Energy Savings Analysis to Support NYStretch-Energy (2018): Energy Efficiency Measures Description

The NYStretch-Energy (2018) Analysis include 16 energy efficiency measures (EEMs) using ASHRAE Standard 90.1-2013 as the baseline. Six prototypes (10-story High-rise Apartment, 20-story High-rise Apartment, Large Hotel, Large Office, Standalone Retail, and Secondary School) are simulated in three climate zones (4A, 5A, and 6A). Each measure and some combinations are simulated in the analysis as described below.

The following table summarizes the EEMs and their applicable prototype buildings.

EEM #	Measure Description	Hotel	Office	School	Retail	10-story Apt	20-story Apt
1	Enhanced insulation for roofs and walls	yes	yes	yes	yes	yes	yes
2	Enhanced windows	yes	yes	yes	yes	yes	yes
3	Air leakage testing for large buildings	yes	yes	yes	NA	yes	yes
4	Reduced LPD for interior lighting and high efficacy lights in dwelling units	yes	yes	yes	yes	yes	yes
5	Occupancy sensors and automatic lighting controls including egress lighting	yes	yes	yes	yes	yes	yes
6	Exterior lighting control	yes	yes	yes	yes	NA	NA
7	Fan power limit: 0.8 W/cfm VAV and 0.65 W/cfm CAV	yes	yes	yes	yes	NA	yes
8	High efficiency cooling towers in CZ 5 & 6	NA	yes	NA	NA	NA	NA
9	Hotel guestroom HVAC vacancy control	yes	NA	NA	NA	NA	NA
10	SWH waste heat recovery	yes	NA	NA	NA	yes	yes
11	Plug load reduction	yes	yes	yes	NA	NA	NA
12	Thermal bridging reduction	yes	NA	NA	NA	yes	NA
13	Exterior lighting power reduction	yes	yes	yes	yes	NA	NA
14	Efficient elevator	yes	yes	NA	NA	yes	yes
15	ERV for apartment makeup air units	NA	NA	NA	NA	yes	yes
16	Demand-based recirculated DHW controls	NA	yes	yes	NA	yes	yes
Optional Measures							
OPTION 1	HVAC equipment efficiency (DX and boiler)	yes	yes	yes	yes	yes	yes
OPTION 2	Reduced LPD (10%)	yes	yes	yes	yes	yes	Yes
OPTION 3	Enhanced envelope performance (10%)	yes	yes	yes	yes	yes	Yes
OPTION 4	Reduced infiltration (0.25 cfm/sf)	yes	yes	yes	NA	yes	yes
OPTION 4	DOAS	Not modeled					
OPTION 5	Onsite renewable energy	Not modeled					
Efficiency Packages							

NYStretch	All EEMs (1-16)	yes	yes	yes	yes	yes	yes
NYStretch + Option 1	NYStretch with HVAC equipment efficiency option	yes	yes	yes	yes	yes	yes
NYStretch + Option 2	NYStretch with reduced LPD	yes	yes	yes	yes	yes	Yes
NYStretch + Option 3	Enhanced envelope performance (10%)	yes	yes	yes	yes	yes	Yes
NYStretch + Option 4	NYStretch with reduced infiltration (0.25 cfm/sf)	yes	yes	yes	NA	yes	Yes

EEM01 Enhanced insulations for roofs and walls

EEM01 increases the insulation requirement for opaque envelopes (i.e., roof and above grade wall). The specific insulation values in EEM01 and applicable building types are given below in **Table 1** and **Table 2**.

Affected Prototypes: All

Source of EEM data: 189.1-2017 with tiny differences, probably due to rounding.

