Building Type[83]	Window Type	Heating System Type[84]	DRF_{North} (kW/ft²)	DRF_{East} (kW/ft²)	DRF_{South}[85] (kW/ft²)	DRF_{West} (kW/ft²)
Other[86]	Single Pane	Electric	9.15E-04	1.54E-03	-5.66E-05	2.69E-03
		Gas	9.24E-04	1.29E-03	-4.56E-04	2.33E-03
	Double Pane	Electric	4.63E-04	8.00E-04	-8.48E-04	1.37E-03
		Gas	4.74E-04	6.64E-04	-1.15E-03	1.18E-03
Public Assembly	Single Pane	Electric	1.10E-03	1.84E-03	1.83E-03	3.88E-03
		Non-electric	1.21E-03	2.04E-03	1.97E-03	4.69E-03
	Double Pane	Electric	5.61E-04	9.44E-04	9.38E-04	2.48E-03
		Non-electric	6.10E-04	1.04E-03	1.01E-03	3.19E-03
Public Order and Safety (Police and Fire Station)	Single Pane	Electric	1.04E-03	2.03E-03	2.34E-03	2.36E-03
		Non-electric	1.07E-03	2.19E-03	2.54E-03	2.53E-03
	Double Pane	Electric	1.04E-03	2.03E-03	2.34E-03	2.36E-03
		Non-electric	1.07E-03	2.19E-03	2.54E-03	2.53E-03
Religious Worship	Single Pane	Electric	5.90E-03	1.32E-02	5.95E-03	1.32E-02
		Non-electric	3.38E-03	7.84E-03	3.33E-03	7.55E-03
	Double Pane	Electric	3.13E-03	6.11E-03	3.55E-03	6.75E-03
		Non-electric	1.81E-03	3.45E-03	2.14E-03	7.55E-03
Service (Beauty, Auto Repair Workshop)	Single Pane	Electric	9.37E-04	9.53E-04	1.88E-03	1.70E-03
		Non-electric	6.39E-04	1.07E-03	1.96E-03	1.69E-03
	Double Pane	Electric	2.99E-04	4.94E-04	1.10E-03	8.64E-04
		Non-electric	3.19E-04	1.15E-03	1.15E-03	5.78E-04

Default Savings

No default savings will be awarded for this measure if the proper values are not provided in the customer application.

Source

The primary source for this deemed savings approach is prototypical building energy models defined by the 2008 Database for Energy Efficient Resources (DEER),[87] modified to represent Richmond, VA and Elizabeth City, NC weather and program-specific window characteristics.

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[87] http://www.energy.ca.gov/deer/

8 NON-RESIDENTIAL SMALL BUSINESS IMPROVEMENT PROGRAM

Dominion's Non-Residential Small Business Improvement Program provides small business owners incentives to use Dominion-approved contractors to provide many of the measures already provided through existing legacy programs that typically target non-residential building owners: Non-Residential Heating and Cooling Efficiency program and the Non-residential Lighting Systems and Controls program. In addition, four retrocommissioning measures are provided. Program measures are summarized in Table 8-1.

According to the program terms and conditions, as of June 2017, to be eligible to participate in this program, Dominion Energy Virginia non-residential customers must be of a privately-owned business with five or fewer locations that has not exceeded monthly demand threshold of 100 kW three or more times in the past 12 months, has not opted out of participation, is responsible for the electric bill and is the owner of the facility or reasonably able to secure permission to complete measures. Once a customer participates in the program and receive a rebate, they cannot opt out for three years following the year of participation.

Prior to June 1, 2017, the Small Business Improvement Program delivered refrigeration measures to Virginia customers, but stopped per an SCC ruling.[88]

Table 8-1: Non-residential Small Business Improvement Program Measure List

End-Use	Measure	Manual Section
HVAC	Duct Testing & Sealing	Section 8.1.1
	Unitary/Split AC, HP, and Chiller Tune-up	Section 8.1.2
	Refrigerant Charge Correction	Section 8.1.3
	Unitary/Split AC & HP Upgrade	Section 6.1.1
	Mini-split Heat Pump	Section 6.1.2
	Dual Enthalpy Air-side Economizer	Section 6.1.5
	Variable Frequency Drive	Section 6.1.4
	Programmable Thermostat	Section 8.1.8
Lighting	Lighting, Fixtures, Lamps, and Delamping	Section 5.1.1
	Sensors & Controls	Section 5.1.2
	LED Exit Signs	Section 8.2.3
Other	Compressed Air Leak Repair	Section 8.3.1

[88] As of June 1, 2017, refrigeration measures ceased to be offered through this program as a result of the ruling in Virginia SCC Case No. PUE-2016-00111 issued and effective on the same date.

8.1 Heating Ventilation and Air Conditioning (HVAC) End Use

8.1.1 Duct Testing and Sealing

Measure Description

This measures provides building owners incentives to use Dominion-approved, duct-sealing contractors to reduce conditioned-air leakage to unconditioned spaces by the following steps: 1) test non-residential duct systems for air leakage, 2) seal the ducts using an aerosol-based product, and then 3) test the sealed duct systems for air leakage to confirm that sealing the ducts reduced the air-leakage rate.

Eligible ductwork is connected to a unitary HVAC system or a heat pump and occurs within an unconditioned plenum space or between an insulated, finished ceiling and a roof surface. Based on DNV GL's judgment, this measure is applicable to ductwork at unitary and chiller-cooled systems.

Savings Estimation Approach

For all system types, gross annual electric energy savings are calculated according to the following equation:

$$\Delta kWh = \Delta kWh_{cool} + \Delta kWh_{heat}$$

Unitary Systems, Air Source Heat Pumps, and AC Units

Gross annual electric cooling and heating energy savings are calculated according to the following equations.

Unitary systems, for air-source heat pumps and AC units, $Size_{cool}$ < 65,000 Btu/h:

$$\Delta kWh_{cool} = Size_{cool} \times \frac{12\ kBtuh/ton}{SEER} \times FLH_{cool} \times \left(1 - \frac{\overline{n}_{dist,base}}{\overline{n}_{dist,ee}}\right)_{cool}$$

Unitary systems, for air-source heat pumps and AC units, $Size_{heat}$ < 65,000 Btu/h:

$$\Delta kWh_{heat} = Size_{heat} \times \frac{1}{HSPF} \times FLH_{heat} \times \left(1 - \frac{\overline{n}_{dist,base}}{\overline{n}_{dist,ee}}\right)_{heat}$$

Unitary systems, for air-source heat pumps and AC units, $Size_{cool}$ ≥ 65,0O0Btu/h and all ground-source heat pumps:

$$\Delta kWh_{cool} = Size_{cool} \times \frac{12\ kBtuh/ton}{IEER} \times FLH_{cool} \times \left(1 - \frac{\bar{n}_{dist,base}}{\bar{n}_{dist,ee}}\right)_{cool}$$

Unitary systems, for air-source heat pumps and AC units, $Size_{heat}$ ≥ 65,000 Btu/h and all ground-source heat pumps:

$$\Delta kWh_{heat} = Size_{heat} \times \frac{1}{COP \times 3.412\ Btuh/W} \times FLH_{heat} \times \left(1 - \frac{\bar{n}_{dist,base}}{\bar{n}_{dist,ee}}\right)_{heat}$$

Gross coincident demand reduction is calculated according to the following equation:

$$\Delta kW = Size_{cool} \times \frac{12\ kBtuh/ton}{EER} \times \left(1 - \frac{n_{dist,pk,base}}{n_{dist,pk,ee}}\right) \times CF$$

Chiller Systems

Water-cooled chiller systems, cooling savings:

$$\Delta kWh_{cool} = Size_{cool} \times \frac{kW}{ton_{IPLV}} \times FLH_{cool} \times \left(1 - \frac{\bar{n}_{dist,base}}{\bar{n}_{dist,ee}}\right)_{cool}$$

Air-cooled chiller systems, cooling savings:

$$\Delta kWh_{cool} = Size_{cool} \times \frac{12\ kBtuh/ton}{EER_{IPLV}} \times FLH_{cool} \times \left(1 - \frac{\bar{n}_{dist,base}}{\bar{n}_{dist,ee}}\right)_{cool}$$

Chiller system heating savings for systems <65,000 Btu/h:

$$\Delta kWh_{heat} = Size_{heat} \times \frac{1}{HSPF} \times FLH_{heat} \times \left(1 - \frac{\bar{n}_{dist,base}}{\bar{n}_{dist,ee}}\right)_{heat}$$

Chiller system heating savings for systems ≥65,000 Btu/h:

$$\Delta kWh_{heat} = Size_{heat} \times \frac{1}{COP \times 3.412\ Btuh/W} \times FLH_{heat} \times \left(1 - \frac{\bar{n}_{dist,base}}{\bar{n}_{dist,ee}}\right)_{heat}$$

For all system types, heating systems with non-electric primary heat will receive zero heating savings.

Gross coincident demand reduction is calculated according to the following equations:

Water-cooled chiller systems:

$$\Delta kW = Size_{cool} \times \frac{kW}{ton_{full\ load}} \times \left(1 - \frac{\bar{n}_{dist,peak,base}}{\bar{n}_{dist,peak,ee}}\right) \times CF$$

Air-cooled chiller systems:

$$\Delta kW = Size_{cool} \times \frac{12\ kBtuh/ton}{EER_{full\ load}} \times \left(1 - \frac{\bar{n}_{dist,peak,base}}{\bar{n}_{dist,peak,ee}}\right) \times CF$$

Where:

ΔkWh = gross annual electric energy savings

ΔkW = gross coincident demand reductions

$Size_{cool}$ = system cooling capacity in tons, based on nameplate data

$Size_{heat}$ = nominal rating of the unitary systems (heat pumps or AC units)

SEER = seasonal energy efficiency ratio (SEER). It is used for heat pumps and AC units that are smaller than 65,000 Btu/h.

IEER = integrated energy efficiency ratio (IEER) of a unit's efficiency at four load points: 100%, 75%, 50%, and 25% of full cooling capacity. It is used for heat pumps and AC units that are 65,000 Btu/h or larger.

EER = energy efficiency ratio (EER) of heat pump and air-conditioning systems at full-load conditions. (See Equation 3 in Sub-appendix V to convert SEER to EER, if EER is not provided.)

HSPF = heating seasonal performance factor (HSPF). It is used for heat pumps. (See Equation 5 in Sub-appendix V to convert COP to HSPF, if HSPF is not provided.)

