

# ShopTalk

Plant Operations Support Consortium

Volume 19, Number 3

Spring 2015

## Carbon Dioxide Refrigerant Heat Pumps – An Introduction to a Game-Changing Technology

By Ken Eklund, WSU Energy Program, Building Science Team Leader

What if there was a natural refrigerant that could be used in heat pump water heaters (HPWHs) that had the thermal lifting power to heat water in a single pass from ground water temperature to 150°F, using only heat from outside air as cold as minus 20°F? There is, and that refrigerant is carbon dioxide (CO<sub>2</sub>). One might think of CO<sub>2</sub> only as a pollutant responsible for heating up our planet. However, pound-for-pound, conventional refrigerants have a vastly greater climate change impact than CO<sub>2</sub>.

To investigate other uses for CO<sub>2</sub> refrigerant, the WSU Energy Program conducted the first field study in the Pacific Northwest using CO<sub>2</sub> refrigerant in residential HPWHs. Our lab tests show very impressive results. Using the same Northern Climate scale that the Northwest Energy Efficiency Alliance uses to rate HPWHs, the CO<sub>2</sub> HPWH rated 3.2 compared

to traditional HPWHs, which rate in the low 2+ range.

WSU utility partners are interested because the test system is a split system – all the heat is taken from outside air by the compressor and exchanged to water, which is pumped to a storage tank inside the house. Unlike conventional residential HPWHs, there is no negative impact on heated space (that is, heat is not taken from conditioned inside air).

Four utilities partnered with WSU to find test sites:

- Tacoma Power helped put one in Tacoma;
- Ravalli Electric Coop found a very cold site above Corvallis, Montana (south of Missoula);
- Avista located a system in Addy, Washington (north of Spokane); and
- The Energy Trust of Oregon found a site in Portland.



Using CO<sub>2</sub> as a refrigerant was so promising that Coca Cola® started changing all of its vending machines worldwide to operate on CO<sub>2</sub> refrigerant.

Local plumbers and electricians installed the systems, and now we have over one year of data on all sites. The systems' performance, even in very cold locations, exceeds expectations. On average, they use only 25% of the energy used by an electric resistance water heater, and the test water heaters have no electric backup elements – all of the work is done by the heat pump.

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*Shop Talk* is an electronic newsletter of the Plant Operations Support Consortium, providing information focused on facility operations.

We welcome feedback from readers. To provide feedback or to subscribe to the Consortium electronic Listserv, email us at [PlantOps@energy.wsu.edu](mailto:PlantOps@energy.wsu.edu).

Archived issues of *Shop Talk* are available at:  
[www.energy.wsu.edu/PublicFacilitiesSupport/PlantOperations/ShopTalk.aspx](http://www.energy.wsu.edu/PublicFacilitiesSupport/PlantOperations/ShopTalk.aspx)

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Editing: Melinda T. Spencer  
Design: Gerry Rasmussen

WSUEEP15-015 • June 2015

## Shop Notes

By **Edwin Valbert,**  
**Consortium Manager**

With summer just around the corner, many WSU Energy Program Consortium members are gearing up to do facility-related improvements and upgrades, taking advantage of good weather and reduced use of the buildings. With that in mind, don't forget your Consortium staff stands ready to help.

Consortium support ranges from reviewing proposed project scopes, specs, and pricing to actual onsite construction management. We can also assist with selecting equipment and materials, and participate in vendor, architect, engineer, or contractor selection. If you need more room to store new equipment or supplies, we can help you find new homes for the stuff you no longer need. And if you're looking for new equipment, we can help you locate it. Don't let the busy summer repair/upgrade season overtax you and your team. Pick up the phone or drop us an email – we love to help.

I want to give a big shout out to all our sponsors, speakers, and attendees who made the **11th Annual EFC Conference** in Leavenworth a big success. The ideas shared and connections made by those who attended continue to pay dividends year-round. We are already looking forward to May 3, 4 & 5, 2016, when we will be back in



Edwin Valbert

Leavenworth for another round of connecting and learning. Conference proceedings are available on the EFC website under the "Conference Proceedings" tab ([www.energy.wsu.edu/efc](http://www.energy.wsu.edu/efc)).