Table 1. U-factors for Above-Grade Walls (Btu/hr-ft^2-F)

		90.1-2013		Proposed 2018 NYStretch	
Climate Zones	**Opaque Elements**	**Non-Residential**	**Residential**	**Non-Residential**	**Residential**
4A	Mass	0.104	0.090	0.099	0.086
	Metal Building	0.060	0.050	0.057	0.048
	Steel-Framed	0.064	0.064	0.061	0.061
	Wood-Framed and Other	0.064	0.064	0.061	0.061
5A	Mass	0.090	0.080	0.086	0.076
	Metal Building	0.050	0.050	0.048	0.048
	Steel-Framed	0.055	0.055	0.052	0.052
	Wood-Framed and Other	0.051	0.051	0.048	0.048
6A	Mass	0.080	0.071	0.076	0.067
	Metal Building	0.050	0.050	0.048	0.048
	Steel-Framed	0.049	0.049	0.047	0.044
	Wood-Framed and Other	0.051	0.051	0.048	0.046

Table 2. U-factors for Roofs (Btu/hr- ft^2-F)

		90.1-2013		Proposed 2018 NYStretch	
Climate Zone	**Opaque Elements**	**Non-Residential**	**Residential**	**Non-Residential**	**Residential**
4A	Insulation Entirely above Deck	0.032	0.032	0.030	0.030
	Metal Building	0.037	0.037	0.035	0.035
	Attic and Other	0.021	0.021	0.020	0.020
5A	Insulation Entirely above Deck	0.032	0.032	0.030	0.030
	Metal Building	0.037	0.037	0.035	0.035
	Attic and Other	0.021	0.021	0.020	0.020
6A	Insulation Entirely above Deck	0.032	0.032	0.029	0.029
	Metal Building	0.031	0.029	0.028	0.026
	Attic and Other	0.021	0.021	0.019	0.019

EEM02 Enhanced Windows

EEM02 requires more stringent fenestration on U-factor and SHGC than 90.1-2013. Improved values are proposed for both windows and skylights as shown in Table 3. Skylight changes are only applicable to the Standalone Retail and Secondary School prototypes.

Affected Prototypes: All

Source of EEM data: 189.1-2017 for skylight and NBI's Multifamily Buildings Guide for windows.

Table 3. Fenestration properties

		90.1-2013					Proposed 2018 NYStretch				
Climate Zones	**Fenestration Elements**	**Fenestration Types**	**Non-Res (U-factor)**	**Non-Res (SHGC)**	**Res (U-factor)**	**Res (SHGC)**	**Fenestration Types**	**Non-Res (U-factor)**	**Non-Res (SHGC)**	**Res (U-factor)**	**Res (SHGC)**
4A	**Vertical Fenestration WWR 0-40%**	Nonmetal Framing	0.35	0.40	0.35	0.40	Non AW fenestration	0.30	0.35	0.30	0.35
		Metal Framing, Fixed	0.42		0.42		Class AW, Fixed window	0.36		0.36	
		Metal Framing, Operable	0.50		0.50		Class AW, Operable window	0.43		0.43	
		Metal Framing, Entrance Door	0.77		0.68						
	Skylights, 0-3%	All types	0.50	0.40	0.50	0.40	All types	0.48	0.38	0.48	0.38
5A	**Vertical Fenestration WWR 0-40%**	Nonmetal Framing	0.32	0.40	0.32		Non AW fenestration	0.27	0.35	0.27	0.35
		Metal Framing, Fixed	0.42		0.42		Class AW, Fixed Window	0.36		0.36	
		Metal Framing, Operable	0.50		0.50		Class AW, Operable	0.43		0.43	
		Metal Framing, Entrance Door	0.77		0.68						
	Skylights, 0-3%	All types	0.50	0.40	0.50	0.40	All types	0.48	0.38	0.48	0.38
6A	**Vertical Fenestration WWR 0-40%**	Nonmetal Framing	0.32	0.40	0.32	0.40	Non AW fenestration	0.27	0.35	0.27	0.35
		Metal Framing, Fixed	0.42		0.42		Class AW, Fixed Window	0.34		0.34	
		Metal Framing, Operable	0.50		0.50		Class AW, Operable	0.41		0.41	
		Metal Framing, Entrance Door	0.77		0.68						
	Skylights, 0-3%	All types	0.50	0.40	0.50	0.40	All types	0.48	0.38	0.48	0.38

EEM03 Air Leakage Testing for Large Buildings

EEM03 adds air leakage testing as a requirement and is based on DOE/PNNL's proposal CE105 developed for the 2018 IECC. Air leakage testing is required for large buildings and the threshold for different climate zones is listed in **Table 4** below. The tested buildings need to meet air leakage rate of 0.40 cfm/ ft^2 at 75 Pa or less. The baseline (90.1-2013) infiltration rate has been modeled as 1.00 cfm/ ft^2 and this EEM reduces the infiltration rate to 0.40 cfm/ft^2. Standalone Retail prototype is not affected by this EEM because its floor area doesn't meet the thresholds.

