

City of Tumwater Resource Conservation Management Program (Phase 1)



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Executive Summary

The purpose of this study was to provide a baseline assessment of energy efficiency improvement opportunities at the Tumwater City Hall, Old Town Center, Headquarters Fire Station, North End Fire Station and Library. A baseline assessment utilizes information obtained during a brief period of observation to characterize the existing equipment and operation for the purpose of evaluating opportunities for saving energy and other resources.

The GA-WSU Team conducted on-site energy walk-throughs May 15, June 3 and July 24, 2008. Each visit included comprehensive tours of City of Tumwater buildings, including Old Town Center, Headquarters Fire Station, North End Fire Station, City Hall, Public Works Operations Building, Henderson and Crosby House Museums and the Tumwater Library. They also included individual and collective interviews with facilities maintenance and other building occupants/users.

The City of Tumwater has committed to climate change mitigation through their participation in the U.S. Mayor's Climate Protection Agreement and the ICLEI Five Milestones process and even developed their own detailed Climate Change Action Report. The City has also committed reducing its greenhouse gas emissions to seven percent below year 2000 levels. In its Climate Change Action Plan, the City notes that building energy use represents the second greatest source of greenhouse gas emissions in the city. However, despite an energy conservation program started in 2003, energy use in City buildings has increased annually since then, other than a slight dip between 2005 and 2006. It seems that a more aggressive commitment to facility energy savings will be needed to achieve the city's stated goals.

Key Observations and Opportunities for Improvement at City Hall:

- Having the police station integrated as a part of City Hall requires an air handler, boiler, and water heater to operate 24/7 for the entire facility rather than primarily during business hours. This issue will be resolved soon when the police station is renovated with independent energy systems.
- Sixty to eighty percent of the employees are sufficiently uncomfortable at their desks that they either operate personal space heaters or otherwise attempt to modify air flow to improve their personal comfort. Consider replacing the pressure-dependent air distribution terminal boxes with pressure-independent boxes along with a direct digital control (DDC) system and rebalancing the air distribution system to provide better control and comfort. If this is not done, consider replacing the existing supply air diffusers with models designed for use with variable air volume to achieve better air distribution within each space.
- Provide separate heating, cooling, and water heating for the Police Station so that the larger equipment in City Hall doesn't have to operate 24/7.

- Most of the lighting on the main floor is still T-12 fluorescent; these fixtures should be group relamped with T-8 lamps and electronic ballasts.
- Critical end uses in the City Hall are currently served from a utility meter in an adjacent building, and without a submeter to account for the energy used by City Hall. Such a submeter should be installed.
- Perform a combustion efficiency test on the boilers and have them cleaned and adjusted as needed to optimize efficiency. In addition, determine if plans to replace the boilers are actually necessary.

Key Observations and Opportunities for Improvement at other buildings:

- Lighting is dated. More efficient lighting options could be obtained (Old Town Center, Facilities Building).
- All windows are aluminum and single-paned. Retrofit of windows is recommended (Facilities Building, Old Town Center).
- Consider automated sensors for heating or lighting recommended (Old Town Center, Headquarters Fire Station, Facilities Building)

Key Observations and Opportunities for Improvement at all buildings:

- Create and implement a more formal energy management plan that includes energy accounting and benchmarking.
- Consider hiring or contracting for the services of an energy conservation manager and take advantage of generous financial incentives offered by Puget Sound Energy for conservation projects.

Acknowledgement

This report was developed with outstanding assistance from the staff at Tumwater City Hall. In particular, Jeff Vrabel, City Facilities Manager; Greg Adamich, Buildings Maintenance Supervisor; and Walter Renaud, Buildings Maintenance, who provided important information and participated fully in the walk-through assessments. The assessments were performed by the GA-WSU Team, consisting of staff members from Plant Operations Support Consortium and the Washington State University Extension Energy Program, including Bob MacKenzie, Phil Partington, Larry Covey, Rob Penney and Bill Kingery. For more information on WSU Extension Energy Program, access www.energy.wsu.edu.

We wish to thank the U.S. Department of Energy's Building Technologies Program for their funding of the Northwest Building Efficiency Center (NBEC), the program through which the Tumwater City Hall assessment was performed. NBEC delivers information on energy efficient technologies to builders, code officials and public building managers so they can significantly reduce building energy use in the region, striving to deliver the right information at the right time, in the best manner, to the people who can implement successful energy efficiency projects. For more information on NBEC, link to www.nwbuildings.org.

Disclaimer

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The information contained in this report is confidential and intended only for the use of the GA-WSU Team and the City of Tumwater unless written permission is specifically provided by the City of Tumwater.

Introduction

In many ways, Washington state is ahead of the game when it comes to energy conservation and can boast of having some of the lowest energy prices in the country. Yet, “State energy experts estimate energy costs per capita in Washington will average \$3,950 in 2008, which represents a nearly 25 percent increase in just three years” [Source: “[Energy Prices Impact Budget](#)”, [Access Washington](#)]. Much of this is because of the continual increase in energy costs and finite resource levels.

Residents in Washington state can expect a 16 percent increase in the cost of natural gas this winter compared to last. That means an increase in the cost of electricity is also anticipated, since natural gas is used to generate electricity. [Source: “[Energy Prices Impact Budget](#)”, [Access Washington](#)]

Energy prices have risen in recent years and are likely to continue that trend. Proactively, City of Tumwater officials asked State of Washington’s GA-WSU Team to perform the following critical actions:

- Review all City of Tumwater-owned buildings (On-Site Investigation).
- Review/incorporate all previous work completed by former City Intern.
- Interview maintenance employees as well as facility managers.
- Obtain the last (12) months of utility bills.
- Evaluate utility bills and create a spreadsheet.
- Provide report/presentation to stakeholders of findings.

