goldstein

Katherine Morgan

Newspaper Articles

Good Ventilation is Essential for a Healthy and Efficient Building

Measuring Carbon Dioxide Inside Buildings – Why is it Important?

Training Opportunities for RCMs

WSU Energy Program staff reviewed currently available training in Washington state and the Northwest. A useful resource for training by The Pacific Northwest Center of Excellence for Clean Energy includes a "smart grid career lattice" for energy jobs, including resource conservation managers. Further information about career path, training, educational programs and types of employers may be found at http://cleanenergyexcellence.org/careers/ResourceConservationManager/.

Organizations

Building Operator Certification (BOC) Program, Northwest Energy Efficiency Council

BOC offers Level I and Level II (advanced) series of courses. The Level I classes are especially applicable for RCMs.

Level I Classes:

- Building Systems Overview
- Facility Electrical Systems
- Energy Conservation Techniques
- HVAC Systems and Controls
- Efficient Lighting Fundamentals
- O&M Practices for Sustainable Buildings
- Indoor Environmental Quality

Level II Classes:

- Preventive Maintenance & Troubleshooting Principles
- Advanced Electrical Diagnostics
- HVAC Troubleshooting & Maintenance
- HVAC Controls & Optimization
- Motors in Facilities
- Water Efficiency for Building Operators

Northwest Energy Efficiency Alliance (NEEA)

Through BetterBricks (http://www.betterbricks.com/events), NEEA lists classes and trainings.

Puget Sound Energy (PSE)

Workshops for RCMs within PSE territory include how to use Energy Interval Service, various aspects of Utility Manager energy accounting software, etc.

Seattle Design Lab

Provides classes and information on energy efficient lighting: http://lightingdesignlab.com/.

AEE

The Association of Energy Engineers offers on line courses and a Certified Energy Manager (CEM) certification that is a useful way to show energy efficiency knowledge for RCMs.

http://www.aeecenter.org/i4a/pages/index.cfm?pageid=1

Washington State Community and Technical Colleges

The WSU Energy Program conducted a review of programs and classes focused on energy, sustainability, technical skills training and energy management. Seventeen of the 34 Washington state community and technical colleges offer energy programs and/or classes (http://www.sbctc.ctc.edu/general/c_index.aspx).

Courses and programs at colleges may change every quarter, semester or year. Colleges that have programs or classes that appear to provide some of the critical elements needed to become an RCM, or related courses, are listed here:

Bates Technical College, Tacoma
Bellevue CC
Bellingham
Big Bend CC
Cascadia CC
Centralia College
Clark College
Columbia Basin College
Edmonds CC
Grays Harbor College
Lake Washington Technical College
Olympic College
Peninsula College
Seattle Central CC
Shoreline CC
South Seattle CC
Spokane CC
Walla Walla CC
Wenatchee Valley College
Whatcom CC

Bates Technical College, Tacoma

Related courses, not primary for RCM:

- HVAC Technician
- Facilities Maintenance Engineer
  (Course focus is building custodial and maintenance industry)

Bellevue CC

Survey of Energy Systems Management

Bellingham Technical College

Related courses, not primary for RCM:

- Associate in Applied Science (AAS) – Heating, Ventilation, Air Conditioning & Refrigeration

Big Bend CC

Related courses, not primary for RCM:

- Industrial Electrical Technology

Cascadia Community College

Associate in Applied Science (AAS) degree in environmental technologies and sustainable practices - business emphasis.

> Technical degree that covers both the practical and scientific basis for measuring, monitoring, and recommending actions to reduce and innovative energy use and applications in commercial settings

Energy Management Specialist Certificate

> Focus on energy management, with an emphasis on employment in careers including energy auditor, energy analyst, building technician, resource conservation manager, efficiency manager, measurement and verification technician, and system technician. Energy management specialists emphasize energy conservation and efficiency while working in the evaluation, planning, design, installation, and maintenance of a wide range of energy-related systems and processes in new and existing commercial and residential buildings.

Energy Audit Specialist Certificate

> Prepares students for entry-level employment in the area of energy auditing. Students completing this certificate will be qualified to conduct energy audits in residences, multi-family housing, and commercial settings.

Centralia College

Related courses, not primary for RCM:

- Pacific Northwest Center of Excellence for Clean Energy
- Energy Industry Fundamentals Curriculum Modules

Clark College

Related courses, not primary for RCM:

- Power Utilities Technology Certificate of Proficiency

Columbia Basin College

Related courses, not primary for RCM:

- Associate in Applied Science (AAS) Nuclear Technology Instrumentation and Control
- Solar /Photovoltaic Design Certificate

Edmonds Community College

Degrees and Certificates

- Building Operations
- Commercial Lighting Auditor
- Construction Industry Training
- Energy Accounts Specialist
- Energy Efficiency Technician
- Energy Management Degree
- Residential Energy Auditor
- Sustainability

Grays Harbor College

Related courses, not primary for RCM:

- Associate in Applied Science (AAS) Energy Technology Power Operations

Lake Washington Technical College

Related courses, not primary for RCM:

- Associate in Applied Science (AAS) Energy and Science Technology
- Bio Energy Certificate
- Energy Technology Certificate

Olympic College

National Sustainable Building Advisor Certificate (see Whatcom CC)

Peninsula College

Related courses, not primary for RCM:

- Associate in Applied Science (AAS) Energy Technology Power Operations (via Centralia College)

Seattle Community Colleges

Certificates are available at the Seattle Central, North Seattle, and South Seattle campuses

- Commercial Building Performance Certificate
- Multifamily Energy Auditing Certificate
- National Sustainable Building Advisor Certificate (also at Community Colleges of Spokane)
- Residential Energy Auditing

The South Seattle Community College Georgetown Campus offers a green jobs training. Non-certificate energy-related classes are offered at various campus locations:

- Energy Management
- PSE: Building Control
- PSE: Project Scheduling
- Intro to Building Simulation
- Intro to Energy Codes
- Basic Weatherization Tech
- Residential Energy Audit
- Energy & Resources – Now & Future
- Energy Efficient Design

Shoreline College

Energy Audit 2: Commercial Short-Term Certificate

Courses for additional training:

- Associate in Applied Science (AAS) Clean Energy Technology
- Zero Energy Building Practices Certificate
- Solar Photovoltaic Designer Short term Certificate
- Zero Energy Building Practices Short Term Certificate
- Energy Audit 1: Residential Short Term Certificate

Spokane Community College

Related courses, not primary for RCM:

- Associate in Applied Science (AAS) HVAC and Electrical
- Associate in Applied Science (AAS) Electrical Maintenance and Automation
- Residential Energy Auditor Certificate

Community Colleges of Spokane Institute for Extended Learning

- National Sustainable Building Advisor Certificate (see Whatcom CC)

Walla Walla Community College

Related courses, not primary for RCM:

- Energy Systems Technology – Electrical
- Energy Systems Heating, Ventilation, Air Conditioning, and Refrigeration
- Energy Systems Technology – Wind Energy

Wenatchee Valley College

Related courses, not primary for RCM:

- ATS Environmental Systems and Refrigeration Technology

Whatcom Community College

The National Sustainable Building Advisor Certificate program teaches students to:

- Analyze the costs and benefits of incorporating sustainable building measure
- Take advantage of financial incentives and technical assistance offered by governments, utilities and non-profit organizations
- Work with architects, designers, builders, building operators and utilities to improve a building's performance
- Establish a sustainable design goal for project development
- Assist in the education and training of staff in sustainable building
- Identify and discuss the key practices of sustainable building
- Establish competencies in applying LEED™, Built Green™ and other relevant criteria or established guidelines

Northwest Energy Education Institute (NEEI) at Lane Community College, Eugene, Oregon

This out-of-state community college has long been a leader in energy efficiency education, and may be the first to have an RCM program. It deserves mention given the regional scope of the Institute and the range of the energy education offerings.

In the first year of the two-year RCM Program – Energy Programs/Science Division, RCM classes are shared with the core energy management courses:

- Materials Management / Solid Waste Management
- Understanding the LEED Framework and Green Buildings
- Carbon Footprints for Climate Action in Complex Organizations (GHG/Carbon Footprint)
- Conducting a Full Sustainability Assessment
- Fostering Sustainable Practices

RCM Basic Toolkit Provided by the WSU Energy Program

Digital Camera

3x optical zoon and USB cable, 4 GB memory card, mini tripod and carrying case

Infrared Thermometer

Wide Range mini infrared 12:1 thermometer with laser pointer

Digital Ballast Identifier Meter

Electronic vs. Magnetic Ballast Checker

Temperature and Relative Humidity

Digital Sling Psychrometer

Lighting

Digital Pocket Foot Candle Light Meter

Chemical Tracer Smoke

Smoke Puffer kit with 2 vials of replacement "smoke"

Plug Load Meter

Kill-A-Watt EZ Power Meter

Comfort and Ventilation

Carbon dioxide meter and data logger (e.g. HOBO Temp/RH/2x External)
Includes CO_2 monitor adapter cable and datalogger software

Basic and Hand Tools

LED Flashlight (2)
Multi-tool (aka Leatherman)
Multi-bit ratchet and screwdriver set
Vise grips/pliers
Adjustable wrench
Clipboard
16-foot tape measure

RCM Equipment Loan Program Guidelines

Shared RCM Program Use of Equipment

1. Staff will label and number equipment upon its arrival
2. Equipment will be stored in secure location at the WSU Energy Program Olympia office.
3. Equipment list will be recorded in an Excel spreadsheet, including serial numbers.
4. Equipment list and equipment status (available or on loan) will be entered into the Shared RCM SharePoint website. The Shared RCM SharePoint website is exclusively for the eight Shared RCMs and WSU Energy Program RCM staff to share information and network through April 30, 2012.

   Detailed documentation on use and maintenance of each piece of equipment will be provided on the Shared RCM SharePoint website, available to the borrower.

5. To request an equipment loan, Shared RCM will request a reservation on the SharePoint equipment calendar, and send a pre-formatted email request to WSU RCM staff.
6. WSU Energy Program staff will ship or hand-deliver equipment, depending on location, to Shared RCM.
7. Shared RCM will send a pre-formatted "equipment received" email, noting agreement to stated terms and conditions of loan.

   Terms and conditions will include clause to ensure that the RCM knows how to use borrowed equipment.

8. WSU staff will record as "on loan" in SharePoint.
9. To return equipment, Shared RCM will email WSU staff their intent to return, and the proposed method and date of return.
10. Depending upon Shared RCM location, equipment may be transferred directly to another Shared RCM without first returning to WSU.
11. Upon receipt of the equipment the Shared RCM will report condition and function of equipment.
12. Direct loans from one Shared RCM to another will be documented and SharePoint updated.
13. Upon receipt of returned equipment, WSU Energy Program RCM staff will:
    - Change status of equipment in SharePoint to "available," list date returned, etc.
    - Inspect equipment for wear and tear, calibration and general working condition
    - Calibrate and/or repair equipment if necessary
    - Return equipment to storage

Shared RCM Loaner Equipment and Instruments

Thermal Imagers (3)
Power dataloggers w/ various current transformers (5)
Flow meters with software and data cables (2)
Vane anemometers (2)
Data loggers:

- Motor on/off (16)
- Light on/off (14)
- Temperature/relative humidity/external channels (16)
- Four-channel indoor/external (8)
- Humidity, temperature, airflow and light meter sensors (3)

Equipment Loan Program Post-Shared RCM Program

The WSU Energy Program is exploring the possibility of using the WSU Energy Library for the equipment loan program after the Shared RCM Program ends. A similar method as above would be used to track equipment. Equipment would be housed on WSU Energy Program premises. Equipment could be loaned to other WSU programs, state and local public agencies, and non-profits for public-sector use only. Information on the person and agency requesting the loan, loan requests, receipt of equipment and equipment returns would be tracked using a similar approach.

Puget Sound Energy's RCM Program

Menu of services

Puget Sound Energy's Resource Conservation Manager program is comprised of a menu of service features which can be negotiated to meet the specific needs of your organization. Typical services include:

- Assisting in the design and implementation of your RCM program
- Assisting in the hiring or contracting a Resource Conservation Manager
- Providing assistance in developing baselines, resource policy and facility plans
- Assisting in analyzing and reporting savings relative to an established baseline
- Providing training for Resource Manager and other facility personnel such as custodians and maintenance staff
- Providing educational materials for classroom or building occupant use
- Providing electronic PSE billing data for import into resource accounting software
- Providing cash incentive programs for specific actions by occupants and staff in individual facilities that reduce energy consumption
- Providing metering solutions for viewing of facility natural gas and electric meter data

Incentives

Initial cash incentive

For qualifying organizations, Puget Sound Energy will pay a cash incentive determined as a percentage of the typical RCM salary to help get program started with initial set-up of utility database and program organization. Typically, PSE will fund 25 percent of the first year salary.

