From Behavior Change to Environmental Outcomes In Sustainable Hospitality: Metrics, Formulas, Variables, & Assumptions

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Northeast Waste Management Officials' Association (NEWMOA)

Connecticut • Maine • Massachusetts • New Hampshire • New Jersey • New York • Rhode Island • Vermont

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Introduction

The Northeast Waste Management Officials' Association (NEWMOA) is undertaking an effort to improve the measurement and estimation of positive environmental outcomes from sustainable hospitality practices. This work was initiated to support state and local government programs that are conducting outreach, assistance, and certification initiatives within the hospitality sector. The intent is to improve the ability of these programs to calculate the positive environmental impacts of their sustainability efforts and thereby not only strengthen these programs but also lead to broader adoption of sustainable practices and better messaging and marketing of sustainable hospitality initiatives.

This Final document represents the conclusion of Phase 1 of NEWMOA's Hospitality Metrics Project. It contains a series of formulas for calculating environmental outcomes from sustainable hospitality efforts. These formulas allow for estimating environmental outcomes from behavior changes tracked at facilities. This document is intended to provide complete transparency as to the underlying assumptions made, including references for data points that are used.

NEWMOA began Phase 1 by examining the metrics used by Maine's Environmental Leader Certification Program for hospitality businesses and Vermont's Green Hotels Program. NEWMOA also reviewed the metrics used in Florida's Green Lodging Performance Worksheet and New York State's Environmental Performance Worksheet. Many other online calculators, tools, and resources were also examined. The formulas and data points used by these state programs were examined and in some cases NEWMOA staff spoke with state program staff to better understand the background behind their measurement methodologies. Areas where the formulas, underlying data, and/or assumptions could be improved upon were identified through these discussions. NEWMOA staff worked to further develop the formulas, analyze and improve upon the assumptions, and research data sources to use in populating the formulas.

A Draft document for Phase 1 was circulated in July 2010. NEWMOA invited approximately 400 sustainable hospitality practitioners and other stakeholders to review and comment on the Draft. The formal review period ended on September 27, 2010 and NEWMOA held a webinar to review the comments received and discuss the next steps on October 19, 2010. A total of 79 people downloaded the draft and 5 submitted written comments; 45 people attended the live webinar and contributed to the discussion. This Final document represents NEWMOA's work to address the comments received during the review period and revise and incorporate new information (where applicable).

In addition, this document attempts to include "real-world scenario" examples for each metric based on the 2008 summary data from Maine's Environmental Leader Certification Program for lodging facilities in the State. In 2008, Maine's certification program listed 98 lodging facilities with a total of 4,813 rooms among them. For the purposes of this exercise, NEWMOA estimates 100 facilities with a total of 5,000 rooms in each of the metric examples. NEWMOA also uses the data collected from Maine's program when creating examples for other metrics, such as estimating the total number of incandescent bulbs replaced with CFLs throughout all the facilities in a state program (in this case, NEWMOA estimates 20,000 bulbs). Please note that although the examples used in this document assume that every single room in every single facility is implementing each of the sustainable practices (i.e., 100 percent compliance with each metric); this is not true of the Maine program, or any other program known to NEWMOA. The data used in the examples is meant to represent the maximum potential environmental savings that could result from implementing these practices if all facilities participate.

In subsequent phases of the project NEWMOA will use these formulas and data points to create online tools that technical assistance providers and lodging operations can use to calculate the environmental benefits of their sustainability efforts. This online resource will be available online for anyone to use. It will walk the user through a series of questions about practices at the facility and, using the calculators developed by NEWMOA with input from state programs, the system will calculate environmental outcomes associated with behavior changes, such as gallons of water saved by facilities that implement a linen/towel reuse program.

For more information about NEWMOA's Hospitality Metrics Project, visit: www.newmoa.org/prevention/projects/hospitality/measurement.cfm.

Metrics Key

Blue text = direct measure (provided by the facility or state technical assistance program)
Green text = part of the formula for this metric is linked to a previous calculation
Red text = point of note that programs and/or facilities should consider when estimating their own results
Purple links = links to a calculator, tool, or website referenced or used in a calculation
Underlined text = links to another Section in the document
Italicized text = intermediate measure or previously calculated metric used in calculation
Yellow highlighted bold text = final environmental outcome

Acknowledgements

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Metrics Category #1
Water Conservation Measures

Section 1A: Implementing Laundry Reuse Programs for Towels and Linens

Variables:
Total number of guest rooms = direct measure from the facility[i]
Occupancy rate (i.e., percent of guest rooms that are filled on a given night) = 54.7%[1]
Average length of guest stay = 2.47 nights[2]
Participation rate (i.e., percent of guests that participate in the reuse program) = 55.8%[3]
Average number of guests/guest stay (per room) = 1.72[4]
Number of towel sets saved per guest per guest stay = 1.47 towel sets[5]
Number of bed linens saved per guest per guest stay = 1.47 bed linen sets[6]
Pounds of laundry per towel set = 1.75 lbs.[7]
Pounds of laundry per bed linen set (queen sized) = 3 lbs.[8]
Gallons of water per pound of laundry = 2.69 gallons[9]

Formulas:
(Occupancy rate) x [(number of rooms) x (365 nights/year) x (stay/room days)] = *Guest stays per year*

(Participation rate) x {(Guests/stay) x [(Number of towel sets saved/guest) x (pounds/towel set)] + [(number of bed linen sets saved/guest) x (pounds/bed linen set)]} = *Pounds of laundry saved per stay*

(*Guest stays/year*) x (*pounds of laundry saved/stay*) = *Pounds of laundry saved per year*

(*Pounds of laundry saved/year*) x (gallons of water/pound of laundry) =
Gallons of water saved per year when instituting a laundry reuse program for towels and bed linens

Example – 5,000 Rooms in a State Program:
(0.547) x [(5,000 rooms) x (365 nights/1 year) x (1 stay/2.47 room days)] = *404,160 guest stays per year*

(0.558) x {(1.72 guests/1 stay) x ([(1.47 towel sets saved/1 guest) x (1.75 pounds/1 towel set)] + ([(1.47 bed linen sets saved/1 guest) x (3 pounds/1 bed linen set)])} = *6.7 pounds of laundry saved per stay*

(*404,160 guest stays/1 year*) x (*6.7 pounds of laundry saved/1 stay*) = *2,707,872 pounds laundry saved per year*

(*2,707,872 pounds of laundry saved/1 year*) x (2.69 gallons of water/1 pound of laundry) =
7,284,175.68 gallons of water saved per year when instituting a laundry reuse program

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[i] Note: Although the number of guest rooms is supplied separately by each facility, state technical assistance programs should add up the number of guest rooms across all participating facilities to get the total number of guest rooms in the Program.

Section 1B: Switching to Ozone Washers for Laundry

Note: This metric does not take into consideration the reduced loads of laundry that may result from a laundry reuse program. It is designed to be used separately from Metric #1A and to demonstrate the water savings when an ozone washer is used in place of a traditional machine.

Variables:
Total number of guest rooms = direct measure from the facility
Occupancy rate (i.e., percent of guest rooms that are filled on a given night) = 54.7%[10]
Average number of guests/guest stay (per room) = 1.72[11]
Pounds of laundry per towel set = 1.75 lbs.[12]
Pounds of laundry per bed linen set (queen sized) = 3 lbs.[13]
Difference in gallons of water per pound of laundry = 0.46 gallons[14]

Formulas:
(Occupancy rate) x (number of rooms) x (365 days/year) = *Room days per year*

(*Room days/year*) x (guests/guest room) = *Guests per year*

(*Guests per year*) x [(Number of towel sets/guest) x (pounds/towel set)] + [(number of bed linen sets/guest) x (pounds/bed linen set)] = *Pounds of laundry generated per year*

(*Pounds of laundry/year*) x (gallons of water saved/pound of laundry) =
Gallons of water saved per year when using Ozone washers

Example – 5,000 Rooms in a State Program:
(0.547) x (5,000 rooms) x (365 days/1 year) = *998,275 room days per year*

(*998,275 room days/1 year*) x (1.72 guests/1 guest room) = *1,717,033 guests per year*

(*1,717,033 guests/1 year*) x ([(1 towel set used/1 guest) x (1.75 pounds/1 towel set)] + [(1 bed linen set used/1 guest) x (3 pounds/1 bed linen set)]) = *8,155,906.75 pounds of laundry generated per year*

(*8,155,906.75 pounds of laundry/1 year*) x (0.46 gallons of water saved/1 pound of laundry) =
3,751,717.11 gallons of water saved per year when using Ozone washers

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Section 1C: Switching to Low-flow Showerheads

Variables:
Average number of guests per year = *calculated in Section 1B*
Difference in flow rate (gallon/min) from non-conserving shower head to conserving shower head = 1.83 gpm[15]
Average length of shower (minutes) = 8.2 minutes[16]
Average number of showers/day/guest = 0.67 showers per day[17]

Formulas:
(*Guests per year*) x [(Difference in flow rates, gallons/minute) x (average length of shower, minutes) x (average number of showers/day/guest)] =
Gallons of water saved per year when switching from standard to low-flow shower heads

Example – 5,000 Rooms in a State Program:
(*1,717,033 guests/1 year*) x [(1.83 gallons saved/1 minute) x (8.2 minutes/1 shower) x (0.67 showers/1 day/1 guest)] =
17,263,084.12 gallons of water saved per year when switching to low-flow shower heads

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Section 1D: Switching to Low-flow Faucets & Faucet Accessories

Note: Low-flow faucet accessories include faucet restrictors, flow regulators, aerators, and laminar devices.

Variables:
Average number of guests per year = *calculated in Section 1B*
Difference in flow rate (gallons per minute) from non-conserving faucets to conserving faucets = 0.52 gpm[18]
Average number of minutes a faucet is run per day = 8.1 minutes[19]

Formulas:
(*Guests per year*) x [(Difference in flow rates, gallons/minute) x (minutes/day/guest)] =
Gallons of water saved per year when switching from standard to low-flow faucets

Example – 5,000 Rooms in a State Program:
(*1,717,033 guests/1 year*) x [(0.52 gallons saved/1 minute) x (8.1 minutes/1 day/1 guest)] =
7,232,143 gallons of water saved per year when switching to low-flow faucets

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Section 1E: Switching to Low-flow (High-efficiency) Toilets

Variables:

Average number of guests per year = *calculated in Section 1B*
Difference in flush volume per flush = 1.2 gallons[20]
Average number of flushes per day per person = 5.32 flushes[21]

Formulas:

(*Guests per year*) x [(Difference in flush volume, gallons/flush) x (number of flushes/day/guest)] =
Gallons of water saved per year when switching from standard to high-efficiency toilets

Example – 5,000 Rooms in a State Program:

(*1,717,033 guests/1 year*) x [(1.2 gallons saved/1 flush) x (5.32 flushes/1 day/1 guest)] =
10,961,538.67 gallons of water saved per year when switching to high-efficiency toilets

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Metrics Category #2
<u>Reductions in Chemical Use</u>

Section 2A: Cleaning Detergent Reduced when Implementing Laundry Reuse Programs

<u>Variables:</u>
Pounds of laundry saved per year = *<u>calculated in Section 1A</u>*
Amount of detergent per pound of laundry = 0.00177 gallons of detergent [22]

<u>Formulas:</u>
(*Pounds of laundry saved/year*) x (0.00177 gallons of detergent/pound of laundry) =
Amount of detergent saved per year from reduced wash loads

<u>Example – 5,000 Rooms in a State Program:</u>
(*2,707,872 pounds of laundry saved/1 year*) x (0.00177 gallons of detergent/1 pound of laundry) =
<u>4,792.93 gallons of detergent saved</u> per year from reduced wash loads

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Section 2B: Chlorine Bleach Reduced when Implementing Laundry Reuse Programs

<u>Variables:</u>
Pounds of laundry saved per year = *<u>calculated in Section 1A</u>*
Amount of chlorine bleach per pound of laundry = 0.37 ounces[23]
Unit conversion = 1 gallon is equivalent 128 ounces

<u>Formulas:</u>
(*Pounds of laundry saved/year*) x (oz. of bleach/pound of laundry) x (1 gallon/128 oz.) =
Amount of chlorine bleach saved per year from reduced wash loads

<u>Example – 5,000 Rooms in a State Program:</u>
(*2,707,872 pounds of laundry saved/1 year*) x (0.37 oz. of bleach/1 pound of laundry) x (1 gallon/128 oz.) =
<u>7,827.44 gallons of chlorine bleach saved</u> per year from reduced wash loads

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Section 2C: Switching to Ozone Washers for Laundry

Note: This metric does not take into consideration the reduced loads of laundry that may result from a laundry reuse program. It is designed to be used separately from Metrics #2A and #2B, and to demonstrate the cleaning chemical savings (i.e., detergent and chlorine bleach) when an ozone washer is used in place of a traditional machine.

