Dear ROSEMARY CHIAVETTA,

Here are some additional comments to be submitted with my previous comments for the open comment period on the 2021 Technical Reference Manual. I would appreciate your help in getting these comments to the appropriate person and letting me know that you have received this.

PENNSYLVANIA PUBLIC UTILITY COMMISSION

Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources— Technical Reference Manual 2021 Update; Doc. No. M-2019-3006867

[49 Pa.B. 2074]
[June 27, 2019]

I appreciate your help again and thank you for your time again.

Brian McGowan

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Brian McGowan

Implementation of the Alternative Energy Portfolio Standards Act of 2004: Standards for the Participation of Demand Side Management Resources— Technical Reference Manual 2021 Update; Doc. No. M-2019-3006867

[49 Pa.B. 2074]
[June 27, 2019]

I would like to offer these additional comments to my original comments in response to the "Additional Residential EE&C Measure Protocols" section of the Tentative Order and "Additional C&I measures".

I would like to suggest that the commission develop a measure protocol for inclusion in the Final 2021 TRM Manual.

I believe the Drain Water Heat Recovery devices would be best listed under Section 2.3.1 – Heat Pump Water Heaters, Section 2.3.2 – Solar Water Heaters, Section 2.3.3 – Fuel Switching: Electric Resistance to Fossil Fuel Water Heater

I believe the desuperheater recovery type devices would be best listed under Section 3.2.1 – HVAC Systems. These can also be used in restaurants or ay place that has refrigeration as they work equally well on refrigeration systems as AC systems.

I am able to provide more information if requested. Please do not hesitate to ask.

Thank you for your time.
Brian McGowan
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Cost/Savings analysis

In the simplest most conservative example in Pennsylvania for a family of 4.

Installed Cost of 4" diameter by 40" (36" coil with 2" at each end for connection) length by ½" coil pipe is approximately $1025.00

Peco Electricity cost/kWh this month:

Distribution	$0.06361
Generation	$0.06211
Transmission	$0.00573
Total	$0.13145

So estimate of $0.13/kWh used in the chart below is close enough.

Estimated savings of 200kWh/month= $26.00

$1025.00 cost /$26.00 monthly savings = approximately 40 months to break even.

Greater than 15 year (180 months) service life – 40 month breakeven = 140 months

140 months remaining service life X $26.00 = $3640.00 (28,000kWh) total life savings.

I can furnish this whole document on request.

Water Heating Costs and drain water heat recovery and air conditioning heat recovery

Monthly Savings

Hospital

Occupancy per day 500	DWHR Savings Per Month	ACHR Savings Per Month
Gallons per person35		
Typical Monthly Expenditures		
Gallons of hot water per month 532,292		
Electric Water Heater Cost $12,845	$5,230	$8,563
Gas Water Heater Cost$5,110	$2,081	$3,407
BTU's Used310,491,052	BTU's Rcvrd 126,414,214	BTU's Rvcrd 206,994,035

Health Club

Showers per day300	DWHR Savings Per Month	ACHR Savings Per Month
Gallons per person25		
Typical Monthly Expenditures		
Gallons of hot water per month 228,125		
Electric Water Heater $5,505	$2,241	$3,670
Gas Water Heater $2,190	$892	$1,460
BTU's Used 133,067,594	BTU's Rcvrd 54,177,520	BTU's Rcvrd 88,711,729

Dormitory

Occupancy - 2 person per room 200

Average Occupancy98%

Gallons, per person, per day30

Person per room2

Typical Monthly Expenditures	DWHR Savings Per Month	ACHR Savings Per Month
Gallons of hot water per month 357,700		
Electric Water Heater $8,632	$3,514	$5,755
Gas Water Heater $3,420	$1,393	$2,280
BTU's Used 208,649,987	BTU's Rcvrd 84,950,352	BTU's Rcvrd 139,099,991

Full Service Hotel

Number of rooms290

Average Occupancy66%

Gallons, per person, per day30

Person per room2

Typical Monthly Expenditures	DWHR Savings Per Month	ACHR Savings Per Month
Gallons of hot water per month 349,305		
Electric Water Heater $8,429	$3,432	$5,619
Gas Water Heater $3,340	$1,360	$2,227
BTU's Used203,753,100	BTU's Rcvrd 82,956,619	BTU's Rcvrd 135,835,400

