Triennial Plan VI Potential Measures Memorandum

To:	Lauren Scott; Efficiency Maine Trust
From:	John Walczyk, Eduardo Ramirez-Lopez, Matthew Wisnefske, Kyland Narcisse, Arthur Winfield; Cadmus
Subject:	Potential Measure Cost Effectiveness Memo
Date:	June 18, 2024

Introduction

Cadmus is supporting Efficiency Maine Trust to review the measures incentivized by other programs and new and emerging technologies to identify any measures that might be included in the Triennial Plan VI period not currently incentivized by the Trust. As a result of that review, Cadmus was asked to develop a list of potential energy efficiency, beneficial electrification, and demand response measures that may be offered in the next program cycle (Triennial Plan VI: 2026-2028). While the Trust's current suite of measures was found to be extensive, some potential new measures were identified through our research. In addition, the Trust provided some measures that had been of interest to Staff, including heat pump clothes dryers and commercial refrigeration measures and for Cadmus to assess the cost effectiveness of these measures.

For the new potential measures, Cadmus derived estimated electric energy, capacity, fuel savings, and incremental measure cost from various jurisdictions' Technical Research Manuals (TRMs), white papers, and secondary sources. These inputs represent Cadmus' most informed approximation of what potential savings would be achievable for similar measures installed in Maine. However, these estimates should still be viewed in the context of reasonable uncertainty in measure performance without in-situ evaluated inputs. In the following memo, we include our research approach and initial findings.

Research Process

The Cadmus team reviewed the Trust's current list of measures, its residential and commercial TRMs, and then researched other jurisdictions' incentivized measures and TRMs. This research was compiled in a measure spreadsheet that is attached. A number of measures not currently incentivized by the Trust were identified and discussed with Trust staff. After closer scrutiny, most of these measures were deemed unsuitable for the Maine climate or unlikely to result in savings because of the Maine climate, and were set aside. With the Trust, the team identified twelve measures as promising enough to merit further, detailed research and cost-effectiveness analysis.

Potential Measure Insights for Cost Effectiveness

Cadmus gathered information for the costs, savings, and effective useful life (EUL) of twelve measures, each of which could potentially be included in future Efficiency Maine program offerings. A summary of inputs by measure is provided in Table 1.

Table 1. Equipment Consumption and Savings by Type

Mc Measure	Measure Unit	Electric Energy Savings (kWh)	Capacity Reduction (kW)	Fuel Savings (MMBtu)	Incremental Cost ($)	EUL (Years)	Data Source
Timer on Existing Water Cooler	Per Unit	251.45	-	-	$22.77	5	Regional Technical Forum (RTF)
Advanced Rooftop Unit Controller	Per Ton	11,732.00	3.159	13.50	$509.08	10	IL TRM v 12
Tub Spout Thermostatic Shut-off Valves	Per Unit	147.00	0.005	25.00	$191.99	2 or 10	WI Focus on Energy 2024 TRM
Heat Pump Clothes Dryer with Electric Baseline	Per Unit	435.00	0.056	-	$811.02	12	MI MEMD
Commercial Solar Thermal Water Heating	Per sq. ft.	-4.69	-0.0004	0.68	$207.52	15	CA eTRM
Residential Solar Thermal Water Heating	Per sq. ft.	-118.38	-0.008	11.58	$7,217,03	15	CA eTRM
Induction cooktop with Electric baseline	Per Unit	30.00	0.07	-	$475.00	16	NY TRM v10
Induction cooktop with Fuels baseline	Per Unit	-	-	0.90	$475.00	16	NY TRM v10
Air Curtains	Per Unit	70,666.67	10.77	-	$6,960.00	15	NY TRM v10
Drain Water Heat Recovery Electric and Fuels DHW	Per Unit	5,769.45	0.03	-	$600.00	30	NY TRM v10
Micro VSHP with Fuels Baseline	Per Unit	277.00	0.050	0.79	$72.50	12	NEEA 2022 RETAC
Heat Pump Combi Water Heater with Dual Baselines	Per Unit	578.70	0.020	3.00	$4,700.00	25	Fortis BC
Interior Cellular Shades	Per sq. ft.	0.97	-	0.00	$1.88	13.7	CO TRM