Interagency Agreement #2008-710: *City Resource Conservation Management Program* was affected which lists a scope of work to be finalized by GA-WSU Team staff. This report completes Phase 1 of the scope of work outlined in IAA 2008-710.

Benefits of Improving Energy Efficiency

There are many direct and indirect benefits of improving energy efficiency, including:

- Cut energy bills, freeing up funding for staff and other important resources
- Offset rising energy rates
- Improving staff productivity through improved lighting, comfort, and indoor air quality
- Public appreciation for wise use of natural resources
- Reduce “carbon footprint”
- Take advantage of generous utility and government incentives now available
- And attract favorable media attention, awards, and recognition



Preliminary Baseline Assessment of Tumwater City Hall

This assessment was conducted on July 24, 2008, by Rob Penney and Bill Kingrey, professional engineers at Washington State University Extension Energy Program.

Energy Use Analysis

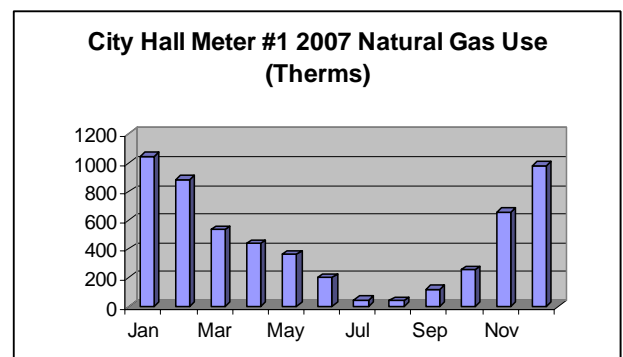
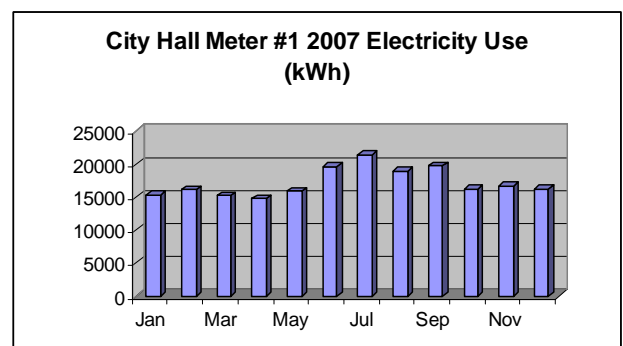
Electrical and natural gas service is provided by Puget Sound Energy (PSE). The utility bills can be challenging to understand, but at about \$25,000 annually, are worth making an effort to synthesize. Many organizations pay their energy bills without regular analysis of their content, so a few observations about the bills from December 27, 2006 to December 26, 2007 are shared below:

- There are no fewer than 12 components to the monthly bills, some of which are difficult to understand. In 2007 there were six rate changes, the January electric use wasn't billed until February, and the November gas bill compensated for a meter reading error in October of over 200 Therms.

- It's useful to maintain a close relationship with the utility's account representative to ensure that the City understands the utility bills, utilizes the most appropriate rate schedule, and takes maximum advantage of all the resources and incentives that the utility has to offer. A good first contact would be Bill Stegner at Puget Sound Energy's

Olympia office. You can reach him at 786-5930.

- The average electricity cost was 8.9 cents per kWh, including energy charges, demand charges, fees, credits, and taxes, but ranged from 8.2 to 9.5 cents per kWh.



- The average rate for natural gas was \$1.26 per Therm. The cost was fairly stable through the seasons, the average rate varying primarily because the fixed monthly customer fee of \$17.50 was one percent of the high winter bill but 26 percent of the much lower summer bill.
- The PSE meter #1 measures energy use of the City Hall, but excludes critical end uses in City Hall that are served from meter #2 in the adjacent building.
- A demand charge of \$8.31 per kW was assessed for months when demand exceeded 50 kW, which was roughly half the year and totaled \$644. The City may want to consider demand reduction measures to reduce this fee, especially after the demand rate rose 50 percent on October 1, 2007.
- The use of natural gas varied considerably from 38 Therms (\$68) in August (when some staff were likely on vacation and it was only used for staff lavatories as well as showers for the Police Department)) up to 1048 Therms (\$1,342) in January when heating peaked due to an unusually low daily average temperature of 37 degrees F.
- Electricity use varied considerably less, dropping less than a third from the summer peak (with air conditioning) to the winter low (used primarily for lighting and office equipment). This reflects the city's mild summers—a peak average daily temperature in July of only 67 degrees F—the envy of much of the country.
- The City pays hundreds of dollars annually through its utility bills into PSE's energy conservation program, so would be well-served to take advantage of utility assistance and incentives.
- Utility rates changed almost monthly (see below). Some of these may seem insignificant details, but when a facility manager is trying to cut energy costs five percent and the energy charge rises 10 percent, energy costs will rise despite the manager's efforts. It is therefore important to look at cutting energy use (which can be controlled) rather than energy costs (which can only partially be controlled).
 - > January 13: the energy charge for electricity increased 9.3 percent, the cost of gas increased 2.3 percent, the credit for wind power more than doubled, and the power cost adjustment (reflecting sudden increases in PSE's costs) dropped to zero.
 - > April 1: the energy charge for electricity dropped back down to almost exactly what it had been late the previous year, while the cost of gas rose another 0.6 percent.
 - > June 6: the utility energy conservation fee rose about six percent.
 - > September 1: the power cost adjustment was restored to about a third of the previous level.
 - > October 1: the energy charge for electricity rose just over 10 percent, the demand rate rose by 50 percent, and the gas delivery charge dropped 0.2 percent.

December 3: the Tumwater City Tax dropped two percent.

