



Mission Statement: To advance the understanding and practice of sound energy and resource management principles, and to provide a network among business, government, and utilities for information, education, and leadership.

TABLE OF CONTENTS

Table listing contents: Holiday Forum (1), President's Corner (2), Energy Manager of the Year Awards (2), Fall Forum: Advancing Smart Grid (3), Chilled Beams: An Emerging HVAC Technology Showing up in Oregon Eugene State Office Building (3), Fast Pyrolysis in Roseburg (4), United Nations Climate Change Conference (4), New Options for Energy Efficient Grocery Stores (5), Measured Savings For Boiler & DDC Projects (6), Portland Public Schools Solar Roofs (7)

HOLIDAY FORUM

Please join us December 10th for the 2009 Oregon APEM Holiday Forum to examine energy efficiency opportunities in refrigeration systems. We have several exciting presentations on tap covering both a commercial refrigeration efficiency pilot project, and details on the application and analysis of variable refrigerant flow systems. Of course, you don't want to miss finding out who has received the coveted recognition as an Oregon APEM Energy Manager of the Year.

The Holiday Forum begins with an inside look at Kaizen Blitz, a new Production Efficiency program piloted by Energy Trust of Oregon. Kaizen Blitz has focused on several sites with substantial refrigeration loads, providing technical support to identify and help implement no-cost/low-cost energy savings measures. The first participants to complete projects, a dairy and a grocery cold storage facility, are realizing outstanding results. Find out the details when Rob Morton, Vice President of Cascade Energy Engineering presents "Kaizen Blitz Re-tunes Refrigeration Systems, Saves Big".

We will also take a real world look at the performance and challenges of using Variable Refrigerant Flow Systems (VRF) in the Northwest. VRF has great energy efficiency potential; but is it delivering the goods? How do we compare VRF to conventional HVAC systems, when AHRI does not have an approved methodology for testing and rating the efficiency of VRF systems? Join Dana Troy, Energy Analyst, GLUMAC Engineering for "Variable Refrigerant Flow Systems (VRF) in the Northwest" an analytical perspective on quantifying VRF performance. This presentation will be followed by, what you've all been waiting for, the Oregon APEM Energy Manager of the Year Awards. After lunch we are offering a tour of a VRF installation in Portland at the beautiful new Mercy Corps World Headquarters building.

Oregon APEM Holiday Forum "A Cool Look at Refrigeration" on December 10, 2009 from 7:30 AM to 2:00 PM at the Embassy Suites in Portland, Oregon

Location: Embassy Suites - Easily accessible by Max and Bus 319 SW Pine Street, Portland, Oregon

- 7:30-8:00 Registration - coffee and pastries
8:00-8:15 Welcome and Introductions - David Christie, Oregon APEM President
8:15-9:15 Rob Morton, Vice President, Cascade Energy Engineering
9:15-9:25 Break
9:25-10:25 Dana Troy, Energy Analyst, GLUMAC Engineering
10:25-10:45 Networking Break
10:45-11:45 Energy Manager of the Year Awards & 2010 Year Announcements - David Christie, Oregon APEM President
11:45-12:45 Buffet Lunch & Networking - included in registration fee
1:00 - 2:00 Tour of Mercy Corps World Headquarters - features full VRF system, integrated solar and eco-roof

You can register online at: www.regonline.com/oregon\_apem\_2009\_holiday\_forum

Or go to our website www.OregonAPEM.org and click the registration link. If you have any questions please contact David Christie: (503) 435-3115 e-mail: djc@mc-power.com



Oregon Association of Professional Energy Managers

P.O. Box 6764
Portland, OR 97228-6764



## PRESIDENT'S CORNER

It's hard to believe I am writing the last President's Corner for 2009 already. I would like to recap briefly what Oregon APEM has accomplished this year.

We held three successful forums. The last one was the Fall Forum on "Advancing Smart Grid." There were over 90 attendees and I heard much positive feedback on it. Kudos to Jessica Rose and her team for

a job well done. Read further in this newsletter to find out more and also watch the OregonAPEM.org web site for PowerPoint presentations from all our recent forums.