Affected Prototypes: All except standalone retail

Source of EEM data: literature review from PNNL and NBI supports to use 1.00 cfm/sf as baseline input.

Table 4. Table Minimum Building Size Requiring Air Leakage Testing

Climate Zones	Residential	Non-Residential
4A	9,000	75,000
5A	6,000	40,000
6A	6,000	40,000

EEM04 Reduced LPD for Interior Lightings

EEM04 reduces the interior LPD. This measure is based on space-by-space LPD requirements in ASHRAE Standard 189.1-2017, which is primarily based on LED sources in luminaires with high optical efficiency and with luminance distributions that are appropriate for the spaces they are serving. The prototype models use a space-by-space method for LPD inputs. For detailed list of LPDs in 189.1-2017, see Addendum AV (with 2nd public review drafts) to 189.1-2004 in Appendix A. Table 5 lists the LPDs by building area type from 90.1-2013 and 189.1-2017.

For the dwelling units in the 10- and 20-story high-rise apartment buildings, use 90% high-efficacy; 65 LPW lamps; 45 LPW luminaires. This is the recommendation from IALD proposal EC128.

Affected Prototypes: All (including display lighting for retail spaces in 20-story apartment building)

Source of EEM data: 189.1-2017

Table 5. Lighting Power Density By Building Area Type

90.1-2013 LPD whole building	189.1-2017 LPD whole building

Building Area Type[a]	LPD, W/ft^2
Automotive facility	0.80
Convention center	1.01
Courthouse	1.01
Dining: Bar lounge/leisure	101
Dining: Cafeteria/fast food	0.90
Dining: Family	0.95
Dormitory	0.57
Exercise center	0.84
Fire station	0.671
Gymnasium	0.94
Health-care clinic	0.90
Hospital	1.05
Hotel/Motel	0.87
Library	1.19
Manufacturing facility	1.17
Motion picture theater	0.76
Multifamily	0.51
Museum	1.02
Office	0.82
Parking garage	0.21
Penitentiary	0.81
Performing arts theater	1.39
Police station	0.87
Post office	0.87
Religious building	1.00
Retail	1.26
School/university	0.87
Sports arena	0.91
Town hall	0.89
Transportation	0.70
Warehouse	0.66
Workshop	1.19

Building Area Type[a]	LPD, W/ft^2	LPD, W/m
Automotive facility	0.64	6.9
Convention center	0.51	5.5
Courthouse	0.74	8.0
Dining: Bar lounge/leisure	0.69	7.4
Dining: Cafeteria/fast food	0.66	7.1
Dining: Family	0.61	6.6
Dormitory	0.52	5.6
Exercise center	0.61	6.6
Fire station	0.50	5.4
Gymnasium	0.67	7.2
Health-care clinic	0.68	7.3
Hospital	0.86	9.3
Hotel/Motel	0.70	7.5
Library	0.72	7.8
Manufacturing facility	0.60	6.5
Motion picture theater	0.62	6.7
Multifamily	0.49	5.3
Museum	0.68	7.3
Office	0.69	7.4
Parking garage	0.12	1.3
Penitentiary	0.67	7.2
Performing arts theater	0.85	9.1
Police station	0.68	7.3
Post office	0.62	6.7
Religious building	0.70	7.5
Retail	0.91	9.8
School/university	0.67	7.2
Sports arena	0.76	8.2
Town hall	0.72	7.8
Transportation	0.51	5.5
Warehouse	0.41	4.4
Workshop	0.83	8.9

a. In cases where both a general building area type and a specifi building area type are listed, the specific building area type shall apply.