Site Visit Observations

Lighting

- **Office Spaces:** Lighting in the main floor office spaces is a mixture of the original T-12 fluorescents in fixtures with parabolic reflectors, and 150-watt incandescent can lights. In the basement, T-8 lights are used in what appears to be the same “egg-crate” parabolic fixtures as upstairs. Throughout the office spaces, the fluorescent lamps are varied in their color temperature (warm and cool colors mixed randomly).
- **City Council Chambers:** In this space, also used as a courtroom, there is indirect fluorescent cove lighting in the ceiling along with recessed can fixtures with horizontal compact fluorescent lamps. The ceiling is textured and painted with a grayish color that is noticeably ineffective in reflecting light downward. A bank of 15” fluorescent U-tube fixtures illuminates the Council members during TV Cable broadcasts.
- **Foyer:** In the foyer daylight is plentiful, but no daylight harvesting dimming controls are installed, so the lights are all operating.
- **Exterior:** Some exterior lighting is operated 24/7 unnecessarily.



HVAC

- **Main System:** The HVAC system includes four air handling units (AHUs), two boilers circulating 140-150 degree water to hydronic coils in the air handling units, electronic controls, and four ground-mounted condensing units with a single two-stage compressor. The 26 terminal units in the building are Parker-Carrier variable volume / variable temperature boxes (VVT). These units are pressure-dependent boxes controlled by a proportional thermostat that opens and closes the boxes in response to zone temperatures.
- **Main Floor System:** The air volume of the main fan serving this system is varied as necessary by a variable frequency drive (VFD) controlling the motor speed to maintain a fixed pressure downstream in the main ductwork. First-stage cooling is provided by an economizer and second-stage cooling for this and all the other air handlers in the building is provided by ground-mounted direct-expansion (DX) condensing units. Heating is provided by a hot water coil supplied by the boilers for all air handlers. The air handling unit serving the main floor runs 24/7 in order to condition the police station, which is occupied 24/7.



- **Council Chambers System:** The HVAC system serving the Council Chambers is a constant volume unit with an economizer, DX coil and hot water coil. This unit runs only when the Council Chambers are in use.
- **Basement System:** Five zones in the basement are served by two air handling units— one serving the training room, and a larger one serving the remainder of the basement. The larger air handler is located in a basement mechanical room. The air handler uses a bypass damper to reduce air volume for part-load operation and a hot water coil for heating. Because of space restrictions, there is no room to bring in air for an economizer, so no economizer is provided.
- **Training Room:** The AHU serving the training room is a small three-ton residential unit with direct expansion (DX) and hot water coils served by the boilers.
- **Computer Room:** The basement also contains a telephone/server room cooled by two ductless split systems.
- **Boilers:** The boilers are Raytherm copper finned water-tube boilers. Two units are provided and staged in accordance with outside temperature. The boilers appear to be in good condition, despite their age.
- **Air Distribution System:** The air distribution system is so unbalanced that it was estimated that 60-80 percent of building occupants utilize personal electric resistance space heaters or otherwise attempt to modify the air flow from diffusers and registers to improve their personal comfort. This is very inefficient. Realistically, there will always be a handful of employees who are not satisfied with the space temperature, but 60-80 percent dissatisfaction indicates a serious malfunction of the system. The air handling unit fans operate 24/7 to accommodate the operation of the police station, which also wastes energy.
- **Variable-Volume/Temperature Boxes:** The VVT boxes are from a different era. Because these units are pressure-dependent, as one unit closes down to restrict flow, the pressure increases in the duct and all the other boxes receive additional flow until the VFD controller can react and slow the fan. The opposite happens when a box opens to increase flow – all the other boxes in the system receive less air. Because of this arrangement, the boxes are continually “hunting” – changing their flow trying to maintain the zone set point. Another problem with this system is the use of conventional diffusers instead of the slot diffusers normally used with shutoff variable air volume (VAV) systems. As the flow rate drops, velocity through the diffusers drops and the air from the diffuser can no longer maintain enough velocity to allow it to “stick” to the ceiling – the air then drops out of the diffuser, creating cold spots directly under it – leading to numerous comfort complaints.
- **Ductwork:** Most of the ductwork is sealed with mastic, which is effective in preventing leaks. However, some recently replaced ducts have not been sealed with mastic



(note the seam at the right on the photo). The access panel in the basement mechanical room was particularly loose.

- **Diffusers:** The supply air diffusers are designed for constant volume use but are being used with a variable air flow system. As a result, when air volumes are reduced during partial load conditions, the conditioned air no longer mixes properly with room air and instead drops into the space.
- **Zoning:** The HVAC system is set back in the Council chambers, but the door between the chambers and the foyer is not consistently kept closed, so the cooler or warmer air of the foyer mixes with air from the chambers.
- **Air-side Economizers.** These are provided on all air handling units except on the larger of the two units serving the basement. Economizers allow for the use of cool, outside air for cooling, reducing the need for air conditioning. This can be a significant energy savings in our climate. However, an alarming percentage of economizers on commercial and institutional facilities do not operate as intended—if at all, so proper operation can't be assumed and should be checked regularly.
- **Controls:** The existing 20-year-old control system by Parker-Carrier is electronic lacks the capabilities of more modern direct-digital controls. Temperature settings for cooling range from 71-75 degrees, while heating settings range from 68-72 degrees.

Water Heating

- The water heater, an AO Smith Lime Tamer (BT-197-860), is a commercial unit located near the boilers and is of the same era. It seems to be approaching the end of its useful life. The estimated energy factor of this unit at about 0.62 – this means that 38 percent of the energy supplied goes up the stack or is lost from piping. The water heater is reportedly set to 110-120 degrees.