Variables:

Pounds of laundry generated per year = *calculated in Section 1B*
Difference in ounces of cleaning chemicals per pound of laundry = 0.138 ounces[24]
Unit conversion = 1 gallon is equivalent 128 ounces

Formulas:

(*Pounds of laundry/year*) x (oz. of chemicals saved/pound of laundry) x (1 gallon/128 oz.) =
Amount of cleaning chemicals saved per year when using Ozone washers

Example – 5,000 Rooms in a State Program:

(*8,155,906.75 pounds of laundry/1 year*) x (0.138 oz. chemicals saved/1 pound of laundry) x (1 gallon/128 oz.) =
8,793.09 gallons of chemicals saved per year when using Ozone washers

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Section 2D: Use of Environmentally Preferable Cleaners

Note: The calculator used in this metric provides assumptions for annual amounts of products used based on square footage and also makes assumptions of % hazardous materials in each based on the average formulation for each type of cleaner. All values are editable if direct measures are available.

Variables:

Total number of guest rooms = direct measure from the facility
Total number of hotels = direct measure from the technical assistance program
Average square footage of guest room = 300 sq. ft.[25]
Average square footage of common spaces = 3,000 sq. ft.[26]

Formulas:

[(Number of guest rooms) x (square feet/guest room)] + [(number of hotels) x (square feet of common space/hotel)] = *Total square footage*

Total square footage plugged into the following EPA calculator: http://www.fedcenter.gov/janitor/ =
Reductions in the type/amount of chemicals (lbs.) by making changes in cleaning products or processes

Example – 5,000 Rooms in a State Program:

[(5,000 guest rooms) x (300 square feet/1 guest room)] + [(100 hotels) x (3,000 square feet of common space/1 hotel)] = *1,800,000 total square footage*

- Enter *1,800,000 total square feet* into the following EPA calculator: http://www.fedcenter.gov/janitor/
- Indicate that the facilities use all of the products (except the ones that do not have a default value)
- Indicate that the facilities will implement all green changes listed in the form
- Generate report (see image below)

	Maximum Reduction Percent	Total Product (lbs)	Hazmat Content (lbs)	HazMat %
Amounts Used Before		**41958**	**8666**	**21**
Purchasing Controls				
Buy/Mix According to Shelf Life	2	785.2	154.9	
Buy Non-Aerosols	10	835.2	262.4	
Buy or Rent Pre-treated Dust Mops	5	0	0	
Improve Mixing				
Mixing Station or Designated Chef	20	4198.8	649.3	
Product Changes				
Less Toxic Ingredients	25	0	1654.6	
Use Fewer Products	5	1158.3	199.2	
Work Changes				
Vacuuming Techniques	1	196.7	42.1	
Clean By Need Not Schedule	20	5107.2	1017.8	
Training Emphasis / Monitor Use	5	2097.9	433.4	
Microfiber Mops	25	1021.9	157.8	
Other Changes				
Auto-Flush Valves	5	443.7	60.6	
Building Perimeter Mats	1	147.2	31.4	
Floor Mats Below Urinals	5	216	21.6	
Reductions From Making Changes		**16208.1**	**4685.1**	
Amount Used After Changes		**25749.9**	**3980.9**	**15**

16,208. 10 pounds of cleaning products and 4,685.10 pounds of hazardous chemicals reduced by making changes in

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Metrics Category #3
<u>Reductions in Energy Use</u>

Section 3A: Total Energy Reduced When Implementing a Laundry Reuse Program

Note: This metric is used to calculate energy savings in both electrical consumption (kWh), from powering the machine, and natural gas energy (BTUs or therms), from using less hot water, both in quantity and temperature. Therefore, the variables and assumptions used for kWh and BTUs in this example are not meant to be equal.

<u>Variables:</u>
Pounds of laundry saved per year = <u>*calculated in Section 1A*</u>
Electricity used per pound of laundry = 0.02 kWh[27]
Natural gas used per pound of laundry = 800 BTUs[28]

<u>Formulas:</u>
[(*Pounds of laundry saved/year*) x (electricity saved/pound of laundry)] =
Total kWh saved per year from reduced laundry loads
<u>And</u>
[(*Pounds of laundry saved/year*) x (natural gas saved/pound of laundry)] =
Total BTUs of energy saved per year from reduced laundry loads

<u>Example – 5,000 Rooms in a State Program:</u>
[(*2,707,872 pounds of laundry saved/1 year*) x (0.02 kWh saved/1 pound of laundry)]
<u>54,157.44 kWh saved per year</u> from reduced laundry loads
<u>And</u>
[(*2,707,872 pounds of laundry saved/1 year*) x (800 BTUs saved/1 pound of laundry)] =
<u>2,166,297,600 BTUs of energy saved per year</u> from reduced laundry loads

Note: These savings are equal to approximately 21,663 therms.

Section 3B: Total Energy Reduced When Switching to Ozone Washers for Laundry

Note: This metric does not take into consideration the reduced loads of laundry that may result from a laundry reuse program. It is designed to be used separately from Metric #3A, and to demonstrate the total energy savings (electricity and natural gas) when an ozone washer is used in place of a traditional machine.

Also note that there are two separate calculations included in this metric. The first covers savings in electricity consumption associated with running the machine. The second calculation covers natural gas reductions from using less hot water, both in quantity and temperature.

Variables:

Pounds of laundry generated per year = *calculated in Section 1B*
Difference in electricity used per pound of laundry = 0.01 kWh[29]
Difference in natural gas energy used per pound of laundry = 600 BTUs[30]

Formulas:

[(*Pounds of laundry/year*) x (electricity saved/pound of laundry)] =
Total kWh saved per year when using Ozone washers
And
[(*Pounds of laundry/year*) x (energy saved/pound of laundry)] =
Total BTUs of energy saved per year when using Ozone washers

Example – 5,000 Rooms in a State Program:

[(*8,155,906.75 pounds of laundry/1 year*) x (0.01 kWh saved/1 pound of laundry)] =
81,559.07 kWh saved per year when using Ozone washers
And
[(*8,155,906.75 pounds of laundry/1 year*) x (600 BTUs saved/1 pound of laundry)] =
4,893,544,050 BTUs of energy saved per year when using Ozone washers

Note: These savings are equal to approximately 48,935 therms.

Section 3C: Hot Water Heating Reduced When Installing Low-Flow Water Devices

Note: Some facilities may only implement one of the water activities listed below; for those facilities, the gallons of water saved for the other activity would be zero. Installing low-flow or high-efficiency toilets are not included as a water conservation activity in this metric because the water used in these devices is not heated.

Variables:
Gallons of water saved per year from low-flow showers = *calculated in Section 1C*
Gallons of water saved per year from low-flow faucets = *calculated in Section 1D*
Energy needed to heat one gallon of water = 581 BTUs[31]

Formulas:
(Gallons of water saved from low-flow showers) + (gallons of water saved from low-flow faucets) = *Total water savings per year*

(*Total gallons of water saved per year*) x (energy needed per gallon of water) =
Total BTUs saved per year from reductions in water use

Example – 5,000 Rooms in a State Program:
(17,263,084.12 gallons) + (7,232,143 gallons) = *24,495,227.12 total gallons of water saved per year*

(*24,495,227.12 gallons of water saved/1 year*) x (581 BTUs energy used/1 gallon of water) =
14,231,726,956.72 BTUs saved per year from reductions in water use

Note: These savings are equal to approximately 142,317.27 therms.

Section 3D: Reducing Water Temperature Settings in Guest Rooms

Note: This metric does not take into consideration the reductions in the amount of water used that may result from a facility installing low-flow showerheads or low-faucets in their guest rooms. It is designed to be used separately from Metric #3C.

Variables:

Average number of guests per year = *calculated in Section 1B*
Average flow rate (gallons per minute) from standard showers = 4.06 gpm[32]
Average length of shower (minutes) = 8.2 minutes[33]
Average number of showers/day/guest = 0.67 showers per day[34]
Average flow rate (gallons per minute) from standard faucets = 1.75 gpm[35]
Average number of minutes a faucet is run per day = 8.1 minutes[36]
Difference in energy needed to heat one gallon of water to maximum temperatures = 191 BTUs[37]

Formulas:

(*Guests per year*) x {[(flow rate gallons/minute) x (average length of shower) x (average number of showers/day/guest)] + [(flow rate gallons/minute) x (average minutes faucet run/day/guest)]} = *Total gallons of water used per year*

(*Total gallons of water used/year*) x (Difference in energy used/gallon of water) =
Total BTUs saved per year by reducing maximum hot water temperatures for guests

Example – 5,000 Rooms in a State Program:

(*1,717,033 guests/1 year*) x {[(4.06 gallons used via shower/1 minute) x (8.2 minutes/1 shower) x (0.67 showers/1 day/1 guest)] + [(1.75 gallons used via faucet/1 minute) x (8.1 minutes/1 day/1 guest)]} = *62,654,534.17 gallons of water used per year*

(*62,654,534.17 gallons of water used/1 year*) x (191 BTUs saved/1 gallon water) =
11,967,016,026. 47 BTUs saved per year by reducing maximum hot water temperatures for guests

Note: These savings are equal to approximately 119,670.16 therms.

Section 3E: Replacing Incandescent Bulbs with CFLs in Guest Rooms

Variables:
Total number of incandescent bulbs replaced with CFLs = direct measure from the facility[ii]
Occupancy rate (i.e., percent of guest rooms that are filled on a given night) = 54.7%[38]
Difference in electricity consumption per CFL vs. standard incandescent (watts) = 47 watts[39]
Use per day (time) = 3 hours[40]

Formulas:
(Number of bulbs replaced with CFLs) x (number of watts saved per CFL) / 1,000 = *Total kilowatts saved*

(*Total kilowatts saved*) x [(Occupancy rate) x (number of hours used per day) x (365 day/1 year)] =
Total kWh saved per year by switching to CFLs

Example – 20,000 Incandescent Bulbs Replaced with CFLs Throughout the State Program:
(20,000 bulbs) x (47 watts saved/1 CFL) / 1,000 = *940 kilowatts saved*

(*940 kilowatts saved*) x [(0.547) x (3 hours of light bulb usage/1 day) x (365 days/1 year)] =
563,027 kWh saved per year by switching to CFLs in guest rooms

Note: To calculate the lifetime energy savings (5.5 years) of switching to CFLs, users may use the formula cited by EnergyStar: (Number of CFLs replaced) x 282 = Total kWh saved over lifetime of CFL
www.energystar.gov/ia/partners/promotions/change_light/downloads/CALFacts_and_Assumptions.pdf

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Section 3F: Replacing Recessed Incandescent Lighting with CFLs in Common Areas

Variables:
Total number of incandescent bulbs replaced with CFLs = direct measure from the facility
Difference in electricity consumption per CFL vs. standard incandescent (watts) = 56 watts[41]
Use per day (time) = 24 hours[42]

Formulas:
(Number of bulbs replaced with CFLs) x (number of watts saved per CFL) / 1,000 = *Total kilowatts saved*

(*Total kilowatts saved*) x [(number of hours used per day) x (365 day/1 year)] =
Total kWh saved per year by switching to CFLs

Example – 10,000 Incandescent Lights Replaced with CFLs Throughout the State Program:
(10,000 bulbs) x (56 watts saved/1 CFL) / 1,000 = *560 kilowatts saved*

(*560 kilowatts saved*) x [(24 hours o flight bulb usage/1 day) x (365 days/1 year)] =
4,905,600 kWh saved per year by switching to CFLs in common areas

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[ii] Note: Although the number of CFLs is supplied separately by each facility, state technical assistance programs should add up the number of bulbs across all participating facilities to get the total number of incandescent bulbs replaced with CFLs in the Program.