EEM05 Occupancy sensors and automatic lighting controls

EEM05 expands the use of occupancy sensors and automatic lighting controls to independently shut off building lighting in all spaces with a few exceptions. ASHRAE 90.1-2013 already covers many spaces

under the occupancy sensor requirements. To simulate the savings of EEM05, additional occupancy sensors are modeled in following spaces:

- Office-open plan
- Corridor/transition
- Stairway
- ~~Lobby~~
- ~~Electrical/mechanical room~~
- Dining area
- ~~Kitchen~~
- Storage >50 sf and <1000 sf
- ~~Workshop~~
- Locker room
- ~~Repair shop~~
- ~~Pharmacy~~
- ~~Banking Area~~
- Playing Area
- Auditorium Seating Area

Time clock light reduction in Egress Areas for unoccupied hours: Lighting load does not exceed 0.02 W/ft2 multiplied by the *gross lighted area* of the *building*.

Note from Eric Richman of ASHRAE 90.1 Lighting Subcommittee Chair: 0.02 W/sf of the entire floor area should be sufficient for egress in typical buildings but jurisdictions can have higher lighting level requirement for safety reasons.

Affected Prototypes: All

Source of EEM data: NYStretch-Energy Code (2018) Working Group (Jack Bailey, see below)

Open Office	OK and currently required in NYC
Corridor / Transition	*See Note 1*
Stairway	*See Note 2*
Lobby	This would be a problem for commercial buildings which are accessible to tenants 24 hours a day, but which may have unoccupied lobbies late at night. No building owner would want a dark lobby late at night when the building is still "open" and accessible.
Electrical / Mechanical	*See Note 3*
Dining Area	OK
Kitchen	*See Note 3*
Storage	OK
Workshop	*See Note 3*
Locker Room	OK
Repair Shop	*See Note 3*
Pharmacy	*See Note 4*
Banking Area	*See Note 4*
Playing Area	OK
Auditorium Seating Area	OK

Note 1
An egress light level of 1 fc minimum must be maintained under current code at most times. In residential buildings, the multiple dwelling law specifically requires that the 1 fc minimum must be maintained at all times. Occupancy sensors cannot be used to reduce lighting below 1 fc minimum.

Note 2
In addition to the above concerns (see note 1), stairways with photoluminescent tape must maintain a minimum of 2 fc at all times to keep the tape charged. Occupancy sensors cannot be used to reduce lighting below 2 fc minimum.

Note 3
These are spaces where a sudden and unexpected loss of light could endanger occupants who are working with dangerous equipment. Occupancy sensors should not be used to turn lights completely off.

Note 4
These are spaces which are perceived as having a high risk of break-ins, and where lights are usually left on all night to discourage crime. Occupancy sensors should not be used to turn lights completely off.

EEM06 Exterior Lighting Control

EEM06 is based on ASHRAE Standard 90.1-2016. This EEM requires outdoor parking area luminaires mounted 24' or less above the ground to be controlled to automatically reduce the power of each luminaire by a minimum of 50% when no activity has been detected for at least 15 minutes. Because most constructions in climate zone 4A are in New York City and have no or limited area of parking lot, the savings of this measure are only analyzed for climate zones 5A and 6A. Because most high-rise apartment buildings are in New York City, we consider this measure is not applicable to high-rise apartments.

EEM06 also reduces other controlled exterior lighting under Section 9.4.1.4b of 90.1-2013 from 30% reduction at night hours (when business is closed) to 50%. Because large hotel is open for business 24 hours a day, the savings are not analyzed for large hotel prototype.

Affected Prototypes:

Parking lot lighting: Large Office, Standalone Retail, Secondary School, and Large Hotel in climate zones 5A and 6A.

Other exterior lighting: Large Office, Standalone Retail, and Secondary School in all climate zones.