Building Envelope

- The walls are wood-framed with masonry exterior.
- The windows are aluminum double-glazed with a U-value of approximately 0.60.
- The roof is wood-framed and sloped with tile, approximately R-30 fiberglass batt insulation with a foil face that minimizes the heat radiating from the roof down to the ceiling. Insulation is installed in between the roof joists so that the attic is part of the insulated shell of the building. In some areas, the insulation has been disturbed and is hanging down in the attic or missing entirely (see photo at right).



Other

- A serious obstacle to analyzing the electrical energy used by the City Hall is that, according to the City Facilities Manager, most of the building is served by one electrical meter (Building #1—City Hall), but more critical end uses are

served by a meter serving Building #2 (Public Works Operations Building), and the power serving these critical end uses is not sub-metered. Critical end uses include the boilers, pumps, septic, some lighting, and cooling for the training room, which is used for meetings during emergencies. Therefore, it is not possible to accurately determine how much electricity the City Hall uses.

Recommendations

Lighting

- Measure the lighting levels in each area and compare with lighting levels appropriate for the type of work currently being performed in that space. If a space is over-lit, lamps and ballasts can be removed from fixtures, lower wattage lamps can be selected, or ballasts can be replaced by those with a lower ballast factor.
- When fluorescent lamps start to fail on the main level, initiate a program of group relamping with T-8 lamps and replace the ballasts with energy-efficient electronic models in the process. This is also recommended in the City of Tumwater's Climate Action Plan report. It may be more cost-effective to replace lamps, ballasts, and reflectors as part of a fixture insert or with an entirely new fixture. In selection, take into consideration the evaluation of lighting needs mentioned above. During the relamping process, clean the fixtures.
- Paint the ceiling of the Council Chambers with a brighter, lighter color to better reflect light downward.
- Stock fluorescent lamps with only one color temperature (80-85 CRI) to achieve uniformity and improved lighting quality.
- Replace any incandescent lamps in exit signs with LED inserts, or replace exit signs with LED, photoluminescent or electroluminescent models. The City's Climate Action Plan report also recommends LED models.
- Explore the use of an automated dimming system for foyer lighting to take advantage of plentiful daylight. Especially if some companion signage were provided, this would send a subtle message to all visitors that the City is committed to energy efficiency and fiscal responsibility, and uses modern technology to accomplish this.

HVAC Major Retrofit

- Investigate replacement of existing Parker-Carrier pressure-dependent variable volume / variable temperature (VVT) air distribution terminal boxes with pressure independent VAV boxes, which will provide better control and comfort. These new boxes use an internal fan to mix room air with conditioned air, maintaining constant air volume (flow) to the space. In zones that are too cool, room air is mixed with primary air to maintain temperature and, if necessary, an electric heating coil is energized. These newer VAV boxes can be tied into the control system to run the fan just fast enough to

provide the minimum required pressure to the most remote VAV box - minimizing energy use. This is the largest measure recommended in this report, both in installed cost and potential savings.

- As part of the VVT box replacement, the primary building automation system should be replaced with a direct digital control system and the zoning should be reconfigured to better serve the existing office layout.
- If the VVT boxes are not replaced with VAV boxes, consider replacing the existing supply air diffusers with units designed for variable air flow.
- Investigate replacement of the existing condensing units and air-handlers serving the Council Chambers and the basement to determine if it is cost effective to replace them with energy efficient DX-VAV units. The existing units use R-22 refrigerant, which will be phased out over the next few years making replacement of refrigerant very expensive.
- Provide a separate HVAC system for the police area of the building to allow night setback of the majority of the building.
- Investigate the viability of replacing the existing constant-speed air handling units serving the basement spaces (other than the training room) and the Council Chambers with models using variable speed blowers rather than a simple pass to accommodate a variable volume air distribution system.

HVAC Maintenance

- Monitor space temperatures throughout the office space (when electric resistance space heaters are off) and then hire a contractor to test and balance the air distribution system to preclude the need for such space heaters. Direct occupants to report their discomfort and avoid using personal space heaters or modifying the heating system diffusers and registers. While it is impossible to satisfy the comfort needs of all occupants simultaneously, a well-balanced system can greatly increase comfort for many while decreasing energy use.
- Inspect the air-side economizers to ensure proper operation. Insure the actuators operate smoothly without binding over their full stroke, the outside air damper closes tightly and the temperature sensors used to initiate changeover are properly calibrated and operate the controller and actuators properly. Check the minimum outside air setting and adjust to provide 20 CFM per person – or as noted on the mechanical plans.
- Seal ductwork leaks with mastic as necessary. Adjust all duct access panels to seal tightly; the access panel in the basement mechanical room was particularly loose.
- When HVAC motors require replacement, choose only Premium-efficient models. Select motors using MotorMaster+ software, available free of charge from the U.S. Department of Energy (<http://www.eere.energy.gov/industry/bestpractices/software.html#mm>).
- Perform a combustion test to ensure the boilers are operating at optimal efficiency. Make adjustment to the burners and controls as needed and

reconsider plans for boiler replacement, as was recommended in the City's Climate Action Plan report. Older boilers may be almost as efficient as new boilers if well maintained and operated. Note that Puget Sound Energy may have an incentive for boiler tune-ups.

- Check all dampers for leakage and replace any missing or deteriorated seals or gaskets on access doors.
- Check all outside air and return air dampers for leakage and proper operation. Replace any missing or deteriorated seals, gaskets, actuators or linkages.
- Make sure the outside condensing units are kept free of debris. However, planting some trees to shade the condensing units can improve cooling efficiency.
- Change air handling filters regularly.
- Check the refrigerant charges of all cooling systems regularly.

HVAC Operation

- Set the dead band between heating and cooling settings for each space to a minimum of five degrees F, as per the Washington State Energy Code section 1412.2.
- Take advantage of night set back in all zones where it is possible.
- Consider using an energy management system to limit peak demand by cycling loads when demand exceeds 50 kW; Tumwater currently pays about \$5.50 per kW over 50 kW.