Full Service Resturaunt

Meals per day500	DWHR Savings Per Month	ACHR Savings Per Month
Gallons per meal5		
Typical Monthly Expenditures		
Gallons of hot water per month 76,042		
Electric Water Heater $1,835	$747	$1,223
Gas Water Heater $730	$297	$487
BTU's Used 44,355,865	BTU's Rcvrd 18,059,173	BTU's Rcvrd 29,570,576

Residential

Occupancy - 4 person home 4	DWHR Savings Per Month	ACHR Savings Per Month
Gallons, per person, per day 35		

Typical Monthly Expenditures

Gallons of hot water per month 4,258

Electric Water Heater $103	$42	$69
Gas Water Heater $41	$17	$27
BTU's Used 2,483,928	BTU's Rcvrd 1,011,314	BTU's Rcvrd 1,655,952

Operating Costs(DWHR) Drain Water Heat Recovery (ACHR) Air Conditioning Heat RecoveryElectric $0.13/kWhGround water temp 50 °F A/C 5 Tons residentialNatural Gas $1.004/Therm Drain water temp 100 °F A/C = 20 Tons commercialWater Heater Energy Factor 0.92 ElectricModel Efficiency 0.57 Cooling Months 8Water Heater Energy Factor 0.61 Natural GasNOTICE: These tables and calculations show potential savings that are viewed here with a range of defined variables.For an accurate estimate of savings, consult your local dealer or Swing Green for an engineering analysis of your facility.

The values contained in these estimating calculators are based on national averages from the Bureau of Labor Statistics, Environmental Protection Agency, U.S. Census Bureau and other sources.

1) . "ACEEE | Emerging Hot Water Technologies and Practices for Energy Efficiency as of 2011." ACEEE, n.d. Web. 20 Jan. 2014. http://aceee.org/research-report/a112

2). "Average Energy Prices in the Los Angeles Area." U.S. Bureau of Labor Statistics. U.S. Bureau of Labor Statistics, n.d. Web. 20 Jan. 2014. http://www.bls.gov/ro9/cpilosa_energy.htm

3). "Energy.gov." Energy Cost Calculator for Electric and Gas Water Heaters. N.p., n.d. Web. 20 Jan. 2014. http://energy.gov/eere/femp/energy-cost-calculator-electric-and-gas-water-heaters-0#output

4). "ENERGY STAR Guide for Restaurants: Putting Energy into Profits." Home : ENERGY STAR. Environmental Protection Agency, n.d. Web. 20 Jan. 2014.

http://www.energystar.gov/buildings/tools-and-resources/energy-star-guide-restaurants-putting-energy-profit

5). "Hot Water Consumption per Occupant." Hot Water Consumption per Occupant. N.p., n.d. Web. 27 Jan. 2014. http://www.engineeringtoolbox.com/hot-water-consumption-person-d_91.html6). "Hotel Revenue Statistics." Statistic Brain RSS. N.p., n.d. Web. 20 Jan. 2014.http://www.statisticbrain.com/hotel-revenue-statistics/

I can furnish this whole report on request.

Manufacturer's testing report excerpts to show example efficiencies

Intertek Listing Constructional Data Report (CDR)

Report Number G100121849CRT-002 Original Issued: 2-Aug-2010 Revised: 7-Apr-2014
Standard(s)
UL 462, Standard for Heat Reclaimers for Gas-, Oil-, or Solid Fuel- Fired Appliances
Third Edition, Dated December 13, 2010
CSA B55.2 Issue:2012/07/01 DRAIN WATER HEAT RECOVERY UNITS
CSA B55.1 Issued: 2012/07/01 Test Method for Measuring Efficiency and Pressure Loss of Drain Water Heat Recovery Units

1.0 Reference and Address

Applicant Watercycles Energy Recovery, Inc. Manufacturer (Same as applicant)

Address Box 231 110 Brewer Street Edenwold SK S0G 1K0

Country Canada
Contact Mr. Andre Cayer
Phone (306) 531-9478
FAX (519) 913-0808
Email andre@watercycles.ca

Page 1

Report No. G100121849CRT-002
Watercycles Energy Recovery, Inc.
Page 2 of 21 Issued: 2-Aug-2010
Revised: 7-Apr-2014

2.0 Product Description

Product: Drain Water Heat Exchanger Coil

Brand name: NA

Description: The product covered by this report is a drain water heat exchanger coil.