COP = coefficient of performance (heating)

$\bar{n}_{dist,base,cool}$ = duct system average seasonal efficiency of baseline (pre-sealing) cooling system

$\bar{n}_{dist,base,heat}$ = duct system average seasonal efficiency of baseline (pre-sealing) heating system

$\bar{n}_{dist,ee,cool}$ = duct system average seasonal efficiency of efficient (post-sealing) cooling system

$\bar{n}_{dist,ee,heat}$ = duct system average seasonal efficiency of efficient (post-sealing) heating system

$n_{dist,peak,base}$ = duct system efficiency of baseline system, under peak conditions (equal to $\bar{n}_{dist,base,cool}$)

$n_{dist,peak,ee}$ = duct system efficiency of efficient system, under peak conditions (equal to $\bar{n}_{dist,ee,cool}$)

$EER_{full\text{-}load}$ = energy efficiency ratio (EER) of air-cooled chillers at full-load conditions.

EER_{IPLV} = energy efficiency ratio (EER) of air-cooled chillers at integrated part load value (IPLV).

$\frac{kW}{ton_{IPLV}}$ = energy efficiency of water-cooled chiller system at integrated part load value (IPLV)

$\frac{kW}{ton_{full\ load}}$ = energy efficiency of water-cooled chiller system at full load

FLH_{cool} = annual cooling equivalent full load hours (FLH)

FLH_{heat} = annual heating equivalent FLH

CF = peak coincidence factor

Input Variables

Table 8-2: Input Values for Duct Sealing Savings Calculations

Component	Type	Value	Unit	Source(s)
$Size_{cool}$	Variable	See customer application	tons of cooling capacity (per unit)	Customer application
$Size_{heat}$	Variable	See customer application	kBtu/h (per unit)	Customer application
SEER	Variable	See customer application	kBtu/kW-hr	Customer application
		Default: See Table 12-10 and Table 12-11 in Sub-appendix VII		ASHRAE 90.1-2010, Table 6.8.1A and 6.8.1B
IEER	Variable	See customer application	kBtu/kW-hr	Customer application
		Default: See tables in Sub-appendix VII, based on equipment type		ASHRAE 90.1-2010, Table 6.8.1A and 6.8.1B
EER	Variable	See customer application	kBtu/kW-hr	Customer application
		Default: See tables in Sub-appendix VII, based on equipment type		ASHRAE 90.1-2010, Table 6.8.1A and 6.8.1B
HSPF	Variable	See customer application	kBtu/kW-hr	Customer application
		Default: See tables in Sub-appendix VII, based on equipment type		ASHRAE 90.1-2010, Table 6.8.1B
COP	Variable	See customer application	-	Customer application
		Default: See tables in Sub-appendix VII, based on equipment type		
$kW/ton_{full\ load}$	Variable	See customer application[89]	kW/ton	Customer application
		Default: see Table 12-13 in Sub-appendix VII		ASHRAE 90.1-2010, Table 6.8.1C
kW/ton_{IPLV}	Variable	See customer application	kW/ton	Customer application
		Default: see Table 12-13 in Sub-appendix VII		ASHRAE 90.1-2010, Table 6.8.1C

[89] When missing either the IPLV or the full load value, use either Equation 7 in Sub-appendix V, as relevant.

Component	Type	Value	Unit	Source(s)
$EER_{full\ load}$	Variable	See customer application[90]	kBtu/kW-h	Customer application
		Default: see Table 12-13 in Sub-appendix VII		ASHRAE 90.1-2010, Table 6.8.1C
EER_{IPLV}	Variable	See customer application	kBtu/kW-h	Customer application
		Default: see Table 12-13 in Sub-appendix VII		ASHRAE 90.1-2010, Table 6.8.1C
$\overline{\eta}_{dist,base,cool}$	Variable	See customer application	percent	Customer application
		Default: No insulation, 30% leakage.		New York TRM 2018, p. 123-124
$\overline{\eta}_{dist,base,heat}$	Variable	See customer application along with Table 8-3 and Table 8-4	percent	Customer application
		Default: No insulation, 30% leakage		New York TRM 2018, p. 111-112
$\overline{\eta}_{dist,ee,cool}$	Variable	See customer application along with Table 8-3 and Table 8-4	percent	Customer application
		Default: No insulation, 15% leakage		New York TRM 2018, p. 111-112
$\overline{\eta}_{dist,ee,heat}$	Variable	See customer application along with Table 8-3 and Table 8-4	percent	Customer application
		Default: No insulation, 15% leakage		New York TRM 2018, p. 111-112
$\eta_{dist,peak,base}$	Variable	See customer application along with Table 8-3 and Table 8-4	percent	Customer application
		Default: No insulation, 30% leakage		New York TRM 2018, p. 111-112
$\eta_{dist,peak,ee}$	Variable	See customer application along with Table 8-3 and Table 8-4	percent	Customer application
		Default: No insulation, 15% leakage		New York TRM 2018, p. 111-112
FLH_{heat}	Fixed	See Table 12-4 in Sub-appendix II	hours (annual)	Mid-Atlantic TRM 2018, p. 418
FLH_{cool}	Fixed	For chiller systems, see Table 12-5 in Sub-appendix II; for all other system types, see Table 12-3 in Sub-appendix II	hours (annual)	Mid-Atlantic TRM 2018, p. 417; Mid-Atlantic TRM 2018 p. 437
CF	Fixed	0.68	-	Calculated CF from Dominion's DSM Phase I program. April 1, 2012 EM&V Report, Sub-appendix C-1, p. F-191

[90] When missing either the IPLV or the full load value, use either Equation 8 in Sub-appendix V, as relevant.

[91] Appendix C-1, Commercial HVAC Program: Load Shape and Net Savings Analysis Evaluation Report; Evaluation, Measurement and Verification Report for Dominion Virginia Power, Case PUE-2010-00084, Apr. 1, 2012, p. F-1.

The New York TRM (2018) provides values for duct system efficiency for uninsulated ducts and ducts with R-6 insulation for four building types: assembly building, fast food restaurant, full service restaurant, and small retail. The average column in Table 8-3 is a simple average of the four building types. The values for R-2, R-4 and R-8 insulation have been calculated by scaling the results using an engineering relationship of the effectiveness of increasing R-values (non-linear).

The manual provides efficiencies for only five leakage-rate bins: 8%, 15%, 20%, 25%, and 30%. In preparation for receiving duct leakage percentages that do not match these specific values, DNV GL used a linear regression to model duct system efficiency as a function of leakage proportion. The coefficients from this model were used to compute duct system efficiency for any leakage value between 0% and 50%.

Table 8-3: Duct System Efficiency by Broad Building Type Categories[92]

Duct Total Leakage (%)	Duct System R-Value	Assembly Building		Fast Food Restaurant		Full Service Restaurant		Small Retail		Average	
		Heating	Cooling	Heating	Cooling	Heating	Cooling	Heating	Cooling	Heating	Cooling
8	Uninsulated	0.857	0.922	0.766	0.866	0.797	0.854	0.614	0.838	0.759	0.870
15	Uninsulated	0.829	0.908	0.734	0.853	0.765	0.845	0.581	0.827	0.727	0.858
20	Uninsulated	0.810	0.897	0.714	0.844	0.743	0.837	0.559	0.818	0.707	0.849
25	Uninsulated	0.793	0.886	0.693	0.834	0.721	0.829	0.538	0.809	0.686	0.840
30	Uninsulated	0.776	0.873	0.675	0.823	0.701	0.820	0.520	0.799	0.668	0.829
8	R-2	0.877	0.954	0.821	0.906	0.845	0.904	0.691	0.885	0.808	0.912
15	R-2	0.846	0.938	0.780	0.889	0.807	0.893	0.648	0.871	0.770	0.898
20	R-2	0.826	0.926	0.754	0.878	0.781	0.884	0.619	0.861	0.745	0.887
25	R-2	0.807	0.913	0.729	0.865	0.755	0.874	0.593	0.850	0.721	0.875
30	R-2	0.789	0.899	0.707	0.852	0.732	0.864	0.570	0.839	0.699	0.863
8	R-4	0.886	0.970	0.848	0.925	0.869	0.929	0.729	0.908	0.833	0.933
15	R-4	0.855	0.952	0.802	0.907	0.827	0.917	0.681	0.893	0.791	0.917
20	R-4	0.833	0.940	0.774	0.894	0.799	0.908	0.649	0.883	0.764	0.906
25	R-4	0.814	0.926	0.747	0.881	0.772	0.897	0.621	0.871	0.738	0.893
30	R-4	0.795	0.911	0.723	0.867	0.748	0.885	0.594	0.859	0.715	0.881
8	R-6	0.896	0.986	0.875	0.945	0.893	0.954	0.767	0.931	0.858	0.954
15	R-6	0.863	0.967	0.825	0.925	0.848	0.941	0.714	0.915	0.813	0.937
20	R-6	0.841	0.954	0.794	0.911	0.818	0.931	0.679	0.904	0.783	0.925
25	R-6	0.821	0.939	0.765	0.896	0.789	0.919	0.648	0.891	0.756	0.911
30	R-6	0.801	0.924	0.739	0.881	0.763	0.907	0.619	0.879	0.731	0.898
8	R-8	0.901	0.994	0.889	0.955	0.905	0.967	0.786	0.943	0.870	0.965
15	R-8	0.867	0.974	0.836	0.934	0.858	0.953	0.731	0.926	0.823	0.947
20	R-8	0.845	0.961	0.804	0.919	0.827	0.943	0.694	0.915	0.793	0.935
25	R-8	0.825	0.946	0.774	0.904	0.798	0.930	0.662	0.901	0.764	0.920
30	R-8	0.804	0.930	0.747	0.888	0.771	0.918	0.631	0.889	0.738	0.906

[92] NY TRM 2018, Appendix H. Distribution Efficiencies, p. 509 – 512. New York City values are used for heating and cooling efficiencies for different building types. This table represent more R-Values and total duct leakage (%) than the reference table and for those cases, regression analysis was performed to obtain the respective heating and cooling duct system efficiencies.

Table 8-4: Duct System Efficiency Mapping to Building Type[93]

Building Type	Associated Duct System Efficiency Building Type
Education **Education – College and University** **Education – High School** **Education – Elementary and Middle School** **Health Care – inpatient** **Health Care – outpatient** **Lodging – (Hotel, Motel, and Dormitory)** **Office – Small (< 40,000 sq ft)** **Office – Large (≥ 40,000 sq ft)** **Other** **Warehouse and Storage**	Average
Food Sales **Food Sales – Gas Station Convenience Store** **Food Sales – Convenience Store** **Food Sales – Grocery** **Mercantile (Retail, not Mall)** **Mercantile (Mall)** **Service (Beauty, Auto Repair Workshop)**	Small Retail
Food Service **Food Service – Fast Food** **Food Service – Other**	Fast Food Restaurant
Food Service – Restaurant **Food Service – Full Service**	Full Service Restaurant
Public Assembly **Public Order and Safety (Police and Fire Station)** **Religious Worship**	Assembly Building

Default Savings

If the proper values are not supplied, a default savings may be applied using conservative input values. Default hours of use will be taken from the above chart if the building type is available.