Section 3G: Replacing Incandescent Bulbs with LEDs in Guest Rooms

Variables:

Total number of incandescent bulbs replaced with LEDs = direct measure from the facility[iii]
Occupancy rate (i.e., percent of guest rooms that are filled on a given night) = 54.7%[43]
Difference in electricity consumption per LED vs. standard incandescent (watts) = 54 watts[44]
Use per day (time) = 3 hours[45]

Formulas:

(Number of bulbs replaced with LEDs) x (number of watts saved per LED) / 1,000 = *Total kilowatts saved*

(*Total kilowatts saved*) x [(Occupancy rate) x (number of hours used per day) x (365 day/1 year)] =
Total kWh saved per year by switching to LEDs

Example – 20,000 Incandescent Bulbs Replaced with LEDs Throughout the State Program:

(20,000 bulbs) x (54 watts saved/1 LED) / 1,000 = *1,080 kilowatts saved*

(*1,080 kilowatts saved*) x [(0.547) x (3 hours of light bulb usage/1 day) x (365 days/1 year)] =
646,882 kWh saved per year by switching to LEDs in guest rooms

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Section 3H: Replacing Recessed Incandescent Lighting with LEDs in Common Areas

Variables:

Total number of incandescent bulbs replaced with LEDs = direct measure from the facility
Difference in electricity consumption per LED vs. standard incandescent (watts) = 58 watts[46]
Use per day (time) = 24 hours[47]

Formulas:

(Number of bulbs replaced with LEDs) x (number of watts saved per LED) / 1,000 = *Total kilowatts saved*

(*Total kilowatts saved*) x [(number of hours used per day) x (365 day/1 year)] =
Total kWh saved per year by switching to LEDs

Example – 10,000 Incandescent Lights Replaced with LEDs Throughout the State Program:

(10,000 bulbs) x (58 watts saved/1 LED) / 1,000 = *580 kilowatts saved*

(*580 kilowatts saved*) x [(24 hours of light bulb usage/1 day) x (365 day/1 year)] =
5,080,800 kWh saved per year by switching to LEDs in common areas

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[iii] Note: Although the number of LEDs is supplied separately by each facility, state technical assistance programs should add up the number of bulbs across all participating facilities to get the total number of incandescent bulbs replaced with LEDs in the Program.

Section 3I: Replacing Illuminated Exit Signs with LED Exit Signs

Variables:
Total number of LED signs replaced = direct measure from the facility[iv]
Difference in electricity consumption between incandescent and LED signs (kWh/machine/year) = 306 kWh[48]

Formulas:
(Number of exit signs replaced with LEDs) x (difference in kWh per year) =
Total kWh saved per year by switching to LED exit signs

Example – 20 Exit Signs Replaced with LEDs Throughout the State Program:
(20 LED signs) x (306 kWh saved/1 year) =
6,120 kWh saved per year by switching to LED exit signs

Section 3J: Installing "Vender Miser" on Vending Machines

Variables:
Total number of vending misers installed = direct measure from the facility[v]
Difference in electricity consumption with and without vending miser (kWh/machine/year) = 1,876 kWh[49]

Formulas:
(Number of vending misers installed) x (difference in kWh per year) =
Total kWh saved per year by installing "vending misers" in vending machines

Example – 35 Vending Misers Installed on Vending Machines Throughout the State Program:
(35 vending misers installed) x (1,876 kWh saved/1 year) =
65,660 kWh saved per year by installing "vending misers" in vending machines

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[iv] Note: Although the number of LED exit signs is supplied separately by each facility, state technical assistance programs should add up the number of devices across all participating facilities to get the total number of exit signs replaced with LEDs in the Program.
[v] Note: Although the number of vending misers is supplied separately by each facility, state technical assistance programs should add up the number of devices across all participating facilities to get the total number of vending misers used in the Program.

Metrics Category #4
Waste Reduction Measures

Section 4A: Implementing a Recycling Program in Guest Rooms

Variables:
Number of guest stays per year = *calculated in Section 1A*
Average amount of waste generated in a guest room during a stay = 6.71 pounds[50]
Percent of waste that is recyclable = 80%[51]

Formulas:
(*Guest stays/year)* x (amount of waste generated per room per stay) = *Amount of waste generated per year*

(*Amount of waste generated per year*) x (percent that is recyclable) =
Amount of recyclable waste captured per year when implementing a guest recycling program

Example – 5,000 Rooms in a State Program:
(*404,160 guest stays/1 year)* x (6.71 pounds of waste/1 room/1 stay) = *2,711,913.60 total pounds of waste generated per year (in the guest rooms)*

(*2,711,913.60 pounds of waste/1 year*) x (0.80) =
2,169,530.88 pounds of recyclable waste captured per year when implementing a guest recycling program

---

Section 4B: Implementing a Food Composting Program

Note: Unlike Metric #4A, which evaluates the amount of waste generated by guests in their hotel guest rooms, this metric takes into consideration the total amount of waste generated by each guest throughout the entire hotel. Most of the food consumed by hotel guests is not done so in their guest room, but in the hotel restaurants, bars, banquet rooms, or other facilities.

Variables:
Average number of guests per year = *calculated in Section 1B*
Amount of waste generated per person per day = 1.83 pounds[52]
Percent of compostable food waste = 55%[53]

Formulas:
(*Guests per year*) x (amount of waste generated per guest per day) = *Amount of waste generated per year*

(*Amount of waste generated per year*) x (percent that is compostable) =
Amount of compostable waste captured per year when implementing a composting program

Example – 5,000 Rooms in a State Program:
(*1,717,033 guests/1 year*) x (1.83 pounds of waste/1 guest/1 day) = *3,142,170.39 total pounds of waste generated per year (throughout the hotel)*

(*3,142,170.39 pounds of waste/1 year*) x (0.55) =
1,728,193.71 pounds of compostable waste captured per year when implementing a composting program

---

Section 4C: Installing Refillable Amenity Dispensers

Variables:

Total number of refillable amenity devices installed = direct measure from the facility[vi]
Occupancy rate (i.e., percent of guest rooms that are filled on a given night) = 54.7%[54]
Number of amenity bottles per room per day = 2 bottles[55]
Average bottle size = 0.6 pounds (1 oz.)[56]

Formulas:

(Number of amenity devices installed/1 room) x (Number of amenity bottles used per day per room) = *Number of amenity bottles saved per day per room*

(Number of bottles saved per day) x [(Occupancy rate) x (365 day/1 year)] = *Number of bottles saved per year*

(*Number of bottles saved per year*) x (bottle size) =
Pounds of amenity bottle waste reduced per year when installing refillable amenity dispensers

Example – 600 Amenity Dispensers Installed Throughout the State Program:

(600 amenity devices/1 room) x (2 amenity bottles/1 day/1 room) = *1,200 amenity bottles saved per day*

(1,200 bottles saved/1 day) x [(0.547) x (365 day/1 year)] = *239,586 bottles saved per year*

(*239,586 bottles saved/1 year*) x (0.6 pounds/1 bottle) =
143,751.6 pounds of amenity bottle waste reduced per year when installing refillable amenity dispensers

---

[vi] Note: Although the number of amenity dispensers is supplied separately by each facility, state technical assistance programs should add up the number of devices across all participating facilities to get the total number of amenity dispensers used in the Program.

Section 4D: Switching to Post-Consumer Recycled-Content Paper

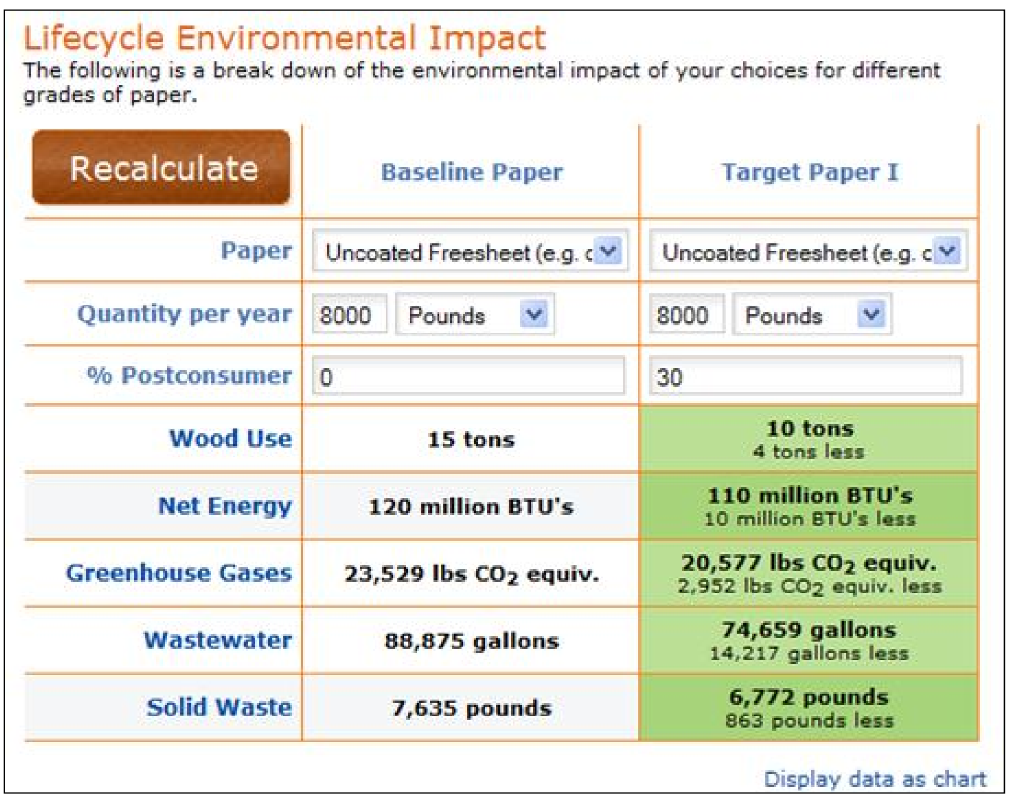
<u>Variables:</u>
Total number of hotels = direct measure from the technical assistance program
Amount of paper used per hotel per year (reams) = 16 reams[57]
Weight of each ream of paper = 5 lbs.[58]
Percent of post-consumer recycled content paper = 30%[59]

<u>Formulas:</u>
(Number of hotels) x (number of paper reams used per hotel per year) x (weight of each paper ream) = *Total amount of paper used (pounds)*

Total amount of paper used plugged into the following EDF calculator: www.edf.org/papercalculator = **Breakdown of environmental impacts avoided from increasing recycled content of paper**

<u>Example – 100 Facilities in a State Program:</u>
(100 hotels) x (16 reams/1 hotel/1 year) x (5 pounds/1 ream) = *8,000 pounds of paper used per year*

- Use the following EDF calculator: www.edf.org/papercalculator/ to "Compare individual papers"
- Select "Uncoated Freesheet copy paper" as the Paper Grade
- Enter *8,000 pounds of paper* as the Quantity per year
- Enter zero percent recycled content in Baseline paper
- Then click on "Add a 2nd Paper" to enter the increased recycled content of the paper
- Enter than same Paper Grade and Quantity as before
- Enter 30 percent recycled content for this new paper
- Click calculate and generate report (see image below)


Lifecycle Environmental Impact
The following is a break down of the environmental impact of your choices for different grades of paper.