Another very encouraging development this year is strong support from two student chapters of Oregon APEM: the Lane Community College (LCC) Chapter in Eugene and the Oregon Institute of Technology (OIT) Chapter in Portland. Andy Kuss, who is now a regular Oregon APEM Board member, helped start the LCC chapter. Jake Soto, a former Oregon APEM student Board member helped start the OIT chapter and is this year's president there. Students from both colleges are active on the Oregon APEM Board and regularly attend the forums. We also reach out to other local colleges. To also help encourage student membership, at the last Board meeting, we voted to amend the membership term for students to run from September to August, coinciding with the school year.

Oregon APEM is an organization of Energy Professionals that works to help further the goals of energy managers in promoting conservation and the efficient use of energy. Oregon APEM is an excellent resource, whether it be in the form of learning about new technologies, networking with colleagues, or meeting prospective new employers and employees. The increase in student membership provides an excellent resource for fresh, new and dedicated talent for the energy efficiency field.

I believe, especially now, in this time of economic hardship, energy efficiency is a field that has a very promising future. My best wishes to all you and keep "kicking watts."

Sincerely,

**David Christie**

President, Oregon APEM

## ENERGY MANAGER OF THE YEAR AWARDS

Each year Oregon Association of Professional Energy Managers chooses to honor those who have made outstanding contributions to our field by designating them as the Energy Manager of the Year. Only individuals or organizations that have made outstanding accomplishments or achievements in the field of energy management are eligible to receive this award. An Energy Manager of the Year will have gone above and beyond expectations; their work will have broken new ground, inspired the Energy Management community, or have contributed to the broader knowledge in the field of energy management and conservation. The Energy Manager of the Year 2009 awards will be presented at the Oregon APEM Holiday Forum.

Awards are given in up to three categories each year. Typically the three categories are 1) Utilities, 2) Government or Institutions, and 3) Individual or Commercial. Occasionally there will be exceptional work that defies classification; this will result in the nominee receiving the President's Award. A few of the past Energy Manager of the Year recipients have included:

- **Northwest Energy Education Institute (NEEI), Institutional/Program Energy Manager of the Year 2008:** for their educational work in the field and their roles contributing to the excellence of our local (sometimes national and international) energy professionals.
- **The founders and organizers of the Building Simulation Users Group (BSUG). Commercial/Industrial Energy Manager of the Year 2008:** for their continuing work in improving the quality of energy modeling.
- **Governor Ted Kulongoski, President's Award 2007:** recognizing Oregon's Governor for his energy conservation leadership and significant contributions towards reducing the impacts of global climate change.
- **Reid Hart at Eugene Water and Electric Board (EWEB), Utility Manager of the Year 2007:** for his leadership and contributions to EWEB's commercial energy conservation programs. Specifically recognizing his work on the development and promotion of the Western Premium Economizer program.
- **Dave Cone and Gresham Barlow School District, Government Institutional Energy Manager of the Year 2004:** The US Department of Energy and the Environmental Protection Agency have recognized Gresham-Barlow as the most energy efficient school district in the entire country.

Join us at the Oregon APEM Holiday Forum on December 10th 2009 to honor those who continue to make our state and the northwest leaders in energy management, renewables and conservation.

# FALL FORUM: ADVANCING SMART GRID



*Oregon APEM Board members Sara Hope Smith and Colleen Collins greet attendees to the fall forum.*



*The fall forum was at maximum capacity as attendees listened to dynamic presentations on smart meters.*

With growing energy demand, increasing electricity costs, rising grid congestion and the critical need to bring new sources of renewable energy to the grid, the smart grid is a hot topic these days. The Oregon APEM Fall Forum, held on October 8th at the World Trade Center in Portland focused on the efforts underway to advance smart grid. Oregon's energy management professionals came out in record numbers to show their interest.

Steve Hawke, Senior Vice President, Portland General Electric started things off by sharing with us what we can hope to achieve with smart grid and what PGE's doing to help get us there. Central to the smart grid system is the smart meter, an advanced electric meter capable of providing real time information and feedback on grid performance. Earlier this year, PGE began the installation of more than 800,000 smart meters across their 4,000 square mile service territory. PGE believes this investment will lead to better utility management, more effective response time, and provide customers with more accurate and timely billing. One of Steve's analogies compared our current electrical system to the gas guzzling V-8 powered cars of the 60's, and said where we are going with smart grid is equivalent to fuel injection, overhead cams, and aluminum blocks allowing cars to use less than half the fuel to achieve comparable performance.