Models: DX-20XX, DX-30XX, DX-40XX, WX-20XX, WX-30XX and WX-40XX

Model Similarity: They are all manufactured in a similar fashion and the only differences are diameter and length. A DX model is a dual coil unit with a ¾ inch fresh waterline fitting and WX is a single coil, 20 means it has a 2 inch diameter drain pipe, 30 means it has a three inch diameter drain pipe and 40 means it has a 4 inch diameter drain pipe. The last two numbers (XX) are the nominal length in inches. Lengths can range from 36 to 60inches for the WX series.

Ratings: Design pressure is 200 PSI

Other Ratings: NA

Report No. G100121849CRT-002
Watercycles Energy Recovery, Inc.
Page 13 of 21 Issued: 2-Aug-2010
Revised: 7-Apr-2014
7.0 Illustrations
Illustration 7 - Rating Results for WX-30XX

Diameter(in)	Diameter (cm)	Length (in)	Calculated Efficiency (%) @ 9.5 L/min	Pressure Loss (KPA) @ 9.5 L/min
3	76.2	36	40	9.4
3	76.2	42	43	10.71
3	76.2	48	46	11.23
3	76.2	60	51	14.53

**All Efficiency results have a 0.5% Margin of error.

I can furnish this whole document on request.

The Vermont technical reference manual lists drain water heat recovery devices at this location in their TRM.

Drain Water Heat Recovery Device

Measure Number: III-D-9-a (Multifamily New Construction Program, Hot Water End Use)
Version Date & Revision History
Draft date: Portfolio 74
Effective date: 1/1/2012
End date: TBD
Referenced Documents:
1. Energy Savings calculations based on *Drain Water Heat Recovery Characterization and Modeling – Final Report, C. Zaloum, M. Lafrance, J Gusdorf, 2007.*
2. DWHR Calculator.xls

Description
Drain water heat exchanger installed to capture and reuse energy from main drain pipe to preheat incoming cold water to water heater and shower. This measure is only applicable to units serving 2 or more apartments and is not supported for buildings with natural gas since it has been found to not be cost effective.
Algorithms
Demand Savings
N/A
Energy Savings[3398]
$\square kWh = (0.017 \times \varepsilon \times 8.623 \times HS \times 365 / (DHW_e)) * FLAG$

Where: kWh = gross customer annual kWh savings for the measure (kWh)

0.017 = 60/1000/3.6 (minutes/watts/megajoules)
ε = Drain Water Heat Recovery device efficiency[399]
8.623 = Heat Flux [400]
HS = Household/Apartment Shower Minutes/Day [(Bedrooms + 1) x 5.3 [401]]
365 = Days per year
DHW_e = Domestic Hot Water Recovery Efficiency
= 0.98 [402]
FLAG = 1 if domestic hot water system is electric; 0 otherwise

Baseline Efficiencies – New or Replacement

The baseline condition is an existing or proposed main drain pipe without heat recovery.

Energy Savings[398]

[398] Energy Savings calculations based on *Drain Water Heat Recovery Characterization and Modeling – Final Report, C. Zaloum, M. Lafrance, J Gusdorf, 2007*,p. 29

[399] For example efficiencies see Zaloum, Lafrance, Gusdorf , p. 13.

[400] Assumed Showerhead flow of 1.5 gpm, Incoming Cold Water Temp of 55°F, Shower Water Temp of 105°F and a drop of 6°F from shower to drain. See 'DWHR Calculator.xls' for details of the calculation.

[401] 5.3 minutes per person per day is derived from EPA WaterSense document (http://www.epa.gov/watersense/docs/home_suppstat508.pdf) which suggests 11.6 gallons of water per person per day for shower use. This was based on a 1999 study (http://www.waterrf.org/ProjectsReports/PublicReportLibrary/RFR90781_1999_241A.pdf) that metered 1088 households for 4 weeks. The average flow rate for these showers was 2.2 gpm making the number of minutes per day 11.6/2.2 = 5.27 minutes.