Some recent examples of your Consortium offering value for membership include:

- Connecting surplus equipment with those who need it
- Assisting with LEED building reports
- Assisting with complex staffing questions
- Evaluating energy use of small appliances in classrooms
- Providing ENERGY STAR® Portfolio Manager data support

Contact us – **360-956-2230** or [plantops@energy.wsu.edu](mailto:plantops@energy.wsu.edu) – with your requests for assistance or to find out how you can save time and money by having the Consortium in your toolkit. ☺

*Edwin*

# Peninsula College Shows What a Strong Master Plan can do for Custodial Operations

By Phil Partington, Consortium Staff

Beginning in 2009, Peninsula College in Port Angeles faced significant budget challenges, which resulted in reduced staff in the facilities department. At the same time, the college replaced more than 75 percent (160,000 square feet) of its total square footage. These changes meant that the college's Custodial Operations staff had to maintain about 50,000 additional square feet with four fewer custodians while also responding to additional staff demands.

While this story isn't new for public entities, Peninsula College's Custodial Operations took an innovative approach to tackle the challenge. They recognized that they simply did not have enough time and personnel to meet these expectations, so they gathered information to better understand and manage the increased workloads and customer expectations. They began by doing a comprehensive evaluation of their processes, schedules, routes, and workloads. This included job-shadowing staff.

"It was key to involve custodial staff from the start," said Patty McCray-Roberts, director of Support Services at the college. "We wanted to make sure to take advantage of their expertise. Future capital planning and

campus standards were improved based on what we learned from them."

This led to the development of a Custodial Master Plan, which supported the overall Facility Master Plan and other strategic initiatives of the college.

"Developing the master plan really turned the tables for us," said McCray-Roberts. "It helped support an increase in staffing to meet minimum standards, and the evaluation and reduction of some workloads. Most importantly, the challenges we were facing became a collaborative college effort to solve. Through the process, the college community collectively decided what compromises they were willing to make in order to maintain a manageable level of service within our existing budget constraints. This was huge for us, and a nice outcome of our efforts."

The plan was formulated and aligned with published standards and expectations, and became the basis for communicating, decision-making, and realigning practices based on desired standards and staffing. The Custodial Master Plan, completed in 2012, provides clear expectations for workers and customers, is flexible enough to invite feedback, and



JayDee Smith and Patty McCray-Roberts

can be adjusted as needed.

McCray-Roberts explains that many side benefits to this process went beyond increased staffing and reduced workload, such as:

- Fresh ideas and best practices/solutions were applied to old problems.
- Staff buy-in and participation were incredible.
- End-users were engaged in the process and participated in decisions regarding acceptable level of services.

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# King County Emphasizes Education in Tackling Energy Goal

By Phil Partington, Consortium Staff

With the demand to conserve energy and keep up with rapid changes in technology, educating facilities staff is more critical than ever. Yet many who hold the purse strings of public organizations do not seem to understand this, which is what makes King County's innovation so special.

The county made a commitment to reduce normalized energy use of county buildings by 15 percent by the end of 2015 and 20 percent by 2020. In tackling this goal, they recognize the need to identify and support necessary changes in occupant/employee behaviors. What's most impressive is that they haven't simply acknowledged the need, but have integrated the strategy into their plan of attack.

"We emphasized upgrading technology and processes where it was most applicable," said David Broustis, energy manager with the county, "but we knew the benefits wouldn't be so fruitful if those implementing the improvements weren't properly

trained to handle the changes and be energy conscious. Ultimately, they're the ones who will determine the success of this plan."