We also heard from JR Gonzalez of the Oregon Public Utilities Commission about the need for smart grid, the obstacles in the regulatory system and the changes in the works to smooth the transition. Lastly, Bob Jenks, Executive Director of the Citizens

Utility Board offered a more critical look at issues we must consider as the region advances smart grid. He talked of what we need and how current efforts including PGE's smart meters aren't getting us there. He raised questions about the maturity of the technology and potential replacement costs as larger states like California implement similar programs. Bob made the case that smart grid needs to go beyond one-way communicating devices reacting to the grid needs, that these "smart" devices need to give useful real time feedback to us, the consumer.

Each of these presentations was followed by a lively question and answer period. And as always the forum included ample opportunities for networking and discussion. For those who could stick around after lunch, the forum was capped off with the rare opportunity for tours of Portland General Electric's Load Control Center and Distributed Generation Load Center.

Oregon APEM felt it was important and timely to connect our members with Northwest leaders driving this significant shift towards smart grid. The forum provided great dialogue to help connect the visions with the realities that energy managers will have to face to meet the challenges and opportunities on the horizon. Northwest communities and leaders continue to attract attention from political, environmental and business leaders all the way to the White House. We hope that the information provided will help you as an energy professional to continue this dialogue and be a player in the advancement of smart grid.

## CHILLED BEAMS: AN EMERGING HVAC TECHNOLOGY SHOWING UP IN OREGON EUGENE STATE OFFICE BUILDING

Chilled beams have been used extensively throughout Europe, and now we have the opportunity to see how they perform in our moderate Oregon climate. The renovation of the Eugene State Office Building completed in late spring of 2009, incorporated "Chilled Beams" as the basis for their HVAC upgrade. You will have a chance to see their new HVAC system and ask questions about how it is working during the tour of the Eugene State Office Building that is being arranged as part of the Oregon APEM 2010 Spring Forum in Eugene.

## FAST PYROLYSIS IN ROSEBURG



*Kate Brown stands in front of the fast pyrolysis machine at the demonstration near Roseburg.*



*The machine produces bio-oil, which smells like hickory.*

On a hot day in late August, Kate Brown, Secretary of State and Chair of the Oregon Sustainability Board, and staff members attended a demonstration of fast pyrolysis. The Umpqua National Forest hosted the demonstration at the Lemelo Sand Shed, about 90 minutes up the Umpqua River highway from Roseburg.

Fast pyrolysis is the rapid thermal decomposition of organic compounds in the absence of oxygen. It creates three products – a liquid bio-oil, a solid bio-char, and a collection of gases known as syngas. The organic feedstock must be dry before utilization in the pyrolyzer's reactor that heats it to over 1000°F. The bio-oil may directly power space heaters, furnaces, boilers, and some turbines. Due to the excessive water and acidity, it needs refining before use in combustion engines, like a car or heavy machinery as bio-diesel. The bio-char is a finely ground, carbon-rich, charcoal ash for possible use in the agricultural industry as a soil amendment. It helps plants grow up to seven times faster. The syngas is a collection of combustible gases that can be recycled back into the machine to keep it running and to perpetuate the cycle.

But, what does this have to do with sustainability? Here's the answer. The area around Roseburg suffered greatly when the lumber mills closed due to economic drivers. The organic matter that feeds the fast pyrolysis machine comes from woody debris, or woody biomass, sustainably harvested out of the forests. By sustainably harvesting the woody debris, it eliminates possible fuel for catastrophic forest fires and at the same time can be used for this new process.

Fast pyrolysis creates new jobs for unemployed forest and wood experts, creates a fossil fuel alternative, and prevents major forest fires. It's a win/win for environmentalists and the forest community. Once they develop the most cost-effective manner to refine the bio-oil into a compatible fuel for combustion engines, this process shows tremendous promise for Douglas County, and other areas that surround Oregon's 4.25 million acres of forest-lands that could produce woody biomass.

**More pictures:** [http://sustainability.oregon.gov/DAS/FAC/SUSTOR/osb\\_photos\\_roseburg.shtml](http://sustainability.oregon.gov/DAS/FAC/SUSTOR/osb_photos_roseburg.shtml)

**More information:** <http://www.fs.fed.us/r6/umpqua/projects/fast-pyrolysis/index.shtml>

## UNITED NATIONS CLIMATE CHANGE CONFERENCE

The Kyoto Protocol is Due to Expire in 2012. The United Nations Climate Change Conference, scheduled for December 7 through December 18, 2009 in Copenhagen, Denmark, is the conference where the details of the treaty to succeed the Kyoto Protocol are expected to be worked out. The United States never adopted the Kyoto Protocol; but currently is showing interest in influencing the outcome of the Copenhagen Conference.