Water Heating

- When the water heater reaches the end of its useful life (which could be soon), select an energy-efficient model using the GAMA directory, available at the WSU Energy Program library and some public libraries. This replacement was recommended in the City's Climate Action Plan report.
- If a recirculation pump is used, ensure that it is operated with a timer or other control such that it will not run during unoccupied periods.
- Use a thermometer to ensure that the hot water temperature at the fixture closest to the water heater is 120 degrees F; adjust water heater thermostat as needed.

Building Envelope

- Reinstall the vapor barrier and insulation where they have been disturbed and are hanging down from in the attic. Check for air leaks between the roof and the top of the walls and at the roof peaks. Carefully seal all leaks using non-expanding foam.
- Although the attic space is within the insulated shell of the building, it is not conditioned, so it would be effective to install weatherstripping on attic access doors.

Other

- Install a submeter on the power feed coming from Building #2, which provides power to critical end uses in the City Hall. This will allow a comprehensive accounting of energy used at City Hall (as well as at Building #2), which is currently not possible.
- Consider having a full recommissioning performed on the building to ensure that all systems are operating optimally.
- Consider purchasing Green Power from Puget Sound Energy to help achieve the City's Climate Change Action Plan goals. For more information, go to <http://www.pse.com/business>

Preliminary Baseline Assessment of Other City of Tumwater Buildings

This assessment was conducted on May 15, 2008 and June 3, 2008 by Bob MacKenzie, Phil Partington and Larry Covey, staff members of the Plant Operations Support Consortium.

Old Town Center

Address: 215 N 2nd Ave SW



- Building is only partially occupied with Senior Center and Parks and Recreation.
- Building has 30-year plus boiler that appears to be highly inefficient.
- No building automation system
- No central energy management system
- Manual controls on heating/ventilating system, where automated sensors might be more energy efficient. For example, one unoccupied floor had all its heaters turned to “high.” Building occupants at time of walk-through expressed dissatisfaction with temperature control. An automated system could help alleviate this problem.
- Lighting is dated. More efficient lighting options could be obtained, which is consistent with the City of Tumwater’s Climate Action Plan report.

FIGURE 1-1

T12 and T8 Comparison (4 ft. lamps)				
	T12s with magnetic ballast		T8s with electronic ballast	
Number of lamps	Input watts	Efficacy (lumens/watt)	Input watts	Efficacy (lumens/watt)
2	72	73	58	94
4	144	73	112	97

[Source: Alliantenergy.com]

- All windows are aluminum and single-paned. The Climate Action Plan report recommends retrofit of windows in this building.
- There is no visible sign of composting.

Headquarters Fire Station

Address: 311 Israel Rd SW



- Facilities seemed to be running appropriately, though unoccupied rooms were the same temperature as occupied rooms.
- All lights were on during the day in the main engine bay.
- Several user controls could go to occupancy sensor.

North End Fire Station

Address: 405 Linwood Ave SW



- Has many similar issues as the Headquarters Fire Station, but building is less occupied and more lights are turned off.
- Occupancy is varied, typically staffed weekends. Utilities seem high for occupancy.
- Office computer was running while building was unoccupied. Unless 1) the computer is on a network that requires it to be left on for frequent updates, or 2) the computer is being used as a sort of server, leaving a computer on all day – though minor in comparison to some energy eaters – can quickly add up utility costs.

“A typical PC consumes something like 300 watts. Let’s assume that you use your PC for four hours every day, so the other 20 hours it is on would be wasted energy. If electricity costs 10 cents per kilowatt-hour in your area, then that 20 hours represents 60 cents a day. 60 cents a day adds up to \$219 per year.” Using energy-saving features built into modern machines can cut that figure in half, but that’s still a waste of roughly \$100 per year simply because a computer wasn’t turned off when it wasn’t being used.

[Source: Howstuffworks.com]

City Hall

Address: 555 Israel Rd SW #1



- Please see “*Tumwater City Hall Preliminary Baseline Assessment*” (Section 5 of this report) for a more in-depth look at Tumwater City Hall.
- Older style light fixtures – tubes (T12s and T8s). See Figure 1-1 under Old Town Center.
- Inefficient mechanical systems, especially in basement.
- Antiquated building automation system.
- Could easily be fitted for occupancy sensor
- Thermostat on walls to adjust temperatures (human factors).
- There are renovated spaces where HVAC hasn’t been balanced (i.e., IT temperature is controlled by Public Works professionals in different work space).
- As a result of the aforementioned, many use space heaters under their desks while others try to block vents. One option is to encourage staff to wear warmer clothes as opposed to using a space heater. If extra heat is necessary, we recommend using radiant electric heaters. Turn heater off when away from the desk. A 1,500-watt heater running continuously for 3,000 hours will use \$225 if the cost is \$0.05 per kWh. (Space heaters are also a safety hazard when left on unattended.) [Source: “[Conservation Ideas – Building Occupant](#)”]
- Boiler could benefit from efficiency measures.
- Abnormally hot in basement
- Some exterior lights are turned on 24/7 next to police station for security reasons.

Henderson House Museum

Address: 602 Deschutes Way SW



- The GA-WSU Team staff recommends not focusing on making adjustments to the Henderson House in pursuit of energy conservation to ensure it maintains its historical significance. However, if City of Tumwater deems energy conservation in this building a priority, we first suggest looking into passive measures before taking retrofitting measures or making physical adjustments to the building.