Salary guarantee

PSE will provide a salary guarantee that the customers' total resource bill savings achieved by RCM activities relating to occupant and behavioral practices and improvements in operational and maintenance (O&M) practices exceed the salary of the RCM. If not, the difference will be paid to the customer up to the value of the natural gas and electrical savings achieved, as determined by weather corrected reduction of the customer's utility bills or by single measure calculations agreed to by PSE. (Requires full-time RCM position.)

Resource accounting software

PSE will assist in selection, purchase and set-up of resource accounting system software and support maintenance fees.

Energy Efficiency FACTSHEET

RCM: A Tool for Public Facilities

So many utility customers – school districts, local governments, universities, and others – have been unable to implement even simple energy efficiency improvements with short paybacks. The reason is often a lack of qualified staff. Few have the time and expertise to systematically investigate and capitalize on energy efficiency opportunities. Many organizations feel unable to justify the expense of hiring someone to accomplish this, especially in tough economic times.

A resource conservation manager (RCM) is one potential solution. This person helps a facility reduce operating costs, increase efficiency and promote environmentally friendly operations.

A RCM program is a coordinated effort to manage the resources and services used – and waste generated – by the facility. It involves careful tracking of resources and attention to operational efficiency. The program focuses on occupant comfort, cost-effectiveness and assuring that equipment is used only when needed. Operational savings are gained through organization, analysis and communication.

A facility can expect to see quantifiable results within the first six months once a comprehensive RCM program is in place. Most RCM programs achieve eight to 10 percent savings on utility bills after the first year, depending on the number of facilities involved and level of management commitment. In a good application, the energy savings more than cover the salary of the RCM.

Even as public-sector budgets shrink, RCM programs are cropping up in organizations, both large and small, particularly in school districts and local governments. Many of these new RCM programs are supported by utility incentive assistance to cover the start-up costs.

RCM Activities

Among the activities of a RCM are the following key tasks:

Itemize and track resource use in all aspects of the organization

Using resource accounting software, a RCM can analyze billing data to identify billing errors, select better rate schedules, track down inefficient equipment, locate hidden water leaks, institute efficient operational procedures, and more. Once established, resource accounting can be used to set savings goals for the organization and forecast resource budgets.

> *"In a good application, the energy savings more than cover the salary of the RCM."*

Useful accounting tools include **Utility Manager** from LPB Energy Management (*www.lpbenergy.com*) and **EnergyCAP** (*www.energycap.com*). EPA's **Energy Star Portfolio** is not as in-depth as the others but can also be useful. A directory of building energy software tools can be found at *www.eere.energy.gov/buildings/tools_directory*.

Stimulate resource efficiency interest among staff and occupants

Efficiency thrives on good communication. RCMs use proven in-house communication and

education strategies to heighten efficiency awareness among operations staff, management and occupants.

Identify cost-effective and efficient capital projects

A RCM can help to identify cost-effective capital projects through resource tracking, facility audits and by gaining a good understanding of each facility's operations. RCMs can also simplify budget forecasting because anticipated savings can be calculated in advance and documented during post-project operations.

Demonstrate responsible resource use to the public

When budgets get tight, the RCM can document the progress of efficiency efforts and demonstrate that the organization is carefully and successfully managing resources.

Leverage programmatic and financial resources

Utilities, local governments, state government and federal agencies all have tools and services (and, in some cases, funding) that can be used in RCM program efforts.

Key Elements for Success

Some key elements for success have revealed themselves as RCM programs have evolved. The applicability of these elements varies according to the need and culture of the particular organization:

- Strong policy outlining RCM goals and responsibilities and highlighting management commitment
- A qualified person, properly equipped to act as the Resource Conservation Manager
- An administrator or manager who helps navigate the RCM program through policy/management channels – a "champion" for the program
- Buy-in and support by facilities and maintenance staff and occupants
- A recognition program with awards for occupants and staff who contribute the most
- Patience by all to allow the work to be done correctly and consistently

A sample of equipment used by RCMs to measure and track facility resources.

What to Expect

A full-time RCM will stay very busy for two years in an organization that has been spending at least one million dollars per year on utility costs. That level of involvement may decline naturally after the resource accounting system is fully operational, facility audits and reports are completed and facility operating guidelines are instituted. Capital efficiency projects could be scheduled beyond the two-year period.

In approximately three years, the RCM's workload may evolve to include helping with plans for new facilities and making plans for more capital intensive projects. Ongoing work will consist of data entry and analysis, periodic routine reports, facility surveys, and training/education refreshers.

With changes in staff, building use, and technology, the RCM role continues to have ongoing importance. Renewal of occupant and management encouragement and training programs is crucial throughout the life of the RCM program, as is recognition for continued or maintained improvements.

The annual salary of a full-time RCM can range from $50,000-$100,000, depending on experience and qualifications. Experience shows that after the first year, the salary can be paid for by utility savings. By the end of the second year, savings will likely surpass the cost of the RCM program. After that, some level of involvement is needed to maintain savings and continue to free the organization's budget of avoidable resource expenditures.

Additional costs include:

- Resource accounting software – $500-$10,000 *(depending on the organization's size and complexity)*
- Computer and printer – $2,000
- Light meter and miscellaneous tools – $500
- Incentives and recognition
- Staff training

A Role for Utilities

Utilities seeking to stimulate energy savings among their customers would do well to consider promoting (and financially supporting) the formation of RCM programs. Focus on the larger school districts, local governments, colleges, universities, and other utility customers with enough buildings and energy use to make the investment worthwhile. Once kick-started, the program will hopefully operate for years and deliver an excellent return on investment.

Additional Information

For additional information on getting a successful RCM program started that will generate energy savings for years, visit the WSU Extension Energy Program RCM website: *www.energy.wsu.edu/apps/Projects/ResourceConservationManagement.aspx*.

Check out other resources on energy efficiency and best practices at *www.EnergyExperts.org*.

WSUEEP10-024 Rev. 1 2010 • August 2010

WASHINGTON STATE UNIVERSITY
EXTENSION ENERGY PROGRAM
www.energy.wsu.edu

Resource Conservation Manager Program: Shared RCMs Showcase Savings in Washington State

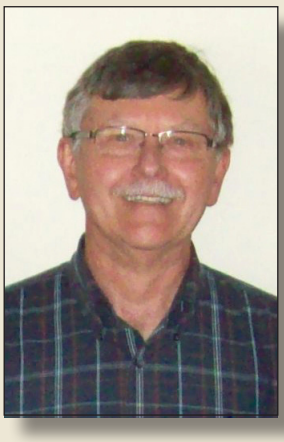
Shared RCM Program

The Shared RCM Program developed by the Washington State University (WSU) Extension Energy Program in cooperation with the Washington State Department of Commerce was started to help public facilities reduce energy and resource use, save money, and establish strategies to enhance energy efficiency in the long-term.

Many local governments would like to have a resource conservation management program but may not feel that they can support a Resource Conservation Manager (RCM) position. The Shared RCM Program was developed to address this need.

With funds from the American Recovery and Reinvestment Act, this program helped create Shared RCM positions in seven locales across Washington. An existing program in Skagit County, which has also received assistance from the Shared RCM Program, is helping the other locales with the benefit of their experience.

The 39 public agencies in these locales – including cities, counties, public school districts, and ports – teamed up to address their mutual commitment to save energy and resources.



Equipped with energy usage interval data recorded at the Burlington Public Library, Ric Boge – Shared RCM for nine agencies in Skagit County – spotted a spike in energy use that occurred at 4 a.m. every day. This spike caused high demand charges, which are expensive.

When the facility manager scaled back early morning startup of the library's heating and cooling systems, demand charges dropped, usage dropped and the library saved about $2,300 in one year.

Shared RCMs are solving problems, saving money and freeing up staff time

Washington State's Shared RCMs have been busy assessing, tracking and analyzing the resources used in facilities that are owned and operated by these public agencies. The program is still young, but the Shared RCMs have already helped the agencies in these partnerships reduce energy and water use, solid waste expenses, waste and pollution.

These measures save money and free up time so facilities' staff can focus on preventive maintenance and other tasks that keep the facilities safe and comfortable.

Shared RCMs are always looking for ways to:

- ***Reduce energy, water and waste disposal costs***
  Low-cost projects and operational changes can reduce resource costs by 10 percent or more. Some of the funds that once went to pay for energy, garbage disposal, water and sewer can be redirected to deferred maintenance programs, capital projects, the RCM's salary and other needs.

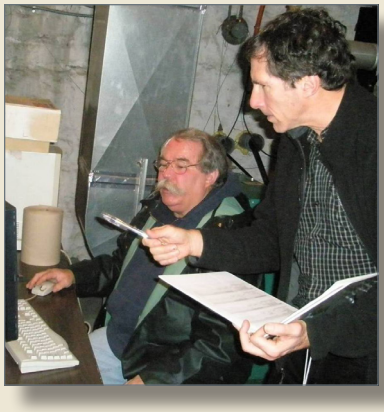
- ***Itemize and track resource use in all areas of an organization***
  Using resource accounting software, Shared RCMs analyze billing data to identify billing errors, select better rate schedules, track down inefficient equipment, locate hidden water leaks, and institute efficient operational procedures.

- ***Stimulate interest in resource conservation among facility staff and occupants***
  Efficiency thrives on good communication. Shared RCMs work to heighten resource conservation awareness among operations staff, management and occupants of a facility. This often includes promoting policies about resource use, developing recognition programs that encourage resource-saving actions and supporting teams that help implement the conservation plan.

- ***Identify capital projects that will help save even more***
  Shared RCMs identify cost-effective capital projects through resource tracking, facility audits and a good understanding of each facility's operations. By calculating anticipated savings in advance of these improvements, Shared RCMs can also help simplify budget forecasting.

- ***Demonstrate responsible resource use***
  As budgets get tighter, Shared RCMs have a crucial role in showing stakeholders that they are getting a great return on their investment. By documenting the progress of efficiency efforts, Shared RCMs demonstrate that an organization is carefully – and successfully – managing public resources.

- ***Create, update and implement resource conservation plans***
  The resource conservation plans developed by Shared RCMs are living documents that are reviewed and adjusted regularly so that they closely match real conditions. Cultivating relationships with facility operators and maintenance staff is crucial; a resource conservation plan will not work without the support and expertise of these staff.



Brian Goldstein (on right) working with Russ Hendricks, facilities manager at Fort Worden State Park.

Brian Goldstein, Shared RCM for five agencies in Jefferson County, used data loggers to measure the temperature in rental houses at Fort Worden. The furnaces were turned on at midnight so the houses would be warm by the 3 p.m. check-in time. Using the data loggers, Brian found that it took only 8 hours – not 15 hours – to warm the houses.

By starting the furnaces at 6 a.m. instead of midnight, staff found that they could dramatically reduce energy use without compromising the comfort of the occupants.

Shared RCMs also:

- Keep managers in each of the partnerships' agencies informed,

- Provide staff training so everybody knows how their actions affect resource conservation, and

- Make sure each facility is poised to take advantage of the tools, services and funding available to support resource conservation.

Shared RCMs rely on support from managers

A resource conservation program will succeed only if agency managers support it. By backing a strong policy that outlines program goals and highlights management's commitment, managers shepherd RCM efforts through administrative channels. When staff sees management's support of the program, they know that resource conservation is an integral part of their daily operations.

Sustained effort is necessary to maintain and grow savings

Washington's Shared RCMs are already reporting savings after only about a year on the job. Shared RCMs pick the low-hanging fruit first then look for more ways to conserve resources and sustain the savings that have already been achieved. The Shared RCM's role continues to evolve as new staff is hired, building uses change and technology improves.

To maintain a resource conservation program, Shared RCMs must continue to:

- Monitor resource conservation program components to make sure facilities are operating as efficiently and cost-effectively as possible.
- Look for opportunities to replace inefficient equipment so savings continue to grow. Rebates and incentives are available, but someone needs to keep these opportunities in focus so public agencies can benefit from them.
- Promote the program and renew encouragement and training programs so that everyone is on board to help meet resource conservation goals.

Without this minimum level of effort, the efficiencies gained by the Shared RCM Program could easily be lost as staff reverts to the old way of doing things, energy use goes back up, and resource conservation drops from view.

During a walkthrough of a 1980s-era elementary school in Bonney Lake, Jay Donnaway – Shared RCM for four agencies in Pierce County – heard the urinals flushing as he approached the restrooms even though nobody was using the facilities. When the school was built, the urinals were programmed to flush automatically every few minutes all day, all night, all year!

To remedy this, Jay worked with school staff to program the flushing mechanism so it is in sync with the school schedule and does not keep flushing when the building is unoccupied.