In 2013, the county's Energy Task Force partnered with the Building Operator Certification (BOC) program ([www.theboc.info](http://www.theboc.info)), a nationally recognized, competency-based training and certification program that focuses on energy efficiency in facilities, to develop a customized approach that blended communication, training, and post-credentialing activity. This plan was carried out in three phases:

- **Phase 1** – Communicate expectations to operating engineers, supervisors, and energy managers; identify barriers; and invite staff to participate in a seven-month BOC Level 1 course.
- **Phase 2** – This was the training portion. The BOC course included a kick-off session led by energy managers and leadership to discuss goals and expectations for operating engineers. A mid-course debrief session with the engineers was held to review their action lists and to address and resolve unforeseen barriers.
- **Phase 3** – This phase included an end-of-course debrief, a mini workshop for managers that focused on practical steps to support and motivate the engineers, and continued professional development through a Level 2 course to be held in 2015.

"What's especially great about this process is that it's not something we do and then move on from," said Broustis. "The plan is that it will continue as part of our policy and culture for years to come."

Such improvements cannot be made without the support of leadership, and King County's leaders

See **King County** on page 7



David Broustis of King County and Cynthia Putnam of the National BOC Program proudly hold the county's 2015 Energy/Facilities Connections Innovations Award.

# Slash Plug Loads in 6 Steps

## Low- and no-cost tips to stop the energy drain

By Janelle Penny, senior editor of *BUILDINGS Magazine*

Plug loads are becoming one of the fastest growing end uses of energy, the New Buildings Institute warns, and their drain on energy budgets is on the rise.

This group includes any devices that plug into a building's electrical system. In a typical office, the worst offenders are desktop equipment such as computers, monitors, and printers, notes Suzanne Foster Porter, director of research and technical services for ECOVA, an energy and sustainability management firm. Small offices also see a disproportionate amount of their plug load stemming from IT closets and computer rooms.

Fortunately, occupant participation and low-cost technology can shave up to 40% off of your building's plug load. Could one of these six ideas help unlock savings at your facility?

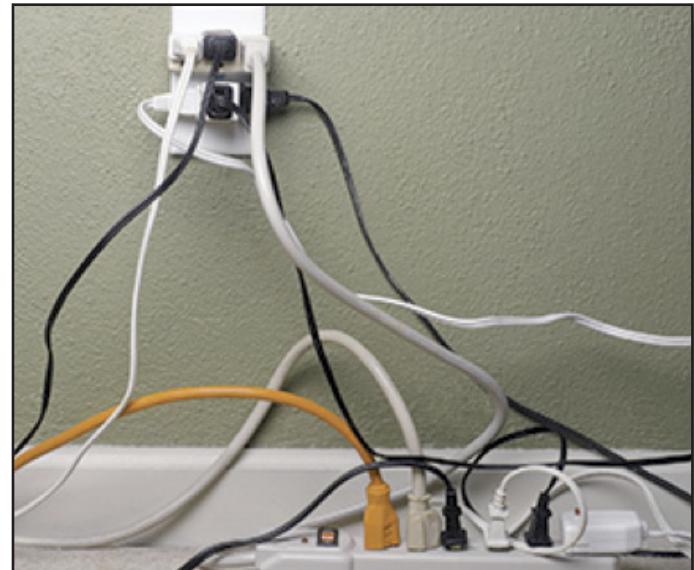
### 1) Dispel Common Myths

Many people still believe that turning computers off and then on again uses more energy than just leaving them on, Foster Porter notes. Start improving occupants' energy behavior by providing facts and figures about why your organization is pushing for lower energy consumption.

"It's important to have training for how to manage power at your workstation," Foster Porter says. "This can be done in a variety of ways, including IT onboarding, but it should be specific to what has been implemented in that person's space. The point isn't just to say what someone should do, but to tie it back to the company mission and why you're trying to reduce energy use in the first place – for example, 'We're doing this to cut costs' or 'We're doing this to walk our talk on being green.'"

### 2) Use Better Computer Settings

The default energy settings on many computers aren't very efficient, and occupants may overestimate how much energy they're saving. Using



Attack plug loads with better behavior and low-cost tools to drive down energy costs. Photo courtesy of *BUILDINGS Magazine*.

standby mode while away from the computer helps. However, some may believe their computers are saving energy on standby when their absence actually just puts the computer in idle mode. This means that after a certain number of minutes without use, the screensaver appears or the screen goes black, but the computer is still running at full power waiting for its owner to come back.