Source(s)

The primary sources for this deemed savings approach is the New York TRM 2018, p. 111-114, Mid-Atlantic TRM 2018, and ASHRAE 90.1-2010.

93 Where "Building Type" does not clearly map to "Associated Duct System Efficiency Building Type," "Associated Duct System Efficiency Building Type is assigned to most conservative type." Full building type list was consolidated to map directly to 2003 U.S. DOE CBECS building types. Full building type list from Mid-Atlantic TRM. Original sources: Connecticut Program Savings Document for 2012 Program Year (September, 2011), p. 219-220. http://www.ctenergyinfo.com/2012%20CT%20Program%20Savings%20Documentation%20FINAL.pdf. 2003 US DOE CBECS building type definitions. http://www.eia.gov/emeu/cbecs/building_types.html.

8.1.2 Unitary/Split Air Conditioning, Heat Pump, and Chiller Tune-up

Measure Description

This measure involves tuning up packaged air conditioning units, heat pump units (both air and ground source), and air- and water-cooled cooled chillers at small commercial and industrial sites. All HVAC applications other than space cooling and heating—such as process cooling—are ineligible for this measure.

For the Small Business Improvement Program, this measure is separated from the Refrigerant Charge Adjustment retrocommissioning measure. However, this measure is also offered by the Commercial Non-Residential Prescriptive Program in which case, the tune-up and the refrigerant charge adjustment steps are combined into a single measure.

Savings Estimation

Algorithms and inputs to calculate heating, cooling savings, and demand reductions for unitary/split HVAC and package terminal AC system tune-ups are provided below. Gross annual electric energy savings and gross coincident demand reduction are calculated according to the equations following this section.

Cooling Energy Savings

For air-source heat pumps and AC units <65,000 Btu/h, the cooling energy savings are calculated as follows:

$$\Delta kWh_{cool} = Size_{cool} \times \frac{12\ kBtuh/ton}{SEER} \times FLH_{cool} \times TUF$$

For air-source heat pumps, AC units ≥65,000 Btu/h, and all ground-source heat pumps, the cooling savings are calculated as follows:

$$\Delta kWh_{cool} = Size_{cool} \times \frac{12\ kBtuh/ton}{IEER} \times FLH_{cool} \times TUF$$

For air- and water-cooled chillers:

$$\Delta kWh_{cool} = Size_{cool} \times IPLV \times FLH_{cool} \times TUF$$

Gross coincident demand reduction is calculated according to the following equation for air-conditioning and heat pump systems and chillers:

$$\Delta kW = Size_{cool} \times \frac{12\ kBtuh/ton}{EER} \times CF \times TUF$$

Heating Energy Savings

For air-source heat pumps <65,000 Btu/h, the heating energy savings are calculated as follows:

$$\Delta kWh_{heat} = Size_{heat} \times \frac{1}{HSPF} \times FLH_{heat} \times TUF$$

For air-source heat pumps ≥65,000 Btu/h and all ground-source heat pumps, the heating energy savings are calculated as follows:

$$\Delta kWh_{heat} = Size_{heat} \times \frac{1}{COP \times 3.412\ Btuh/W} \times FLH_{heat} \times TUF$$

Gross annual electric energy savings are calculated by combining the cooling and heating energy savings according to the following equation:

$$\Delta kWh = \Delta kWh_{cool} + \Delta kWh_{heat}$$

For AC units and air- and water-cooled chillers, there are no heating energy savings:

$$\Delta kWh_{heat} = 0$$

Gross coincident demand reduction is calculated according to the following equation:

$$\Delta kW = Size_{cool} \times \frac{12\ kBtuh/ton}{EER} \times CF \times TUF$$

Where:

ΔkWh	= gross annual electric energy savings
ΔkW	= gross coincident demand reductions
ΔkWh_{cool}	= gross annual electric cooling energy savings
ΔkWh_{heat}	= gross annual electric heating energy savings
$Size_{cool}$	= tons of cooling capacity of equipment
$Size_{heat}$	= heating capacity of equipment, if applicable.
SEER	= seasonal energy efficiency ratio (SEER) of the installed air conditioning equipment. It is used for heat pumps and AC units that are smaller than 65,000 Btu/h.
IEER	= integrated energy efficiency ratio (IEER) of the existing or baseline air conditioning equipment. IEER is a weighted average of a unit's efficiency at four load points: 100%, 75%, 50%, and 25% of full cooling capacity. It is used for heat pumps and AC units that are 65,000 Btu/h or larger.
FLH_{cool}	= annual full load cooling hours
FLH_{heat}	= annual full load heating hours
IPLV	= energy efficiency at integrated part load value (IPLV) of chillers. For air-cooled chillers, this is typically shown as EER_{IPLV}; for water-cooled chillers, this is typically shown as kW/ton_{IPLV}.
TUF	= rate of energy efficiency improvement due to tune-up
EER	= energy efficiency ratio of air-conditioning and heat pump systems and air- and water-cooled chillers at full load conditions.
HSPF	= heating seasonal performance factor (HSPF) of existing heat pump. HSPF is used in heating savings for air-source heat pumps.

COP = coefficient of performance of existing heating equipment. Ground source heat pumps use COP to determine heating savings.

CF = coincidence factor

Input Variables

Table 8-5: Input Variables for AC/HP/Chiller Tune-up Measure

Component	Type	Value	Units	Source(s)
$Size_{cool}$	Variable	See customer application	tons of refrigeration	Customer application
$Size_{heat}$	Variable	See customer application	kBtu/h	Customer application
		Default for heat pumps: 12 x $Size_{cool}$		Engineering constant
FLH_{cool}	Fixed	For chillers, see Table 12-5 in Sub-appendix II; for all other systems, see Table 12-3 in Sub-appendix II	hours (annual)	Mid-Atlantic TRM 2018 p. 417
FLH_{heat}	Fixed	For heat pumps, see Table 12-4 in Sub-appendix II	hours (annual)	Mid-Atlantic TRM 2018 p. 418
HSPF/SEER/ IEER/ EER/COP	Variable	For AC/HP, see Table 12-11 in Sub-appendix VII; For chillers, see Table 12-13 in Sub-appendix VII	k/kW-hour (except COP is -)	ASHRAE 90.1-2010 Table 6.8.1A and Table 6.8.1B
IPLV	Variable	See customer application	For air-cooled chillers, Btu/W; for water-cooled chillers, kW/ton	Customer application
		Default: See Table 12-13 in Sub-appendix VII		ASHRAE 90.1-2010 Table 6.8.1B
RCA_Done[94]	Variable	See customer application	True/False	Customer application

[94] RCA_Done is only relevant to the Non-Residential Prescriptive Program; it is neither collected nor used for the Small Business Improvement Program because Refrigerant Charge Adjustment is a separate measure.

Component	Type	Value	Units	Source(s)
TUF	Fixed	If RCA was not done: For AC units: 0.023 For HP units: 0.027 If RCA was done (only for Commercial Non-Residential Prescriptive Program): For AC units: 0.050 For HP units: 0.050 For chillers: 0.050	-	Mid-Atlantic TRM 2018 p. 450, California 2013-14 Evaluation Report,[95] and Wisconsin Focus on Energy 2018 TRM, p. 199-202.
CF	Fixed	Use system capacity to assign CF: < 11.5 tons = 0.588 ≥ 11.5 tons = 0.874	-	Mid-Atlantic TRM 2018 p. 408

Source

The primary sources for this deemed savings approach include the Mid-Atlantic TRM 2018, p. 417-418, the California 2013-14 Impact Evaluation Report,[95] and the Wisconsin Focus on Energy TRM 2017, p. 199-202.

[95] California Public Utilities Commission (2016). Impact Evaluation of 2013-14 Commercial Quality Maintenance Programs (HVAC3): www.calmac.org/publications/HVAC3ImpactReport_0401ES.pdf.

8.1.3 Refrigerant Charge Adjustment

Measure Description

This measure involves adjusting the amount of refrigerant charge at air conditioners and heat pumps for packaged and split systems at small commercial and industrial sites. All HVAC applications other than space cooling and heating—such as process cooling—are ineligible for this measure.

Savings Estimation

Algorithms and inputs to calculate cooling, heating and demand reductions for unitary/split air-conditioning and heating pump systems that receive refrigerant charge adjustments are provided below. Gross annual electric energy savings are calculated according to the equations that follow.

Cooling Energy Savings

For air-source heat pumps and AC units <65,000 Btu/h, gross annual electric cooling energy savings are calculated according to the following equation:

$$\Delta kWh_{cool} = Size_{cool} \times \frac{12\ kBtuh/ton}{SEER} \times FLH_{cool} \times RCF$$

For air-source heat pumps and AC units ≥65,000 Btu/h and ground-source heat pumps, gross annual electric cooling energy savings are calculated according to the following equation:

$$\Delta kWh_{cool} = Size_{cool} \times \frac{12\ kBtuh/ton}{IEER} \times FLH_{cool} \times RCF$$

Heating Energy Savings

For air-source heat pump units <65,000 Btu/h, gross annual electric heating energy savings are calculated according to the following equation:

$$\Delta kWh_{heat} = Size_{heat} \times \frac{12\ kBtuh/ton}{HSPF} \times FLH_{heat} \times RCF$$

For air-source heat pump units ≥65,000 Btu/h and ground-source heat pumps, gross annual electric heating energy savings are calculated according to the following equation:

$$\Delta kWh_{heat} = Size_{heat} \times \left(\frac{12\ kBtuh/ton}{COP \times 3.412\ Btuh/W}\right) \times FLH_{heat} \times RCF$$

Cooling and heating savings are added to calculate the gross annual electric energy savings as follows:

$$\Delta kWh = \Delta kWh_{cool} + \Delta kWh_{heat}$$

Cross coincident demand reduction is calculated according to he following equation:

$$\Delta kW = Size_{cool} \times \frac{12}{EER} \times RCF \times CF$$

Where,

$Size_{cool}$	= Unit capacity for cooling
$Size_{heat}$	= Unit capacity for heating
EER	= Energy Efficiency Ratio (EER) at full load
SEER	= seasonal energy efficiency ratio (SEER) of the installed air conditioning equipment. It is used for heat pumps and AC units that are smaller than 65,000 Btu/h.
IEER	= integrated energy efficiency ratio (IEER) of the existing or baseline air conditioning equipment. IEER is a weighted average of a unit's efficiency at four load points: 100%, 75%, 50%, and 25% of full cooling capacity. It is used for heat pumps and AC units that are 65,000 Btu/h or larger.
HSPF	= Heating Seasonal Performance Factor
COP	= Coefficient of Performance (heating)
FLH_{cool}	= Full load hours for cooling
FLH_{heat}	= Full load hours for heating
RCF	= Refrigerant Charge Factor
CF	= Demand Coincidence Factor