Jay calculated that the urinals were flushing unnecessarily for 5,610 hours per year, wasting 201,960 gallons of water per year and incurring costly sewer charges. In addition to eliminating unnecessary wear on the equipment, the school district now has an extra $1,162 per year to spend on more important things.

For more information

For more information about the Shared RCM Program, see the WSU Extension Energy Program's RCM Network website: *http://www.energy.wsu.edu/PublicFacilitiesSupport/ResourceConservation.aspx* or contact Karen Messmer, *messmerk@energy.wsu.edu*, at (360) 956-2000.

Acknowledgement:
This project is funded in whole or in part by funds made available through the American Recovery and Reinvestment Act (ARRA). This funding was awarded by the U.S. Department of Energy through the Energy Policy Division of the Washington State Department of Commerce under Energy Efficiency and Conservation Block Grant No. DE-EE0000849.

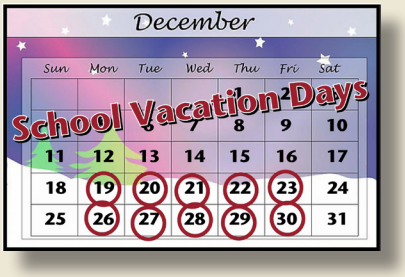
Our Mission

To advance environmental and economic well-being by providing unmatched energy services, products, education and information based on world-class research.

Overview

Our staff of approximately 100 people (energy engineers, energy specialists, technical experts, software developers, energy research librarians and more) works out of our Olympia, Spokane and other satellite offices. Operating similar to a consulting firm, the WSU Extension Energy Program is a self-supported department within the University.

Our customers include large and small businesses, public and private utilities, local and state governments, tribes, federal agencies and facilities, manufacturing plants, professional and trade associations, schools, universities, national laboratories, and consumers. For more information, visit our website at www.energy.wsu.edu.



Brian Goldstein, Shared RCM for five agencies in Jefferson County, learned that the Chimacum School District's computer-based control system was normally managed by a contractor, who had not entered the holiday schedules in the system.

Using Energy Interval Service (provided by Puget Sound Energy), Brian noticed that the contractor did not reduce the heating at the middle school and high school over winter break, so he recommended that the contractor train the operations staff on how to enter holidays into the control system. Now the staff has added holidays to the schedule, beginning with spring break in March 2011.

The impact was immediate. By adjusting the building heating schedules, the school district saved 4,200 kWh per day – or $400 per day – totaling $2,000 saved during spring break week!

Now that the operations staff is adjusting the heating schedule for all of the school-year vacations, Brian estimates that the school district will save $9,600 per year.

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Resource Conservation Manager Ron Major: Raising the Bar for Washington State

By Melinda Thiessen Spencer, WSU Extension Energy Program

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Our customers include large and small businesses, public and private utilities, local and state governments, tribes, federal agencies and facilities, manufacturing plants, professional and trade associations, schools, universities, national laboratories, and consumers. For more information, visit our website at www.energy.wsu.edu.

Tasks don't come much taller than this: come up with fresh ideas to save resources for the agency responsible for the smooth operation of scores of buildings that house thousands of people who get things done for the state. But this is the task that Ron Major, the Resource Conservation Manager (RCM) at the Washington State Department of General Administration (GA), tackles every day.

As the central support agency for Washington's state government, GA serves state agencies, city and county governments, school districts, colleges and universities, and not-for-profit organizations in addition to managing the Capitol Campus and other state-owned buildings throughout the state. As GA's RCM, Ron is quick to point out that he is part of a team composed of executive and administrative staffs, fiscal managers, policy makers and on-site technical and custodial staffs who are instrumental in changing how the work of the state gets done. Here he gives us a snapshot of the methods he's employing to save money, staff time and environmental resources at GA-managed facilities.

Ron Major measures the light levels in a GA office area.

> **It's impossible to do resource conservation management without the support of HVAC and control technicians and custodial staff. They are eager and have good ideas.**
>
> Ron Major

Upgrading utility metering

Resource conservation management is about more than energy use, but that is a big component. "We can't manage what we don't measure," Ron says when discussing one of his primary responsibilities – itemizing and tracking energy use in GA-managed facilities. This was a big challenge when he started out. "There was one meter for natural gas at the central steam plant and one for electricity for the entire Capitol Campus," Ron tells us. "Without sub-metering, we couldn't determine how much energy an individual building was using or if operational changes were effective."

Utility costs were invisible to tenants because utility bills were rolled into lease payments. And because the tenants were not aware of the resources they were using, they likely used more than necessary.

Ron worked with the facilities staff to equip all buildings with sub-meters for steam, electricity and chilled water. While the sub-metering did not provide direct savings, the information that is now available from the separate meters has helped create awareness about energy efficiency among each building's staff.

By decoupling utilities from leases, the actual resource use was clear. Ron hopes that all stakeholders will share the incentive to reduce consumption. "This takes lots of dedication, focus and time," he adds. "We're not quite there yet, but we expect this move to make a difference."

These separate bills also support Ron's case when he has to approach a utility about a billing error. "The best example of this is a refund the state got from Puget Sound Energy (PSE) due to a metering issue at the substation," Ron notes, adding that PSE was very helpful in this process. "Between their data and ours, we were able to come to a resolution that returned $400,000 to the state."

Developing an in-house building tune-up program

Other early steps in the process of making the buildings that GA manages more energy efficient included programing the building control systems (BCSs) so they provide conditioned air only when people are in a building and adjusting lighting schedules so lights go off when people go home.

When instituting changes that everyone can buy into and that really pay off, Ron takes a team approach. "We assembled a team to perform functional testing of the heating, ventilating and air conditioning (HVAC) equipment and the BCS at the Natural Resources Building," Ron says, following an approach to improve building efficiency developed by the Pacific Northwest National Laboratory.

When GA's team found that some equipment wasn't functioning optimally, they made no-cost or low-cost adjustments that have led to improved comfort, better air quality and enhanced energy efficiency in many GA-managed buildings. The payoff? Adjusting the mechanical systems at the Natural Resources Building alone is saving $30,000 per year in utility costs.

Similar measures are now used by staff who work to optimize the efficiency of the mechanical systems in other GA-managed buildings.

Savings resulting from GA's RCM Program

"These and other measures have saved the taxpayers of Washington $1.9 million since 2006. If not for this focus on resource conservation management, most of these changes and savings would not have happened." – Ron Major

These savings include:

- One-time return of funding from metering error: $400,000.
- Adjusting mechanical systems at the Natural Resources Building saves $30,000 per year in utility costs.
- Separating domestic water from irrigation water at Plaza Garage saved over $39,000 the first year.
- Water savings from performance contract changes save $71,000 in utility costs annually.
- Composting food waste is saving the state nearly $20,000 in landfill disposal fees each year.

Ron Major

Paying for irrigation water separate from domestic water

The Capitol Campus uses water for domestic purposes and for irrigation. Domestic water usage is billed at a higher rate because sewer charges are added, so it is vital that water for domestic and irrigation uses be measured and billed separately.

By analyzing the Capitol Campus water bills, Ron found that the state had been paying domestic water rates and sewer charges for water that was used for irrigation. "We worked with the City of Olympia to change out water meters to separate domestic and irrigation water," Ron says. The Plaza Garage is a great example of the financial impact this change has made.

"The Plaza Garage meter served a couple of restrooms and shop sinks; most of the water was used for irrigation. We separated the domestic water from the irrigation water, and saved over $39,000 the first year."

Reducing water use

When GA installed low-flow bathroom fixtures with a $250,000 incentive from the Lacey-Olympia-Tumwater-Thurston County (LOTT) wastewater utility through an Energy Performance Contract, "We saw a 23 percent reduction in domestic water use," Ron notes. "The same project improved our irrigation system, resulting in a 45 percent reduction in irrigation water use." These improvements save $71,000 in utility costs annually. And the amount of water saved by these measures equals the annual water use of about 1,500 Northwest homes!

Composting food waste

When food waste is mixed with other waste in desk-side trash cans, custodians have to empty each trash can every day to prevent odor and sanitation problems. This takes a lot of time, which means it costs a lot of money. What would it take to convert this waste into a resource?

The answer is a pilot food composting program, which began to take shape in January 2009. Ron worked with GA's Custodial and Recycling Manager Cory Noffsinger, custodians and tenant agency representatives in the Natural Resources Building to collect the food waste in a central location. This waste was collected daily and sent to a nearby composting company – Silver Springs Organics in Tenino – that turns it into a landscape product. The project drew in one or two additional buildings per month so, by the end of 2009, all Capitol Campus buildings were participating in the food composting program.

"In 2009 alone, this food composting program saved the state $6,000 in solid waste disposal fees," Ron tells us, adding, "By the end of 2010, more than 220 tons of food waste had been diverted from landfills, saving the state nearly $20,000 in landfill disposal fees."

> **"Stay in touch daily with staff who do the work of managing facilities. Encourage them to watch for anomalies and trends in energy use, and to approach problems through investigation rather than 'band-aid' solutions."**
>
> Ron Major

And since food waste is no longer causing odor or sanitation problems in individual trash cans, desk-side waste collection has been reduced to once per week. Ron says, "Custodians are spending less time emptying trash so the state has effectively gained six FTEs of custodial time. Now custodians have time to do deeper cleaning and take care of other projects to improve building health."

GA is building on this momentum. In its 2009 Sustainability Plan, GA aimed to compost 10 percent of food waste from GA-managed buildings by 2013. They have already met – and far exceeded – this goal, composting close to 90 percent of this food waste by early 2011.

Building a team that thrives on change

An RCM sells change. To succeed at this, an RCM needs to work across departmental lines to identify and capture savings. "It is crucial to pay attention to the challenges and opportunities presented from all perspectives in the organization," Ron says.

To have an enduring impact, resource conservation activities must also be championed by people in all tiers of an organization. "It is essential for executive management to be on board and take an active role in pushing the agenda," Ron stresses. It is equally important that on-site technical and custodial staff have the opportunity to take ownership of certain aspects of the program so it has a firm foundation and is sustainable, Ron adds. "If you work through these changes with on-the-ground staff, the changes become systemic."

Ron relies on in-house communication and education strategies to heighten awareness of resource conservation activities among operations staff, management and occupants. And he attends tenant meetings to let facilities managers know about conservation and savings opportunities and to get buy-in from them.

Making resource conservation the norm

GA is not only strengthening its resource conservation practices in house; it is also serving as an example and resource for other state agencies, providing leadership, services, and technical assistance. GA is also working to integrate resource conservation into Washington State's policies and procedures, including the Capitol Campus Master Plan, GA Strategic Plan, and Historic Landscape Preservation Master Plan, as well as influence capital planning and budget efforts. "By identifying necessary improvements that require funding, GA is able to inform the legislature about how these improvements can save money and resources over the equipment's lifetime," Ron says.

As GA's RCM, Ron plays an important role in finding solutions to reduce costs across the organization and reinvesting the savings to support the mission. So it is fitting to note how Ron brings the spirit of sustainability home: "We set up an RCM revolving fund that is funded by a portion of the savings from past energy efficiency projects," he says. "This account is used as seed money and working capital to fund small energy efficiency projects done with in-house staff. The fund is replenished with utility grant dollars." That's "reduce-reuse-recycle" in action.

More information about RCM

- **Ron Major**, GA Resource Conservation Manager, (360) 239-4134, *ron.major@ga.wa.gov*.
- The Washington State University Extension Energy Program's RCM Network website: *www.energy.wsu.edu/PublicFacilitiesSupport/ResourceConservation.aspx*.
- For further information about Resource Conservation Manager support, contact **Karen Messmer**, *messmerk@energy.wsu.edu*, at (360) 956-2090.

Acknowledgement

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WASHINGTON STATE UNIVERSITY
EXTENSION ENERGY PROGRAM

www.energy.wsu.edu

Resource Conservation Manager Deke Jones: Doing a thousand things better to improve the bottom line

By Melinda Thiessen Spencer, WSU Energy Program

WSU Energy Program Mission

To advance environmental and economic well-being by providing unmatched energy services, products, education and information based on world-class research.

Overview

Our staff of approximately 100 people (energy engineers, energy specialists, technical experts, software developers, energy research librarians and more) works out of our Olympia, Spokane and other satellite offices. Operating similar to a consulting firm, the WSU Energy Program is a self-supported department within the University.

Our customers include large and small businesses, public and private utilities, local and state governments, tribes, federal agencies and facilities, manufacturing plants, professional and trade associations, schools, universities, national laboratories, and consumers.

For more information, visit our website, *www.energy.wsu.edu*.

Deke Jones is the go-to guy helping the cities of Auburn and Federal Way reduce their energy use. As the Shared Resource Conservation Manager (RCM) for these cities, Jones is finding ways to optimize building efficiency to save energy and money.