Source of EEM data: ASHRAE Standard 90.1-2016

EEM07 Fan Power Limit

EEM07 limits the fan energy used by HVAC equipment. It requires that variable air volume systems use no more than 0.80 W/cfm and constant air volume systems use no more than 0.65 W/cfm for fan power. These limits are used for fan motor larger than 5 nameplate horsepower to compute the new static pressure for fans based on the fan power limitation rules established previously in the development of the prototype models. The baseline fan power is approximately 0.92 W/cfm for variable air volume fans, and 0.68 W/cfm for constant volume fans.

A system based efficiency metric kW/RT was also proposed for NYStretch but it is not included in the analysis.

Affected Prototypes: All (only central exhaust fans and outdoor air makeup units in 20-story high-rise apartments)

Source of EEM data: NBI's New Construction Guide

EEM08 Cooing Tower Efficiency

EEM08 specifies a cooling tower efficiency of 80 gpm/hp for systems with 900 gpm and larger and chiller plants over 300 tons. The cooling tower gpm/hp is captured as reduced fan power for the cooling tower. For ASHRAE Standard 90.1-2013 baseline, the cooling tower efficiency is 40.2 gpm/hp.

Affected Prototypes: Large Office. Only applicable in climate zones 5A and 6A as a way to address concerns about the potential structure impacts if cooling towers are installed on the roof in New York City (climate zone 4A).

Source of EEM data: CEE CASE study

EEM09 Hotel Guestroom HVAC Vacancy Control

EEM09 reduces guestroom energy usage in hotels by resetting the temperature setpoint during the period when a guestroom is unoccupied or unrented. This measure is also in ASHRAE Standard 90.1-2016. The measure requires the guest room thermostat setpoint to be automatically raised by at least 4°F in the cooling mode and lowered by at least 4°F in the heating mode within 30 minutes of all occupants leaving the guest room. When the guest room is unrented and unoccupied, HVAC setpoints are required to be automatically reset to 80°F or higher in the cooling mode and to 60°F or lower in the heating mode. These changes are implemented by changing the thermostat setpoint schedules for unrented guest rooms and for rented guest rooms during unoccupied hours.

Affected Prototype: Large Hotel

Source of EEM data: ASHRAE 90.1-2016

EEM10 Service Water Heating Waste Heat Recovery

EEM10 proposes that 40% of hot water loads to be met by waste heat recovery (from SHW, heat-recovery chiller, building equipment, process equipment or a combined heat and power system) or solar thermal water heating systems or a combination of both. To implement this EEM, the SWH consumption is reduced by 40% through post-processing.

EEM10 specifies that 40% of hot water needs are met either through drain water waste heat recovery or using a solar thermal water heating system or a combination of both. PNNL researched various methods through which drain water waste heat recovery can be accomplished and the typical returns achieved using drain water waste heat recovery.

- Using a direct heat exchanger on the drain water return provides about 30% recovery.
- Collecting greywater from the building into a single tank and using a water-source heat pump to extract heat from the greywater to provide all the service water heating (SWH) results in more than 75% recovery[1].
- Various other research papers indicate 30-60% savings from drain waste heat recovery for multi-family buildings[2].
- Up to 50% of the hot water load could be covered using solar water heating even in cold climates (Aldrich and Williamson 2016).

Thus, it was found that 40% waste heat recovery from SWH is possible and was used for this measure.

Affected Prototypes: Large Hotel, 10-story and 20-story High-rise Apartment.

Source of EEM data: Ecotope and study from ACEEE Hot Water Forum 2017

EEM11 Plug Load Reduction

EEM11 reduces plug load energy usage. This measure has two parts: 1) upgrade major commercial kitchen appliances to ENERGY STAR®, and 2) use Centralized Computer power management to turn-off computers and monitors at night. The computer power management requirement is based on California's Building Energy Efficiency Standards for Residential and Nonresidential Buildings (Title 24).