The Kyoto Protocol was not adopted by the United States because it never received consent of 2/3rd of the Senate. If any of you, as energy professionals, are interested in sharing your extensive knowledge on energy conservation and climate change with our United States Senators or with the President, email contact information through their respective websites is listed below. The websites all note that because of security measures mail to their Washington DC offices is delayed by two to three weeks and suggest using email.

### President Barack Obama

<http://www.whitehouse.gov/contact/>

### Oregon United States Senators

**Jeff Merkley**  
[merkley.senate.gov/contact/](http://merkley.senate.gov/contact/)

**Ron Wyden**  
[wyden.senate.gov/contact/](http://wyden.senate.gov/contact/)

### Washington State United States Senators

**Maria Cantwell**  
[cantwell.senate.gov/contact/](http://cantwell.senate.gov/contact/)

**Patty Murray**  
[murray.senate.gov/contact/](http://murray.senate.gov/contact/)

## OIT STUDENT CHAPTER NEWS

This is an exciting time for students in the energy field. There is a lot to learn and Portland is the place to be. As the year unfolds we anticipate new experiences and opportunities to expand our knowledge of energy management. We look forward to seeing you all at the winter forum

Fall term has been busy at OIT and the Oregon APEM student club is gearing up for the forthcoming year. We held our first meeting of the year on Thursday, September 1st. This meeting was intended to raise interest among new students and to reengage returning students. We discussed the benefits of Oregon APEM, announced the Fall Forum, and had a guest speaker, Kellee Jackson. She spoke about the organization and her experiences with it, as well as, giving a summary of her career background and how it relates to energy management. We had a great turn out. New and returning students were excited to hear about the fall forum and several were able to attend.

The student officers are hard at work planning events for the current and future terms. Our goal each term is to have one student member meeting, as well as one evening speaker, and one weekend tour of a local or regional energy related business/building. A couple of ideas that were brought up during an officers meeting were tours of a wind farm and a presentation about energy auditing. As the year goes on and student involvement increases we hope to incorporate ideas and suggestions from student members. If any Oregon APEM members would be interested in speaking to our group or leading a tour we would love to hear from you. Please contact Colleen Collins at [colleen.collins@oit.edu](mailto:colleen.collins@oit.edu).

# NEW OPTIONS FOR ENERGY EFFICIENT GROCERY STORES

Several new products have recently been introduced by manufacturers of grocery store refrigeration equipment. Some of these currently make more economic sense to implement than others. This article describes six of these energy efficiency measures and discusses typical paybacks (based on typical Oregon commercial rates of about \$0.06 blended per kWh) and does not including utility incentives or tax credits (which vary by region and can cover 10% to 70% of project costs).

**Case Lighting:** LED lighting is available for new reach-in frozen food display cases from all the major manufacturers. 35-watt LED lamps replace 60-watt 5' T12 High Output lamps. The extra cost for LEDs in a new case can vary by a factor of four, depending on the manufacturer. Paybacks are about 15 years prior to incentives or tax credits. LED retrofit kits are available for existing cases, and the quality of these kits varies significantly. The best kits generate lighting that is similar to the existing fluorescent lights, and the worst kits leave the aisle looking like a Christmas tree with white lights everywhere. One major manufacturer now offers an LED option for the under-shelf lighting in open refrigerated meat display cases. These 15-watt LED lights replace the standard 32-watt T8 lamps. The cost of these LED under shelf lights is still very high (about \$300 per shelf) with a payback of about 30 years.

**Triple pane glass doors** with an anti-fog coating are available from most manufacturers of reach-in frozen food display cases. The triple pane glass saves energy by reducing heat loss through the doors and through reducing the size (and energy use of) the case anti-sweat heaters. The triple pane glass door option with anti-fog coating costs about \$150 per door and the payback is usually under 10 years when ordered with new cases. Triple pane doors are available as a retrofit for some models of cases, but the installed cost triples (about \$450 per door) and the savings decrease (because the anti-sweat heaters cannot be adjusted in the field).