“The first passive measures to utilize are operational controls; that is, controlling how and when a building is used. These controls incorporate programmatic planning and scheduling efforts by the owner to minimize

usage of energy-consuming equipment. A building should survey and quantify all aspects of energy usage, by evaluating the monies expended for electricity, gas, and fuel oil for a year and by surveying how and when each room is used. This will identify ways of conserving energy by initiating operational controls such as:

- lowering the thermostat in the winter, raising it in the summer
- controlling the temperature in those rooms actually used
- reducing the level of illumination and number of lights (maximize natural light)
- using operable windows, shutters, awnings and vents as originally intended to control interior environment (maximize fresh air)
- having mechanical equipment serviced regularly to ensure maximum efficiency
- cleaning radiators and forced air registers to ensure proper operation

The passive measures outlined above can save as much as 30 percent of the energy used in a building. They should be the first undertakings to save energy in any existing building and are particularly appropriate for historic buildings because they do not necessitate building alterations or the introduction of new materials that may cause damage. Passive measures make energy sense, common sense, and preservation sense!”

(Source: [U.S. Department of the Interior National Park Services](#))

Facilities Building

Address: 7007 Capitol Blvd SW



- Building has seven-day programmable thermostat.
- Older mechanical equipment could be switched out with newer units.
- Building was previously a fire station. For this reason, there is a large hot water tank so that fire fighters could take showers. However, current building occupants don't take showers, so they don't need the large hot water tank.
- Building has poor lighting – fixing this issue might not necessarily be a direct energy savings, but could boost morale and increase safety in some areas of the building, thereby improving productivity. See Figure 1-1 under Old Town Center.
- All windows are single-paned
- Exterior doors in vehicle bays are not insulated
- In vehicle bay, heat is controlled by human factor. Automated system could increase energy efficiency of building.

Library

Address: 7023 New Market Street SW

- Building air flow could be an issue. There's a pocket in the ceiling in the center of building, which may capture heat. Ceiling fan may be possibility to push air back in circulation. Ceiling fans don't lower the temperature in a room, but they do provide a breeze that can make occupants feel at least 5 degrees cooler. Ensure the fan blades are rotating counter-clockwise for a cooling effect if fans are the desired option. Moreover, installing a larger fan rather than a smaller one might be beneficial, as it enables the occupant to have more speed settings and cover larger areas while not costing much more than smaller fans to operate.
[Source: Phoenixabout.com]
- Some computers were running even though the library was closed. See explanation about turning off computers under North End Fire Station.
- Motion sensors could be applied to vending machines.
- Public restrooms could have automated sinks.
- Should find ways to reduce hot water tank size.



Review of Climate Action Plan and ICLEI's Five Milestone Process

Background

In May 2008, the City of Tumwater's Climate Protection Intern, Andrew Deffobis, generated a Climate Action Plan report to assess the City's outlook on global climate change and recommended future steps toward improvement. Per Interagency Agreement 2008-710, Plant Operations Support Consortium staff was tasked with, "Review/incorporate all previous work completed by City intern."

Climate Action Plan Report Introduction

Deffobis begins the report with an overview of how "human-induced climate change is among the most pressing environmental problems facing this generation and those to come" (page 6). He reports that the City of Tumwater's municipal operations released 3,141 tons of eCO₂ in 2000, 4,451 tons in 2006, and in 2020 are projected to emit 240 percent more than they did in 2000 (page 6). In response, City of Tumwater has committed to iclei.org (Local Governments for Sustainability) Five Milestone Process to combat global warming:

- Milestone 1: Conduct a baseline emissions inventory and forecast
- Milestone 2: Adopt an emissions reduction target
- Milestone 3: Develop a Climate Action Plan for reducing emissions
- Milestone 4: Implement policies and measures
- Milestone 5: Monitor and verify results

[Source: <https://icleiusa.org/>]

According to the report, City of Tumwater has committed to reduce its emissions as a City by seven percent below its 2000 levels by 2012, and keep them there beyond 2020.

ICLEI's Cities for Climate Protection® (CCP)

Page 14 of the Climate Action Plan report features ICLEI and its mission to "improve the global environment through local action." Deffobis focuses on the Five Milestone Process of ICLEI's CCP Campaign, which is an establishment of local governments worldwide tasked with the challenge of reducing greenhouse gas emissions, improving air quality and enhancing urban sustainability. Deffobis adds that Tumwater joined the CCP campaign on December 5, 2006.

CACP Software

ICLEI created the Clean Air and Climate Protection (CACP) Software package with Torrie Smith Associates to enable users to estimate emissions from energy consumption and waste generation within a community. Deffobis reports that over 170 U.S. cities and counties use the CACP software to reduce their

greenhouse gas emissions. Yet, he also acknowledges that there are disadvantages to the software. Perhaps the most noteworthy drawback being that the software depends on the quality and quantity of data available. Therefore, Deffobis concludes that results produced by the software should merely be considered calculations (page 15). Deffobis provided his findings in section II-B of the report.

Climate Action Report Recommendations Summary (pp. 26-28)

Here are highlighted recommendations of the Climate Action Plan report that are relevant to this assessment.

- **Contract with Washington State Energy Outreach Office**
 - This was included in 2008 City Budget
- **\$25,000 Capital Facilities Plan Project**
 - Utilize City of Tumwater’s 2008-2013 Capital Facilities Plan funds to make energy-efficiency upgrades to city buildings.
- **Municipal Buildings Fluorescent Lighting Retrofits**
 - Replace all T12 fluorescent light bulbs and magnetic ballasts with more efficient T8 lights and electronic ballasts
- **LED Exit Sign Retrofit**
 - Replace incandescent Exit Signs with LED fixtures, which use less energy
- **Golf Course and City Hall LED Retrofits**
 - Replace incandescent can lighting in City Hall and the Golf Course Pro-Shop/Restaurant building with LED fixtures, which use less energy
- **Replace Various Heating Systems in City Buildings**
 - Replace water heaters and boilers in City Hall and Old Town Center, and the heating system in the Facilities building
- **Insulation and Window Retrofits**
 - Upgrade insulation in Old Town Center, and replace and upgrade windows and insulation in the Facilities building

“Future Steps”

The City of Tumwater Climate Action Plan calls for “some type of oversight” to be adopted by the city “in order to sustain the momentum that Tumwater’s Climate Protection Program has generated thus far” (page 29).