Summary of Cost-Effectiveness Analysis

Cadmus ran a benefit to cost ratio (BCR) analysis using Efficiency Maine's Primary Cost Test tool. For each measure, an appropriate summer peak factor was determined based on estimated anticipated runtimes, seasonality, and comparability to other program measures. In-service rate (ISR) and realization rates for energy and demand (RRe and RRd) were set to one, while free-ridership and spillover were set to zero. Avoided costs were based on the 2024 Avoided Energy Supply Cost study by Synapse Energy Economics[i], including the social cost of carbon discounted at 2%. Measures were not anticipated to offset any other form of energy generation (including propane, heating oil, kerosene, wood, or gasoline)

[i] AESC 2024 Materials | Synapse Energy (synapse-energy.com)

as most inputs were taken from TRMs where existing electric measures or natural gas were being offset by each measure. Additionally, the team did not calculate potential non-energy benefits, such as water savings. Finally, no program administration, implementation, evaluation, or other costs were included as part of this analysis. Given the above discussion, the results below should be considered exploratory and approximate. Ideally, in-state evaluated results would provide a clearer picture of the potential value these measures could offer. Results from the BCR calculations are provided in Table 2.

Table 2. Preliminary Benefit/Cost Ratio Analysis

Measure Name	BCR Gross
Timer on Existing Water Cooler	10.47
Advanced Rooftop Unit Controller	73.23
Tub Spout Thermostatic Shut-off Valves (10-year EUL)	33.09
Tub Spout Thermostatic Shut-off Valves (2-year EUL)	7.83
Heat Pump Clothes Dryer with Electric Baseline	1.55
Commercial Solar Thermal Water Heating	0.90
Residential Solar Thermal Water Heating	0.50
Induction Cooktop with Electric Baseline	1.06
Induction Cooktop with Fuels Baseline	0.64
Air Curtains	31.95
Drain Water Heat Recovery Electric and Fuels DHW	35.77
Micro VSHP Fuels Baseline	15.23
Heat Pump Combi Water Heater with Dual Baselines	0.75
Interior Cellular Shades	1.12

Description of Measures

The following identified measures highlight those that had a greater than 1.00 benefit to cost gross ratio using AESC 2024:

- **Timer on Existing Water Cooler** - This measure is for the use of a plug-in wall timer that turns off a water cooler during specified hours to prevent unnecessary energy use. This saves energy by reducing standby losses from water cooler cycling to keep cold or hot water ready to dispense. For this measure to show the savings and benefit to cost ratio presented to Efficiency Maine Trust, the timer must be grounded and have capability of 7-day programmable scheduling with battery backup and must be installed on a water cooler.[ii]

- **Advanced Rooftop Unit Controller** - The Advanced Rooftop Controls (ARC) measure installs demand-controlled ventilation with optional supply-fan speed control via a variable-frequency drive to a single-zone, packaged HVAC unit with a functioning integrated economizer already installed. The demand-controlled ventilation modulates the outside air damper based on CO_2 concentration in the conditioned space. The supply-fan speed control options consist of setting the fan speed to 40%

[ii] Regional Technical Forum. (2024, April 3). *Commercial Water Cooler Timer Research Strategy*. Commercial timers on water coolers. https://rtf.nwcouncil.org/measure/commercial-timers-water-coolers/

in ventilation mode and to 90% in heating and cooling modes, or of setting the fan speed to 40% in ventilation mode, to 75% in 1st stage heating and 1st stage cooling modes, and to 90% in 2nd stage heating and 2nd stage cooling modes. The measure results in fan, cooling, and heating savings compared to a baseline scenario of constant-volume, constant-ventilation operation typical of single-zone, packaged HVAC units. BCR Gross calculation assumes savings for a low-rise office, a 10 ton heating/cooling capacity HVAC, and a 2-speed supply fan control.[iii]

- **Tub Spout Thermostatic Shut-off Valves** - This measure is installing a thermostatic shut-off valve (TSV) to the existing tub spout and a normally closed, low-flow shower head (or a shower head equipped with a thermostatic valve) to replace a typical tub spout diverter valve and standard-flow showerhead. The valve diverts water flow to the shower head once the temperature reaches 95°F, then the showerhead also closes, thereby conserving water and saving energy required for water heating.[iv] The team considered the potential variance in EUL for this measure, alternating between a two- and ten-year assumption. In both cases, the measure was highly cost effective. The cost effectiveness would drop below one if the installation rate for this measure were to fall below 15%.