Recalculate	Baseline Paper	Target Paper I
Paper	Uncoated Freesheet (e.g. c	Uncoated Freesheet (e.g. c
Quantity per year	8000 Pounds	8000 Pounds
% Postconsumer	0	30
Wood Use	15 tons	10 tons 4 tons less
Net Energy	120 million BTU's	110 million BTU's 10 million BTU's less
Greenhouse Gases	23,529 lbs CO_2 equiv.	20,577 lbs CO_2 equiv. 2,952 lbs CO_2 equiv. less
Wastewater	88,875 gallons	74,659 gallons 14,217 gallons less
Solid Waste	7,635 pounds	6,772 pounds 863 pounds less

Display data as chart

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Metrics Category #5
Reductions in Greenhouse Gas (GHG) Emissions

Section 5A: Replacing Incandescent Bulbs with CFLs

Variables:
Energy saved by switching to CFLs to guest rooms (kWh) = *calculated in Section 3E*
Energy saved by switching to CFLs in common areas (kWh) = *calculated in Section 3F*
CO_2 emissions (kWh) = 1.54 lbs. per kWh[60]
Unit conversion = 1 ton is equivalent to 2,000 pounds

Formulas:
(*Energy savings from guest rooms + energy savings from common areas*) x (CO_2 emissions per kWh) x (1 ton/2,000 pounds) =
GHG emissions reduced by switching to CFLs

Example – 30,000 Incandescent Bulbs Replaced with CFLs Throughout the State Program:
(*563,027 kWh + 4,905,600 kWh*) x (1.54 lbs. of CO_2 emissions/1 kWh/1 year) x (1 ton/2,000 pounds) =
4,211 tons of CO_2 emissions reduced per year when switching to CFLs

Note: To calculate an estimate of the amount of greenhouse gas emissions reduced over the lifetime of a CFL (5.5 years), users may use the formula cited by EnergyStar below:
(Number of CFLs replaced) x 409 = Total greenhouse gas emissions reduced over lifetime
www.energystar.gov/ia/partners/promotions/change_light/downloads/CALFacts_and_Assumptions.pdf

---

Section 5B: Replacing Incandescent Bulbs with LEDs

Variables:
Total number of incandescent bulbs replaced with LEDs = direct measure from the facility
Difference in CO_2 emissions = 267.67 lbs of CO_2 per bulb[61]
Unit conversion = 1 ton is equivalent to 2,000 pounds

Formulas:
(Number of LEDs replaced) x (difference in CO_2 emissions) x (1 ton/2,000 pounds) =
GHG emissions reduced by switching to LEDs

Example – 30,000 Incandescent Bulbs Replaced with LEDs Throughout the State Program:
(30,000 bulbs) x (267.67 lbs. of CO_2 emissions/1 bulb/1 year) x (1 ton/2,000 pounds) =
4,015 tons of CO_2 emissions reduced per year when switching to LEDs

---

Section 5C: Replacing Illuminated Exit Signs with LED Exit Signs

Variables:
Total number of signs replaced with LEDs = direct measure from the facility
Difference in GHG emissions = 502 lbs of CO_2 per sign[62]
Unit conversion = 1 ton is equivalent to 2,000 pounds

Formulas:
(Number of LED signs replaced) x (difference in CO_2 emissions) x (1 ton/2,000 pounds) =
GHG emissions reduced by switching to LED exit signs

Example – 20 Exit Signs Replaced with LEDs Throughout the State Program:
(20 LED signs) x (502 lbs. CO_2 emissions/1 sign/1 year) x (1 ton/2,000 pounds) =
5.02 tons of CO_2 emissions reduced per year when switching to LED exit signs

---

Section 5D: Adding "Vending Miser" to Vending Machines

Variables:
Total number of vending misers installed = direct measure from the facility
Difference in GHG emissions = 1.14 tons CO_2 per machine[63]

Formulas:
(Number of vending misers installed) x (difference in CO_2 emissions) =
GHG emissions reduced by installing "vending misers" to vending machines

Example – 35 Vending Misers Installed on Vending Machines Throughout the State Program:
(35 vending misers) x (1.14 tons CO_2 emissions/1 machine/1 year) =
39.9 tons of CO_2 emissions reduced per year when installing "vending misers" to vending machines

---

Section 5E: Implementing a Recycling Program In Guest Rooms

Note: The calculator used in this metric provides assumptions for annual greenhouse gas emission reductions based on the amount of waste recycled versus landfilled, incinerated, etc. All input values are editable if direct measures are available.

Variables:

Recyclable waste captured when implementing guest recycling = *calculated in Section 4A*

Formulas:

(Pounds of waste recycled) x (0.0005 tons/1 pound) = *Tons of waste recycled per year*

Tons of waste recycled plugged into the following EPA calculator: www.epa.gov/climatechange/wycd/waste/calculators/Warm_Form.html =

Reduced GHG emissions from alternative waste scenarios

Example – 5,000 Rooms in a State Program:

(2,169,530.88 pounds of recyclable waste) x (0.0005 tons/1 pound) = *1,084.77 tons of waste recycled per year*

- Using the EPA calculator at: www.epa.gov/climatechange/wycd/waste/calculators/Warm_Form.html, enter the following amounts for "Mixed Recyclables" under the Baseline Scenario (Step 1):
  - 0 tons recycled (first column)
  - 542.385 tons landfilled (second column)
  - 542.385 tons combusted (third column)
- Enter the following amounts for "Mixed Recyclables" in the Alternative Scenario (Step 2):
  - *1,084.77 tons recycled* (column 7)
  - 0 tons landfilled (column 8)
  - 0 tons combusted (column 9)
- Click on the button for "National Average" under Step 3 Landfill Characteristics
- Click on the button for " Default Distance" under Step 4 Waste Transport Characteristics
- Click on the button for "Metric Tons of Carbon Dioxide Equivalent" under Step 5 Results Output
- Create Summary Report (see image below) – **2,851 $MTCO_2E$ reduced**

GHG Emissions Analysis — Summary Report

Print Summary

(Version 11, 8/10)

Analysis of GHG Emissions from Waste Management

GHG Emissions from Baseline Waste Management Scenario (MTCO2E):	-265
GHG Emissions from Alternative Waste Management Scenario (MTCO2E):	-3,116
Total Change in GHG Emissions: (MTCO2E):	**-2,851**

Material	Baseline Scenario					Alternative Scenario						Change (Alt - Base) MTCO2E
	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted	Total MTCO2E	Tons Source Reduced	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted	Total MTCO2E	
Mixed Recyclables	0	542	542	N/A	-265	N/A	1,085	0	0	N/A	-3,116	**-2,851**

Note: The Baseline Scenario in this example assumes an equal amount of waste landfilled and combusted. However, the individual amounts of waste landfilled and composted may be changed depending on the state and/or individual facility, as long as the total amount of waste generated in column 5 equals 1,084.77 tons.

Section 5F: Implementing a Food Composting Program

Note: The calculator used in this metric provides assumptions for annual greenhouse gas emission reductions based on the amount of food waste composted versus landfilled, incinerated, etc. All input values are editable if direct measures are available.

Variables:
Food waste composted per year = *calculated in Section 4B*

Formulas:
(Pounds of waste composted) x (0.0005 tons/1 pound) = *Tons of waste composted per year*

Tons of waste composted plugged into the following EPA calculator:
www.epa.gov/climatechange/wycd/waste/calculators/Warm_Form.html =
Reduced GHG emissions from alternative waste scenarios

Example – 5,000 Rooms in a State Program:
(1,728,193.71 pounds of composted waste) x (0.0005 tons/1 pound) = *864.10 tons of waste composted per year*

- Using the EPA calculator at: www.epa.gov/climatechange/wycd/waste/calculators/Warm_Form.html, enter the following amounts for "Food Scraps" under the Baseline Scenario (Step 1):
  - 432.05 tons landfilled (second column)
  - 432.05 tons combusted (third column)
  - 0 tons composted (fourth column)
- Enter the following amounts for "Food Scraps" in the Alternative Scenario (Step 2):
  - 0 tons landfilled (column 8)
  - 0 tons combusted (column 9)
  - *864.10 tons composted* (column 10)
- Click on the button for "National Average" under Step 3 Landfill Characteristics
- Click on the button for " Default Distance" under Step 4 Waste Transport Characteristics
- Click on the button for "Metric Tons of Carbon Dioxide Equivalent" under Step 5 Results Output
- Create Summary Report (see image below) – **440 MTCO$_2$E reduced**

GHG Emissions Analysis — Summary Report Print Summary

(Version 11, 8/10)

Analysis of GHG Emissions from Waste Management

GHG Emissions from Baseline Waste Management Scenario (MTCO2E):	269
GHG Emissions from Alternative Waste Management Scenario (MTCO2E):	-171
Total Change in GHG Emissions: (MTCO2E):	**-440**

	Baseline Scenario					Alternative Scenario						
Material	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted	Total MTCO2E	Tons Source Reduced	Tons Recycled	Tons Landfilled	Tons Combusted	Tons Composted	Total MTCO2E	Change (Alt - Base) MTCO2E
Food Scraps	N/A	432	432	0	269	0	N/A	0	0	864	-171	**-440**

Note: The Baseline Scenario in this example assumes an equal amount of food landfilled and combusted. However, the individual amounts of food landfilled and composted may be changed depending on the state and/or individual facility, as long as the total amount of food waste generated in column 5 equals 864.10 tons.

Section 5G: Switching to Low-VOC Paint

Variables:

Gallons of paint used = direct measure from facility[vii]

Difference in amount of VOCs in standard paint vs. low-VOC paint (grams/liter) = 200 grams/liter[64]

Unit conversion = 1 ton is equivalent to 907,184.74 grams

Formulas:

[(*Gallons of paint used*) x (3.79 liters/1 gallon)] x (difference in amount of VOCs) x (1 ton/907,184.74 grams) =
Amount of VOCs reduced by switching to low-VOC paint

Example – 175 Gallons of Paint Used Throughout the State Program:

[(*175 gallons*) x (3.79 liters/1 gallon)] x (200 grams VOCs/1 liter) x (1 ton/907,184.74 grams) =
0.15 tons of VOC emissions reduced by switching to low-VOC paint

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[vii] Note: Although the gallons of paint used is supplied separately by each facility, state technical assistance programs should add up the number of gallons across all participating facilities to get the total gallons of paint used in the Program.

Metrics Category #6
Associated Financial Savings

Section 6A: Implementing Laundry Reuse Programs for Towels and Linens

Variables:
Water saved from reductions in wash loads (gallons) = *calculated in Section 1A*
Cost of water ($/gallon) = $0.0019 per gallon[65]
Amount of detergent reduced = *calculated in Section 2A*
Amount of bleach reduced = *calculated in Section 2B*
Cost of cleaning chemicals (detergent plus bleach) = $0.13 per ounce[66]
Electricity saved from reductions in wash loads (kWh) = *calculated in Section 3A*
Cost of electricity ($/kWh) = $0.10 per kWh[67]
Natural gas saved from reductions in wash loads (BTUs) = *calculated in Section 3A*
Cost of natural gas ($/therm) = $1.12 per therm[68]

Formulas:
Subpart 1: Water Savings
[(*Water saved*) x (cost of water per gallon)] = **Savings in water costs**

Subpart 2: Cleaning Chemical Savings
{[(*Detergent saved)* + (*bleach saved*)] x (cost of chemicals per ounce)} = **Savings in cleaning chemical costs**

Subpart 3: Electricity Savings
[(*Electricity saved*) x (cost of electricity per kWh)] = **Savings in electricity costs**

Subpart 4: Natural Gas Energy Savings
[(*Natural gas saved*) x (1 therm/100,000 BTUs) x (cost of natural gas per therm)] = **Savings in energy costs**

Final:
(*Savings in water*) + (*Savings in electricity*) + (*Savings in natural gas energy*) =
Total financial savings associated with implementing a laundry reuse program for towels and linens

Example – 5,000 Rooms in a State Program:
Subpart 1: Water Savings
[(*7,284,175.68 gallons*) x (0.0019/1 gallon)] = **$13,839.93 in water costs**

Subpart 2: Cleaning Chemical Savings
{[(*4,792.93 gal*) + (*7,827.44 gal*)] x [(0.13/1 ounce) x (128 ounces/1 gallon)]} = **$210,002.96 in chemical costs**

Subpart 3: Electricity Savings
[(*54,157.44 kWh*) x (0.10/1 kWh)] = **$5,415.74 in electricity costs**

Subpart 4: Natural Gas Energy Savings
[(*2,166,297,600 BTUs*) x (1 therm/100,000 BTUs) x (1.12/1 therm)] = **$24,262.53 in natural gas energy costs**

Final: Total Cost Savings from this Program/Activity
(*$13,839.93*) + (*$210,002.96*) + (*$5,415.74*) + (*$24,262.53*) =
$253,521.16 saved per year from implementing laundry reuse programs for towels and linens

Section 6B: Switching to Ozone Washers for Laundry

Note: This metric does not take into consideration the reduced loads of laundry that may result from a laundry reuse program. It is designed to be used separately from Metric #6A and to demonstrate the total cost savings when an ozone washer is used in place of a traditional machine.