"There's not that much difference between standby and off because if a computer is truly in standby mode, it's using less power," Foster Porter says. "But users don't do a great job of powering down unless they're supported with some low- and no-cost technologies. You can implement better power management settings using software that already comes with your computers."

### 3) Scale Up to Enterprise-Level Software

Though the power management software packaged with new computers can make a sizable dent in

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## Plug Loads

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energy consumption, it also offers occupants an easy override opportunity.

"Users can change the individual power management settings on their own without necessarily understanding the implications of that change," explains Foster Porter. "If I'm tired of my computer going to sleep after 15 minutes of not being used, I can change it so it never goes to sleep, but that completely negates the power savings possible in sleep mode. Enterprise-level power management software allows users some personal control, but sets boundaries. For instance, you can have the computer turn off after four hours of inactivity so that at least it goes to sleep at night."

### 4) Try Smart Plug Strips

Consider supplementing power-saving settings with special plug strips that use timers, load sensors, or occupancy sensors to shut off power to certain devices when no one is using them.

A strip with a timer can reduce energy at night and over weekends, while one with an occupancy sensor could be used to shut off some devices (such as speakers or the monitor) when no one is present. Some models cut power to selected peripherals whenever the computer enters, sleep, standby, or disconnected mode.

"This still requires behavior intervention in terms of showing occupants the plug strips and explaining what they do, but the technology supports their actions," says Foster Porter. "They don't personally have to turn off the printer, speakers, and monitor."

### 5) Centralize Equipment

Imaging equipment like printers, scanners, and fax machines are the third biggest contributors to plug loads, Foster Porter says. If your office has dedicated printers for every desk, consider purchasing a shared one and putting it in a central location.

This strategy offers an added cost savings, as maintaining one communal printer requires much less time and labor than multiple small ones.

***There's not that much difference between stand-by and off because if a computer is truly in standby mode, it's using less power. But users don't do a great job of powering down unless they're supported with some low-and no-cost technologies.***

Suzanne Foster Porter  
Director of Research and  
Technical Services  
ECOVA

### 6) Work with IT on Purchasing

Team up with your counterparts in the IT department to make sure energy performance is included in procurement specs for future technology purchases. ENERGY STAR certified equipment is a good start, but in some cases, you may be able to find devices that use even less energy than the ENERGY STAR cap.

"Ensure that the performance specifications are well matched with what each workstation needs," recommends Foster Porter. "If someone is only using a computer for email, light word processing, and surfing the Internet, they could switch to a Mini PC instead – it's less costly than a laptop but has similar functionality in terms of processing power and speed of memory. Those are an option for many workstations where big computing isn't required." ☈

*Written by Janelle Penny and reprinted with the permission of BUILDINGS Magazine, [www.buildings.com](http://www.buildings.com)*

## Peninsula College

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During development of the master plan, JayDee Smith was the custodial lead who provided critical data needed to determine cleaning space standards. Dee is credited with keeping the lines of communication open between the custodial staff and the college. Largely resulting from his expertise and professionalism during the process, Smith is now the Auxiliary Manager who oversees the custodial staff, shipping and receiving, and room scheduling.



Peninsula College was recently honored at the 2015 Energy/Facilities Connections Conference for their innovative process in developing a strong master plan, and received one of two annual

EFC Innovations Awards. We applaud their collaboration and out-of-the-box thinking – their efforts are worthy of emulation.

If you are interested in hearing more about Peninsula College's process to develop an effective master plan, contact Patty McCray-Roberts at **460-417-7967** or [pmroberts@pencol.edu](mailto:pmroberts@pencol.edu).

The Plant Operations Support Consortium can help you with this as well. You can reach Consortium staff at **360-956-2230** or [plantops@energy.wsu.edu](mailto:plantops@energy.wsu.edu). ☀

## King County

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have made a formal commitment to train 40 or more building engineer personnel so they have the skills to improve energy performance and save taxpayer dollars.

An energy loan program was also established to help fund conservation projects. Operating engineers are now more knowledgeable about the county's energy goals and plans, and are supporting its implementation by recommending actions to improve energy efficiency. They also have a better understanding of their buildings' energy performance, know how to create an energy use benchmark, and know where to go for additional energy performance information.