With guidance from Puget Sound Energy (PSE) and the Washington State University (WSU) Energy Program, Jones brings his eye for detail and knowledge of facilities management to this task, along with his affable commitment to "management by wandering around."

The cities set ambitious goals for the three-year term of Jones' Shared RCM employment: reduce energy use by three percent in Year 1, five percent more in Year 2, and an additional five percent in Year 3, for a total reduction in energy use of 13 percent by 2013.

Deke Jones works by the credo "Saving energy isn't about doing one thing a thousand times better; it is about doing a thousand things one time better" – a concept he adapted from A Passion for Excellence *by Tom Peters.*

Results of implementing no-cost and low-cost conservation measures from July 1, 2010 to June 30, 2011

City of Auburn
Decreased overall energy consumption by 4.11 percent

Saved an estimated $29,214 during Year 1

City of Federal Way
Decreased overall energy consumption by 4.24 percent

Saved an estimated $28,494 during Year 1

These results beat the goal of three percent energy savings in each city

As Year 1 wrapped up in 2011, Jones reported clear success. Energy use decreased by over four percent in each city, which he attributes to making innumerable no-cost or low-cost adjustments and inviting city staff to pitch in by changing behaviors, such as unplugging device chargers and space heaters. To create this momentum, Jones focuses on four main tasks.

1. Identify and implement energy conservation measures

At the top of Jones' to-do list when he started this job was to visit each site managed by the cities of Federal Way and Auburn. "Site" normally refers to a stand-alone building with a separate electricity meter as well as parks, cemeteries and pump and lift stations.

During site visits, Jones talks with occupants to learn about their comfort issues and other concerns. He inspects each facility to find opportunities to make them more energy efficient.

He also identifies bigger projects that can be partially funded by grants and incentives from the utility, such as heating, ventilating and air conditioning (HVAC) system upgrades and replacement of air handlers, control systems, chillers and heat pumps.

No-cost measures = behavior changes

"Making sure we turn off the lights and the water when we're not using them are easy fixes, and the cheapest, most effective way to conserve," Jones says. "But that involves changing our attitudes and our behaviors, which happens gradually over time."

Simple things that building occupants can do to save energy include putting on sweaters instead of turning on space heaters, using desk lamps instead of overhead lights, unplugging personal devices, such as phone chargers, and respecting the thermostat set points. These little things add up.

> *"The search for energy savings can be quite infectious. Deke's enthusiasm for the RCM program has the entire City looking for light switches to turn off. Once bitten by the bug, it's hard not to go home and look for energy savings there also."*
>
> – Steve Burke
> Construction Projects Manager
> City of Auburn

Would anyone notice if the lights surrounding this skylight were turned off during the day?

Low-cost measures = adjusting schedules, initiating retrofits

Jones monitors energy use and demand, and documents this information in an energy use profile for each site. He then meets with Operations and Maintenance staff and recommends actions such as:

- Installing light timers or occupancy sensors so lights are not on when no one is around,
- Sealing doors and windows to reduce leaks,
- Removing lights from overlit areas and vending machines, and
- Adjusting heating or cooling schedules to closely align with building use schedules.

The initial costs of these improvements are quickly paid for by energy savings.

Capital measures = construction, equipment, retrofits and controls

"Once we've looked at how we can save energy with little or no

cash outlay, and people are beginning to change their usage and habits," Jones says, "we turn to some of the conservation activities that involve heavier capital investments and large-scale changes."

These improvements are spelled out in the Resource Conservation Management Plan and Operating Standards that Jones has completed for each city. These investment measures may include:

- Installing roof and wall insulation,
- Upgrading to more efficient lights,
- Installing newer HVAC controls,
- Replacing aging HVAC equipment, and
- Upgrading building envelopes.

2. Manage energy use/cost database for city facilities

Jones uses the software applications Utility Manager and Energy Interval Service provided by PSE to monitor how energy is used in each facility. Jones can quickly spot abnormal or unusual trends by tracking use per day, cost per day, unit cost, load factor and peak demand.

This information lets Jones bench-mark and prioritize which facilities to address first because they use the most energy. He can also understand how adjusting the facility's systems, such as HVAC or lighting, may help save energy.

Jones shares this information with facility staff and managers so he can point to specific fixes that can lead to energy and financial savings.

Jones also reviews utility bills for each site to make sure the city has not been overcharged.

> *Deke has exceeded our expectations by successfully leading us to not only find ways to save energy, but implement cost effective solutions and motivate awareness in others, which has an influence beyond the work place.*
>
> – Steve Ikerd, Manager
> Parks and Facilities
> City of Federal Way

3. Develop and deliver information to promote conservation behaviors

Jones presented 11 all-staff RCM training sessions to City of Auburn employees and collaborated with PSE in a presentation targeting businesses in the Auburn community. These presentations focused on the efforts and impacts of the RCM program and the simple, everyday things people can do to save energy in the workplace and at home.

4. Administer grants, rebates and reports

As a Shared RCM, Jones prepares status reports and action plans to make sure city managers know what is going on at each site; it is crucial that managers understand the value of the energy efficiency investment decisions they will be asked to make.

In addition, Jones has cultivated a good relationship with the utility. He works closely with PSE staff to make sure he applies PSE's expertise and leverages all available rebates and incentives to save the cities money.

Deke Jones with Auburn City staff at Auburn water pumping station.

To date, the RCM program has secured rebates for low-cost efficiency measures totaling approximately $5,000 for Auburn and $4,500 for Federal Way. These rebate amounts will continue to grow as more and more low-cost measures are implemented throughout both cities.

Biggest hurdle

Because we cannot touch or feel energy efficiency, and someone else pays the bill at our workplaces, it can be difficult to understand how our small decisions over the course of a day or a month or an entire career make a difference.

"Energy savings are not sexy and too often are invisible," Jones says. "But energy use is an ongoing expense that keeps rising, so we need to get it under control."

To help people remain mindful of their energy use, Jones highlights

the importance of doing small things better, day after day. "The thousand small things we can all do to save energy add up to significant savings."

More information about RCM

WSU Energy Program provides technical and program support: *www.energy.wsu.edu/PublicFacilitiesSupport/ResourceConservation.aspx*

PSE provides support such as training, resource accounting software, incentives and outreach: *www.pse.com/savingsandenergycenter/ForBusinesses/Pages/Resource-Conservation-Manager.aspx*

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SPOTLIGHT

Auburn: Spotlight on City Hall and the Operation and Maintenance Facility

No-cost/low-cost changes at Auburn's City Hall and Operation and Maintenance (O&M) facility reduced energy use at these facilities by more than seven percent in the past year. Deke Jones, the Resource Conservation Manager that Auburn shares with Federal Way, reports that these savings are due to improvements in the HVAC system, lighting and conservation behaviors.

Controls optimize HVAC operation

In the O&M facility, constant vehicle and staff traffic entering and exiting the building through roll-up bay doors caused continuous heating/cooling fluctuations and heavy demands on the HVAC system. Heaters in the shop area keep temperature at 70°F, but the heat escaped when the roll-up doors were left open even when there was no vehicle traffic.

To stop this huge energy draw, Jones and the facility manager had micro-switches installed so the heaters turn off when the doors are open. This simple change forces common-sense behavior: close the doors if you want the heaters to work. Jones reports that O&M staff "are not loving" this new set up – yet – but it is a change that makes sense and was long overdue.

Lighting retrofits and controls manage lighting levels

Auburn facilities management staff installed occupancy sensors in individual offices and shared areas in these buildings. They also replaced incandescent, halogen and metal halide lamps with compact fluorescent lamps (CFLs) and light-emitting diodes (LEDs) wherever possible. The biggest lighting offenders were in the O&M facility: the 400 watt metal halide lamps were energy hogs and their lighting quality had degraded over time. Thanks to the recommendation of Jay Donnaway (another Western Washington RCM), Jones had these 34 lamps replaced with 180 watt CFLs, which provide better quality light and use less energy.

While mechanics did not like the light quality at first, Jones "met them in the middle" and added a few fluorescent fixtures where needed. The O&M staff members have grown to appreciate the lighting changes. In addition, they appreciate that Jones listened to their concerns and was receptive to compromise so they can stay focused on their work.

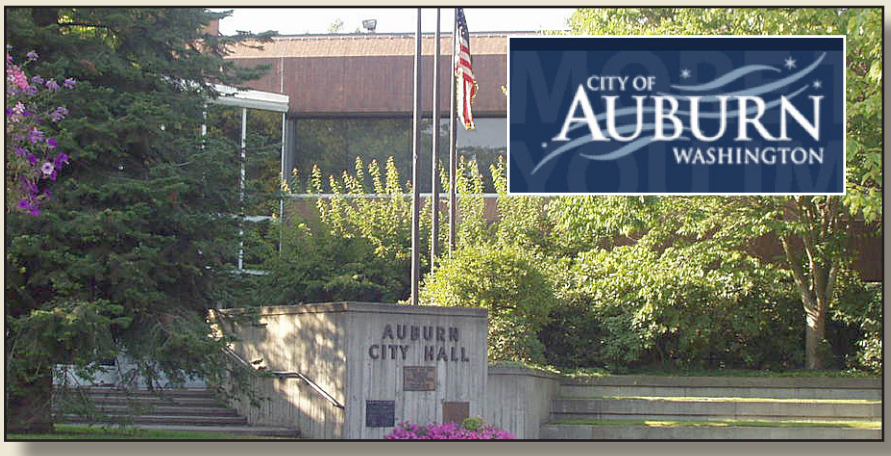
Conservation behaviors by staff and building occupants

Jones held meetings with Auburn staff and posted reminders in work areas to encourage staff members to reduce their energy use wherever possible.

One small change that really helped save energy in the glass-walled City Hall was when employees closed the blinds at night. When the blinds were left open, the interior temperature of the building dropped by 10°F so the heating system had to work harder to bring the building back up to a comfortable temperature each morning. But when employees closed the blinds at the end of each day, the nighttime heat loss was cut in half, and the city saw a corresponding reduction in heating costs.

Jones noticed that some employees were using space heaters they brought from home. This is a problem; the additional heat generated by space heaters tells the thermostats that the building is warm enough so the HVAC system quits producing heat and may even go into cooling mode.

Jones and facilities staff dealt with this issue by adjusting the HVAC settings so employees would be more comfortable without supplemental heaters. And if some employees still required space heating, Jones recommended radiant panels, which use only a fraction of the electricity of typical space heaters.



Auburn City Hall

SPOTLIGHT

Federal Way: Spotlight on Energy-Saving Projects at City Hall

From June 2011 to December 2011, energy use at the Federal Way City Hall dropped 13.7 percent. Twelve percent is attributable to the new HVAC system; the rest – nearly two percent – is the result of no-cost/low-cost measures. Deke Jones, the Resource Conservation Manager that Federal Way shares with Auburn, says these savings are due to conservation behaviors by employees and easy but dramatic changes to how the building was illuminated.

Lighting controls and de-lamping

Federal Way facilities staff retooled the old-school lighting strategies in use at City Hall by:

- Installing 62 occupancy sensors in offices and common areas, including conference rooms and restrooms
- Removing unnecessary bulbs from 60 fixtures
- Installing five programmable timers to shut off large areas of lights
- Re-setting the schedules of large panels of lights so they did not remain on 24/7

In the Council Chambers, halogen spotlights were left on continuously because no one knew how to reprogram them. These lights burned out quickly and produced a lot of heat, which often forced the air conditioner to work harder. Jones replaced these spotlights with LED bulbs that have a much longer life expectancy and do not produce heat.

Jones also recommended that nearly 2,000 halogen bulbs used to light the curved soffit in the Council Chambers be replaced with LED rope lights that cost only $285 for 275 feet. This inexpensive change reduced energy use by this fixture by 1,000 percent. In addition, because LEDs do not produce as much heat as halogen lamps, the Council Chambers do not heat up as much and trigger the air conditioner. This simple and inexpensive change reduced energy use, maintenance costs and air conditioning expenses.

In the Art Hallway, overhead lights were left on 24/7. Jones and facility staff installed a light timer so the lighting can be shut off on weekends and holidays. They also removed seven halogen fixtures from existing track lighting and replaced the remaining halogen lamps with LEDs. The Arts Commissioner is happy with the changes and feels that the art is now lit better.

These no-cost and low-cost measures will generate energy savings of 2.5 to 3 percent per year. Jones spent $6,000 on occupancy sensors, energy efficient lamps and timers, plus $2,500 for labor, totaling $8,500. The city received a rebate from PSE for $3,500, so net expenditures were only $5,000. With reduced energy consumption, the simple payback is 3.5 years, not to mention the immediate improvement in cash flow.