Variables:

Water saved from reductions in wash loads (gallons) = *calculated in Section 1B*
Cost of water ($/gallon) = $0.0019 per gallon[69]
Amount of cleaning chemicals reduced = *calculated in Section 2C*
Cost of cleaning chemicals (detergent plus bleach) = $0.13 per ounce[70]
Electricity saved from reductions in wash loads (kWh) = *calculated in Section 3B*
Cost of electricity ($/kWh) = $0.10 per kWh[71]
Natural gas saved from reductions in wash loads (BTUs) = *calculated in Section 3B*
Cost of natural gas ($/therm) = $1.12 per therm[72]

Formulas:

Subpart 1: Water Savings
[(*Water saved*) x (cost of water per gallon)] = **Savings in water costs**

Subpart 2: Cleaning Chemical Savings
[(*Chemicals saved*) x (cost of chemicals per ounce)] = **Savings in cleaning chemical costs**

Subpart 3: Electricity Savings
[(*Electricity saved*) x (cost of electricity per kWh)] = **Savings in electricity costs**

Subpart 4: Natural Gas Energy Savings
[(*Natural gas saved*) x (1 therm/100,000 BTUs) x (cost of natural gas per therm)] = **Savings in energy costs**

Final: Total Cost Savings from this Program/Activity
(*Savings in water*) + (*Savings in chemicals used*) + (*Savings in electricity*) + (*Savings in natural gas energy*) =
Total financial savings associated with using Ozone washers

Example – 5,000 Rooms in a State Program:

Subpart 1: Water Savings
[(*3,751,717.11 gallons*) x (0.0019/1 gallon)] = **$7,128.26 in water costs**

Subpart 2: Cleaning Chemical Savings
[(*8,793.09 gallons*) x (0.13/1 ounce) x (128 ounces/1 gallon)] = **$146,317.02 in cleaning chemical costs**

Subpart 3: Electricity Savings
[(*81,559.07 kWh*) x (0.10/1 kWh)] = **$8,155.91 in electricity costs**

Subpart 4: Natural Gas Energy Savings
[(*4,893,544,050 BTUs*) x (1 therm/100,000 BTUs) x (1.12/1 therm)] = **$54,807.69 in natural gas energy costs**

Final: Total Cost Savings from this Program/Activity
(*$7,128.26*) + (*$146,317.02*) + (*$8,155.91*) + (*$54,807.69*) =
$216,408.88 saved per year when using Ozone washers

Section 6C: Installing Low-Flow Water Devices

Note: Some facilities may only implement one or two of the water conservation programs listed below; for those facilities, the gallons of water saved would be zero. Note that the water used in low-flow or high-efficiency toilets is not heated.

Variables:

Water saved from using low-flow showers (gallons) = *calculated in Section 1C*
Water saved from using low-flow faucets (gallons) = *calculated in Section 1D*
Water saved from using low-flow toilets (gallons) = *calculated in Section 1E*
Cost of water ($/gallon) = $0.0019 per gallon[73]
Natural gas saved from using low-flow showers (BTUs) = *calculated in Section 3C*
Natural gas saved from using low-flow faucets (BTUs) = *calculated in Section 3C*
Cost of natural gas ($/therm) = $1.01 per therm[74]

Formulas:

Subpart 1: Water Savings
[(*Water saved from low-flow showers*) + (*Water saved from low-flow faucets*) + (*Water saved from low-flow toilets*)] x (cost of water per gallon) = **Savings in water costs**

Subpart 2: Natural Gas Energy Savings
[(*Natural gas saved from low-flow showers*) + (*Natural gas saved from low-flow faucets*)] x (1 therm/100,000 BTUs) x (cost of natural gas per therm) = **Savings in natural gas energy costs**

Final: Total Cost Savings from this Program/Activity
(*Savings in water*) + (*Savings in natural gas energy*) =
Total financial savings associated with installing low-flow water devices

Example – 5,000 Rooms in a State Program:

Subpart 1: Water Savings
[(*17,263,084.12 gallons*) + (*7,232,143 gallons*) + (*10,961,538.67 gallons*)] x (0.0019/1 gallon) = **$67,367.86 in water costs**

Subpart 2: Natural Gas Energy Savings
[(*14,231,726,956.72 BTUs*)] x (1 therm/100,000 BTUs) x (1.01/1 therm) = **$143,740.44 in natural gas energy costs**

Final: Total Cost Savings from this Program/Activity
(*$67,367.86*) + (*$143,740.44*) =
$211,108.30 saved per year by installing low-flow water devices

---

Section 6D: Reducing Water Temperature for Guest Rooms

Variables:
Natural gas saved by reducing hot water temperatures for guest rooms (BTUs) = *calculated in Section 3D*
Cost of natural gas ($/therm) = $1.01 per therm[75]

Formulas:
(*Energy saved from reducing maximum temperature setting*) x (1 therm/100,000 BTUs) x (cost of natural gas per therm) =
Savings in energy costs by reducing maximum hot water temperature for guests

Example – 5,000 Rooms in a State Program:
(*11,967,016,026. 47 BTUs*) x (1 therm/100,000 BTUs) x (1.01/1 therm) =
$120,866.87 saved per year by reducing maximum hot water temperature for guests

---

Section 6E: Replacing Incandescent Bulbs with CFLs

Variables:
Energy saved by switching to CFLs in guest rooms (kWh) = *calculated in Section 3E*
Energy saved by switching to CFLs in common areas (kWh) = *calculated in Section 3F*
Cost of electricity ($/kWh) = $0.10 per kWh[76]

Formulas:
[(*Energy saved from guest rooms, in kWh*) + (*Energy saved from common areas, in kWh*)] x (cost of electricity per kWh) =
Savings in electricity costs by switching to CFLs

Example – 30,000 Incandescent Lights Replaced with CFLs Throughout the State Program:
[(*563,027 kWh*) + (*4,905,600 kWh*)] x (0.10/1 kWh) =
$546,862.70 saved per year in electricity costs by switching to CFLs

Note: To calculate the lifetime energy savings (5.5 years) of switching to CFLs, users may use the formula cited by EnergyStar: (Energy saved, in kWh) x ($0.09) = Cost savings over the lifetime of the CFL
www.energystar.gov/ia/partners/promotions/change_light/downloads/CALFacts_and_Assumptions.pdf

---

Section 6F: Replacing Incandescent Bulbs with LEDs

Variables:
Energy saved by switching to LEDs in guest rooms (kWh) = *calculated in Section 3G*
Energy saved by switching to LEDs in common areas (kWh) = *calculated in Section 3H*
Cost of electricity ($/kWh) = $0.10 per kWh[77]

Formulas:
[(*Energy saved from guest rooms, in kWh*) + (*Energy saved from common areas, in kWh*)] x (cost of electricity per kWh) =
Savings in electricity costs by switching to LEDs

Example – 30,000 Incandescent Lights Replaced with LEDs Throughout the State Program:
[(*646,882 kWh*) + (*5,080,800 kWh*)] x (0.10/1 kWh) =
$572,768.20 saved per year in electricity costs by switching to LEDs

---

Section 6G: Replacing Illuminated Exit Signs with LED Exit Signs

Variables:
Energy saved by switching to LED exit signs (kWh) = *calculated in Section 3I*
Cost of electricity ($/kWh) = $0.10 per kWh[78]

Formulas:
(*Energy saved, in kWh*) x (cost of electricity per kWh) =
Savings in electricity costs by switching to LED exit signs

Example – 20 Exit Signs Replaced with LEDs Throughout the State Program:
(*6,120 kWh*) x (0.10/1 kWh) =
$612.00 saved per year in electricity costs by switching to LED exit signs

---

Section 6H: Adding "Vender Miser" to Vending Machines

Variables:
Energy saved by installing vending misers to vending machines = *calculated in Section 3J*
Cost of electricity ($/kWh) = $0.10 per kWh[79]

Formulas:
(*Energy saved, in kWh*) x (cost of electricity per kWh) =
Savings in electricity costs by adding "vending misers" to vending machines

Example – 35 Vending Misers Installed on Vending Machines Throughout the State Program:
(*65,660 kWh*) x (0.10/1 kWh) =
$6,566.00 saved per year in electricity costs by adding "vending misers" to vending machines

---

Section 6I: Implementing a Recycling Program in Guest Rooms

Variables:
Waste captured when implementing guest recycling = *calculated in Section 4A*
Cost savings when diverting recyclables from solid waste disposal ($/ton) = $162.38 per ton[80]

Formulas:
(Waste recycled) x (1 ton/2,000 pounds) x (disposal cost savings) =
Savings in waste disposal costs by increasing guest recycling

Example – 5,000 Rooms in a State Program:
[(*2,169,530.88 pounds*) x (1 ton/2,000 pounds)] x ($162.38/1 ton) =
$176,144.21 saved per year by increasing guest recycling

Section 6J: Implementing a Food Composting Program

Variables:
Food waste captured when implementing a composting program = *calculated in Section 4B*
Cost savings when diverting composting food waste from solid waste disposal ($/ton) = $79.19 per ton[81]

Formulas:
(Food waste composted) x (1 ton/2,000 pounds) x (disposal cost savings) =
Savings in waste disposal costs by implementing a composting program

Example – 5,000 Rooms in a State Program:
[(*1,728,193.71 pounds*) x (1 ton/2,000 pounds)] x ($79.19/1 ton) =
$68,427.83 saved per year by implementing a composting program

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References for Variables Used

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[1] The American Hotel & Lodging Association (AHLA) 2009 Lodging Industry Profile (based on direct measures of 50,800 properties) estimates a national average occupancy rate of 54.7%. www.ahla.com/content.aspx?id=30505

Note: Programs may want to override this default value with a value that may be more representative for their state (if known). For example, Maine DEP uses a 60% occupancy rate based on conversations with Longwood International about average annual occupancy rates for lodging facilities in the state of Maine. State hospitality or tourism associations may be able to provide this information; individual facilities should also be able to measure their annual occupancy rates.

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[2] NEWMOA calculates an average length of guest stay of 2.47 nights based on information from the following references:

- The HVS 2007 U.S. hotel franchise guide estimates that the average length of guest stay is 2 nights (checkout is the 3rd day). www.hvs.com/Bookstore/HVS2007U.S.HotelFranchiseFeeGuide.pdf
- The AHLA 2009 Lodging Industry Profile estimates that 40% people travel for business. Of that group, 36% spend just 1 night at a hotel, 22% spend 2 nights, and 42% spend 3 or more nights (weighted average 0.824 nights). For the remaining 60% of people classified as leisure travelers, 48% spend 1 night, 25% spend 2 nights, and 27% spend 3 or more nights in a hotel (weighted average 1.074 nights). For the purposes of this variable calculation, NEWMOA will assume a maximum of 3 nights spent at a hotel for both groups, resulting in an overall average length guest stay of 1.9 nights. www.ahla.com/content.aspx?id=30505
- A marketing survey of 2,200 travelers conducted by the U.S. Travel Association and Ypartnership estimated that an average trip length is 3 nights for business travel and for 4 nights for leisure (overall average 3.5 nights). www.hotelworldnetwork.com/day44 (citing a publication at: www.ypartnership.com/?#publications).

Formula =
{2 + [(((.36 x 1) + (.22 x 2) + (.42 x 3)) x 0.40) + (((.48 x 1) + (.25 x 2) + (.27 x 3)) x .60] + [(3 + 4) / 2]} / 3 = 2.47 nights

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[3] NEWMOA calculates an average participate rate of 55.8% based on the following references:

- Project Planet estimates that participation rates in optional towel/linen reuse programs range from 30-80%. www.greensuites.com/Environmentally-Friendly-Hotel-Programs/Green-Marketing-Linen-Towel-Reuse-programs
- Similarly, a study by the Cornell Hotel & Restaurant Association determined that hotels that instituted laundry reuse programs achieved a guest participation rate of 30-70% depending on whether the program was “opt-in” (30% compliance) or “opt-out” (70% compliance). www.savewaternc.org/Documents/LinenReuseforWebinar.pdf
- A case study at the Crowne Plaza Ravinia in Atlanta, GA utilizing an “opt-out” laundry reuse program (i.e., towels and bed linens are replaced only upon guests’ request) resulted in a 45% participation rate for towels and 80% participation rate for bed linens. Combining these values yields an average participation rate of 62.5% for overall laundry reuse. www.savewaternc.org/Documents/LinenReuseProgramX.pdf

Formula = {[(30 + 80)/2] + [(30 + 70)/2] + [(45 + 80)/2]} / 3 = 55.8% participation rate

Note: Individual facilities may want to override this default value with a value that is specific to the type of laundry reuse program in place at the hotel (i.e., opt-in versus opt-out).

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[4] NEWMOA calculates an average value of 1.72 guests per hotel room, based on information from the following references:

- Maine DEP estimates that each room contains 2.1 guests – based on conversations with Greg Dougall from the Maine Innkeepers Assoc.
- The P2 Hospitality Program in Erie County, NY posed this question to their hotels – one major hotel in Buffalo reported that they average 1.37 guests per room.
- HVS, a global consulting firm for the hospitality sector, estimates 1.2 to 2.5 guests per room depending on the reason for travel. Specifically, this reference indicates that guests traveling for business typically do not share rooms so the range is 1.2-1.3 guests per room (average 1.25 guests). When guests are traveling for leisure they are more likely to share a room so the range is 1.8-2.5 people per room (average 2.15 guests). www.hospitalitynet.org/news/154000320/4044780.search?query=average+%22people+per+room%22+hotel+cvb

Formula = {2.1 + 1.37 + [(1.25 + 2.15)/2]} / 3 = <u>1.72 guests per room</u>

Note: Programs may want to override this default value with a value that may be more representative for their state (if known) – state hospitality or tourism associations may be able to provide this information. Individual facilities should also be able to estimate their average guests per room.