**Electrically commutated motors (ECM)** are now available as a high efficiency option for the small fractional horsepower evaporator fan motors used on display cases and walk-in coolers. These evaporator motors range in size from 1/25 hp to ¼ hp. The standard (shaded pole) motors used for years on evaporator fans are about 20% efficient, permanent split capacitor (PSC) motors are about 40% efficient, and the recently introduced ECM motors achieve about 65% efficiency. Until 2009 there was no federally mandated efficiency requirement for fractional horsepower motors, and as a result shaded pole motors were widely used and the 40% efficient PSC motors were marketed as the high efficiency option. The use of shaded pole motors in refrigeration cases and walk-in coolers was just outlawed; now manufacturers can only use medium efficiency PSC motors or the new high efficiency ECM motors. Using electrically commutated motors instead of permanent split capacitor motors in new cases cost about \$35 each and can payback in 5 years. Retrofitting existing motors to ECM motors will cost at least twice as much. If you are considering an ECM retrofit, it is very important to find an experienced and knowledgeable contractor. ECM motors are complex to program – each motor can be set up to operate 8 different ways. They offer more flexibility, but also are more complex to install and difficult to set up properly when not factory-installed.

**Compressors:** Scroll compressors have recently been introduced by major refrigeration manufacturers and they are often promoted as an energy efficient option. However, a close examination of the performance data shows that the most efficient of the reciprocating style compressors are often up to 10% more efficient than the new scroll type compressors over much of their normal operating ranges. The maintenance costs of scroll compressors are much lower compared to reciprocating style compressors so they are expected to generate maintenance savings, even when they do not provide energy savings. Often the Scroll compressors can be equipped with variable speed drives to vary the capacity to more closely match the load on the compressor. Variable speed drives if used to vary capacity are assumed to automatically generate large energy savings, but it is more common for manufacturers to vary the capacity by axially separating the scroll members to unload the compressor. Scroll compressors equipped with variable capacity control (unloaders) are less efficient than the best reciprocating compressors. One manufacturer publishes data showing that at 50% load their scroll compressor (with variable capacity unloader) uses 60% power (while their reciprocating compressor uses 50% power), and at 33% load the scroll uses 45% power (compared to the reciprocating using 33% power). It doesn't always save energy to replace a reciprocating compressor with a scroll (though it often may). Verify condition and model of compressor and then do careful calculations before recommending replacement of a good quality reciprocating compressor with a scroll.

Variable speed drives have recently been field added to some reciprocating compressors (not by the factories that make the compressors), even though the major manufacturers do not publish performance data to allow quantification of energy savings. The use of the variable speed drives on reciprocating compressors does permit a soft start on the motor which decreases wear and tear on the compressors, but the energy savings that can be generated from their use does not appear to be significant.

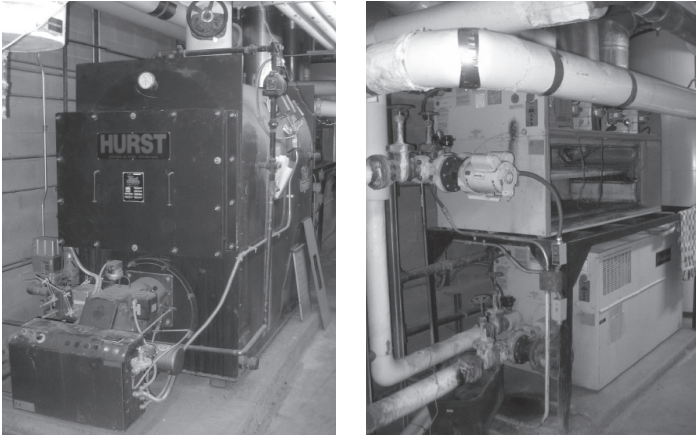
**Heat recovery** from refrigeration compressors can be effectively used to generate domestic hot water in grocery stores, which use a fair amount of hot water for cleaning. Heat recovery for space heating is also economically advantageous in both the mild and extreme climate zones in Oregon, primarily due to the relatively low electric rates and relatively high gas rates we currently have throughout most of Oregon.

**Daylight controls** underneath skylights can generate large energy savings for new grocery stores, although careful attention must be paid to the design, installation and commissioning of the controls so that they work properly. Care must also be taken to determine the appropriate size and spacing of the skylights to maximize lighting savings while minimizing night time heat loss (and daytime heat gain) through the skylights (which have an insulating R-value of about 2 compared to the roof which will have an R-value of about 20).

# MEASURED SAVINGS FOR BOILER & DDC PROJECTS



Exterior of facility. Photograph by Dennis Oberto.