- **Heat Pump Clothes Dryer with Electric Baseline** - This measure is installing a dryer that operates without the need of an exhaust vent to the outside. It features a tumbler like a conventional dryer, but instead of blowing hot air over the clothes and dispersing that air outside through a duct system, a heat pump dryer recycles the air. It warms it in the tumbler, then condenses the moisture into water via evaporative cooling.[v]

- **Induction Cooktop with Electric baseline** - This measure is applicable to the replacement of electric resistance cooktops with electric induction cooktops. Induction cooktops heat food faster, are easier to clean, are less likely to burn users, and have a higher cooking efficiency than electric resistance stoves.

- **Air Curtains** - Also known as air doors, air curtains act as a controlled barrier for environmental and thermal separation between conditioned and unconditioned air when a building's doors are opened. They reduce cross mitigation of warm, lighter air flowing through the upper part of the opening and cold, heavier air flowing through the lower part of the opening while allowing an uninterrupted flow of traffic and unobstructed vision through the opening.[vi]

[iii] (2023). (tech.). *2024 Illinois Statewide Technical Reference Manual for Energy Efficiency* (12th ed., Vol. 2: Commercial and Industrial Measures, p. 510).

[iv] Public Service Commission of Wisconsin. (2024). (rep.). *Wisconsin Focus on Energy 2024 Technical Reference Manual* (pp. 672–673). Madison, WI.

[v] Deziel, C. (2024, February 5). *What to know about heat pump dryers*. Family Handyman. https://www.familyhandyman.com/article/heat-pump-dryer/

[vi] New York State Joint Utilities. (2023). (tech.). *New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs* (10th ed., Ser. Residential, Multi-family, and Commercial/Industrial Measures, p. 508).

- **Drain Water Heat Recovery Electric and Fuels DHW** - This measure covers the installation of drain water heat recovery systems on a main waste drain in commercial applications. Drain water heat recovery (DWHR) systems are drainage heat exchangers that recover heat from drain greywater to preheat cold water entering the water heater. By preheating cold water entering the storage tank, the water heater consumes less energy to heat the water to the desired temperature.

- **Micro VSHP Fuels Baseline** - This measure is a micro heat pump which is an appliance that works on the same principles as an air conditioner. Vertical stack heat pumps (VSHP), also known as heat pump ventilation or micro heat pumps, use energy from ventilated air to heat your home and/or water. Micro VSHPs (Variable Speed Heat Pumps) are a new development in the market and consequently, there is limited existing cold-climate research on this measure. However, The New York State Energy Research and Development authority (NYSERDA) program is conducting a pilot program involving 72 Micro VSHPs (or Window HPs), with potential expansion to 30,000 units if the pilot is successful. [vii]

- **Interior Cellular Shades** – This measure is pleated shades for windows, which creates "cells" between pleats and captures air between the shade and the window, to provide added insulation to reduce energy loss through windows. [viii]

Among all tested measures, the highest BCRs were observed for advanced rooftop unit controllers, tub spout thermostatic shut-off valves with a ten-year assumed EULs, air curtains, and drain water heat recovery. Other units that passed the gross BCR include timers on existing water coolers, tub spouts with thermostatic shutoff valves with a two-year assumed EULs, and micro-variable speed heat pumps (VSHP) with a dual fuel baseline[ix], and Heat pump clothes dryers with electric baseline. The Induction Cooktop with Electric baseline and Interior Cellular Shades measures pass the gross BCR by a slimmer margin.

[vii] NEEA. (2023, June 18). *Micro HP Field Study*. Micro Heat Pump Field Study Results - Product Council. https://neea.org/product-council-documents/micro-heat-pump-field-study-results-product-council

[viii] Office of Energy Efficiency & Renewable Energy. (2021, Dec). Interior Cellular Shades Boost Home Energy Performance. https://www.energy.gov/sites/default/files/2021-12/bto-cellular-shades-factsheet-112221.pdf

[ix] More about this pilot study can be found https://www.nyserda.ny.gov, or on the following hyperlink: https://www.nyserda.ny.gov/About/Newsroom/2023-Announcements/2023-09-20-Governor-Hochul-Announces-Installation-Of-Window-Heat-Pumps-For-New-York-City