Replacing the halogen bulbs in the Council Chamber soffit fixture with LEDs is reducing the fixture's energy use by 1,000 percent.

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Resource Conservation Manager Brian Goldstein: Keeping his eyes on the stars and his feet on the ground

By Melinda Thiessen Spencer, WSU Energy Program

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For more information, visit our website, *www.energy.wsu.edu*.

Brian Goldstein taking measurements at a Jefferson County facility.

A person needs a special set of skills to navigate the archipelago of 134 sites owned or managed by five public agencies to assess the resources used at each site. Add occasional challenges such as budget shortfalls and very busy staff, and you have mapped the daily journey of **Brian Goldstein**, Shared Resource Conservation Manager (RCM) for the Chimacum School District, City of Port Townsend, Fort Worden State Park, Jefferson County and Port Townsend School District.

Key to Goldstein's success is his knack for keeping track of details without losing site of the big picture: to help the partner agencies reduce energy and water use by 10 percent by the end of his three-year RCM contract. Goldstein is one of those people who, as Theodore Roosevelt would say, is good at "keeping his eyes on the stars and his feet on the ground" – and he makes it look easy.

Goldstein explains, "I think like an engineer, so it's natural for me to keep track of progress, challenges and tasks in lists and spreadsheets," which he shares with the agency partners each month.

Goldstein's first task as a Shared RCM was to build a database so he could evaluate energy and water use at the partner agencies' 134 sites. This information then helped him:

- Prioritize which sites he should visit first,
- Identify resource-saving strategies, and
- Measure progress toward the agencies' resource reduction goals.

Successes in Year 1

1. With help from the RCM interns, Goldstein removed 1,000 fluorescent lamps from overlit areas in the Port Townsend and Chimacum school districts, saving $3,500 in electricity each year while still maintaining standards for lighting defined by the Washington Office of the Superintendent of Public Instruction.

2. By aligning heating schedules with occupancy, Chimacum Primary School reduced its energy use by 15 percent.

3. Goldstein proposed an energy-saving strategy for off-season rental consolidation at Fort Worden State Park. By shutting down expensive rental properties and assigning guests to properties that were less expensive to heat, Fort Worden could save $18,000 in energy costs each year.

4. Energy Interval Service was instrumental in showing high energy use at night in Port Townsend's newly remodeled Cotton Building. This helped determine that the public restroom setpoints were not turned down properly at night.

5. A number of utility billing errors surfaced in the data analysis, saving the partners nearly $7,000 in Year 1.

Building a utility database

Goldstein worked with the utilities that serve the partner agencies to obtain billing data for all 134 sites. Using Utility Manager and other software applications, Goldstein entered this data into a database so he could monitor energy and water use at each site.

With this information in hand, Goldstein looked for billing problems. "With a centralized database of utility bills in place, RCMs are in a unique position to discover billing issues," Goldstein says. For example, an audit of the electric demand charges for Chimacum schools uncovered a billing error during the last quarter of 2010 that resulted in a $5,500 credit to the school district.

The database also enabled Goldstein to calculate the energy use intensity (EUI) for each site, which told him which sites were using the most energy per square foot.

Prioritizing sites with high energy use

Of the 94 sites that required an on-site assessment, Goldstein visited the sites with the highest EUI first. And, he had to get these assessments done as quickly as possible so he could then begin the meaty task of identifying strategies to reduce resource use. Goldstein hired two part-time summer interns from The Evergreen State College to help out. Together, the interns and Goldstein assessed all of the sites

No-cost actions with the greatest impact

Shared RCM Brian Goldstein lists the no-cost actions that have had the greatest impact on resource use for his partner agencies.

Energy use:

1. Optimize building heating schedules by reducing heating during unoccupied periods and adjusting zone heating schedules to reduce demand charges.

2. Minimize fresh air intake while maintaining adequate ventilation.

3. Remove lamps in overlit areas while maintaining state standards for light levels.

Water use and solid waste disposal:

1. Review water meter readings to detect leaks or issues related to overuse, such as inefficient watering schedules.

2. Increase recycling so it becomes feasible to reduce the number of garbage pickups per week.

by the end of Year 1. At each site they identified the types of equipment and lights in use and evaluated if resources were being used efficiently.

Referring to on-site observations and the data and trends evident from the database, Goldstein prepared facility action plans that specify resource-saving strategies for each of these 94 sites. He also wrote a comprehensive Resource Management Plan for each of the five partner agencies.

Identifying resource-saving strategies

These strategies aim to reduce operating costs by optimizing building systems and inspiring occupants to make small behavior changes. Goldstein's recommendations emphasize no-cost and low-cost actions that net immediate payback with minimal investment. He also includes projects that require investment of capital funds, which he hopes to achieve later.

His no-cost/low-cost recommendations include:

- **HVAC:** Adjust temperature setpoints to align with occupancy and reduce outside air when in heating mode.
- **Lighting:** Replace energy-intensive lights with compact fluorescent lights and use occupancy sensors.
- **Electrical appliances**: Replace worn-out appliances with ENERGY STAR-rated appliances and turn off equipment (like computers) when not in use.
- **Water management:** Use drought-tolerant plants, irrigation timers and low-flow fixtures.

Brian Goldstein, center, shown here with Russ Hendricks (left), facilities manager at Fort Worden State Park, and Rich Prill (right), WSU Energy Program building science and indoor environmental quality specialist, assess resource use at Fort Worden.

- **Solid waste management:** Use less and recycle what is left.

However, Goldstein is quick to emphasize that presenting recommendations in a report is just the first step; before a recommendation can be implemented, it must be integrated into the agency workflow. "This ensures that someone 'owns' each change and is responsible for producing results," Goldstein says.

> *Our RCM program has been an eye opener for Fort Worden. We have learned a tremendous amount from the RCM about what we should and can do to reduce utility costs.*
>
> – Jill DeCianne
> Administrative Assistant
> Fort Worden State Park
> Port Townsend

"If the Jefferson County partners implement the recommendations presented in these action plans, the agencies together could save nearly $120,000 each year," which represents six percent of the baseline (2010) utility bills, Goldstein adds. "The agencies will be well on their way to meet the overall goal of ten percent utility savings if they aggressively address the high-impact changes."

Measuring progress

RCMs know that it can take a while to implement changes and inspire people to use resources differently. But as Goldstein hits the mid-point in his three-year contract, he has a lot of good news to share with the partner agencies.

Using the database to track savings as resource-saving strategies are implemented, Goldstein reports that simple changes have already saved Jefferson County residents tens of thousands of dollars. "The partners will be close to meeting the goal of reducing energy by five percent in Year 2, and will easily

meet the five percent water reduction goal."

Challenges

With five agencies to answer to and so many sites in his partnership, Goldstein relies on his linear logic and attention to detail, which help him organize masses of information and keep tabs on progress.

Does anything slow him down? Goldstein names two primary challenges he is facing at the mid-point of his three-year position:

1. Getting action plan recommendations into agency work flow processes. To make sure this happens, Goldstein regularly meets with management and operations staff at each agency to discuss how the recommendations will be implemented.

Leveraging PSE rebates for lighting, Chimacum schools began replacing inefficient fluorescent lights with more efficient models in their high school portables and district office. This project will save the school around $600 per year in electricity and provide better light for the occupants.

Thanks to PSE rebates and the efficiency of staff electricians, the return on this investment is less than one year.

> *Brian Goldstein and the RCM program have helped Chimacum School District identify energy savings in all four of our schools. The RCM recommendations have resulted in significant reductions in our utility costs.*
>
> – Steve Brown
> Director of Facilities and Maintenance
> Chimacum School District #49

2. Convincing agencies that low-cost changes are worth the investment, even in a cash-strapped economy. To accomplish this, Goldstein reminds the agencies that utilities can provide financial assistance to make improvements, and these improvements can help the agencies save money year after year.

More information about RCM

WSU Energy Program provides technical and program support.

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www.energy.wsu.edu/PublicFacilitiesSupport/ResourceConservation.aspx

Puget Sound Energy (PSE) provides training, resource accounting software, incentives and outreach.

PSE's RCM Program website:
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Resource Conservation Manager Katherine Morgan: Focusing on details to find savings

By Melinda Thiessen Spencer, WSU Energy Program

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To advance environmental and economic well-being by providing unmatched energy services, products, education and information based on world-class research.

Overview

Our staff of over 100 people (energy engineers, energy specialists, technical experts, software developers, energy research librarians and more) works out of our Olympia, Spokane and satellite offices. Operating similar to a consulting firm, the WSU Energy Program is a self-supported department within the University.

Our customers include large and small businesses, public and private utilities, local and state governments, tribes, federal agencies and facilities, manufacturing plants, professional and trade associations, schools, universities, national laboratories, and consumers.

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Katherine Morgan inspects equipment at the Bremerton Wastewater Treatment Plant.

Katherine Morgan, the Shared Resource Conservation Manager (RCM) for the Port of Bremerton and the cities of Bremerton, Bainbridge Island and Poulsbo, is adept at balancing energy-saving ideals with purse-tightening realities.

Serving in this role since mid-2010, Morgan is employed by Cascade Power Group under an Inter-Local Agreement among these jurisdictions. Start-up funding for Morgan's position was provided by grants from Puget Sound Energy (PSE) and the Washington Department of Commerce using American Recovery and Reinvestment Act funds. Her position is now funded by a grant from PSE and contributions from the agency partners. The Washington State University (WSU) Energy Program has provided technical assistance since the Shared RCM program began. Cascade Power Group assists Katherine by providing support with software, report preparation and a myriad of other functions to help her achieve her RCM objectives.

Morgan's goal is to save the partners money by reducing costs for energy, water and waste disposal. Her strategy is to look for conservation opportunities so the partner agencies and taxpayers can save money while spending little – if any – on upgrades that require capital funds.

Working with facilities operators, Morgan looks for unusual trends in energy or water use. "We work together to find out what is causing overuse," she says. Often, a small change will fix the problem. And typically, those changes will start saving money right away.

Morgan is modest when asked about her accomplishments as RCM. "I support what facilities managers in the partner agencies are already doing by flagging anomalies in resource use so they can check them out," Morgan says. "The biggest thing I've influenced is working with facilities and building staff to look at controls and adjust settings. Small changes can save agencies thousands of dollars with little effort."

Tracking resource use to deliver savings

Morgan uses a software application called *Utility Manager*® – provided through the grant from PSE – to identify where to reduce waste so the partners get the most value from their expenditures for energy, water and waste disposal.

Cascade Power Group seeded *Utility Manager* with historical data and regularly imports current data so Morgan can track trends in utility consumption by comparing historical data with current use. Guided by these insights, she:

- Assessed each site operated by the four partners – 93 in all
- Recommended conservation opportunities for each site
- Worked with facilities staff to make operational and behavioral changes to help meet conservation goals

Morgan says, "The challenge is to manage equipment – and ourselves – to save resources while still providing comfortable working conditions and meeting the needs of those who use these facilities." As detailed below, she is making progress in each jurisdiction.

Bremerton

The City of Bremerton is the largest partner and host agency in the Shared RCM program. Collectively, the 38 sites Morgan monitors here spent over $1,290,000 on energy in 2011.

Morgan works with Bremerton's facility operators to enhance and encourage conservation measures that the city has already identified. She credits committed facilities staff with helping the city save resources by:

- Tuning digital control systems
- Reviewing and resetting heating and cooling schedules and temperature setpoints
- Upgrading lighting

These types of no-cost/low-cost changes resulted in a 15 percent drop in energy use at the Kitsap Conference Center. Ken Millsap, the new General Manager with Columbia Hospitality, formed a Green Team at the conference center. He also actively micro-manages the light and HVAC schedules to conform with the facility's actual use and is looking for better ways to manage food waste.

Other city facilities also turned in impressive improvements. Morgan reports a 7 percent drop in electricity use and a 9 percent drop in gas use in 2011 compared with 2010.

Port of Bremerton

The Port of Bremerton operates the Bremerton National Airport, Bremerton and Port Orchard marinas, and the Olympic View Industrial Park. The port is working to reduce energy use by 10 percent – a challenge because:

> *Katherine's insights have proven valuable in helping us make better decisions about what we can do to reduce our energy consumption and improve our facilities for our tenants.*
>
> Tim Thomson, CEO
> Port of Bremerton

- Much of the energy use is by customers – tenants, boating guests and hangar renters. But Morgan emphasizes that there are still opportunities to reduce the port's operating costs in guest facilities and area lighting.
- Most of the spaces are older and are not in compliance with current energy standards. For example, the airport terminal – characterized by thin walls with many older windows – has been reconfigured many times, but it is difficult to deliver on comfort and energy efficiency when the facility is simply out of date.