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[5] NEWMOA calculates this variable by using the assumption that the average length of guest stay is 2.47 nights. For guests that take advantage of the laundry reuse program, their towels and sheets are changed only once – on the day that they check out of the hotel. For guests that do not reuse their laundry, their towels and bed linens will be changed every day of their stay (2.47 times each). The number of towels and bed linens saved is the difference in laundry sets between the guests whose linens are only changed 1 time and the guest whose linens are changed 2.47 times – in this case, 1.47 set of towels and 1.47 set of bed linens.

Note: Changing the average length of a guest's stay will alter this variable, which in turn can dramatically alter the final calculations.

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[6] See endnote reference 5.

Note: NEWMOA's research and other anecdotal evidence suggest that most facilities that implement a laundry reuse program will change bed linens on the 3rd night of a guests' stay, regardless of their length of stay or participation in the program.

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[7] The Alliance for Water Efficiency estimates that hotel towel sets weigh 1.75 pounds each: www.allianceforwaterefficiency.org/commercial_laundry.aspx.

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[8] The Alliance for Water Efficiency estimates that hotel bed linens (queen-size) weigh 3 lbs each: www.allianceforwaterefficiency.org/commercial_laundry.aspx.

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[9] NEWMOA calculates an average value of 2.69 gallons of water needed per pound of laundry based on information from the following references:

- EPA surveyed industrial laundry facilities on their laundering practices and documented the results in the document, "Technical Development Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category." According to this source, the type of laundry generated by hotel and lodging establishments is categorized as "linen flatwork/full dry" (page 4-12). The average amount of water used for this category of laundry was identified as 2.80 gallons of water per pound of laundry (page 5-7). www.epa.gov/waterscience/guide/laundry/ilpdd_a.pdf
- NEWMOA calculated an average value of 2.58 gallons of water per pound of laundry based on the following information from the Alliance for Water Efficiency:
  - Small to medium size laundries mostly rely on washer-extractors which use 3-4 gallons of water per pound of laundry.
  - Efficient models use less than 2.5 gallons per pound (NEWMOA assumes 2.5 in this calculation).
  - Tunnel washers (used in large commercial/industrial laundry facilities) use 1.5-2 gallons of water per pound of laundry.

  www.allianceforwaterefficiency.org/commercial_laundry.aspx

Formula = {2.80 + [[((3 + 4) / 2) +2.5 + ((1.5 + 2) / 2)] / 3]} / 2 = <u>2.69 gallons of water per pound of laundry</u>

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[10] See endnote reference 1.

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[11] See endnote reference 4.

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[12] See endnote reference 7.

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[13] See endnote reference 8.

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[14] A case study at the Apple Farm Inn and Suites, a hotel in San Luis Obispo, CA compared laundering practices with ozone washers and traditional washing machines. For this case study, the washing machine capacity was 80 pounds per load of laundry and required 126 gallons of water, resulting in an average of 1.58 gallons of water needed per pound of laundry. The ozone machine required 104 gallons of water for the same load of laundry, for an average of 1.3 gallons of water per pound of laundry. The difference between the traditional commercial washers and the ozone washers was 0.28 gallons of water per pound of laundry – or a savings of 18 percent. www.airbestpractices.com/sustainability-projects/water-conservation/ozone-laundry-system-reduces-hotels-operational-costs-40

By using the average number of 2.58 gallons of water per pound of laundry calculated in Section 1A (see endnote reference 9), NEWMOA can estimate that a water savings of 18 percent would be 2.12 gallons of water per pound of laundry when utilizing ozone washers. In this case, the water per pound savings would be 0.46 gallons of water per pound of laundry.

Formula = (0.82) x 2.58 = 2.12 gallons of water per pound when using ozone washers
2.58 – 2.12 = <u>0.46 gallons of water saved</u>

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[15] NEWMOA calculates a water savings of 1.83 gallons per minute using an average flow rate for low-flow showers of 2.23 gallons of water per minute (gpm) compared to an average flow-rate of 4.06 gpm for standard showers, based on the following references:

- The H_2OUSE website estimates that the national average flow rate for all showers is 2.22 gallons of water per minute (including conserving and non-conserving showers – based on a 1999 study), but cites 2.5 gallons per minute as the standard flow rate for low-flow showers. www.h2ouse.org/tour/details/element_action_contents.cfm?elementID=D4D1D449-3191-4C6A-91001A97C2FC4A2E&actionID=78FA9A8B-2756-4B2E-88D58A48310FAA76&roomID=8183044A-3219-48E2-A965ACB77A568AC4
- EPA estimates that standard showerheads use 2.5 gpm. Low-flow showerheads with the Water Sense label must have a flow rate of no more than 2.0 gpm. www.epa.gov/watersense/products/showerheads.html
- HomeTips.com states that the flow-rate for low-flow shower heads is typically 2.5 gpm (but some are as low as 1.6 gpm). It estimates that older shower heads use 5 to 8 gpm. www.hometips.com/cs-protected/guides/showerheads/whatis_lowflow.html
- The California Energy Commission estimates that older showers (installed prior to 1992) have an average flow rate of 5 gpm, compared to low-flow showers that have a flow rate of 2.5 gpm. www.consumerenergycenter.org/myths/shower_vs_bath.html

Formulas = {2.22 +2.5 + [(5 +8)/2] + 5} / 4 = 4.06 gpm average flow rate for standard showers
{[(2.5 + 2.22)/2] + 2.0 + [(2.5 + 1.6)/2] + 2.5} / 4 = 2.23 gpm average flow rate for low-flow showers
4.06 – 2.23 = <u>1.83 gallons of water per minute saved</u>

Note: Programs may want to override this default value with a value that may be more representative for their state (if known). For example, the VT SBDC Green Hotels Program uses a minimum flow rate of 2.5 gpm at a pressure of 80 psi for low-flow shower heads based on conversations with hotels regarding guests' preferences – the participating hotels in Vermont reported that they will rarely go below a 2.5 gpm flow rate.

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[16] The H_2OUSE website cites the national average shower duration of 8.2 minutes. www.h2ouse.org/tour/details/element_action_contents.cfm?elementID=D4D1D449-3191-4C6A-91001A97C2FC4A2E&actionID=11252FC5-E889-45A5-A088549C8CF50361&roomID=8183044A-3219-48E2-A965ACB77A568AC4

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[17] The H_2OUSE website has 0.67 as the average number of showers per person per day. www.h2ouse.org/tour/details/element_action_contents.cfm?elementID=D4D1D449-3191-4C6A-91001A97C2FC4A2E&actionID=11252FC5-E889-45A5-A088549C8CF50361&roomID=8183044A-3219-48E2-A965ACB77A568AC4

Note: This value is based on residential use and represents shower use in a 24-hour period. It is likely that hotel guests at facilities that have fitness centers, swimming pools or spas would take additional showers; therefore, facilities may want to override this default value with another value that may be more representative (in known).

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[18] NEWMOA calculates a water savings of 0.52 gallons per minute using an average flow rate for low-flow faucets of 1.23 gallons per minute (gpm) compared to an average flow rate for standard faucets of 1.75 gpm, based on the following references:

- The EPA Water Sense program cites the standard faucet flow rate as 2.2 gallons per minute (gpm); low-flow faucets use 0.8 to 1.5 gpm. www.epa.gov/watersense/docs/faucet_spec508.pdf
- The H_2OUSE website lists the national average faucet flow rate as 1.3 gpm, but does not specify whether this is for a conserving or non-conserving faucet. www.h2ouse.org/tour/details/element_action_contents.cfm?elementID=1D4BABB7-8E4C-4524-98836EECCC5AEE08&actionID=11252FC5-E889-45A5-A088549C8CF50361&roomID=8183044A-3219-48E2-A965ACB77A568AC4

Formulas = (2.2 + 1.3) / 2 = 1.75 gpm average flow rate for standard faucets
{[(0.8 + 1.5)/2] + 1.3} / 2 = 1.23 gpm average flow rate for low-flow faucets
1.75 – 1.23 = <u>0.52 gallons of water per minute saved</u>

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[19] The H_2OUSE website cites that the average amount of time a faucet is run per person per day is 8.1 minutes. www.h2ouse.org/tour/details/element_action_contents.cfm?elementID=1D4BABB7-8E4C-4524-98836EECCC5AEE08&actionID=11252FC5-E889-45A5-A088549C8CF50361&roomID=8183044A-3219-48E2-A965ACB77A568AC4

Note: This value is based on residential use and represents faucet use in a 24-hour period. It is likely that hotel guests do not stay in their rooms for the same length of time as a person would stay in their house. NEWMOA has not been able to find any references on the number of hours per day, or the percent of time in a day, that guests spend in the hotel.

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[20] NEWMOA calculates a water savings of 1.2 gallons per flush using an average flow rate for low-flow toilets of 1.41 gallons of water per flush compared to an average flow rate for standard toilets of 2.61 gallons per flush, based on the following references:

- The EPA Water Sense Program states that a conservative estimate of standard flush volume is 1.6 gallons; flush volume for high-efficiency toilets is no more than 1.28 gallons. www.epa.gov/watersense/docs/spec_het508.pdf
- The H_2OUSE website cites non-conserving (standard) toilets as using 3.61 gallons of water per flush and conserving (high efficiency or low-flow) toilets as using 1.54 gallons of water per flush. www.h2ouse.org/tour/details/element_action_contents.cfm?elementID=5812B5A5-E0BE-4D14-A202C8DAE8CE491F&actionID=11252FC5-E889-45A5-A088549C8CF50361&roomID=8183044A-3219-48E2-A965ACB77A568AC4

Formulas =(1.6 + 3.61) / 2 = 2.61 average flow rate for standard toilets
(1.28 + 1.54) / 2 = 1.41 average flow rate for low-flow toilets
2.61 – 1.41 = <u>1.2 gallons of water per flush saved</u>

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[21] The H_2OUSE website cites the average number of toilet flushes per person per day of 5.17 (non-conserving) or 5.46 (conserving) – this represents an average of 5.32 flushes per person per day. www.h2ouse.org/tour/details/element_action_contents.cfm?elementID=5812B5A5-E0BE-4D14-A202C8DAE8CE491F&actionID=11252FC5-E889-45A5-A088549C8CF50361&roomID=8183044A-3219-48E2-A965ACB77A568AC4

Formula = (5.17 + 5.46) / 2 = 5.32 flushes per person per day

Note: This value is based on residential use and represents toilet use in a 24-hour period. It is likely that hotel guests do not stay in their rooms for the same length of time as a person would stay in their house. NEWMOA has not been able to find any references on the number of hours per day, or the percent of time in a day, that guests spend in the hotel.