Affected Prototypes: Large Office, Secondary School, and Large Hotel

[1] Source: Email correspondence with Ecotope on SWH waste heat recovery systems.
[2] Source: ACEEE Hot Water Forum 2017: http://aceee.org/conferences/2017/hwf#presentations

Source of EEM data: 189.1-2017 for commercial kitchen and Title 24 for computer power management

EEM12 Thermal Bridging

EEM12 captures the impact of thermal bridging of wall assemblies. Using the Building Envelope Thermal Bridging Guide[3] (Morrison-Hershfield), U-factors are developed for exterior walls assuming thermal bridging from balconies for the Large Hotel and two High-rise Apartments prototypes. A second set of U-factors is developed for improved assemblies that attempt to mitigate thermal bridging. NBI developed and provided PNNL the U-factors for the baseline and advanced cases.

It should be noted that this measure is simulated using a separate baseline, i.e., other measures or the EEM bundles are not affected by the base U-factors developed for this measure.

Affected Prototypes: Large Hotel and 10-story High-rise Apartment

Source of EEM data: NBI research. NBI's Multifamily Building Guide

EEM13 Exterior Lighting Power Reduction

The proposed lighting power requirement will be the same as ASHRAE 189.1-2017, which affects the power of exterior lighting for parking lot, entrance, and façade. Because most buildings in New York City (climate zone 4) do not have parking lot, the savings to parking lighting are applied to climate zones 5A and 6A only. Because most high-rise apartment buildings are in New York City and have no or limited exterior lighting, the savings of this measure are not analyzed for high-rise apartments.

Zone	90.1-2013	90.1-2016	189.1-2017	90.1-2013	90.1-2016	189.1-2017	90.1-2013		90.1-2016	189.1-2017
	Parking Lots (W/ft2)			Building facades (W/ft2 for each illuminated wall)			Main Doors	Other Doors	Entrances and exits	Entrances and exits
							W/linear foot of opening			
0	0	0	0	0	0	0	0	0	0	0
1	0.04	0.03	0.03	0	0	0	20	20	14	12.6
2	0.06	0.04	0.03	0.10	0.10	0.10	20	20	14	12.6
3	0.10	0.06	0.05	0.15	0.15	0.14	30	20	21	20
4	0.13	0.08	0.05	0.20	0.20	0.19	30	20	21	20

[3] https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/power-smart/builders-developers/building-envelope-thermal-bridging-guide-1.1.pdf

Affected Prototype: Large hotel, large office, standalone retail, and secondary school. Facade and entrance lighting savings are captured in all climate zones. Parking lighting savings are captured in climate zones 5A and 6A. No parking lot exterior lighting power in 4A (New York City).

Source of EEM data: 189.1-2017

EEM14 Elevator

This measure is similar to Section 609.2.1.2.3 in the 2015 IgCC, which requires elevator system to recover the potential energy released during motion. Based on NBI's literature review, regenerative drive can potentially reduce average elevator energy consumption per day by about 5% for tall buildings.

Affected Prototype: Large hotel, large office, 10-story apartment, and 20-story apartment.

Source of EEM Data: NBI research. 2015 IgCC

EEM15 Energy Recovery Ventilator for Apartment Makeup Air Units

Section 6.5.6.1 in ASHRAE Standard 90.1-2013 provides an ERV exception to fan systems where the largest source of air exhausted at a single location is less than 70% of the design outdoor airflow rate. High-rise apartment buildings often have more than two rooftop central exhaust fans. This EEM modifies the exception to require ERV for those exhausts unless they are far from each other (more than 30 foot). The analysis adds ERVs to the makeup air RTUs supplying ventilation air to the corridors and they recover latent and sensible heat from the building exhaust to ventilation air intake. The baseline 90.1-2013 models in the two apartment buildings do not have ERV. Considering in practice it might be difficult to recover all exhaust air from the ERV, we only assume 70% of exhaust air to be covered by ERV.

Affected Prototype: 10-story High-rise Apartment, and 20-story High-rise Apartment.

Source of EEM data: 2016 NYCECC and 90.1-2016

EEM16 Demand-based Controls for Recirculated Service Water Heating Systems

This measure is the same as Section C404.6.1 in the 2015 IECC, which requires buildings with recirculated SWH systems to automatically turn off the circulation pumps when the water temperature in the circulation loop is either at or above the desired setpoint or when there is no hot water demand.