Morgan evaluated 17 sites at the Port of Bremerton. Overall, energy use dropped by 2 percent during her first year on the job. In addition, from July 2011 through June 2012, electricity use dropped by nearly 6 percent and demand charges also went down, saving the port over $13,204.

Paying attention to how resources

are used is the key, Morgan says. For example, "The maintenance supervisor at the airport keeps a sharp eye on things. His vigilance was rewarded when the maintenance shop posted the greatest improvement" among the port's facilities.

Poulsbo

Morgan evaluated 24 sites in Poulsbo. Pinpointing how much resource use changed since Morgan began her Shared RCM position in 2010 is difficult because several city departments moved to the new City Hall. But for the group of buildings in continuous use, energy use went down 9 percent for the year ending June 2012, saving $6,343.

To achieve these savings, Morgan credits staff who pay attention to resource use trends. "I work with facilities staff to re-program thermostats at the library and make sure a hidden-away air intake is kept clear. And staff at other buildings make sure thermostats, lights and equipment are used efficiently."

For example, a Poulsbo operations supervisor noticed that energy use was increasing at the caretaker's residence at Raab Park. The supervisor worked with the caretaker to make sure space heaters and lights were turned off when not needed and to verify that the filter on the heater was clean so it would run more efficiently. These small changes cut energy use at the caretaker's residence by over 15 percent.

But, as Morgan is careful to note, "It's not always about immediate savings. It is just as important to spot trends that indicate a problem and work with staff to fix the underlying problem."

Port Orchard's Marina Park

Port Orchard's Marina Park hosts community waterfront events and serves as a neighborhood playground.

By monitoring energy use at the park, Morgan was able to catch a big increase (52 percent) in energy use in one of the park's restrooms over the winter. "If we hadn't been monitoring energy use, we wouldn't have noticed this spike," she adds.

A space heater was being used to keep the pipes from freezing, which was very inefficient. "After we added a thermostat to the heater, electricity use dropped by 21 percent. This is a good example of the savings we can capture just by paying attention," Morgan says.

The long-term solution will probably involve insulating the pipes. Until that happens, having the heater on a thermostat is helping reduce its impact on energy use and costs.

Spending money to save money: Poulsbo's new City Hall

Spending money to save money is a tough sell, even in a rollicking economy. But, as Morgan notes, "If agencies are willing to make timely capital investments, these strategic improvements will continue to pay back over time by reducing utility costs."

The City of Poulsbo is a case in point. Between 2010 and 2011, staff moved from several older buildings to the new Poulsbo City Hall. The new building is more efficient than the buildings that were vacated.

This efficiency is demonstrated by the aggregate energy use per square foot (Energy Use Intensity, or EUI). A building's EUI is calculated by taking the total energy consumed in one year and dividing it by the total floorspace of the building.

The combined EUI for the old city hall, police station and public works administrative office was notably greater than the EUI for the new city hall, which now houses these city departments and provides much improved work and community spaces. The EUI for the older buildings in 2010 was 66; **the EUI for the new city hall as of mid-2012 is 54, an 18 percent reduction that reflects a significant decrease in energy use**. The new city hall recently qualified to apply for the U.S. Department of Energy's ENERGY STAR® certification.

Old City Hall + Police Station + Public Works =
Overall 2010 EUI of 66

New City Hall =
Overall mid-2012 EUI of 54

Bainbridge Island

Morgan evaluated 14 sites in the City of Bainbridge Island. Energy use at these facilities went down by nearly 2 percent between mid-2010 and mid-2011. In fact, every building except the Bainbridge Island City Hall reduced its electricity use during this time. The biggest reductions were at the police station (down 8 percent) and the senior center/commons (down 6 percent). Morgan attributes these successes to managers who vigilantly monitored heaters, lights and thermostats.

The City of Bainbridge Island is a strong advocate of resource conservation, with policies in place to support conservation goals. For example, over the past year, improvements at the municipal courts facility saved 59 percent of electric costs, avoiding over $1,000 in annual operating cost. And when the senior center portion of the commons facility was rebuilt, many green features were incorporated.

Morgan describes one of the challenges that Bainbridge facilities operators face when trying to meet conservation goals. "At one public works facility where staff members wash vehicles and store equipment, the lights were designed to never be turned off." She says, "The only option staff have is to turn off half the lights at the breaker. But by going the extra mile and doing this during the long days of summer, public works staff saw the value of installing light switches as a permanent fix," which Morgan hopes will happen in the near future.

Dollars Saved During Katherine Morgan's First Two Years as Shared RCM
July 2010 – June 2012

Partner/Group	Total Energy Cost Savings
Bremerton/Occupied	$86,217
Bainbridge Island/Occupied	$3,888
Bainbridge Island/Utilities	$9,212
Poulsbo/Occupied	$8,646
Poulsbo/Utilities	$4,223
Port of Bremerton/Airport	$8,858
Total	$121,044

Buildings that opened or closed during this period were excluded. The Bremerton utilities group and port marinas group had increased costs unrelated to the program and were excluded here. Base year July 2009 – June 2010, adjusted for weather where valid.

For more information

The **WSU Energy Program** provides technical and program support:
WSU Energy Program
RCM Network website:
www.energy.wsu.edu/PublicFacilities Support/ResourceConservation.aspx

Puget Sound Energy provides training, resource accounting software, incentives and outreach:
PSE's RCM Program website:
www.pse.com/savingsandenergycenter/ForBusinesses/Pages/Resource-Conservation-Manager.aspx

Contact:
Katherine Morgan's grant-funded RCM position ends on September 30, 2012. If you have questions about ongoing resource conservation efforts, please contact:

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Kitsap Sun

Printer-friendly story
Read more at kitsapsun.com

Four Kitsap Governments Team to Help Each Other Save Energy

By Steven Gardner

Sunday, February 21, 2010

BREMERTON — Three cities and the Port of Bremerton use PSE program to cut utility costs.

Four local governments are agreeing to a pact to help each other reduce energy usage.

The cities of Bremerton, Poulsbo, Bainbridge Island and the Port of Bremerton are taking advantage of federal stimulus money and a Puget Sound Energy program to reduce usage over three years.

The Bremerton and Poulsbo city councils approved the agreement Wednesday. The Bainbridge Island City Council and the Port of Bremerton commissioners will consider the issue this week.

Port officials led efforts to get the governments to collaborate on the program, which is called Resource Conservation Management.

The group will hire a single employee for three years to study how each jurisdiction can save on energy costs. The program is projected to save 2 percent on energy usage during the first year and 5 percent during each of the next two.

Total savings for the four agencies is expected to be around $278,000 in year three.

The PSE program looks at operations and maintenance and is designed to create savings in utility spending.

The utility company will contribute $21,000 per year for the program and Washington State University, using federal stimulus money administered by the state Department of Commerce, will contribute $75,000 over two years and will provide technical support.

It's the WSU grant that allows the four agencies — particularly smaller jurisdictions like the port, Bainbridge and Poulsbo — to work together.

Phil Williams, Bremerton's public works director, said the city was probably big enough to take advantage of the PSE program on its own. "We would have done it ourselves had this opportunity not come up, but this is better than that because I'm not sure we need a full-time person," he said.

Port Orchard was invited to participate, but members of the City Council's finance committee declined. Port Orchard Mayor Lary Coppola said the chief concern among finance committee members was that the city would be on the hook to pay a permanent salary beyond the three-year program.

Of the funding not provided by PSE and WSU, Bremerton will pick up 60 percent to pay for the employee and will get 60 percent of the work. Bainbridge Island will pay 20 percent, while Poulsbo and the port will pay 10 percent each.

Every jurisdiction is projected to save more on energy costs than it is paying, Williams said.

BONNEY LAKE & SUMNER COURIER-HERALD

Sumner School District officials hope to cut utility costs, keep education off the chopping block

By DANIEL NASH
Bonney Lake-Sumner Courier-Herald Reporter, Reporter
Jan 24 2011, 2:34 PM

The Sumner School District office used to be an easily spotted landmark on Wood Avenue, thanks to a pair of spotlights that shone on its entryway through the night. Tonight, and every night since the beginning of the school year, the office sits in the dark as just one of several new cost-saving measures.

A grant-funded contract employee is helping the Sumner School District – as well as the cities of Bonney Lake, Sumner and Buckley – make the most efficient use of their utilities. School district officials say they hope the savings will help them avoid cuts in education-related portions of the budget.

RELATED STORIES
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- Sumner School District Science Fair winners announced
- Sumner School District shows Christmas spirit

Pierce County
- None at this time.

The contractor, Jay Donnaway, is a resource conservation manager with Sound Environmental Consulting. The funding for his position with the district and cities comes from a $75,000 federal Department of Energy grant through the American Recovery and Reinvestment Act of 2009, as well as a $28,000 a year – for three years – grant through Puget Sound Energy.

"Last spring, the city of Bonney Lake's executive assistant, Brian Hartsell, asked if we would be interested in partnering on this (DOE grant through Washington State University) offered to the cities," Executive Director of Business Services Debbie Campbell said. "Bonney Lake needed to have a partner, and that could include schools, because they needed a certain amount of utility costs to be eligible."

They and the other cities worked out a deal. Donnaway began working out of the main district office in September and the district secured the greatest percentage of his time, Campbell said.

But because the school district is a utilities client of both Bonney Lake and Sumner, some changes affect all of the interdependent parties.

"When we sat down at the table, I told everyone 'You may win some, you may lose some, but let's get it right,'" Donnaway said.

An example he provides comes out of the Auburn School District and the city of Auburn, his previous clients. Donnaway found that Auburn Riverside High School's water account had been improperly placed in the city account, overcharging the district $160,000. It was a loss for the city, but the refund gained jobs for the district.

Donnaway has a background in solid waste management and a passion for energy efficiency that seeps into his personal life – he owns a Volkswagen Eclectic that he recently finished converting into an electric car. His eyes light up when he shows a graph demonstrating a 10 percent drop in electricity use for Sumner High School during the year so far, compared with the previous year. That change reverses a years-long trend of rising utilities costs at that school; the 2009-10 school year had a 21 percent spike in electricity costs over the previous year.

"Utilities are often something that is not a priority in many organizations because they're in the background of operations," he said. "But you need to (be able to) turn on the lights."

Donnaway's tasks hit on three general fronts: familiarizing himself with utility patterns, finding and correcting inefficiencies in the system, and finding and correcting inefficiencies in everyday human use of utilities.

As part of the Puget Sound Energy grant, Donnaway has access to the company's database of utility consumption and costs, a system he is "becoming intimately familiar with."

The database not only shows costs, but the energy or water consumption that should be associated with those costs, allowing him to see where costs should be for each Sumner district building compared to similar customers.

The system has already allowed him to spot an instance of excessive water consumption at Lakeridge Middle School, which pointed to a pipe leak that has since been corrected, Campbell said. A faulty energy meter at Victor Falls Elementary School was similarly flagged and corrected.

The district's waste pick-up has been drastically reorganized by Donnaway. All garbage pick-up services have been changed to on-call service, meaning the district pays for pick-up when their dumpsters are full, as opposed to regular – and regularly charged – pick-ups. Recycling has moved entirely to "single stream" pick-up, meaning school employees don't need to spend time sorting recyclables. Dumpsters are now locked down to prevent dumping from outside parties.

"The other element of the equation is behavioral, meaning how people use lights and (heating and air conditioning)," Donnaway said. "And a lot of it can seem counter-intuitive. For example, propping open a door to cool down an assembly actually makes it hotter because the system is responding to the colder temperature."

The rewards for changing behaviors can be significant, as he demonstrated to the district school board at the Jan. 12 meeting.

"Even a 1 percent drop in utility use should gain $20,000 for student learning," he said.

Bonney Lake-Sumner Courier-Herald Reporter, Reporter Daniel Nash can be reached at dnash@courierherald.com or 360-802-8210.

Article published Jun 19, 2012

Clallam hears draft energy plan

By Rob Ollikainen
Peninsula Daily News

PORT ANGELES — Clallam County has a new plan to conserve energy and to lower costs.

A draft "facility resource conservation management plan," which applies to the Clallam County Courthouse and several other county facilities, was presented at the commissioners' work session Monday.

Perry Spring, the county's resource conservation manager, said some of the steps are as simple as turning off the lights at the end of the work day, powering down computers and phasing out the use of space heaters.

No action was taken Monday. The three county commissioners will consider adopting the plan in the coming weeks.

Spring was hired in September 2010 through a grant from the state Department of Commerce.

He has been studying energy consumption and introducing energy-saving measures for five government entities: Clallam County, the cities of Port Angeles and Sequim, Olympic Medical Center and Clallam Transit.

Clallam County was the administrator in a shared pilot program funded by the 2009 federal stimulus package that put $75,000 into the resource conservation program in both 2010 and 2011.