Input Variables

Table 8-6: Input Variables for Refrigerant Charge Adjustment

Component	Type	Value	Units	Source(s)
$Size_{cool}$	Variable	See customer application	tons (cooling capacity)	Customer application
$Size_{heat}$	Variable	See customer application	tons	Customer application
		Default: = $Size_{cool}$		
FLH_{cool}	Fixed	See see Table 12-5 in Sub-appendix II, Table X, or Table 12-3 in Sub-appendix II, depending upon equipment type	hours (annual)	Mid-Atlantic TRM 2018 p. 418
FLH_{heat}	Fixed	Table 12-4 in Sub-appendix II	hours (annual)	Mid-Atlantic TRM 2018 p. 417
EER/SEER	Variable	See customer application	Btu/W-hr	Customer application
		Default = See Table 12-10 and Table 12-11 in Sub-appendix VII		ASHRAE 90.1-2010 Table 6.8.1A and Table 6.8.1B
HSPF/COP	Variable	See customer application	Btu/W-hr (for HSPF); COP is -	Customer application
		Default = See Table 12-10 and Table 12-11 in Sub-appendix VII		ASHRAE 90.1-2010 Table 6.8.1B

Component	Type	Value	Units	Source(s)
RCF	Fixed	AC units: 0.027 HP units: 0.022	-	Mid-Atlantic TRM 2018 p. 450 and California 2013-2014 Evaluation Report[96]
CF	Fixed	Use system capacity to assign CF as follows: < 11.5 tons = 0.588 ≥ 11.5 tons = 0.874	-	Mid-Atlantic TRM 2018, p. 408

Source

The primary sources for this deemed savings approach include the Mid-Atlantic TRM 2018, p. 398 - 412 and the California 2013-14 Impact Evaluation Report, p. BB-2 to BB-3.

[96] California Public Utilities Commission (2016). Impact Evaluation of 2013-14 Commercial Quality Maintenance Programs (HVAC3). www.calmac.org/publications/HVAC3ImpactReport_0401ES.pdf

8.1.4 Unitary/Split AC & HP Upgrade

This measure is also offered through the Non-Residential Heating and Cooling Efficiency program. The savings approach is described in Section 6.1.1.

8.1.5 Mini-split Heat Pump

This measure is also offered through the Non-Residential Heating and Cooling Efficiency program. The savings approach is described in Section 6.1.2.

8.1.6 Dual Enthalpy Air-side Economizer

This measure is also offered through the Non-Residential Heating and Cooling Efficiency program. The savings approach is described in Section 6.1.5.

8.1.7 Variable Frequency Drive

This measure is also offered through the Non-Residential Heating and Cooling Efficiency program. The savings approach is described in Section 6.1.4.

8.1.8 Programmable Thermostats

Measure Description

This measure involves the installation of programmable thermostats[97] for cooling and/or heating systems in spaces with no existing setback control. The programmable thermostat shall setback the temperature setpoint during unoccupied periods. The savings will be realized from reducing the system usage during unoccupied times. The baseline operation of the HVAC units are assumed to be in continuous ON mode during the unoccupied period with fans cycling to maintain the occupied period temperature setpoints.

Savings Estimation

AC Units

Gross annual electric energy savings are calculated according to the following equation for units <65,000 Btu/h:.

$$\Delta kWh = \left[Size_{cool} \times \left(\frac{12}{SEER}\right) \times FLH_{cool} \times ESF_{cool}\right]$$

Gross annual electric energy savings are calculated according to the following equation for units ≥65,000 Btu/h:

$$\Delta kWh = \left[Size_{cool} \times \left(\frac{12}{IEER}\right) \times FLH_{cool} \times ESF_{cool}\right]$$

Gross coincident demand reduction is considered to be zero since space conditioning equipment typically operates at maximum capacity during peak periods.

$$\Delta kW = 0$$

Heat Pumps

Gross annual electric energy savings are calculated according to the following equation for units <65,000 Btu/h:

$$\Delta kWh = \left[Size_{cool} \times \left(\frac{12}{SEER}\right) \times FLH_{cool} \times ESF_{cool}\right] + \left[Size_{heat} \times FLH_{heat} \times \left(\frac{1}{HSPF}\right) \times ESF_{heat}\right]$$

Gross annual electric energy savings are calculated according to the following equation for units ≥65,000 Btu/h:

[97] Non-communicating thermostats are not eligible for the demand response programs.

$$\Delta kWh = \left[Size_{cool} \times \left(\frac{12}{IEER}\right) \times FLH_{cool} \times ESF_{cool}\right] + \left[Size_{heat} \times FLH_{heat} \times \left(\frac{12}{3.412 \times COP}\right) \times ESF_{heat}\right]$$

Gross coincident demand reduction is considered to be zero since space conditioning equipment typically operates at maximum capacity during peak periods.

$$\Delta kW = 0$$

Input Variables

Table 8-7: Input Parameters for Programmable Thermostat Measure

Component	Type	Value	Units	Source(s)
$Size_{cool}$	Variable	See customer application	tons of cooling capacity	Customer application
$Size_{heat}$	Variable	See customer application	kBtu/h	Customer application
FLH_{heat}	Fixed	Table 12-4 in Sub-appendix II	hours (annual)	Mid-Atlantic TRM 2018, p. 418
FLH_{cool}	Fixed	Table 12-5 in Sub-appendix II, Table X, or Table 12-3 in Sub-appendix II, depending upon equipment type	hours (annual)	Mid-Atlantic TRM 2018, p. 417
SEER/IEER	Variable	See customer application	kBtu/kW-hour	Customer application
		Default: See Table 12-10 and Table 12-11 in Sub-appendix VII		ASHRAE 2010, Table 6.8.1A
HSPF/COP	Variable	See customer application	kBtu/kW-hour (except COP is -)	Customer application
		See Table 12-10 and Table 12-11 in Sub-appendix VII		ASHRAE 2010, Table 6.8.1A
ESF_{cool}	Fixed	0.09	-	NY TRM 2018, pg. 140
ESF_{heat}	Fixed	0.02	-	NY TRM 2018, pg. 140

Source

The primary source for this deemed savings approach is the New York TRM 2018, p. 139 to 142.

8.2 Lighting End Use

8.2.1 Lighting, Fixtures, Lamps, and Delamping

This measure is also offered through the Non-Residential Lighting Systems and Controls program. The savings approach is described in Section 5.1.1.

8.2.2 Sensors and Controls

This measure is also offered through the Non-Residential Lighting Systems and Controls program. The savings approach is described in Section 5.1.2.

8.2.3 LED Exit Signs

Measure Description

This measure realizes energy savings by installing an exit sign that is illuminated with light emitting diodes (LED). This measure should be limited to retrofit installations.

Savings Estimation Approach

Gross annual electric energy savings are calculated according to the following equation:

$$\Delta kWh = \frac{(Qty_{base} \times watts_{base} - Qty_{ee} \times watts_{ee})}{1{,}000\ W/kW} \times HOU \times WHF_e \times ISR$$

Gross coincident demand reduction is calculated according to the following equation:

$$\Delta kW = \frac{(Qty_{base} \times watts_{base} - Qty_{ee} \times watts_{ee})}{1{,}000\ W/kW} \times WHF_d \times CF \times ISR$$

Where:

ΔkWh = gross annual electric energy savings
ΔkW = gross coincident demand reduction
Qty_{base} = number of baseline exit signs
$watts_{base}$ = connected load of the baseline exit sign
$watts_{ee}$ = connected load of the efficient exit sign
Qty_{base} = number of baseline exit signs
Qty_{ee} = number of efficient exit signs
HOU = average hours of use per year
WHF_e = waste heat factor for energy to account for cooling savings from efficient lighting
WHF_d = waste heat factor for demand to account for cooling savings from efficient lighting
CF = coincidence factor
ISR = in-service rate, the percentage of rebated measures actually installed

Input Variables

Table 8-8: Input Values for LED Exit Sign Calculations

Component	Type	Value	Unit	Source(s)
Qty_{base}	Variable	See customer application	-	Customer application
Qty_{ee}	Variable	Default: Equal to Qty_{base}	-	Customer application

Component	Type	Value	Unit	Source(s)
$watts_{base}$	Variable	See customer application	watts	Customer application
		Default: 16 W CFL		Mid-Atlantic TRM 2018 p. 311, ENERGY STAR®[98]
$watts_{ee}$	Variable	See customer application Default: 5 W LED	watts	Mid-Atlantic TRM 2018 p. 311, ENERGY STAR®
HOU	Fixed	8,760	hours (annual)	Mid-Atlantic TRM 2018 p. 312
WHF_e	Variable	See Table 12-6 in Sub-appendix III	-	Mid-Atlantic TRM 2018 p. 312
WHF_d	Variable	See Table 12-6 in Sub-appendix III	-	Mid-Atlantic TRM 2018 p. 312
CF	Fixed	1.0	percent	Mid-Atlantic TRM 2018 p. 312[99]
ISR	Fixed	1.0	percent	Mid-Atlantic TRM 2018 p. 312[100]

Note that the coincidence factor (CF) is 1 for this measure since exit signs are on continuously, including during the entirety of the peak period.

Default Savings

If the proper values are not supplied, a default savings may be applied using conservative input values. The default gross annual electric energy savings will be assigned according to the following calculation:

$$\Delta kWh = \frac{(Qty_{base} \times watts_{base} - Qty_{ee} \times watts_{ee})}{1{,}000\ W/kW} \times HOU \times WHF_e \times ISR$$

$$\Delta kWh = \frac{(1 \times 16W - 1 \times 5W)}{1{,}000\ W/kW} \times 8{,}760\ hours \times 1.0 \times 1.0$$

$$= 96.4\ kWh$$

The default gross coincident demand reduction are calculated using the following calculation:

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98 LED exit sign default values come from an ENERGY STAR® report: Save Energy, Money and Prevent Pollution with Light-Emitting Diode (LED) Exit Signs:http://www.energystar.gov/ia/business/small_business/led_exitsigns_techsheet.pdf (accessed 7/13/2018).