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[22] EPA surveyed industrial laundry facilities on their laundering practices and documented the results in the document, "Technical Development Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category." According to this source, the type of laundry generated by hotel and lodging establishments is categorized as "linen flatwork/full dry" (page 4-12). The average amount of detergent used for this category of laundry was identified as 0.00177 gallons of detergent (0.23 ounces) per pound of laundry (page 4-21). www.epa.gov/waterscience/guide/laundry/ilpdd_a.pdf

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[23] NEWMOA estimates an average of 0.37 ounces of chlorine bleach needed per pound of laundry, based on the following references:

- Information from Clorox® suggests using 6 oz. (¾ cup) of chlorine bleach for a standard load of white laundry. www.clorox.com/blogs/dr-laundry/?cat=9
- A reference from the College of Agriculture, Consumer and Environmental Sciences at New Mexico State University has directions on using chlorine bleach for washing clothes, as follows:
  - For most top-loading washing machines, do not use more than 1 cup of liquid chlorine bleach per load.
  - If the machine is extra large, use 1¼ cup of bleach.
  - For front-loading machines, do not use more than ½ cup of bleach.
  http://aces.nmsu.edu/pubs/_c/c-503.html
- The previous data points are based on residential laundry use standard sized machines. The Grand Valley State University estimates that the average laundry capacity for residential washing machines is 18 pounds of laundry. www.gvsu.edu/housing/?id=2292FDBE-E529-C634-5BA4B32A2DDB3C60

Formula = {0.75 + [(1 + 1.25 + 0.5) / 3] / 2} = 0.835 cups per load of laundry (0.52 gallons or 6.68 ounces)
(6.68 ounces of bleach/1 load) x (1 load/18 pound of laundry) = 0.37ounces of bleach per pound of laundry

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[24] A case study at the Apple Farm Inn and Suites, a hotel in San Luis Obispo, CA compared laundering practices with ozone washers and traditional washing machines. For this case study, the washing machine capacity was 80 pounds per load of laundry and required 7.8 ounces of cleaning chemicals, resulting in an average of 0.098 ounces of chemicals needed per pound of laundry. The ozone machine required 6 ounces of cleaning chemicals for the same load of laundry, for an average of 0.075 ounces per pound of laundry. The amount of chemicals needed in an ozone laundry system (detergent and bleach) was reduced by 1.8 ounces – or a savings of 23 percent. www.airbestpractices.com/sustainability-projects/water-conservation/ozone-laundry-system-reduces-hotels-operational-costs-40

By using the average amount 0.6 ounces of total cleaning chemicals needed per pound of laundry (i.e., 0.23 ounces of detergent plus 0.37 ounces of chlorine bleach), calculated in Sections 2A and 2B (see endnote references 22 and 23), NEWMOA can estimate that a chemical savings of 23 percent would be 0.462 ounces of chemicals per pound of laundry when utilizing ozone washers. In this case, the chemicals per pound savings would be 0.126 ounces of chemicals per pound of laundry.

Formula = (0.77) x 0.6 = 0.462 ounces of chemicals per pound when using ozone washers
0.6 – 0.462 = 0.138 ounces of chemicals saved

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[25] The Maine DEP program uses the assumption that the average hotel guest room size is 300 sq. ft. and average common space/lobby is 3,000 sq. ft. This was affirmed by other members of NEWMOA's hospitality workgroup during a previous conference call.

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[26] See endnote reference 24.

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[27] A case study at the Apple Farm Inn and Suites, a hotel in San Luis Obispo, CA compared laundering practices with ozone washers and traditional washing machines. For this case study, the washing machine capacity was 80 pounds per load of laundry and the standard machine required 1.53 kWh of electricity per load of laundry. This is equal to an average of 0.02 kWh of electricity needed per pound of laundry. www.airbestpractices.com/sustainability-projects/water-conservation/ozone-laundry-system-reduces-hotels-operational-costs-40

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[28] A case study at the Apple Farm Inn and Suites, a hotel in San Luis Obispo, CA compared laundering practices with ozone washers and traditional washing machines. For this case study, the washing machine capacity was 80 pounds per load of laundry and the standard machine required 0.62 therms of natural gas per load of laundry, which is an average of 0.008 therms needed per pound of laundry. Note: one "therm" is equal to 100,000 British Thermal Units (BTUs). www.airbestpractices.com/sustainability-projects/water-conservation/ozone-laundry-system-reduces-hotels-operational-costs-40

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[29] A case study at the Apple Farm Inn and Suites, a hotel in San Luis Obispo, CA compared laundering practices with ozone washers and traditional washing machines. For this case study, the washing machine capacity was 80 pounds per load of laundry and required 1.53 kWh of electricity per load of laundry. This is equal to an average of 0.02 kWh of electricity needed per pound of laundry. The ozone machine required 1.07 kWh for the same load of laundry, for a per pound average of 0.01 kWh.
www.airbestpractices.com/sustainability-projects/water-conservation/ozone-laundry-system-reduces-hotels-operational-costs-40

Formula = 0.02 – 0.01 = <u>0.01 kWh electricity saved per pound of laundry</u>

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[30] A case study at the Apple Farm Inn and Suites, a hotel in San Luis Obispo, CA compared laundering practices with ozone washers and traditional washing machines. For this case study, the washing machine capacity was 80 pounds per load of laundry and required 0.62 therms of natural gas per load of laundry, which is an average of 0.008 therms needed per pound of laundry. The ozone machine required 0.12 therms for the same load of laundry, for a per pound average of 0.002 therms. www.airbestpractices.com/sustainability-projects/water-conservation/ozone-laundry-system-reduces-hotels-operational-costs-40

Formula = (0.008 – 0.002) x 100,000 = <u>600 BTUs saved per pound of laundry</u>

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[31] One British thermal unit (BTU) is the energy required to raise one pound of water by one degree Fahrenheit (F). In the U.S., water temperature starts at approximately 50 degrees F. Hot water temperatures of 104-120 degrees F are preferred for dish-washing, laundry, and showering. A U.S. gallon of water weighs 8.3 pounds. Therefore, it takes 581 BTUs of energy to raise a gallon of water from 50 to 120 degrees F when doing a load of white laundry (most common in hotels). http://en.wikipedia.org/wiki/Water_heating

Formula = [1 gallon water x 8.3 lbs x (120 – 50)] = <u>581 BTUs per gallon of water used for laundry</u>

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[32] NEWMOA calculates an average flow-rate of 4.06 gpm for standard showers, based on the following references:

- The H_2OUSE website estimates that the national average flow rate for all showers is 2.22 gallons of water per minute (including conserving and non-conserving showers – based on a 1999 study). www.h2ouse.org/tour/details/element_action_contents.cfm?elementID=D4D1D449-3191-4C6A-91001A97C2FC4A2E&actionID=78FA9A8B-2756-4B2E-88D58A48310FAA76&roomID=8183044A-3219-48E2-A965ACB77A568AC4
- EPA estimates that standard showerheads use 2.5 gpm. www.epa.gov/watersense/products/showerheads.html
- HomeTips.com estimates that older shower heads use 5 to 8 gpm. www.hometips.com/cs-protected/guides/showerheads/whatis_lowflow.html
- The California Energy Commission estimates that older showers (installed prior to 1992) have an average flow rate of 5 gpm. www.consumerenergycenter.org/myths/shower_vs_bath.html

Formula = {2.22 +2.5 + [(5 +8)/2] + 5} / 4 = <u>4.06 gpm average flow rate for standard showers</u>

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[33] See endnote reference 16.

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[34] See endnote reference 17.

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[35] NEWMOA calculates an average flow rate for standard faucets of 1.75 gpm, based on the following references:

- The EPA Water Sense program cites the standard faucet flow rate as 2.2 gallons per minute (gpm). www.epa.gov/watersense/docs/faucet_spec508.pdf
- The H_2OUSE website lists the national average faucet flow rate as 1.3 gpm, but does not specify whether this is for a conserving or non-conserving faucet. www.h2ouse.org/tour/details/element_action_contents.cfm?elementID=1D4BABB7-8E4C-4524-98836EECCC5AEE08&actionID=11252FC5-E889-45A5-A088549C8CF50361&roomID=8183044A-3219-48E2-A965ACB77A568AC4

Formulas = (2.2 + 1.3) / 2 = 1.75 gpm average flow rate for standard faucets

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[36] See endnote reference 19.

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[37] Powers Controls, a water technology company surveyed hotels on the water temperatures used in their guest rooms and found that average maximum hot water temperatures were 126.1 degrees F for showers and 127.9 degrees F for faucets (or 127 degrees F overall). However, they recommend that all water for use in hotel guest rooms (faucets, showers, and tubs) be heated to a maximum of 104 degrees F to eliminate the risk of scalding. http://www.allstays.com/Features/Xpr-ScaldingWaterAtHotels.htm

The reference for the calculations in the formulas noted below, which are used for determining the energy needed to heat water to varying degrees of temperature, is noted in endnote reference 31.

Formulas = (1 gallon of water) x (8.3 pounds) x [127-50] = 639 BTUs of energy to heat water to 127 degrees F
(1 gallon of water) x (8.3 pounds) x [104-50] = 448 BTUs of energy to heat water to 104 degrees
639 – 448 = 191 BTUs of energy saved per gallon of water by reducing the target hot water temp

Note: Individual facilities should use their own judgment when determining the maximum water temperature accessible for guest rooms and may alter this formula in accordance with their specific temperature settings.

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[38] See endnote reference 1.

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[39] The U.S. Department of Energy uses the general assumption is that each bulb replacement is from a 60-watt incandescent bulb to a 13-watt CFL. Therefore, the difference in electricity consumption between these two bulbs is 47 watts per bulb. www.energystar.gov/ia/partners/promotions/change_light/downloads/CALFacts_and_Assumptions.pdf

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[40] The U.S. Department of Energy estimates that each CFL is turned on (i.e., used) for an average of three hours per day. www.energystar.gov/ia/partners/promotions/change_light/downloads/CALFacts_and_Assumptions.pdf

Note: This value is based on residential use and represents lighting use in a 24-hour period. It is likely that hotel guests do not stay in their rooms for the same length of time as a person would stay in their house. NEWMOA has not been able to find any references on the number of hours per day, or the percent of time in a day, that guests spend in the hotel.

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[41] The U.S. Department of Energy Report, "*Energy Savings of Light Emitting Diodes in Niche Lighting Applications*," estimates that the average wattage for incandescent recessed lighting used in commercial facilities is 72 watts. The equivalent CFL wattage would be 16 watts, for an energy difference of 56 watts per bulb. http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/nichefinalreport_october2008.pdf

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[42] According to conversations with state programs in NEWMOA's hospitality workgroup, the lighting for most hotel common areas is kept on 24 hours a day, 7 days a week.

[43] See endnote reference 1.

[44] An article on Productdose.com cites the average energy use for general incandescent lighting as 60 watts and the equivalent LED energy use for the same lighting as 6 watts, for a savings of 54 watts per bulb.
http://cmos.productdose.com/article.php?article_id=1142

[45] See endnote reference 40.

[46] The U.S. Department of Energy Report, "*Energy Savings of Light Emitting Diodes in Niche Lighting Applications*," estimates that the average wattage for incandescent recessed lighting used in commercial facilities is 72 watts. The equivalent LED wattage would be 14 watts, for an energy difference of 58 watts per bulb.
http://apps1.eere.energy.gov/buildings/publications/pdfs/ssl/nichefinalreport_october2008.pdf

[47] See endnote reference 42.

[48] Old incandescent exit signs consume up to 40 watts of electricity and use 350 kWh per year. Energy Star-qualified LED exit signs consume less than 5 watts of electricity and use approximately 44 kWh per year, for an annual savings of 306 kWh per year.
www.energystar.gov/ia/business/small_business/led_exitsigns_techsheet.pdf

Note: This default value uses the assumption that the current illuminated exit signs use incandescent bulbs. This is consistent with what Maine DEP and Vermont SBDC have found in use at hotels participating in their Programs. However, fluorescent bulbs and CFLs may also be used in exit signs. These signs consume up to 16 watts of electricity and use up to 140 kWh per year. Therefore, when replacing these signs with LEDs, the annual savings is 96 kWh per year. Individual facilities may want to override this default value with a value that is specific to the type of exit sign they are replacing (i.e., incandescent versus fluorescent).

[49] NEWMOA calculates an average savings of 1,876 kWh per year based on information from the following references:

- Information in a National Resources Defense Council PowerPoint presentation given in 2002 states that vending misers save 2,000 kWh per machine per year. This is the value that is currently used by the sustainable hospitality programs in Maine and Vermont. http://aceee.org/files/pdf/conferences/mt/2002/HorowitzWS23.pdf
- A study completed by Tufts University in 2001 found that vending machines without vending misers consumed 3,468 kWh per year and vending machines with vending misers consumed 1,716 kWh per year. Therefore, the total kWh reduced by installing these devices was estimated at 1,752 kWh per year per machine. The electricity usage for these figures was estimated based on the energy consumption of a beverage vending machine measured for one week in an occupied dormitory. Note: The value is based on testing in a dormitory setting; hotel vending machine use may be different. http://sustainability.tufts.edu/downloads/VendingMiserHandout-updated020310.pdf

Formula = (2,000 + 1,752) / 2 = 1,876 kWh saved per year

[50] The North Carolina Division of Pollution Prevention and Environmental Assistance (DPPEA) states that hotel rooms generate 1-2 pounds of waste per day on non-checkout days and 2-4 pounds of waste on checkout days. www.p2pays.org/ref/01/00356.pdf

Based on NEWMOA's previous calculation (see endnote reference 2) that the average length of a guest's stay is 2.47 nights and assuming that the checkout day is the third day (i.e., day number 3.47), NEWMOA estimates that the total amount of waste generated per room for the entire length of the guests' stay is 6.71 pounds.