The consortium of governments covered a 50 percent match based on the amount of energy they use.

Spring's contract will expire June 30.

"Great work," Commissioner Mike Doherty told Spring after an hourlong presentation.

The plan includes a baseline analysis of energy use patterns and elements of implementation.

The purpose of the program is to help cities and counties establish and implement long-term energy efficiency standards for their buildings.

Main goals in the plan include:

-- Cultivate a culture of stewardship, conservation, sustainability and be a community leader.

-- Develop and maintain tools to monitor, assess and continuously improve the resource/utility performance of facilities.

Steps to meet these goals include employee “green teams,” bulletin board postings, newsletters and staff communications.

Clallam County is in the midst of a facilities upgrade at the courthouse at 223 E. Fourth St. in Port Angeles. The upgrade includes a new heating, ventilation and air conditioning system and more efficient solar panels.

The county owns or operates 150 other buildings at 30 locations. There are also 20 county parks, 13 of which have buildings or structures with utilities.

Action plans were developed for the Clallam County Courthouse, Camp David Jr., Salt Creek Park, the Clallam County Veterans Center and other county’s facilities, Spring said.

Clallam County averaged $440,192 per year on utility costs from 2008 to 2010. Seventy-three percent of that spending, or $319,056 per year, was for energy.

Refuse accounted for 12 percent of utility spending, water accounted for 9 percent and sewer was 6 percent.

Total utility spending fell from $455,000 in 2008 to $428,000 in 2010 before it rose to $436,000 last year. Spring’s figures were not adjusted to rises in utility rates.

Spring said he will provide similar presentations to the other four government in the grant.

“I think next steps really need to include how much staff time is going to be involved and associated with this model,” Commissioner Jim McEntire said.

“Staff time is not free. We need to be careful that the input costs for this don’t overwhelm the benefit derived on the other side of the equation. Staff time, I think, is going to be at a premium going ahead.”

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Reporter Rob Ollikainen can be reached at 360-452-2345, ext. 5072, or at rob.ollikainen@peninsuladailynews.com.

WASHINGTON STATE UNIVERSITY
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Good Ventilation is Essential for a Healthy and Efficient Building

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To advance environmental and economic well-being by providing unmatched energy services, products, education and information based on world-class research.

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We are part of the College of Agricultural, Human and Natural Resource Sciences. We report directly to the WSU Vice President of Agriculture and Extension.

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Most of us spend about half of our waking hours in office or school buildings. It follows that the quality of air in these buildings can affect the health, productivity and comfort of the occupants. Measures that protect air quality, such as adequate ventilation, should be taken seriously.

Indoor air quality (IAQ) is determined by:

- Concentrations of contaminants in the air, and
- How effectively the ventilation system brings in appropriate volumes of fresh air and distributes it to people throughout the building.

The information presented here is designed to:

- Help facility managers understand the importance of continually monitoring a building's ventilation rate to ensure adequate IAQ is maintained as the number of people in each area of a building (or zone) changes throughout the day.

- Explain how much outside air (OSA) should be brought into a building.
- Describe symptoms of ventilation problems.
- Discuss the importance of assessing pressure differentials (inside to outside and zone to zone).
- Provide guidance for controlling indoor air pollutants.

See the companion factsheet, *"Measuring Carbon Dioxide Inside Buildings – Why is it Important?"** to learn how carbon dioxide (CO_2) levels in a building can be used to monitor IAQ and for guidance about obtaining accurate CO_2 measurements.

Bringing fresh air inside

Scientific studies clearly show that people who work in buildings where adequate fresh air is provided and properly delivered to the building occupants are more productive than those who work in buildings that are inadequately ventilated.

Good ventilation is essential for a comfortable, healthy and productive indoor environment, so a top priority for facility managers should be to understand and tune the building's heating, ventilation and air conditioning (HVAC) system so it meets the needs of the building occupants throughout the day.

The ventilation rate is the flow of outside air (OSA) into a building per unit of time.

** Available on the Washington State University Energy Program website: http://www.energy.wsu.edu/PublicFacilitiesSupport/ResourceConservation.aspx.*

Symptoms of ventilation problems

- Stuffy or stale conditions
- Noticeable odors from outdoors or other areas in the building
- Very low or high relative humidity, dampness or window condensation
- Pressure imbalances between the inside and outside, which can make it difficult to open or close doors
- Noise or drafts from air delivery vents
- Spillage or back-drafting of combustion equipment
- Dust and dirt accumulation
- Reports of comfort or health issues
- Unusually high utility costs

As workers and students come and go throughout the day, the air quality in the building changes. People continually generate CO_2, so CO_2 levels can build up throughout the day unless OSA is brought in through the HVAC system to dilute the CO_2. As the CO_2 builds up, so can other potentially serious indoor air pollutants.

Bringing in OSA that has been filtered and heated or cooled to the appropriate temperature is essential to control odors, reduce exposure to indoor air pollutants, and purge moisture and contaminants in a building.

How much OSA is too much?

It is important to bring only enough OSA into the building as needed to maintain healthy conditions. To accomplish this, the facility manager needs to monitor and control the building's ventilation rate.

If too much OSA is brought in, the HVAC system will have to work harder to heat or cool the OSA to the appropriate temperature, resulting in wasted energy and excessive utility payments.

If too little OSA is brought in, the CO_2 concentrations will rise throughout the day, as will concentrations of pollutants and odors. These impacts are exaggerated in buildings where the HVAC system re-circulates 70 to 80 percent of the indoor air.

If just enough OSA is brought in, the levels of CO_2, pollutants, odors and moisture will more likely be within appropriate guidelines and the HVAC system will not have to work harder than necessary to maintain a comfortable temperature.

However, ventilation is not a cure-all for IAQ issues. Strong pollutant sources in the building, including occupant-created pollutants and those emitted from carpets and other building furnishings, can overwhelm typical fresh air exchange rates, so a practical IAQ policy that works to limit pollutant sources should also be implemented.

Recommended ventilation rates

Building codes and guidance, such as American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE) Standard 62.1, define ventilation

rates and dictate that adequate ventilation should be provided either naturally or mechanically. Ventilation recommendations are continually evolving; it is a good idea to check codes that apply to your building.

Ventilation rates can be determined and maintained through ***prescriptive*** or ***controlled methods***.

The **prescriptive ventilation method** requires specific volumes of OSA in cubic feet per minute of OSA per person (cfm/p) ***plus*** a prescribed volume of OSA per square foot of the space (cfm/sqft). These two values are combined to determine the total ventilation rate for the space at full occupancy.

The prescriptive method also requires up to 20 percent more OSA if the:

- Supply and return systems are both at ceiling level.
- HVAC system does not circulate the air down to the occupant level during heating mode, such as with a variable air volume or multi-zone system.

Prescriptive methods can be difficult to employ because they:

- Require direct measurements of the OSA flow rates per balancing standards, which can be difficult, time-consuming and subject to significant errors.
- Assume full occupancy all the time, which may result in overventilation. For this reason, the prescriptive method is likely not as energy efficient as the controlled method.

Relationship between measured CO_2 and ventilation rate per person

*The CO_2 values in this table are approximate.**

CO_2 (ppm)	**Outside Air** (ventilation rate)	
2,400	5 cfm/p	Unacceptable
1,400	10 cfm/p	Poor
1,000	15 cfm/p	Classrooms
800	20 cfm/p	Offices
600	25 cfm/p	
~ 380	< - - - - - - >	Outdoors

The figures given assume:

- A constant number of occupants over an extended period,
- Occupants are sedentary adults,
- The ventilation rate is constant (although occupied spaces are rarely at full occupancy for more than a fraction of an hour), and
- The OSA CO_2 concentration is about 380 ppm.

** Check code requirements for your building; codes and guidance continually evolve.*

ASHRAE recommends that indoor CO_2 levels not exceed the outdoor concentration – which is about 380 ppm – by more than about 650 ppm.

Meeting and maintaining prescribed air exchange rates can be difficult without practical and effective OSA monitoring strategies.

The **controlled ventilation method** recommends using sensors to control the ventilation rate. The most common system of this type is Demand Controlled Ventilation (DCV).

DCV systems use CO_2 sensors to continually adjust the ventilation rate to meet the actual occupant loads and activity levels in the building. DCV systems are especially useful for spaces that experience variable occupancy rates, such as conference rooms, classrooms, auditoriums, dining rooms and open workspaces. As more people occupy a space, they exhale more CO_2. When the DCV system senses that CO_2 levels are rising, it increases the volume of OSA that is brought in through the HVAC system so the CO_2 level is controlled to a pre-set value.

According to the U.S. Department of Energy's Federal Energy Management Program, DCV systems have been demonstrated to save 5 to 27 percent of HVAC energy usage in a typical office environment *(see Resources #16 and 17)*. The cost to implement this feature is minimal and usually results in a very good payback. The return on investment for larger HVAC systems can be less than one year.

The greater the ventilation rate (volume of OSA per person – cfm/p), the more the CO_2 will be diluted. To maintain an optimal CO_2 level in classrooms and offices (approximately 1,035 ppm of CO_2), the ventilation system should be set to bring in OSA at a rate of 15 to 20 cfm/p.

Assessing pressure differentials

Proper air pressure analysis is also important for maintaining an energy efficient and adequately ventilated space.

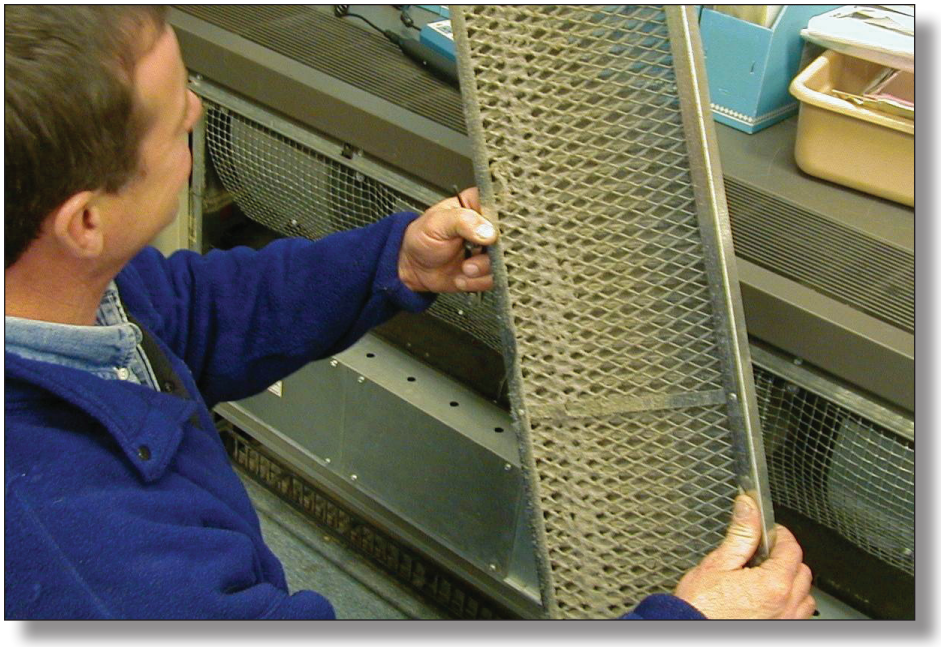
Pressure differentials are created by the HVAC system and/or air leakage through the building envelope. When differential pressure in one part of a building is greater than in an adjacent area, air will flow toward the area with lower pressure. It follows that CO_2, pollutants and other components of indoor air will also migrate to areas with lower pressure.

Uncontrolled pressure differentials can also hinder the ability of the ventilation system to adequately distribute OSA to all zones in the building.

To determine if a space is over- or under-pressurized, differential readings should be taken in each zone in a building. Flow measurements and subsequent balancing are needed to meet the building's design flow rates and delivery of the appropriate volume of OSA.

Controlling indoor air pollutants

Inadequate ventilation permits potentially harmful air pollutants to build up in some areas of a building. As described in the companion factsheet, CO_2 is easy to measure and can be used as an indicator of ventilation adequacy.



Make sure air filters are not clogged so the ventilation system can work properly. Photo: Rich Prill

Many indoor air pollutants are generated by materials used in the building itself, such as carpets, furnishings, cleaning chemicals and stored materials; office equipment; and air entry from areas such as contaminated utility tunnels and connections to the soil.