In conclusion, the GA-WSU Team concurs with the recommendations of the report that have to do with energy conservation, including incorporation of energy efficient upgrades within certain construction projects, municipal building fluorescent lighting retrofits, LED exit sign retrofit and insulation and window retrofits where needed.

The Climate Action Plan notes that building energy use represents the second largest source of greenhouse gas emissions. The Plan calls for reducing emissions to seven percent below year 2000 levels. Part of the plan for achieving these emissions related to buildings is to continue an energy conservation program started in 2003. This includes replacing T12 lamps with T8 lamps, replacing older magnetic ballast with new electronic ballasts and replacing incandescent lamps in exit signs with LED lighting. It also includes an information program to encourage employees to turn off lights. However, energy use in the City's buildings has been rising steadily since 2003 other than a slight dip between 2005 and 2006. While growth may be partly responsible for this lack of success, it seems that the City is not on track to achieve emissions reductions targets without a more aggressive energy management plan in place. Plans include the replacement of the water heat and boiler in the City Hall in 2009.

In addition, the report calls for future oversight of these plans and recommendations for energy reduction. The GA-WSU Team concurs with that methodology, yet it might not be cost effective for Tumwater to hire an FTE given its size. Combining such an FTE with a neighboring city of similar size might prove most beneficial and could be looked into further in Phase 2 of Interagency Agreement 2008-710 if Tumwater chooses the route of hiring a full-time RCM.

Energy Management Recommendations

Energy Management Planning

Improving the energy use of a building is a big team effort. It requires support from City Council and the Planning Commissions, Public Works planners, maintenance and operations staff, building occupants, and some specialized expertise from outside parties. A more formal energy management program should be launched with the following steps:

- Gain top level commitment
- Set up a system of energy accounting and establish a baseline of historical energy use
- Set realistic goals
- Assign responsibilities
- Perform a more comprehensive energy audit yielding prioritized energy saving opportunities (i.e., combustion analysis, infiltration testing, duct work, leakage testing, and more thorough inspection of all equipment).
- Implement low/no cost recommendations
- Evaluate and prioritize capital improvement projects
- Implement capital improvement projects
- And, evaluate results and communicate through media and awards

Benchmarking

Benchmarking is a process where you calculate a building's energy use and compare it with other, similar buildings to find out how your energy consumption compares with similar buildings in your area. In order to benchmark your building you will need to gather the following information:

- At least 12-months of energy consumption and the total monthly costs of each
- Area of the building in square feet (measure or copy from the plans)
- % of the building area that is heated
- % of the building area that is cooled
- Number of workers
- Number of computers
- Weekly operating hours
- Number of months the building is used each year

When you have this information, go to the Environmental Protection Agency's Portfolio Manager (PM) at:

www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager.

You'll need to register, and then input the data for your building following the directions at the website.

One of the first things you'll be asked for is the type of building - choose the option closest to your building type. When you've finished inputting the data, the

PM will calculate the building's energy use in units of thousands of Btu per square foot per year (kBtu/sf-yr) and then rate the building against other similar buildings in your area.

Municipal Resource Conservation Management (RCM) Program

Phase 2 of IAA 2008-710 outlines that the GA-WSU Team will “incorporate findings from [this report] to develop City-wide RCM program. An RCM program is a coordinated effort to manage the resources and services used, and waste generated, by the facilities of a municipality or school district. 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.

With a comprehensive RCM program in place, you can expect to see quantifiable results in the first one to six months. Most RCM programs achieve 10 to 15 percent savings on utility bills after the first year depending on the number of facilities involved and level of management commitment.

RCM strategies have been used in industry and large corporations for many years. As public-sector budgets shrink, RCM programs are cropping up in many organizations, both large and small.

It has been shown to be effective to have someone dedicated to reviewing and improving the energy efficiency of this and other city facilities. This may be less than a full-time position, but at least even a part-time employee (possibly shared with another city or organization) can be more effective than having this responsibility diffused among busy city employees with many competing roles and responsibilities. You can hire a Resource Conservation Manager as staff within your organization, or you can contract for services to perform RCM activities. There is program and financial help available from Puget Sound Energy, as well as program support available from the WSU Energy Program. For a fact sheet to help guide you through the process of contracting for an RCM, see <http://www.energy.wsu.edu/EnergyLibrary.aspx> or www.energy.wsu.edu/.

Puget Sound Energy (PSE) Assistance

The PSE RCM program is available to any school district, public-sector government agency, and commercial or industrial customers, focusing on larger customers with multiple facilities. The RCM program takes an all-resource approach. PSE will work with the customer's designated Resource Conservation Manager whose assigned responsibilities include increasing efficiency and reducing costs of:

- Electricity
- Natural gas

- Water and sewer
- Solid waste and recycling programs

The Resource Conservation Manager is retained by the customer and is accountable for energy savings attributable to efficiency improvements in:

- Occupant behavioral practices by building occupants
- Operations and maintenance practices by administrators, managers, and operations personnel.

Most of the savings are from changes in practices, and do not require major investments in equipment. The RCM also helps identify and champion projects which qualify for additional Puget Sound Energy (PSE) incentives such as:

- Lighting system improvements
- HVAC systems and controls
- Building thermal improvements
- Water heating system improvements
- Retro commissioning

To learn more, contact Lori Moen at (425) 462-3274 or lori.moen@pse.com.