Formulas = (1 + 2) / 2 = 1.5 pounds waste on each non-checkout day
(2 + 4) / 2 = 3 pounds of waste on checkout day
1.5 + 1.5 + (1.5 x 0.47) + 3 = 6.71 pounds of waste over length of stay

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[51] The N.C. DPPEA estimates that 80% of the waste generated from hotel rooms is recyclable. www.p2pays.org/ref/01/00356.pdf

Note: Individual facilities may be able to track the actual amount of recyclable materials recovered. The default value of 80% is used to show the potential reductions in waste if all of the eligible recyclables are properly recovered.

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[52] A field study conducted at the Wyndham Virginia Crossings Hotel and Conference Center, in Glen Allen, VA, found that hotel guests generate an average of 1.83 pounds of waste per person per day.
www.deq.state.va.us/export/sites/default/recycle/pdf/CompostingStudyWyndham2009.pdf

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[53] The same field study conducted at the Wyndham Hotel (see endnote reference 52) also found that each hotel guest generates 1.01 pounds of compostable food waste per day, or approximately 55% of their total waste.
www.deq.state.va.us/export/sites/default/recycle/pdf/CompostingStudyWyndham2009.pdf

Note: Hotel guests at facilities that do not have restaurants, bars, banquets rooms, or other dining facilities, presumable consume more of their food at locations outside of the hotel and therefore, would not generate as much food waste. Therefore, facilities may want to override this default value with another value that may be more representative (in known).

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[54] See endnote reference 1.

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[55] The Maine DEP Program uses the assumption that each lodging facility provides an average of two amenity bottles per room per day (i.e., shampoo and conditioner). This is based on their general knowledge and experience working with facilities.

Note: Individual facilities may want to override this default value with another value that may be more representative to the amount of amenity bottles distributed in each room. For example, some hotels include soap, lotion, mouthwash, etc.

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[56] The Maine DEP Program uses the assumption that the average size of each bottle of shampoo/conditioner is 1 oz., which is equal to 0.6 pounds. This is based on their general knowledge and experience working with facilities.

Note: Individual facilities may want to override this default value with another value that may be more representative to the size of the amenity bottles distributed in each room. In addition, the Dispenser Amenities website has its own calculator for calculating environmental impacts from using disposable amenities and includes fields where hotels can plug in their own information regarding bottle size and types of amenities. www.dispenser-amenities.com/waste.html.

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[57] NEWMOA calculates that lodging facilities use an average of 16 reams of paper per year, based on the following references:

- The Maine DEP Program uses the assumption that hotels use 12 reams of paper per year (one per month) based on a good faith estimate; however Maine DEP acknowledges that this is a conservative estimate.
- A reference from the EPA citing the Lawrence Berkley National Laboratory, states that the average office worker uses 10,000 sheets of paper per year (this is equal to approximately 20 reams). www.epa.gov/osw/conserve/materials/paper/faqs.htm#offices and http://eetd.lbl.gov/paper/html/concept.htm

Formula = (12 + 20) / 2 = 16 reams of paper on average

Note: Individual facilities may want to later this default value to indicate the exact amount of paper used in one year.

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[58] The most common type of paper used is the standard letter sized paper aka "copy paper." Common copy paper has a basis weight of 20 pounds. The standard ream in the U.S. is 500 sheets of 17 x 22 inch paper; so that each sheet of paper is cut to four 8 ½ x 11 inch sheets – which is why this is also referred to as "letter sized paper." This size ream weighs about 5 pounds. http://en.wikipedia.org/wiki/Paper_density

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[59] The Connecticut DEP, Maine DEP, New Hampshire NHSLRP, and Rhode Island DEM sustainable hospitality programs require a minimum of 30% post consumer recycle paper to be used by facilities in order to get points towards their certification.

Note: Individual facilities may want to change this default value if they use a higher recycled content paper. As a result of increasing the recycled content of the paper they use, the facilities will see an increase in environmental savings over the lifecycle of the product.

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[60] The average greenhouse gas emission factor is 1.54 pounds CO_2 per kWh – for one year. The average emission factor over a CFL's lifetime is 1.45 pounds CO_2 per kWh.
www.energystar.gov/ia/partners/promotions/change_light/downloads/CALFacts_and_Assumptions.pdf

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[61] The "My LED Lighting Guide" website states that a 6-watt LED bulb generates 0.01825 tons of carbon emissions per year, compared to an equivalent incandescent bulb, which generates 0.152083 tons of carbon emissions per year. This is a savings of 0.133833 tons (approximately 267.67 pounds) of carbon emissions per bulb when switching from incandescent to LED bulbs.
www.myledlightingguide.com/Article.aspx?ArticleID=5

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[62] Annual CO_2 pollution from LED exit signs is 72 pounds. Incandescent lamp exit signs produce 574 pounds of CO_2. The difference in annual CO_2 emissions between the older exit signs and LED signs is 502 pounds of CO_2 per year when switching from incandescent bulbs. www.energystar.gov/ia/business/small_business/led_exitsigns_techsheet.pdf

Note: This default value uses the assumption that the current illuminated exit signs use incandescent bulbs. This is consistent with what Maine DEP and Vermont SBDC have found in use at hotels participating in their Programs. However, fluorescent bulbs and CFLs may also be used in exit signs. Fluorescent exit signs produce 230 pounds of CO_2 per year. Therefore, when replacing these signs with LEDs, the difference in annual CO_2 emissions is 158 pounds per year. Individual facilities may want to override this default value with a value that is specific to the type of exit sign they are replacing (i.e., incandescent versus fluorescent).

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[63] A study by Tufts University found that vending machines without vending misers contribute 2.26 tons of CO_2 per year and vending machines with vending misers contribute 1.12 tons of CO_2 per year. This represents an annual savings of 1.14 tons when installing these devices in vending machines.
http://sustainability.tufts.edu/downloads/VendingMiserHandout-updated020310.pdf

Note: This is based on the statement that carbon dioxide emissions are 1.3 pounds per kWh. The electricity usage for these figures was estimated based on the energy consumption of a beverage vending machine measured for one week in an occupied dormitory. Note: The value is based on testing in a dormitory setting; hotel vending machine use may be different.

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[64] NEWMOA calculated a difference in VOC emissions of 200 grams per liter of paint based on the following references:

- Federal VOC limits are set at 250 grams per liter (g/l) for flat paints (standard). www.consumerreports.org/cro/magazine-archive/march-2009/home-garden/interior-paints/overview/interior-paints-ov.htm
- Green Seal-certified low-VOC paint is 50 grams/liter for flat paint. www.greenseal.org/certification/standards/paints.cfm

Note: The average values listed above are based on VOC limits for "flat" indoor paint (matte finish), which was determined to be the most common paint type used in hotels, based on conversations with the NEWMOA Regional Hospitality Workgroup. Other paint finishes may vary (e.g., shiny finish). Also, some states have greater restrictions on the amount of VOCs that may be in standard paint, and therefore, state programs or individual facilities may want to override the default value with a value that may be more representative for their state.

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[65] NEWMOA calculated an average cost of $0.0019 per gallon of water, based on the following references:

- The American Water Works Association (AWWA) 2004 water and wastewater rate survey cites a national average water use cost of $0.0018 per gallon.
- The EPA document, "Water on Tap: What You Need to Know" (December 2009) cites the national average cost of water at $2.00 per 1,000 gallons, or approximately $0.002 per gallon. www.epa.gov/safewater/wot/pdfs/book_waterontap_full.pdf

Formula = (0.0018 + 0.0020) / 2 = $0.0019 per gallon

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[66] A case study at the Apple Farm Inn and Suites, a hotel in San Luis Obispo, CA compared laundering practices with ozone washers and traditional washing machines. For this case study, the total costs of the cleaning chemicals used (i.e., detergent and bleach) was approximately 13¢ per ounce (based on $0.99 per load for 7.6 ounces used in traditional machines and $0.78 per load for 6 ounces used in ozone machines). www.airbestpractices.com/sustainability-projects/water-conservation/ozone-laundry-system-reduces-hotels-operational-costs-40

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[67] NEWMOA assumes an average of 10¢ per kWh based on the following references:

- The U.S. Department of Energy estimates that the average retail price of electricity for the commercial sector is $0.1017 per kWh based on August 2010 data estimated over a 12-month period. www.eia.doe.gov/cneaf/electricity/epm/table5_3.html
- A U.S. Department of Energy fact sheet about CFLs estimates the average U.S. residential electricity rate is $0.1008 per kWh for one year (based on 2006 data). The average cost savings over a CFL's lifetime is $0.093 per kWh. www.energystar.gov/ia/partners/promotions/change_light/downloads/CALFacts_and_Assumptions.pdf

Formula = (0.1017 + 0.1008) / 2 = <u>$0.1012 per kWh</u> (rounded to 10¢)

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[68] NEWMOA assumes an average of $1.12 per therm based on the following references:

- The U.S. Department of Energy estimates that the average retail price of natural gas for the commercial sector is $10.06 per thousand cubic feet, which is equal to $1.01 per therm, based on 2009 data. Note: one "therm" of energy is equal to burning 100 cubic feet of natural gas. www.eia.gov/dnav/ng/ng_pri_sum_dcu_nus_a.htm
- Energy Star estimates that the national average cost of natural gas used for heating hot water for clothes washing is $1.10 per therm, based on 2008 data. Note: one "therm" is equal to 100,000 British Thermal Units (BTUs). www.energystar.gov/index.cfm?c=clotheswash.pr_clothes_washers_costsave
- A case study at the Apple Farm Inn and Suites, a hotel in San Luis Obispo, CA compared laundering practices with ozone washers and traditional washing machines. For this case study, the natural gas energy costs were approximately $1.24 per therm (based on $0.77 therms per load for 0.62 therms used in traditional machines and $0.15 therms per load for 0.12 therms used in ozone machines). www.airbestpractices.com/sustainability-projects/water-conservation/ozone-laundry-system-reduces-hotels-operational-costs-40

Formula = (1.01 + 1.10 + 1.24) / 3 = <u>$1.1167 per therm</u> (rounded to $1.12)

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[69] See endnote reference 65.

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[70] See endnote reference 66.

[71] See endnote reference 67.

[72] See endnote reference 68.

[73] See endnote reference 65.

[74] The U.S. Department of Energy estimates that the average retail price of natural gas for the commercial sector is $10.06 per thousand cubic feet, which is equal to $1.01 per therm, based on 2009 data. Note: one "therm" of energy is equal to burning 100 cubic feet of natural gas. www.eia.gov/dnav/ng/ng_pri_sum_dcu_nus_a.htm

[75] See endnote reference 74.

[76] See endnote reference 67.

[77] The U.S. Department of Energy estimates that the average retail price of electricity for the commercial sector is $0.1017 per kWh based on August 2010 data estimated over a12-month period. For the purposes of the calculations used in this document, NEWMOA rounds this value to 10¢ per kWh electricity. www.eia.doe.gov/cneaf/electricity/epm/table5_3.html

[78] See endnote reference 77.

[79] See endnote reference 77.

[80] The Hyatt Regency in Princeton, NJ implemented a recycling program to divert recyclables from trash. In 2009, 21 tons of commingled recyclables (i.e., cans, bottles, glass, plastic, steel, aluminum, paper, and cardboard) were recycled. The hotel saved $3,410 by keeping these recyclables out of the trash compactor – a per ton savings of $162.38.
www.jgpress.com/archives/_free/002205.html

Note: The costs associated with solid waste disposal include hauler fees and disposal tipping fees (via landfill or waste-to-energy facility). Individual hauler fees, as well as state solid waste tipping fees vary widely – they are generally higher in the Northeast and may be different in other regions in the U.S. Programs may want to override this default value with a value that may be more representative for their state (if known).

[81] The Hyatt Regency in Princeton, NJ saved more than $10,000 in one year by having their food scraps composted instead of landfilled. In 2009, the hotel composted 131 tons of food waste for a total savings of $10,374 – or $79.19 per ton. The total savings includes the cost savings associated with keeping food waste out of the trash compactor and reducing the number of trash compactor pulls. www.jgpress.com/archives/_free/002205.html

Note: The costs associated with solid waste disposal include hauler fees and disposal tipping fees (via landfill or waste-to-energy facility). Individual hauler fees, as well as state solid waste tipping fees vary widely – they are generally higher in the Northeast and may be different in other regions in the U.S. Programs may want to override this default value with a value that may be more representative for their state (if known).