99 Efficiency Vermont Technical Reference Manual 2009-55, December 2008.

100 EmPOWER Maryland DRAFT Final Impact Evaluation Report Evaluation Year 4 (June 1, 2012 - May 31, 2013) Commercial & Industrial Prescriptive & Small Business Programs, Navigant, March 31, 2014.

$$\Delta kW = \frac{(Qty_{base} \times watts_{base} - Qty_{ee} \times watts_{ee})}{1{,}000\ W/kW} \times WHF_d \times CF \times ISR$$

$$= \frac{(1 \times 16W - 1 \times 5W)}{1{,}000\ W/kW} \times 1.0 \times 1.0 \times 1.0$$

$$= 0.011\ kW$$

Source(s)

The primary source for this deemed savings approach is the Mid-Atlantic TRM 2018, p. 311-314.

8.3 Other End Use

8.3.1 Air Compressor Leak Repair

Measure Description

This measure involves improving the performance of an existing air compressor by repairing air leaks.

Savings Estimation

Gross annual electric energy savings are calculated according to the following equation:

$$\Delta kWh = hp \times LF \times \frac{cfm}{hp} \times (Leak_{base} - Leak_{ee}) \times \frac{kW}{cfm} \times HOU$$

Gross coincident demand reduction is calculated according to the following equation:

$$\Delta kW = \frac{\Delta kWh \times CF}{HOU}$$

Where:

ΔkWh = gross annual electric energy savings
ΔkW = gross coincident demand reduction
hp = rated horsepower
LF = load factor of air compressor
cfm/hp = compressed airflow rate per air compressor motor horsepower
$Leak_{base}$ = baseline percentage of compressed air produced that is leaked
$Leak_{ee}$ = energy-efficient percentage of compressed air produced that is leaked
kW/cfm = energy consumed for each cubic foot of compressed air per minute produced
HOU = annual hours of operation
CF = coincidence factor of air compressor

Input Variables

Table 8-9. Input Variables for Air Compressor Leak Repair Measure

Component	Type	Value	Units	Source(s)
hp	Variable	See customer application	hp	Customer application
LF	Variable	See customer application	percent	Customer application
cfm/hp	Variable	See customer application	cfm/hp	Customer application
$Leak_{base}$	Variable	See customer application	percent	Customer application
$Leak_{ee}$	Variable	See customer application	percent	Customer application

Component	Type	Value	Units	Source(s)
kW/cfm	Fixed	0.17	kW/cfm	Michigan Energy Measure Database[101]
HOU	Fixed	6,240	hours (annual)	Michigan Energy Measure Database[102]
CF	Fixed	0.865	percent	Michigan Energy Measure Database[103]

Source

The primary source for this deemed savings approach is the Michigan Energy Measure Database 2018, at http://www.michigan.gov/mpsc, Document "FES-I20 Compressed Air Leak Survey and Repair Michigan 11282017.doc," July 2017.

[101] Michigan Energy Measure Database 2018, at http://www.michigan.gov/mpsc, Document "FES-I20 Compressed Air Leak Survey and Repair Michigan 11282017.doc," July 2017, p. 1.
[102] Ibid.
[103] Ibid.

9 NON-RESIDENTIAL PRESCRIPTIVE PROGRAM

Dominion's Non-Residential Prescriptive Program provides qualifying business owners incentives to use pursue one or more of the qualified energy efficiency measures through a local, participating contractor in Dominion's contractor network. To qualify for this program, the customer must be responsible for the electric bill and must be the owner of the facility or reasonably able to secure permission to complete the measures. All program measures are summarized in Table 9-1.

Table 9-1: Non-residential Prescriptive Program Measure List

End-Use	Measure	Manual Section
Cooking	Commercial Convection Oven	Section 9.1.1
	Commercial Electric Combination Oven	Section 9.1.2
	Commercial Electric Fryer	Section 9.1.3
	Commercial Griddle	Section 9.1.4
	Commercial Hot Food Holding Cabinet	Section 9.1.5
	Commercial Steam Cooker	Section 9.1.6
HVAC	Duct Testing & Sealing	Section 8.1.1
	Unitary/Split AC/HP Tune-up	Section 8.1.2
	Variable Speed Drives on Kitchen Fan	Section 9.2.3
Plug Load	Smart Strip	Section 9.3.1
Refrigeration	Door Closer	Section 9.4.1
	Door Gasket	Section 9.4.2
	Commercial Freezers and Refrigerators – Solid Door	Section 9.4.3
	Commercial Ice Maker	Section 9.4.4
	Evaporator Fan ECM Retrofit	Section 9.4.5
	Evaporator Fan Control	Section 9.4.6
	Floating Head Pressure Control	Section 9.4.7
	Low/No-sweat Door Film	Section 9.4.8
	Refrigeration Night Cover	Section 9.4.9
	Refrigerator Coil Cleaning	Section 9.4.10
	Suction Pipe Insulation (Cooler & Freezer)	Section 9.4.11
	Strip Curtain (Cooler & Freezer)	Section 9.4.12
	Vending Machine Miser	Section 9.4.13

9.1 Cooking End Use

9.1.1 Commercial Convection Oven

Measure Description

This measure involves the installation of an ENERGY STAR® qualified commercial convection oven. Commercial convection ovens that are ENERGY STAR® certified have higher heavy load cooking efficiencies and lower idle energy rates making them more efficient than standard models.

Baseline Description

The baseline equipment is assumed to be a standard efficiency convection oven with a heavy-load efficiency of 65% for full-size electric ovens (i.e., a convection oven this can accommodate full-size sheet pans measuring 18 x 26 x 1-inch) and 68% for half-size electric ovens (i.e., a convection oven that can accommodate half-size sheet pans measuring 18 x 13 x 1-inch).

Savings Estimation

Gross annual electric energy savings are calculated using the following equations:

$$\Delta kWh = kWh_{base} - kWh_{ee}$$

where,

$$kWh_{base} = \left[lb_{daily} \times \frac{E_{conv.}}{\eta_{base}} + kW_{base,idle} \times \left(Hours_{daily} - \frac{lb_{daily}}{PC_{base}} \right) \right] \times Days$$

$$kWh_{ee} = \left[lb_{daily} \times \frac{E_{conv.}}{\eta_{ee}} + kW_{ee,idle} \times \left(Hours_{daily} - \frac{lb_{daily}}{PC_{ee}} \right) \right] \times Days$$

Gross coincident demand reduction is calculated using the following equation:

$$\Delta kW = \frac{\Delta kWh}{Hours_{daily} \times Days}$$

Where:

ΔkWh = gross annual electric energy savings
ΔkW = gross coincident demand reduction
$Hours_{daily}$ = average daily operating hours
$E_{conv.}$ = ASTM Energy to Food; the amount of energy absorbed by food during convection cooking
lb_{daily} = pounds of food cooked per day
Days = annual days of operation
η_{base} = baseline equipment cooking energy efficiency
η_{ee} = efficient equipment cooking energy efficiency

$kW_{base,idle}$ = baseline equipment idle energy rate
$kW_{ee,idle}$ = efficient equipment idle energy rate
PC_{base} = baseline equipment production capacity
PC_{ee} = efficient equipment production capacity

Input Variables

Table 9-2: Input Parameters for Convection Oven

Component	Type	Value	Units	Source(s)
$Hours_{daily}$	Variable	See customer application Default: 12	hours (daily)	Mid-Atlantic TRM 2018, p. 507
Days	Variable	See customer application Default: 365	days (annual)	
lb_{daily}	Variable	See customer application Default: 100	lb (daily)	
$E_{conv.}$	Fixed	0.0732	kWh/lb	
PC_{base}	Fixed	Half Size: 45 Full Size: 90	lb/hour	Mid-Atlantic TRM 2018, p. 508
η_{base}	Fixed	Half Size: 0.68 Full Size: 0.65	percent	
$kW_{base,idle}$	Fixed	Half Size:1.03 Full Size: 2.00	kW	
$kW_{ee,idle}$	Fixed	Half Size: 1.00 Full Size: 1.60	kW	
PC_{ee}	Fixed	Half Size: 50 Full Size: 90	lb/hour	
η_{ee}	Fixed	Half Size: 0.71 Full Size: 0.71	percent	

Source

The primary sources for this deemed savings approach is the Mid-Atlantic TRM 2018, p. 506-509.

9.1.2 Commercial Electric Combination Oven

Measure Description

This measure involves the installation of an ENERGY STAR® qualified combination oven. A combination oven is a convection oven that includes the added capability to inject steam into the oven cavity and typically offers at least three distinct cooking modes. This measure applies to time of sale opportunities.

Baseline Description

The baseline equipment is assumed to be a typical standard efficiency electric combination oven.

Savings Estimation

Gross annual electric energy savings are calculated as follows:

$$\Delta kWh = kWh_{base} - kWh_{ee}$$

The baseline annual electric energy consumption is calculated using the following equations:

$$kWh_{base} = kWh_{base,conv.} + kWh_{base,steam}$$

where,

$$kWh_{base,conv.} = \left[lb_{daily} \times \frac{E_{conv.}}{\eta_{base,conv.}} + kW_{base,conv.,idle} \times \left(Hours_{daily} - \frac{lb_{daily}}{PC_{base,conv.}}\right)\right] \times (1 - PCT_{steam}) \times Days$$

$$\mathrm{kWh_{base,steam}} = \left[\mathrm{lb_{daily}} \times \frac{\mathrm{E_{steam}}}{\eta_{\mathrm{base,steam}}} + \mathrm{kW_{base,steam,idle}} \times \left(\mathrm{Hours_{daily}} - \frac{\mathrm{lb_{daily}}}{\mathrm{PC_{base,steam}}}\right)\right] \times \mathrm{PCT_{steam}} \times \mathrm{Days}$$

Similarly, the efficient annual electric energy consumption is calculated using the following equations:

$$kWh_{ee} = kWh_{ee,conv.} + kWh_{ee,steam}$$

where,

$$kWh_{ee,conv.} = \left[lb_{daily} \times \frac{E_{conv.}}{\eta_{ee,conv.}} + kW_{ee,conv.,idle} \times \left(Hours_{daily} - \frac{lb_{daily}}{PC_{ee,conv.}}\right)\right] \times (1 - PCT_{steam}) \times Days$$

$$kWh_{ee,steam} = \left[lb_{daily} \times \frac{E_{steam}}{\eta_{ee,steam}} + kW_{ee,steam,idle} \times \left(Hours_{daily} - \frac{lb_{daily}}{PC_{ee,steam}}\right)\right] \times PCT_{steam} \times Days$$

Gross coincident demand reduction is calculated using the following equation:

$$\Delta kW = \frac{\Delta kWh}{Hours_{daily} \times Days}$$

Where:

- ΔkWh = gross annual electric energy savings
- ΔkW = gross coincident demand reduction
- kWh_{base} = annual energy usage of the baseline equipment
- kWh_{ee} = annual energy usage of the efficient equipment
- $kWh_{base,conv.}$ = baseline annual cooking energy consumption in convection mode
- $kWh_{base,steam}$ = baseline annual steam energy consumption in steam mode
- $kW_{base,conv.,idle}$ = baseline idle energy rate in convection mode
- $kW_{base,steam,idle}$ = baseline idle energy rate in steam mode
- $kWh_{ee,conv.}$ = efficient annual cooking energy consumption in convection mode
- $kWh_{ee,steam}$ = efficient annual steam energy consumption in steam mode
- $kW_{ee,conv.,idle}$ = efficient idle energy rate in convection mode
- $kW_{ee,steam,idle}$ = efficient idle energy rate in steam mode
- $Hours_{daily}$ = average daily operating hours
- Days = annual days of operation
- lb_{daily} = pounds of food cooked per day
- $E_{conv.}$ = ASTM Energy to Food, the amount of energy absorbed by the food during convection mode cooking, per pound of food
- E_{steam} = ASTM Energy to Food, the amount of energy absorbed by the food during steam cooking mode, per pound of food
- $\eta_{base,conv.}$ = baseline equipment cooking energy efficiency in convection mode
- $\eta_{base,steam}$ = baseline equipment cooking energy efficiency in steam mode
- $\eta_{ee,conv.}$ = efficient equipment cooking energy efficiency in convection mode
- $\eta_{ee,steam}$ = efficient equipment cooking energy efficiency in steam mode
- PCT_{steam} = percent of food cooked in steam cooking mode
- $PC_{base,conv.}$ = baseline equipment production capacity in convection mode
- $PC_{ee,conv.}$ = efficient equipment production capacity in convection mode
- $PC_{base,steam}$ = baseline equipment production capacity in steam mode
- $PC_{ee,steam}$ = efficient equipment production capacity in steam mode

Input Variables

Table 9-3: Input Parameters for Commercial Electric Combination Ovens

Component	Type	Value	Units	Source(s)
$Hours_{daily}$	Variable	See customer application Default: 12	hours (daily)	Mid-Atlantic TRM 2018, p. 511

Component	Type	Value	Units	Source(s)
Days	Variable	See customer application Default: 365	days (annually)	Mid-Atlantic TRM 2018, p. 511
lb_{daily}	Variable	See customer application Default: 200	pounds (daily)	Mid-Atlantic TRM 2018, p. 511
PCT_{steam}	Variable	See customer application Default: 0.5	percent	Mid-Atlantic TRM 2018, p. 512
$E_{conv.}$	Fixed	0.0732	kWh/lb	Mid-Atlantic TRM 2018, p. 511
E_{steam}	Fixed	0.0308	kWh/lb	Mid-Atlantic TRM 2018, p. 511
$PC_{base,conv.}$	Fixed	<15 pans: 79 ≥15 pans: 166	lb/hr	Mid-Atlantic TRM 2018, p. 512
$PC_{base,steam}$	Fixed	<15 pans: 126 ≥15 pans: 295	lb/hr	
$\eta_{base,conv.}$	Fixed	0.72	percent	
$\eta_{base,steam}$	Fixed	0.49	percent	
$kW_{base,conv.,idle}$	Fixed	<15 pans: 1.32 ≥15 pans: 2.28	kW	
$kW_{base,steam}$	Fixed	<15 pans: 5.26 ≥15 pans: 8.71	kW	
$kW_{ee,conv.,cooking}$	Variable	= 0.080 x Number of pans + 0.4989	kW	
$kW_{ee,steam}$	Variable	= 0.133 x Number of pans + 0.6400	kW	
$PC_{ee,conv.}$	Fixed	<15 pans: 119 ≥15 pans: 201	lb/hr	
$PC_{ee,steam}$	Fixed	<15 pans: 177 ≥15 pans: 349	lb/hr	
$\eta_{ee,conv.}$	Fixed	0.76	percent	
$\eta_{ee,steam}$	Fixed	0.55	percent	

Source

The primary sources for this deemed savings approach is the Mid-Atlantic TRM 2018, p. 510-514.

9.1.3 Commercial Electric Fryer

Measure Description

This measure involves the installation of an ENERGY STAR® qualified electric commercial fryer. Commercial fryers with the ENERGY STAR® designation offer shorter cook times and higher production rates through advanced burned and heat exchanger designs. Further, frypot insulation reduces standby losses resulting in a lower idle energy rate. This measure applies to both standard-size and large-vat fryers.

Baseline Condition

The baseline equipment is assumed to be a standard efficiency electric fryer with a heavy load efficiency of 75% for standard sized equipment and 70% for large vat equipment.[104]

Savings Estimation

Gross annual energy savings are calculated using the following equation:

$$\Delta kWh = kWh_{base} - kWh_{ee}$$

The baseline gross annual electric energy usage is calculated using the following equation:

$$kWh_{base} = \left[lb_{daily} \times \frac{E_{fry}}{\eta_{base}} + kW_{base,idle} \times \left(Hours_{daily} - \frac{lb_{daily}}{PC_{base}}\right)\right] \times Days$$

Similarly, the efficient gross annual electric energy usage is calculated using the following equation:

$$kWh_{ee} = \left[lb_{daily} \times \frac{E_{fry}}{\eta_{ee}} + kW_{ee,idle} \times \left(Hours_{daily} - \frac{lb_{daily}}{PC_{ee}}\right)\right] \times Days$$

Gross coincident demand reduction is calculated using the following equation:

$$\Delta kW = \frac{\Delta kWh}{(Hours_{daily} \times Days)}$$

Where:

ΔkWh = gross annual electric energy savings
ΔkW = gross coincident demand reduction
kWh_{base} = annual energy usage of the baseline equipment
kWh_{ee} = annual energy usage of the efficient equipment
$Hours_{daily}$ = average daily operating hours

[104] Standard fryers measure 12-18 in. wide and have a shortening capacity of 25-65 lb; large fryers measure 18-24-in. wide and have a shortening capacity greater than 50 lb.

E_{fry} = ASTM Energy to Food ratio, the amount of energy absorbed by each pound of food during frying

lb_{daily} = pounds of food cooked per day

Days = annual days of operation

η_{base} = baseline equipment cooking energy efficiency

η_{eff} = efficient equipment cooking energy efficiency

$kW_{base,idle}$ = baseline equipment idle energy rate

$kW_{ee,idle}$ = efficient equipment idle energy rate

PC_{base} = baseline equipment production capacity

PC_{ee} = efficient equipment production capacity

Input Variables

Table 9-4: Input Parameters for Electric Commercial Fryer Measure

Component	Type	Value	Units	Source(s)
$Hours_{daily}$	Variable	See customer application Default: Standard fryer: 16 Large-vat fryer: 12	hours (daily)	Mid-Atlantic TRM 2018, p. 490
E_{fry}	Fixed	0.167	kWh/lb	Mid-Atlantic TRM 2018, p. 490
lb_{daily}	Variable	See customer application Default: 150	lb (daily)	Mid-Atlantic TRM 2018, p. 490
Days	Variable	See customer application Default: 365	days (annual)	Mid-Atlantic TRM 2018, p. 490
η_{base}	Fixed	Standard fryer: 75% Large-vat fryer: 70%	percent	Mid-Atlantic TRM 2018, p. 490
$kW_{base,idle}$	Fixed	Standard fryer: 1.05 Large-vat fryer: 1.35	kW	Mid-Atlantic TRM 2018, p. 490
PC_{base}	Fixed	Standard fryer: 65 Large-vat fryer: 100	lb/hr	Mid-Atlantic TRM 2018, p. 490
η_{ee}	Fixed	Standard fryer: 83% Large-vat fryer: 80%	percent	Mid-Atlantic TRM 2018, p. 490
$kW_{ee,idle}$	Fixed	Standard fryer: 0.80 Large-vat fryer: 1.10	kW	Mid-Atlantic TRM 2018, p. 490
PC_{ee}	Fixed	Standard fryer: 70 Large-vat fryer: 110	lb/hr	Mid-Atlantic TRM 2018, p. 490

Source

The primary sources for this deemed savings approach is the Mid Atlantic TRM 2018, p. 489-492.

9.1.4 Commercial Griddle

Measure Description

This measure involves the installation of an ENERGY STAR® qualified commercial griddle. ENERGY STAR® qualified commercial griddles have higher cooking energy efficiency and lower idle energy rates than standard equipment. The result is more energy being absorbed by the food compared with the total energy use, and less wasted energy when the griddle is in standby mode. This measure applies to only 10-sq.ft. commercial griddles due to Dominion Energy program requirements.

Baseline Condition

The baseline equipment is assumed to be a standard efficiency electric griddle with a cooking energy efficiency of 65%.

Savings Estimation

Gross annual electric energy savings are calculated using the following equations:

$$\Delta kWh = kWh_{base} - kWh_{ee}$$

where,

$$kWh_{base} = \left[lb_{daily} \times \frac{E_{griddle}}{\eta_{base}} + kW_{base,idle} \times SqFt \times \left(Hours_{daily} - \frac{lb_{daily}}{PC_{base} \times SqFt}\right)\right] \times Days$$

$$kWh_{ee} = \left[lb_{daily} \times \frac{E_{griddle}}{\eta_{ee}} + kW_{ee,idle} \times SqFt \times \left(Hours_{daily} - \frac{lb_{daily}}{PC_{ee} \times SqFt}\right)\right] \times Days$$

Gross coincident demand reduction is calculated using the following equation:

$$\Delta kW = \frac{\Delta kWh}{Hours_{daily} * Days}$$

Where:

ΔkWh	=	gross annual electric energy savings
ΔkW	=	gross coincident demand reduction
kWh_{base}	=	annual energy usage of the baseline equipment
kWh_{ee}	=	annual energy usage of the efficient equipment
SqFt	=	surface area of griddle
$Hours_{daily}$	=	average daily operating hours
$E_{griddle}$	=	ASTM Energy to Food ratio, the amount of energy absorbed by each pound of food during griddling
lb_{daily}	=	pounds of food cooked per day
Days	=	annual days of operation

η_{base} = baseline equipment cooking energy efficiency
η_{ee} = efficient equipment cooking energy efficiency
$kW_{base,idle}$ = baseline equipment idle energy rate
$kW_{ee,idle}$ = efficient equipment equipment idle energy rate
PC_{base} = baseline equipment production capacity
PC_{ee} = efficient equipment production capacity

Input Variables

Table 9-5: Input Parameters for Commercial Griddle Measure

Component	Type	Value	Units	Source(s)
$\mathbf{lb_{daily}}$	Variable	See customer application	lb (daily)	Customer application
		Default: 100		Mid-Atlantic TRM 2018, p. 503
$\mathbf{Hours_{daily}}$	Variable	See customer application	hours (daily)	Customer application
		Default: 12		Mid-Atlantic TRM 2018, p. 503
Days	Variable	See customer application	days (annual)	Customer application
		Default: 365		Mid-Atlantic TRM 2018, p. 503
$\mathbf{E_{griddle}}$	Fixed	0.139	kWh/lb	Mid-Atlantic TRM 2018, p. 503
$\mathbf{PC_{base}}$	Fixed	5.83	lb/hr/ft^2	Mid-Atlantic TRM 2018, p. 504
$\boldsymbol{\eta_{base}}$	Fixed	65%	percent	Mid-Atlantic TRM 2018, p. 504
$\mathbf{kW_{base}}$	Fixed	0.40	kW/ft^2	Mid-Atlantic TRM 2018, p. 504
$\mathbf{kW_{ee}}$	Fixed	0.32	kW/ft^2	Mid-Atlantic TRM 2018, p. 504
$\mathbf{PC_{ee}}$	Fixed	6.67	lb/hour/ft^2	Mid-Atlantic TRM 2018, p. 504
$\boldsymbol{\eta_{ee}}$	Fixed	70%	percent	Mid-Atlantic TRM 2018, p. 504
SqFt	Variable	See customer application	ft^2	Mid-Atlantic TRM 2018, p. 503

Source

The primary source for this deemed savings approach is the Mid-Atlantic TRM 2018, p. 502-505.