Old boiler on left, (2) old water heaters on right. Photographs by Dennis Oberto.

The Umatilla County Justice Center recently lowered their annual natural gas use by 52%. They accomplished this by installing two new high efficiency condensing boilers and a new DDC system to control their central HVAC systems.

The Umatilla County Justice Center is a 75,000 square foot county jail located in the high desert of eastern Oregon. It opened in 1997 and houses approximately 150. The floors are concrete, the walls are masonry with modest glazing in the offices, and there is a flat, built-up roof with insulation.

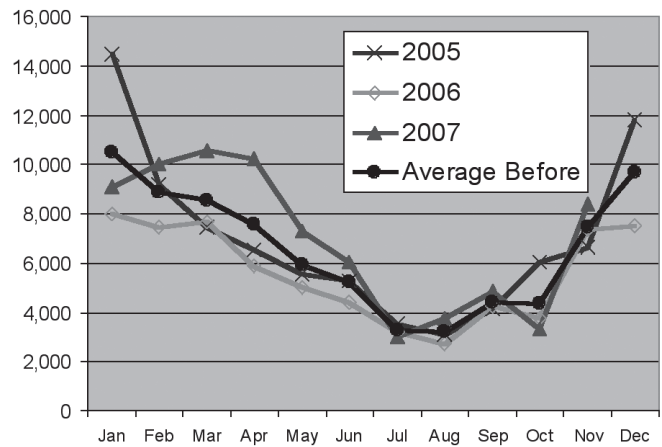
The central plant consisted of one hot water boiler (3,000 MBH) for space heat, and two domestic water heaters (1,300 MBH each). This provided one backup domestic water heater in case one unit was down for repairs, but left the owner without a backup boiler for space heating.

The spaces are heated and cooled by 70 water-source heat pumps. Ventilation air is provided to each water-source heat pump through a central air handling system that delivers 10,000 cfm of outside air. There is one major exhaust air handler, and a runaround glycol heat recovery loop that transfers heat from one airstream to the other. The ventilation air is heated to 65 F through a heat recovery coil and a backup hot water coil and then it is ducted to each water source heat pump. There is also a closed circuit cooling tower that can remove heat from the water-source heat pump loop as needed.



(2) New Boilers. Photograph by Steve Rubbert.

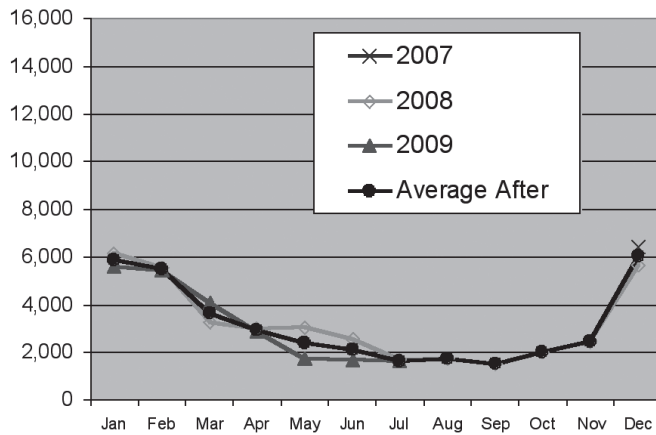
## Gas Use Before Upgrade



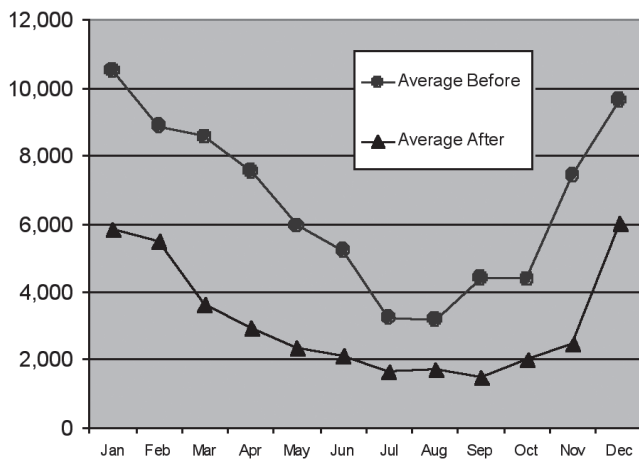
The natural gas use was averaged over 3 years before the upgrades were installed to determine the baseline gas use of the facility. The summer gas use prior to the upgrade was very consistent from year to year when only domestic hot water was being generated, but when the space heating boiler was operating the monthly use varied significantly from year to year. These larger monthly variations are attributed to temporary failures of the automatic HVAC controls and manual adjustments made by staff to maintain occupant comfort until the controls could be repaired.