To control indoor air contaminants:

- **Keep pollutants out of the building**
  - Choose furnishings and finish materials carefully and adopt "green cleaning" practices.
  - Make sure OSA intakes are located away from vehicle exhausts, building exhausts, cooling towers, plumbing vents and generators.
  - Install and correctly maintain the most efficient filters based on the air-handing system capacities.
  - Test ducts to determine if they are meeting design tightness criteria.
  - If necessary, seal ductwork to prevent cross-contamination. Leaky ductwork allows pollutants to move from zone to zone within a building and can carry moisture or pollutants (such as radon and methane) from groundwater or soil into a building.
- **Use exhaust fans to capture and remove pollutants** introduced by people, such as perfumes; from equipment, such as copiers and printers; and from localized sources in storage areas. Be sure to control pressures between zones to keep pollutants from migrating to areas of low pressure.
- **Use integrated pest management measures** to keep rodents, birds and insects out of the space without using chemicals.

Summary

Good ventilation is essential to maintain a comfortable, healthy and productive indoor environment. Facility managers need to understand their building's HVAC system and tune it to achieve the optimal mix of OSA. Ventilation settings should adapt to the building's occupant load to save energy while maintaining a comfortable working environment.

Resources

1. "ASHRAE Standard 62.2.2012: Ventilation for Acceptable Indoor Air Quality," American Society of Heating Refrigerating and Air Conditioning Engineers, Atlanta, GA.
2. "Using Indoor Carbon Dioxide Concentrations to Evaluate Indoor Air Quality and Ventilation," ASTM Standard D-6245 – 12, May 2012.
3. "Standard Test Method for Determining Air Change in a Single Zone by Means of a Tracer Gas Dilution," ASTM Standard Guide E741-11.
4. *IAQ Diagnostics Reference Manual: Hands-On Assessment of Building Ventilation and Pollutant Transport*, University of Tulsa, College of Engineering and Applied Sciences, Department of Chemical Engineering.
5. Indoor Air Quality Scientific Findings Resource Bank, Lawrence Berkeley National Laboratory: *http://energy.lbl.gov/ied/sfrb/*.
6. *1994 Manual for Ventilation Assessment in Mechanically Ventilated Buildings*, National Institute for Standards and Technology, NISTR #5329-1994.
7. U.S. Department of Energy, Energy Efficiency and Renewable Energy: *www.eere.energy.gov*.
8. "Demand-Controlled Ventilation Using CO2 Sensors," U.S. Department of Energy, Federal Energy Management Program: *http://www1.eere.energy.gov/femp/pdfs/fta_co2.pdf*.
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11. ASHRAE Standard 62, Ventilation for Acceptable Indoor Air Quality: *www.ashrae.org*.
12. Building Energy Codes Resource Center, Commercial Ventilation Rate Procedure: *http://resourcecenter.pnl.gov/cocoon/morf/ResourceCenter/article/1587*.
13. Washington State University, Environmental Health and Safety – Ventilation: *http://ehs.wsu.edu/labsafety/manual/s3cventilation.html* .
14. Integrated Pest Management primer, Washington State University Extension: *http://ipm.wsu.edu/*. *(Check with your state for specific recommendations to manage pests.)*
15. Radon primer, Washington State Department of Health: *http://www.doh.wa.gov/communityandEnvironment/Contaminants/Radon.aspx*. *(Check with your state for specific recommendations to manage radon.)*
16. *Demand-Controlled Ventilation: A Design Guide,* Northwest Energy Efficiency Alliance: *http://www.oregon.gov/ENERGY/CONS/BUS/DCV/docs/DCVGuide.pdf*.
17. *Energy Savings and Economics of Advanced Control Strategies for Packaged Air-Conditioning Units with Gas Heat,* Pacific Northwest National Laboratory: *http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-20955.pdf.*

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Measuring Carbon Dioxide Inside Buildings – Why is it Important?

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The quality of air inside a building depends on the concentrations of contaminants – such as gases and particles – and how much fresh air is brought into the building through its ventilation system to dilute and remove these pollutants. It is essential to monitor indoor air quality (IAQ) to provide for occupant health, productivity and comfort.

This factsheet:

- Explains how carbon dioxide (CO_2) levels in a building can be used to monitor IAQ and the ventilation rate.
- Provides guidance about accurately measuring CO_2 levels.

See the companion factsheet, *"Good Ventilation is Essential for a Healthy and Efficient Building,"** to learn about how much fresh air should be brought into a building to keep the environment healthy and comfortable without using excessive energy.

Using CO_2 levels as an indicator of IAQ

The complex mixture of gases and particles in indoor spaces is difficult to measure. However, CO_2 levels, which are easy to measure, can be used in place of other measurements to indicate IAQ.

** Available on the Washington State University Energy Program website: http://www.energy.wsu.edu/PublicFacilitiesSupport/ResourceConservation.aspx.*

CO_2 is produced when people breathe. Each exhaled breath by an average adult contains 35,000 to 50,000 parts per million (ppm) of CO_2 – 100 times higher than is typically found in the outside air (OSA).

The CO_2 concentration in an occupied indoor space indicates if the building's air exchange balance is appropriate – that is, if the optimal amount of OSA is being mixed with air that has been circulating in the building.

Using a CO_2 meter

A CO_2 meter lets you easily and inexpensively measure CO_2 levels in specific areas of your building.

But, because the outdoor CO_2 concentration is included in the amount of CO_2 indoors, you must measure outdoor CO_2 levels when assessing indoor concentrations. Outdoor CO_2 levels are typically around 380 to 500 ppm.

Most CO_2 meters are accurate enough to indicate if ventilation in offices and schools is adequate. Some of these instruments measure only CO_2; others simultaneously measure temperature, relative humidity and other gases, such as carbon monoxide. A new generation of CO_2 monitors can measure volatile organic compound concentrations and infer CO_2 concentrations from these measurements.

What is CO_2?

CO_2 is a natural component of the atmosphere. The amount of CO_2 in an air sample is expressed as parts per million (ppm) – the number of CO_2 molecules per million molecules of air.

The CO_2 levels in the air outside a building are usually 380 ppm or higher, depending on:

- Local conditions – vehicle traffic, industry and other sources of combustion.
- Weather conditions – wind and temperature inversions can cause combustion gases to build up in a local area.

An elevated indoor CO_2 concentration is directly related to the number of occupants in the building, the building's ventilation rate, and the CO_2 level in the outside air.

Indoor CO_2 can accumulate if ventilation is not adequate to dilute and remove the CO_2 that is continuously generated by building occupants.

Instruments that record data internally or are coupled to an external data logger (as opposed to only giving instant readouts) provide valuable data for identifying trends, trouble-shooting and verifying solutions.

How much CO_2 is too much?

Current ventilation guidelines, such as those from the American Society of Heating Refrigerating, and Air Conditioning Engineers (ASHRAE), recommend that indoor CO_2 levels not exceed the local outdoor concentration by more than about 650 ppm. Good practice indicates that the ASHRAE Standard 62.1 target CO_2 level in indoor air is about 1,030 ppm, as follows:

380 ppm CO_2 typically found in OSA
\+ 650 ppm CO_2 (ASHRAE target maximum level)
\= 1,030 ppm CO_2 (ASHRAE maximum recommended indoor level of CO_2)

It is important to adhere to these guidelines. The performance of individuals in schools and offices with elevated CO_2 concentrations can be affected because occupants may become lethargic and drowsy. Additionally, as CO_2 builds up, so do other indoor air contaminants, which increases occupants' exposures to irritating, distracting and potentially unhealthy gases and particulates.

Interpreting indoor CO_2 measurements

Interpreting CO_2 data is often a more significant source of error than instrument accuracy. Meaningful assumptions about ventilation rates based on CO_2 values require that the building or zone be occupied long enough to allow the CO_2 levels to reach a balance with the ventilation rate. This balance is known variously as equilibrium, unity or steady-state.

In an occupied building with a very low ventilation rate, the CO_2 levels will likely increase throughout the day,

Low CO_2 readings do not necessarily indicate adequate ventilation.

never reaching a steady-state concentration. Conversely, a high ventilation rate and good mixing of OSA may prevent CO_2 from accumulating much beyond outdoor levels, so CO_2 concentrations stay low throughout the day.

Unless equilibrium has been reached, CO_2 measurements will not accurately reflect the building ventilation rate. For example, if a CO_2 measurement is taken in a classroom during the first class of the day, CO_2 will not have accumulated to the point where equilibrium has been reached. Therefore, OSA ventilation rates based on this CO_2 measurement will be overestimated.

If a CO_2 measurement is taken in the same classroom at the end of the day and the room's ventilation rate and occupancy have remained fairly consistent throughout the day, it is reasonable to assume that CO_2 equilibrium has been reached. Assumptions about OSA ventilation rates based on this CO_2 measurement will likely be useful for estimating the ventilation rate.

However, errors in CO_2 measurements do occur, often caused by:

- Ventilation systems that modulate the amount of OSA allowed into the building over the course of a day,
- Occupancy rates that fluctuate significantly,
- Instrument or calibration problems,
- Measurement location, and/or
- Poor mixing of the air within the space.

Using CO_2 monitors to automate fresh air ventilation

Once you have evaluated the building's ventilation system and determined if adjustments are necessary, consider installing CO_2 sensors to continuously monitor the CO_2 levels in the building. The HVAC control system can use the CO_2 values to automatically modulate the volume of OSA that is brought in so indoor CO_2 is maintained at or below a preset target concentration.

This strategy is known as Demand Controlled Ventilation (DCV). DCV systems are especially useful for spaces that experience variable occupancy rates, such as cafeterias, gymnasiums, classrooms and conference rooms, because the ventilation rate changes automatically in response to changes in the occupancy density.

DCV systems with CO_2 control sensors have been demonstrated to save 5 to 27 percent** of HVAC energy usage in a typical office environment, depending on occupancy type and use. Savings can be even greater when DCV is installed in spaces with high variability in occupancy, such as conference rooms, cafeterias and gyms.

It is relatively inexpensive to install CO_2 sensors, and they usually bring a very attractive return on investment. These sensors cost between $500 and $5,000, depending on their features:**

- For an HVAC system that has an air-side economizer with a motorized damper already installed in the OSA duct, the cost of adding CO_2 sensors will be close to $500.
- For HVAC systems that need to have a motorized damper added to their outside and return air ducts, along with the associated controls, the cost of adding CO_2 sensors will be higher.

Summary

CO_2 measurements are useful to help you:

- Determine if a building has adequate ventilation.
- Verify that enough OSA is coming in to ensure good IAQ.

It is important that building operators check manufacturers' specifications for calibration frequencies and routinely check the sensors to ensure that they remain calibrated.

When the ventilation system is calibrated correctly, the appropriate volume of OSA is mixed with recirculating air to:

- Dilute indoor air pollutants and CO_2 ,
- Create a healthy and productive environment, and
- Save energy by heating or cooling only the volume of OSA that is required.

Monitoring CO_2 levels also leads to significant energy savings by

***See Resources 7 and 8.*

CO_2 levels to know

- **35,000 to 50,000 ppm** – Amount of CO_2 in each exhale by an average adult
- **5,000 ppm** – Maximum allowable CO_2 level in an industrial workplace
- **380 ppm** – Typical CO_2 level in outside air (OSA)
- **650 ppm** – Indoor CO_2 levels should not exceed the local OSA concentration by more than 650 ppm, as recommended by ASHRAE.
- **1,030 ppm** – Given an average outdoor CO_2 concentration of 380 ppm, indoor CO_2 levels should not exceed 1,035 ppm (380 ppm + 650 ppm = 1,030 ppm).
- **If the outdoor CO_2 is around 380 ppm**, the relationship of the ventilation rate (cubic feet per minute of fresh air delivery) per person and the steady-state CO_2 concentrations should be close to these values:
  - 600 ppm = 25 cfm OSA per person
  - 800 ppm = 20 cfm OSA per person
  - 1,000 ppm = 15 cfm OSA per person
  - 1,400 ppm = 10 cfm OSA per person
  - 2,400 ppm = 5 cfm OSA per person

alerting operators:

- When the building is over-ventilating during hot or cold weather conditions, and
- About whether economizers can provide ample ventilation with OSA when in cooling mode.

Resources

1. American Society of Heating, Refrigerating, and Air Conditioning Engineers, "ASHRAE Standard 62.2.2012: Ventilation for Acceptable Indoor Air Quality," Atlanta, GA.
2. ASTM Standard D-6245 – 12, "Using Indoor Carbon Dioxide Concentrations to Evaluate Indoor Air Quality and Ventilation," May 2012.
3. ASTM Standard Guide E741-11, "Standard Test Method for Determining Air Change in a Single Zone by Means of a Tracer Gas Dilution."
4. *IAQ Diagnostics Reference Manual: Hands-On Assessment of Building Ventilation and Pollutant Transport*, University of Tulsa, College of Engineering and Applied Sciences, Department of Chemical Engineering.
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7. *Demand-Controlled Ventilation: A Design Guide*, Northwest Energy Efficiency Alliance: *http://www.oregon.gov/ENERGY/CONS/BUS/DCV/docs/DCVGuide.pdf*.
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