9.1.5 Commercial Hot Food Holding Cabinet

Measure Description

This measure involves installing an ENERGY STAR® qualified commercial hot food holding cabinet. The installed equipment will incorporate better insulation, reducing heat loss, and may also offer additional energy saving devices such as magnetic door gaskets, auto-door closures, or dutch doors. The insulation of the cabinet also offers better temperature uniformity within the cabinet from top to bottom. This means that qualified hot food holding cabinets are more efficient at maintaining food temperature while using less energy.

Baseline Description

The baseline equipment is assumed to be a standard efficiency hot food holding cabinet.

Savings Estimation

Gross annual electric energy savings are calculated according to the following equation:

$$\Delta kWh = \frac{(watts_{base,idle} - watts_{ee,idle})}{1{,}000\ W/kW} \times Hours_{daily} \times Days$$

Gross coincident demand reduction is calculated according to the following equation:

$$\Delta kW = \frac{(watts_{base,idle} - watts_{ee,idle})}{1{,}000\ W/kW}$$

Where:

ΔkWh = gross annual electric energy savings
ΔkW = gross coincident demand reduction
$watts_{base,idle}$ = idle energy rate of the baseline equipment
$watts_{ee,idle}$ = idle energy rate of the efficient equipment
1,000 = conversion factor for W to kW
$Hours_{daily}$ = average daily operating hours
Days = Annual days of operation

Input Variables

Table 9-6: Input Parameters for Hot Food Holding Cabinet

Component	Type	Value	Units	Source(s)
$watts_{base,idle}$	Variable	40 x Volume	watts	Mid-Atlantic TRM 2018, p. 499
$watts_{ee,idle}$	Variable	0 < Volume < 13: 21.5 x Volume + 0.0 13 ≤ Volume < 28: 2.0 x Volume + 254.0 Volume ≥ 28: 3.8 x Volume + 203.5	watts	Mid-Atlantic TRM 2018, p. 499
Days	Variable	See customer application	days (annual)	Mid-Atlantic TRM 2018, p. 499
		Default: 365		

Component	Type	Value	Units	Source(s)
$Hours_{daily}$	Variable	See customer application	hours (daily)	Mid-Atlantic TRM 2018, p. 499
		Default: 15		

Note: Volume = the internal volume of the holding cabinet (ft^3) = actual volume of installed unit

Source

The primary sources for this deemed savings approach is the Mid-Atlantic TRM 2018, p. 499-501.

9.1.6 Commercial Steam Cooker

Measure Description

This measure involves an ENERGY STAR® qualified commercial steam cookers.Energy efficient steam cookers that have earned the ENERGY STAR® label offer shorter cook times, higher production rates, and reduced heat loss due to better insulation and a more efficient steam-delivery system.

Baseline Description

The baseline condition assumes a standard efficiency, electric boiler-style steam cooker.

Savings Estimation

Gross annual electric energy savings are calculated using the following equation:

$$\Delta kWh = kWh_{base} - kWh_{ee}$$

Baseline annual electric energy consumption is calculated using the following equation:

$$kWh_{base} = kWh_{base,steam} + kWh_{base,idle}$$

where,

$$kWh_{base,steam} = lb_{daily} \times \frac{E_{steam}}{\eta_{base}} \times Days \quad {}_{base,idle}$$

$$= \left[(1 - PCT_{steam}) \times kW_{base,idle} + PCT_{steam} \times PC_{base} \times Qty_{pans} \times \frac{E_{steam}}{\eta_{base}}\right] \times \left(Hours_{daily} - \frac{lb_{daily}}{Qty_{pans} \times PC_{base}}\right) \times Days$$

Similarly, efficient annual electric energy consumption is calculated using the following equation:

$$kWh_{ee} = kWh_{ee,steam} + kWh_{ee,idle}$$

where,

$$kWh_{ee,steam} = lb_{daily} \times \frac{E_{steam}}{\eta_{ee}} \times Days$$

$$kWh_{ee,idle} = \left[(1 - PCT_{steam}) \times kW_{ee,idle} + PCT_{steam} \times PC_{ee} \times Qty_{pans} \times \frac{E_{steam}}{\eta_{ee}}\right] \times \left(Hours_{daily} - \frac{lb_{daily}}{Qty_{pans} \times PC_{ee}}\right) \times Days$$

Where:

ΔkWh = gross annual electric energy savings
ΔkW = gross coincident demand reduction
kWh_{base} = the annual energy usage of the baseline equipment
kWh_{ee} = the annual energy usage of the efficient equipment
$kWh_{base,steam}$ = baseline daily cooking energy consumption
$kWh_{base,idle}$ = baseline daily idle energy consumption
$Hours_{daily}$ = average daily operating hours
E_{steam} = ASTM Energy to Food (kWh/lb); the amount of energy absorbed by each pound of food during steaming
lb_{daily} = pounds of food cooked per day
Days = annual days of operation
PCT_{steam} = percent of time in constant steam mode
Qty_{pans} = number of pans per unit
η_{base} = baseline equipment cooking energy efficiency
η_{ee} = efficienct equipment cooking energy efficiency
$kW_{base,idle}$ = baseline equipment idle energy rate
$kW_{ee,idle}$ = efficient equipment idle energy rate
PC_{base} = baseline equipment production capacity
PC_{ee} = efficient equipment production capacity

Input Variables

Table 9-7: Input Parameters for Commercial Steam Cooker Measure

Component	Type	Value	Units	Source(s)
$Hours_{daily}$	Variable	See customer application Default: 12	hours (daily)	Mid-Atlantic TRM 2018, p. 495
Days	Variable	See customer application Default: 365	days (annual)	Mid-Atlantic TRM 2018, p. 495
lb_{daily}	Variable	See customer application Default: 100	lb (daily)	Mid-Atlantic TRM 2018, p. 495
Qty_{pans}	Variable	See customer application.	-	Mid-Atlantic TRM 2018, p. 495
E_{steam}	Fixed	0.0308	kWh/lb	Mid-Atlantic TRM 2018, p. 495
PC_{base}	Fixed	23.3	lb/hr (per pan)	Mid-Atlantic TRM 2018, p. 495
η_{base}	Fixed	Steam generator: 0.30 Boiler based: 0.26	-	Mid-Atlantic TRM 2018, p. 495
$kW_{base,idle}$	Fixed	Steam generator: 1.20 Boiler based: 1.00	kW	Mid-Atlantic TRM 2018, p. 496
$kW_{ee,idle}$	Fixed	3 pans: 0.40 4 pans: 0.53 5 pans: 0.67 6+ pans: 0.80	kW	Mid-Atlantic TRM 2018,p. 496

Component	Type	Value	Units	Source(s)
PC_{ee}	Fixed	16.9	lb/hr (per pan)	Mid-Atlantic TRM 2018, p. 495
η_{ee}	Fixed	0.5	-	Mid-Atlantic TRM 2018, p. 496
PCT_{steam}	Fixed	0.4	-	Mid-Atlantic TRM 2018, p. 495

Source

The primary sources for this deemed savings approach is the 2018 Mid-Atlantic TRM p. 494-498.

9.2 Heating Ventilation and Air Conditioning (HVAC) End Use

9.2.1 Duct Testing and Sealing

This measure is also provided by the Non-Residential Small Business Improvement Program. The savings are determined using the methodology described in Section 8.1.1.

9.2.2 Unitary/Split Air Conditioning, Heat Pump, and Chiller Tune-up

This measure is also provided by the Non-Residential Small Business Improvement Program. The savings are determined using the methodology described in Section 8.1.2.

9.2.3 Variable Speed Drives on Kitchen Exhaust Fan

Measure Description

This measure involves installing variable speed drives at commercial kitchen exhaust fans so that the fan motor speed matches the demand. The baseline condition is the manual on/off switch and magnetic relay or motor starter for commercial kitchen hoods. The baseline assumes that the fan operates at full speed while in operation.

This measure involves retrofitting a variable-speed drive (VSD) controller at an existing kitchen exhaust fan with a make-up-air fan. The measure includes optical and temperature sensors to detect the level of cooking activity and modulate the speed of the exhaust-air fan accordingly. The optical and temperature sensor(s) are typically located either in the collar of or the inlet to the exhaust-fan hood. The kitchen hood exhaust fans are modulated automatically to vary the exhaust airflow rate and make-up (ventilation) air by adjusting the exhaust and make-up air fan speeds.

The total measure energy savings includes the energy savings resulted from fan power reduction during part load operation as well as a decrease in heating and cooling requirement of make-up air. The measure also provides cooling and heating savings for the make-up air if the existing kitchen system(s) supplies conditioned make-up air through a dedicated make-up air unit. If the supplied make-up air is not conditioned, no heating and cooling savings are provided. Furthermore, the measure does not approve heating savings from gas-fired make-up-air units.

This measure is meant for the kitchen hood exhaust flow control only. The exhaust system from kitchen dishwashers is not included in this measure.