Furthermore, the county now reports quarterly on its countywide energy performance and facility energy use. The county is on track to meet its 2015 energy goal and

is on trajectory to meet its 2020 energy goal, too.

Perhaps the most significant benefit, however, is that operating engineers know the leadership wants to hear their ideas about conservation opportunities.

These concepts might seem simple, but making them a reality requires out-of-the-box thinking, extensive collaboration, and a strong drive to cultivate in-house expertise. King County was one of two recipients of the annual EFC Innovations Award at the 2015 Energy/Facilities Connections Conference in Leavenworth, Washington. The Consortium applauds their efforts; their innovative approach is worth emulating.

For more information on King County's accomplishments, contact David Broustis at **206-477-4544** or [david.broustis@kingcounty.gov](mailto:david.broustis@kingcounty.gov).

For more information on the Building Operator Certification program, visit their website, [www.theboc.info](http://www.theboc.info), or contact Cynthia Putnam at **206-292-3977** or [cynthia@putnamprice.com](mailto:cynthia@putnamprice.com). ☀

**“What’s especially great about this process is that it’s not something we do and then move on from. The plan is that it will continue as part of our policy and culture for years to come.”**

”

David Broustis  
Energy Manager  
King County

## Consortium Members

### K-12 Schools

Bridgeport  
Camas  
Central Kitsap  
Centralia  
Chilliwack, BC  
Conway  
Delta, BC  
Enumclaw  
ESD 101  
ESD 121  
Eton School  
Federal Way  
Forest Ridge School of the Sacred Heart  
Highline  
Inchelium  
**Mount Vernon**  
North Thurston  
Odessa  
Olympia

Orcas Island  
Orondo  
Pateros  
Portland Public Schools, OR  
Reardan-Edwall  
Selkirk  
Shoreline  
Wenatchee  
Wishkah Valley

**Universities/Colleges**  
Bates Technical College  
Bellevue College  
Clark College  
Clover Park Technical College  
Columbia Basin College  
Community Colleges of Spokane

Everett Community College  
Highline Community College  
Lake Washington Institute of Technology  
Olympic College  
Peninsula College  
Pierce College  
South Puget Sound Community College  
The Evergreen State College  
Washington State University Energy Program  
Wenatchee Valley College

### Municipalities

#### **City of Longview**

City of Puyallup  
City of Tumwater  
Clark County  
Jefferson County  
Lakehaven Utility District  
Lewis County  
Pierce County Library System  
Skamania County  
**Sound Transit**  
Thurston County  
Whatcom County

**Miscellaneous**  
Hopelink  
Meydenbauer Center  
Multicare System

### Washington State Agencies

Corrections  
**Early Learning**  
Ecology  
**Employment Security**  
Enterprise Services  
Fish & Wildlife  
Health  
Licensing  
Natural Resources  
Parks & Recreation  
School for the Blind  
Social & Health Services  
State Patrol  
Transportation  
Veterans Affairs

*Our warm welcome to new members in **bold blue** type.  
We look forward to serving your facility and operations needs.*

## CO<sub>2</sub>

Continued from page 1

The Montana system produced enough hot water for a family of four – even with temperatures as low as minus 16°F – while only operating 25% of the time. Research of the demand response potential of these systems at Pacific Northwest National Lab showed they could provide 130 gallons of heated water per day even if shut off for 12 hours. This means these systems could provide space heat as well as hot water.

To test this idea, we are putting combined space and water heating systems in ten houses around the region, including the very cold location of McCall, Idaho, and are monitoring how they perform. While still early, the first series of results indicate positive performance.

For more information, contact Ken Eklund at 360-956-2019 or [eklundk@energy.wsu.edu](mailto:eklundk@energy.wsu.edu). ☺

**ENERGY/FACILITIES CONNECTIONS**  
WASHINGTON STATE UNIVERSITY ENERGY PROGRAM

**The 2016 Energy/Facilities Connections Conference will be**

**May 3-5, 2016.**

**Mark Your Calendars!**