[402] Electric water heaters have recovery efficiency of 98%: http://www.ahrinet.org/ARI/util/showdoc.aspx?doc=576

High Efficiency
High efficiency is installation of drain water heat recovery device.
Operating Hours
N/A
Loadshape
Loadshape #8, Residential DHW conserve

Freeridership/ Spillover Factors		Hot Water End Use	
Measure Category			
Measure Code		HWEDRAIN	
Product Description		Drain Water Heat Recovery	
Track Name	Track No.	Freerider	Spillover
C&I Retrofit	6012CNIR	n/a	n/a
Farm Retrofit	6012FARM	n/a	n/a
Cust Equip Rpl	6013CUST	n/a	n/a
Farm Equip Rpl	6013FARM	n/a	n/a
Farm Rx	6013FRMP	n/a	n/a
Pres Equip Rpl	6013PRES	n/a	n/a
C&I Upstream	6013UPST	n/a	n/a
Act250 NC	6014A250	n/a	n/a
Farm NC	6014FARM	n/a	n/a
Non Act 250 NC	6014NANC	n/a	n/a
LIMF Retrofit	6017RETR	n/a	n/a
LIMF NC	6018LINC	1.0	1.0
LIMF Rehab	6018LIRH	1.0	1.0
MF Mkt NC	6019MFNC	1.0	1.0
MF Mkt Retro	6020MFMR	n/a	n/a
C&I Lplus	6021LPLU	n/a	n/a
Efficient Products	6032EPEP	n/a	n/a
LISF Retrofit	6034LISF	n/a	n/a
RES Retrofit	6036RETR	n/a	n/a
RNC VESH	6038VESH	n/a	n/a
EP GMP Blueline	6042EPEP	n/a	n/a
GMP Furnace	6042EPEP	n/a	n/a
GMP HP	6046RETR	n/a	n/a
VEEP GMP	6048VEEP	n/a	n/a
LIMF Lplus	6052LPLU	n/a	n/a
MFMR Lplus	6053LPLU	n/a	n/a

Persistence
The persistence factor is assumed to be one.
Lifetimes
25 years [403]

Measure Cost
The incremental cost for drain water heat recovery device varies based on the length of the device and the application.

403 Conservative estimate based on product manufacturer published expected lifetime.

	Application		Device Cost [404]	Installation Cost[405]	Total Cost
Length					
SHORT DWHR Device	36" – 40"	New Construction	$560	$100	$660

36" – 40"	Retrofit	$560	$200	$760
MEDIUM DWHR Device 60"	60"	New Construction	$702	$100	$802
	Retrofit	$702	$200	$902
LONG DWHR Device 80"	80"	New Construction	$980	$200	$1180
	Retrofit	$980	$300	$1280
EXTRA-LONG DWHR Device 100"-120"	100"-120"	New Construction	$1200	$200	$1400
	Retrofit	$1200	$300	$1500

404 Device Costs based on available pricing August 2011. Prices vary based on quantity, location, and retailer.
405 Installation costs for retrofit application assumes typical accessibility of main drain line.
406 Assume Tier 1 efficiency level boilers (94% gas or 85% oil) with indirect water heaters (efficiency assumed to be 0.92 * boiler efficiency).

O&M Cost Adjustments

There are no operation and maintenance cost adjustments for this measure

Fossil Fuel Descriptions

□MMBtu = (0.017 x ε x 8.623 x HS x 365 /DHWe) x 0.003412 x (1-FLAG)

Where:

□MMBtu = Annual MMBtu fossil fuel savings per residential unit for the measure

□kWh = kWh savings calculated above

0.003412 = Converts kWh to MMBtu

DHW_e = Fuel Domestic Hot Water Recovery Efficiency

= 86% if gas, 78% if oil [406]

FLAG = 1 if domestic hot water system is electric; 0 otherwise

Reference Tables

None

404 Device Costs based on available pricing August 2011. Prices vary based on quantity, location, and retailer.
405 Installation costs for retrofit application assumes typical accessibility of main drain line.
406 Assume Tier 1 efficiency level boilers (94% gas or 85% oil) with indirect water heaters (efficiency assumed to be 0.92 * boiler efficiency).

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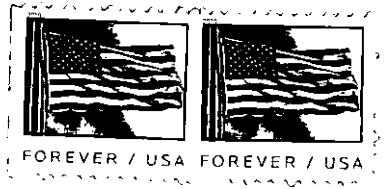

Public Utility Commission
400 North Street.
Harrisburg, PA 17120
ATTN: Rosemary Chiavata
Docket# M-2019-3006867

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