Savings Estimation

Gross annual electric energy savings for the exhaust fan are calculated according to the following equation:

$$\Delta kWh_{EF} = hp_{EF} \times LF_{EF} \times \frac{0.746}{\eta_{EF}} \times HOU \times \Delta Power_{EF}$$

If the make-up air is conditioned, then the cooling and heating savings are calculated according to the following equations:

$$\Delta kWh_{cool} = SqFt_{Kitchen} \times \frac{cfm}{SqFt} \times OF_{EF} \times \Delta cfm_{EF} \times CDD \times \frac{24 \times 1.08}{3{,}412 \times COP_{MUA_{cool}}}$$

$$\Delta kWh_{heat} = SqFt_{Kitchen} \times \frac{cfm}{SqFt} \times OF_{EF} \times \Delta cfm_{EF} \times HDD \times \frac{24 \times 1.08}{3{,}412 \times COP_{MUA_{heat}}}$$

If make-up air is not conditioned, then the cooling and heating savings equal zero.

$$\Delta kWh_{cool} = \Delta kWh_{heat} = 0$$

The total annual electric energy savings for this measure are calculated as follows:

$$\Delta kWh = \Delta kWh_{EF} + \Delta kWh_{cool} + \Delta kWh_{heat}$$

Gross coincident demand reduction is calculated according to the following equation:

$$\Delta kW = \frac{\Delta kWh}{HOU}$$

Where:

ΔkWh_{EF} = gross annual electric energy savings for the exhaust fan
ΔkWh_{cool} = gross annual electric energy savings for cooling the make-up air
ΔkWh_{heat} = gross annual electric energy savings for heating the make-up air
ΔkWh = gross annual electric energy savings
ΔkW = gross coincident demand reduction
hp_{EF} = total motor horsepower of exhaust fan(s)
LF_{EF} = load factor of exhaust fan motor(s)
η_{EF} = efficiency of exhaust fan motor(s)
HOU = annual run hours of use of exhaust fan(s)
$\Delta Power_{EF}$ = proportional exhaust fan power reduction due to VFD
$SqFt_{Kitchen}$ = floor area of kitchen
$\frac{cfm}{SqFt}$ = exhaust airflow rate per square foot of kitchen floor area
OF_{EF} = oversize ratio of exhaust fan system
Δcfm_{EF} = proportional exhaust fan airflow reduction due to VFD
CDD = cooling degree days
$COP_{MUA_{cool}}$ = coefficient of performance of cooling component of make-up air system
HDD = heating degree days
$COP_{MUA_{heat}}$ = coefficient of performance of heating component for make-up air system
0.746 = conversion factor for horsepower to kilowatt
3,412 = conversion factor for Btu/h to kilowatt-hour
24 = conversion factor for day to hour
1.08 = sensible heat factor for air, Btuh/cfm/°F

Input Variables

Table 9-8: Input Parameters for VSD on Kitchen Fan(s)

Component	Type	Value	Units	Source(s)
hp_{EF}	Variable	See customer application	hp	Customer application
LF_{EF}	Fixed	Default: 90%	-	New Jersey Clean Energy Program Protocols to Measure Resource Savings: Revisions to FY2016 Protocols, pg. 89
η_{EF}	Variable	See customer application	-	Customer application
		Default: See Table 6-6 based on hp_{EF}		See Table 6-6 in Section 6.1.4

Component	Type	Value	Units	Source(s)
HOU	Variable	See customer application	hours (annual)	Customer application
		Default: See Table 9-9 that follows		New Jersey Clean Energy Program Protocols to Measure Resource Savings: Revisions to FY2016 Protocols, pg. 90.
$\Delta Power_{EF}$	Variable	See Table 9-9 that follows	-	New Jersey Clean Energy Program Protocols to Measure Resource Savings: Revisions to FY2016 Protocols, pg. 90
$SqFt_{Kitchen}$	Variable	See customer application	ft^2	Customer application
$\frac{cfm}{SqFt}$	Fixed	0.7	cfm/ft^2	ASHRAE 62.1-2010, Table 6.4 – for Kitchen - Commercial
OF_{EF}	Fixed	1.4	-	New Jersey Clean Energy Program Protocols to Measure Resource Savings: Revisions to FY2016 Protocols, pg. 90
Δcfm_{EF}	Variable	See Table 9-9 that follows	-	New Jersey Clean Energy Program Protocols to Measure Resource Savings: Revisions to FY2016 Protocols, pg. 90.
CDD	Variable	See Sub-appendix I	Cooling Degree Days	
HDD	Variable	See Sub-appendix I	Heating Degree Days	
MUA_{cool}	Flag	See customer application	True/False	Customer application
$COP_{MUA_{cool}}$	Variable	See customer application	-	Customer application
		Default: 3.0		New Jersey Clean Energy Program Protocols to Measure Resource Savings 2016, page 90.
$MUA_{electric\_heat}$	Flag	See customer application	True/False	Customer application
$COP_{MUA_{heat}}$	Variable	See customer application	-	Customer application
		Default: 3.0		New Jersey Clean Energy Program Protocols to Measure Resource Savings 2016, page 90.

Table 9-9: Annual Hours of Use, Power and Airflow Reductions due to VSD[105]

Facility Type	Annual Hours of Use (hours)	Proportion of Power Reduction ($\Delta Power_{EF}$)	Proportion of Airflow Reduction (Δcfm_{EF})
Campus	5,250	0.568	0.295
Lodging	8,736	0.618	0.330
Restaurant	5,824	0.552	0.295
Supermarket	5,824	0.597	0.320
Other	5,250	0.584	0.310

Source

The primary sources for this deemed savings approach include the New Jersey Clean Energy Program Protocols to Measure Resource Savings 2016, pages 88-91.

[105] New Jersey Clean Energy Program Protocols to Measure Resource Savings: Revisions to FY2016 Protocols, pg. 88-91: http://www.njcleanenergy.com/files/file/NJCEP Protocols to Measure Resource SavingsFY17_FINAL.pdf.

9.3 Plug Load End-Use

9.3.1 Smart Strip

Measure Description

This measure realizes energy savings by installing a "smart-strip" plug outlet in place of a standard "power strip." A smart strip has the ability to minimize energy losses caused by phantom loads when the devices plugged into the smart strip are not in use.

The baseline condition is a standard "power strip". This strip is simply a "plug multiplier" that allows the user to plug in multiple devices using a single wall outlet. Additionally, the baseline unit has no ability to control power flow to the connected devices.

Savings Estimation Approach

Gross annual electric energy savings are assigned per unit as follows:

$$\Delta kWh = 26.9\ kWh$$ [106]

Gross coincident demand reduction is assigned as follows:

$$\Delta kW = 0\ kW$$

Where:

ΔkWh = gross annual electric energy savings
ΔkW = gross coincident demand reduction

Source(s)

The primary source for this deemed savings approach is the Mid-Atlantic TRM 2018, p. 487.

[106] Energy & Resource Solutions (ERS) 2013. Emerging Technologies Research Report; Advanced Power Strips for Office Environments prepared for the Regional Evaluation, Measurement, and Verification Forum facilitated by the Northeast Energy Efficiency Partnerships." Assumes savings consistent with the 20W threshold setting for the field research site demonstrating higher energy savings (of two available sites). ERS noted that the 20 W threshold may be unreliable due to possible inaccuracy of the threshold setting in currently available units. It is assumed that future technology improvements will reduce the significance of this issue. Further, savings from the site with higher average savings was adopted (26.9 kWh versus 4.7 kWh) acknowledging that investigations of APS savings in other jurisdictions have found significantly higher savings. For example, Northwest Power and Conservation Council, Regional Technical Forum. 2011. "Smart Power Strip Energy Savings Evaluation" found average savings of 145 kWh.

9.4 Refrigeration End-Use

9.4.1 Door Closer (Cooler and Freezer)

Measure Description

This measure realizes energy savings by installing an auto-closer on main doors to walk-in coolers or freezers, or by installing an automatic, hydraulic-type door closer on glass-reach-in doors to coolers or freezers. This measure consists of installing a door closer where none existed before. Gross annual electric energy savings are gained when an auto-closer installation reduces the infiltration of warmer outside air into a cooler or freezer environment.

Savings assume that an auto-closer reduces warm air infiltration on average by 40% and the walk-in coolers and freezer doors have effective strip curtains.[107] To simulate the reduction, the main door open time is reduced by 40%. For walk-in coolers and freezers, savings are calculated with the assumption that strip curtains that are 100% effective are installed on the doorway.

Savings Estimation Approach

Gross annual electric energy savings are assigned according to the refrigeration unit type and temperature setting:

Cooler Doors

$$\Delta kWh = \Delta kWh_{cooler}$$

Freezer Doors

$$\Delta kWh = \Delta kWh_{freezer}$$

Gross coincident demand reduction is assigned according to the refrigeration unit type and temperature setting:

Cooler Doors

$$\Delta kW = \Delta kW_{cooler}$$

Freezer Doors

$$\Delta kW = \Delta kW_{freezer}$$

Where:

ΔkWh = gross annual electric energy savings
ΔkW = gross coincident demand reduction

[107] Tennessee Valley Authority TRM 2017, p. 126. Original sources: California Database for Energy Efficiency Resources, www.deeresources.com (DEER 2008), and San Diego Gas & Electric work paper WPSDGENRRN0110 Rev 0, August, 17, 2012, "Auto-Closers for Main Cooler of Freezer Doors"

ΔkWh_{cooler} = annual electric energy savings for main cooler doors
ΔkW_{cooler} = coincident demand reduction for main cooler doors
$\Delta kWh_{freezer}$ = annual electric energy savings for main freezer doors
$\Delta kW_{freezer}$ = coincident demand reduction for main freezer doors

Input Variables

Table 9-10: Door Closer Gross Annual Electric Energy Savings and Gross Coincident Demand Reduction (per Closer)[108]

Refrigeration Unit Type	Location	Walk-In		Reach-In	
		ΔkWh	ΔkW	ΔkWh	ΔkW
Cooler (High Temperature, 31°F to 55°F)	Richmond, VA	44	0.0050	102	0.0116
	Charlotte, NC	44	0.0050	101	0.0116
Freezer (Medium Temperature, -35°F to 30 °F)	Richmond, VA	173	0.0196	439	0.0501
	Charlotte, NC	171	0.0195	435	0.0497

Default Savings

In the event of incomplete data, make the following conservative assumptions:

- If the door type is missing, assume it is a walk-in door type.
- If the refrigeration system type is missing, assume it is a high-temperature cooler.

Source(s)

The primary source for this deemed savings approach is the Tennessee Valley Authority TRM 2017, p. 125-127.

[108] Methodology from Tennessee Valley Authority TRM 2017, p. 125-127 was used. Savings were revised using the TMY3 weather data for Richmond, VA and Charlotte, NC.