Washington State University Extension Energy Program (WSU) Assistance

WSU provides support for RCMs in Washington, including an on-line RCM guidebook and monthly newsletters. WSUWSU can help cities hiring a RCM by providing job description examples and consultation. Once a city has an RCM on staff, WSU can also provide technical support through their Northwest Buildings Efficiency Center. Their RCM website is: www.energy.wsu.edu/projects/rem/rcm.cfm. The NBEC website is: www.nwbuildings.org. For more information, contact Karen Messmer at (360) 956-2090 or MessmerK@energy.wsu.edu.

Contracting for RCM services

There are likely other companies offering RCM services. One is McKinstry, which offers Resource Conservation Management services on a contract basis. For more information, contact Ray Burton at 206/832-8115.

Potential Financial Incentives through PSE

Fortunately some incentives are being offered to encourage earlier adoption of better technology. PSE's grant programs can provide you with a custom incentive of up to 100 percent of the installed cost for any energy-efficiency project resulting in increased efficiency of equipment fueled by electricity or natural gas supplied by PSE to a business. PSE's grant programs help fund the construction, upgrades, and people that increase the efficiency of your facilities. Grants can help fund:

- Efficiency retrofits and upgrades on existing facilities
- New construction
- Expansion of existing facilities

PSE's generous rebates offer a simple and easy-to-use way to receive funding for common, energy-efficiency improvements. They have more than a dozen rebate programs with over a hundred options for commonly-applied efficiency upgrades. Applicants must have their application approved prior to installing equipment and submit the required documentation afterwards. For more information, call a PSE Energy Advisor at (800) 562-1482.

Opportunities for Outreach and Recognition

It can be helpful to document and share results from successful energy efficiency improvement projects. This can result in public recognition, awards, and sharing lessons learned with similar facilities. Some opportunities include:

- If the building's energy use rating (see under Benchmarking above) is 75 or more (meaning that it uses less energy than 75% of all buildings of the same type, it is eligible for Energy Star certification (www.energystar.gov/index.cfm?c=eligibility.bus_portfoliomanager_eligibility)
- If the building is remarkably and creatively resource-efficient in its construction and operation, it may be a good candidate for the Washington Governor's Award for Sustainable Practices (see www.ecy.wa.gov/programs/hwtr/GovAward/index.html).
- Work with the Plant Operations Support Consortium to write an article for their newsletter, *ShopTalk*. (www.ga.wa.gov/Plant/SHOPTALK.HTM)
- Work with the Association of Washington Cities (www.awcnet.org) to write an article for their newsletter, *The Operator*.

Information Resources

- **Puget Sound Energy** (PSE) offers grants, rebates, a resource conservation manager program, and a direct installation and maintenance program as well as an on-line audit, a web-based application that provides access to usage data from your meters, and the Energy Smart information library. For more information, call (888) 225-5773 or link to www.pse.com/solutions/forbusiness/Pages/efficiencyComPrograms.aspx.
- **U.S. Department of Energy's** (US DOE) EERE Information Center can provide technical assistance on a wide variety of building efficiency questions. Call (877) 337-3463 or link to <http://www.eere.energy.gov/buildings/>.
- **WSU Energy Program Library** has funding from US DOE to provide information for anyone in Washington State information on energy efficiency. Call (360) 956-2076, link to www.energy.wsu.edu/library/, or visit them at 905 Plum Street SE, Building #3, Olympia. The library has one of the most extensive collections of literature and on-line databases in the country.
- **The Lighting Design Lab** in Seattle offers classes ranging from beginning home lighting to advanced controls workshops, both on-site and off-site. In

many cases Continuing Education Credits are available for their classes. Their experienced lighting specialists will meet with you, either on-site or off-site, to review plans for your project and recommend efficient lighting and control strategies, cost-effective products, and other ways to give your building the quality lighting it deserves. Call (800) 354-3864, link to www.lightingdesignlab.com/index.html, or visit them at 400 East Pine St. in Seattle.

- **The Northwest Building Efficiency Center (NBEC)** delivers information on energy efficient technologies to builders, code officials and public building managers so they can significantly reduce building energy use in the region. They offer publications, web resources, training, library research, technical assistance, on-site assessments, peer matching, and speakers. Call (866) 929-6232 or link to www.nwbuildings.org.
- **Lightsearch.com** (www.lightsearch.com) is a specialized search engine for locating lighting products and companies. You can search for fixtures, lamps, ballasts and more.
- **Trade Ally Network** website at www.northwest-lighting.com/TradeAlly.aspx, where you may search for a variety of professional services.

Conclusion

The City of Tumwater has committed to climate change mitigation through their participation in the U.S. Mayor's Climate Protection Agreement and the ICLEI Five Milestones process and even developed their own detailed Climate Change Action Report. Given that greenhouse gas emissions come largely from energy use, the City is thus committed to make significant reductions in the energy use of their facilities and vehicles. Given the sharp increases in all energy prices over recent years that are expected to continue, the City has shown wise leadership by proactively moving to conserve their energy and financial resources while taking responsibility for their part of climate change. The city will enjoy the non-energy benefits of improved comfort and productivity.

Unfortunately, the City's facility energy use has continued to increase steadily since the energy conservation program started in 2003 other than a slight dip between 2005 and 2006. It is hoped that the observations, recommendations, and additional information resources contained in this report will support the city in developing and implementing a more aggressive and successful energy management plan.

The first step towards this goal is to create an internal energy management program with energy accounting, benchmarking, and the establishment of a Resource Conservation Manager position. The next step is to arrange for more detailed energy assessments of the facilities identified as the best opportunities for energy efficiency improvements. This would be followed by funding, implementation, and documentation of recognition for accomplishments. The GA-WSU Team will be providing assistance with many of these items in Phase 2 of IAA 2008-710 and can direct the City to other organizations to provide additional assistance.