In the winter of 2007 one of the domestic water heaters failed. The owner wanted to know what their options were for a high efficiency replacement. The Energy Trust of Oregon sponsored a free energy audit that presented the owner with an option to install high efficiency domestic water heaters, and another option to install two new high efficiency condensing boilers (2,000 MBH each) that could replace both of the domestic water heaters and the space heating boiler. The owner decided to replace all three existing water heaters & boiler, and upgrade the central HVAC system controls with a web-enabled DDC system.

## Gas Use After Upgrade



## Gas Use Before & After



The first (20) months of gas bills since the project was completed have been averaged to determine a “post-upgrade” average gas use.

In the (20) months since this project was installed the average annual gas use has been reduced by 52%.

The new condensing boilers operate with an efficiency ranging from 90% to 95%, depending on the firing rate and the return water temperature. The old boiler and domestic water heaters operated with seasonal efficiencies estimated at 70-75%.

The new DDC system incorporates control strategies for the heat recovery system and the water source heat pump loop.

Two important non-energy benefits of this project are that they now have a backup boiler for space heating, and they have also reduced the quantity of gas-fired equipment they must maintain.

*Submitted by: Rich Davis of Abacus Resource Management Company. Feel free to contact Rich Davis at 503-936-7163 for more information.*

## PORTLAND PUBLIC SCHOOLS SOLAR ROOFS

In Summer 2009, Portland Public Schools (PPS) completed the first large-scale solar project undertaken by a public school district in Oregon. In conjunction with a re-roofing project at nine schools (Atkinson, Creston, Jackson MS, Lane MS, Lent, Columbia/Pioneer HS, Roseway Heights, Scott, and Woodstock), PPS installed 5,565 solar photovoltaic thin-film modules on nearly 130,000 square feet of roof. The project was completed by the start of the 2009-10 school year and cost approximately \$6 million. Through an innovative partnership with Gerding Edlen Sustainable Solutions and a third-party investor, PPS will pay \$0.07 per kWh (escalating at 3% annually) for the next 6-8 years. At the end of that period, PPS will assume full ownership of the system. The 757KW system is expected to produce about 695,000 kWh annually – enough to power, on average, 18% of the nine schools. Solar educational kiosks and materials at the schools allow teachers to integrate renewable energy into classroom learning. PPS has nearly 6 million square feet of roofs and will continue to seek opportunities to incorporate solar as a way to provide a portion of the 40 million kWh that PPS consumes annually.

FAST FACTS	
Project Cost	\$6 Million
Location	9 schools
# of Modules:	5,565 modules (one module is 18 ft x 15.5 in)
Sq Ft of Roof Covered	129,386 square feet
Project Capacity	757 KW (DC)
Power Production	695,000 kWh (AC) annually
% of School Powered	Atkinson (48%), Creston (11%), Jackson (13%), Lane (13%), Lent (37%), Columbia/Pioneer (15%), Roseway Heights (7%), Scott (49%), Woodstock (10%); 18% (average all schools)
PPS Power Cost	\$0.07 per kWh (3% per year escalation rate)
Production Started	August-September 2009
Solar Thin-Film Manufacturer	Uni-Solar, Auburn Hills, MI
Inverter Manufacturer	PV Powered, Bend, OR
Designed & Constructed by	Gerding Edlen Sustainable Solutions, Portland, OR Northwest Solar Solutions, Portland, OR
Third-Party Ownership	SRI Investments LLC
Solar Kiosk & Education	Bonneville Environmental Foundation, Energy Trust of Oregon, Portland General Electric, Pacific Power
Production Data	<a href="http://www.solar4Rschools.org">www.solar4Rschools.org</a>
For more information	Catherine Diviney, Energy Specialist Portland Public Schools 503-916-2000 x74414 <a href="mailto:cdiviney@pps.k12.or.us">cdiviney@pps.k12.or.us</a>



Oregon Association of  
Professional Energy Managers

P.O. Box 6764  
Portland, OR 97228-6764



**Mission Statement:** To advance the understanding and practice of sound energy and resource management principles, and to provide a network among business, government, and utilities for information, education, and leadership.