A recirculated SWH system provides more instant hot water at the water taps but energy losses are greater through pipe thermal losses and pump energy losses than a non-recirculated system. For prototypes that use recirculated SWH systems, PNNL assumed that the SWH pumps in the 90.1-2013 prototypes are always on at constant speed and the SWH temperatures are always maintained at their design setpoint. To estimate the energy savings impacts of the EEM, reductions to the pipe heat loss inputs and recirculation pump power inputs were applied based on the baseline inputs in the 90.1-2013 prototypes. PNNL estimated the savings based on assumed SWH demand profiles in these prototypes.

Although Large Hotel uses recirculated SWH systems, we did not quantify the impacts of the new requirements on them because we assumed the occupants in these building always have SWH demand.

Affected Prototype: Large Office, Secondary School, and 10-story and 20-story High-rise Apartment.

Source of EEM data: 2015 IECC

Efficiency Package Options

Option 1 HVAC Equipment Efficiency

- ### DX Equipment Efficiency

This EEM improves the efficiency of DX equipment by specifying Tier 2 equipment for unitary AC units from the CEE specifications. CEE Tier 1 criteria for water source heat pump are also used. For PTAC, the 189.1-2017 requirements are used. Table 6 shows the CEE specifications compared with those in ASHRAE Standard 90.1-2013.

Affected Prototypes: Standalone Retail, Secondary School, 10-story High-rise Apartment and 20-story High-rise Apartment.

Source of EEM data: CEE Tiers and 189.1-2017

Table 6. CEE Tier 1 and Tier 2 equipment efficiency specifications by equipment type and capacity

Unitary AC	Capacity	<65 kBtu/h	65 <--> 135 kBut/h	135 <--> 240 kBtu/h	240 <--> 760 kBtu/h	> 760 kBtu/h
	Specification	SEER	EER	EER	EER	EER
	IECC2015	14.0	11.0	10.8	9.8	9.5
	90.1-2013	14.0	11.0	10.8	9.8	9.5
	90.1-2016	14.0	11.0	10.8	9.8	9.5
	189.1-2017 (bh)	15.0	12.0	12.0	10.6	10.2
	CEE Tier 1	15.0	11.5	11.5	10.3	9.7
	CEE Tier 2	16.0	12.0	12.0	10.6	10.2
Water to Air HP Cooling Mode	Capacity	<17 kBtu/h	17 <--> 65 kBut/h	65 <--> 135 kBut/h		
	Specification	EER	EER	EER		
	IECC2015	12.2	13.0	13.0		
	90.1-2013	12.2	13.0	13.0		
	90.1-2016	12.2	13.0	13.0		
	189.1-2017(bu)	14.0	14.0	14.0		
	CEE Tier 1	14.0	14.0	14.0		
	CEE Tier 2	NA	NA	NA		
Water to Air HP Heating Mode	Capacity	<17 kBtu/h	17 <--> 65 kBut/h	65 <--> 135 kBut/h		
	Specification	COP	COP	COP		
	IECC2015	4.3	4.3	4.3		
	90.1-2013	4.3	4.3	4.3		

	90.1-2016	4.3	4.3	4.3		
	189.1-2017(bu)	4.6	4.6	4.6		
	CEE Tier 1	4.6	4.6	4.6		
	CEE Tier 2	NA	NA	NA		
PTAC (Standard Size)	Capacity	All Capacities				
	Specification	EER, As of 1/1/2015	EER, Before 1/1/2015			
	90.1-2016	14.0 - (0.300*Cap/1000)	13.8-(0.300*Cap/1000)			
	189.1-2017(bw)	14.4 - (0.300*Cap/1000)				

- **Boiler Efficiency**

This EEM specifies condensing boilers (94.5% efficiency) and in ASHRAE Standard 90.1-2013 baseline the maximum boiler efficiency is 81.25%.

Affected Prototypes: Large Office, Secondary School, Large Hotel, 10-story High-rise Apartment and 20-story High-rise Apartment.

Source of EEM data: NBI Multifamily Guide

Option 2 Reduced lighting power density system

Exceed Stretch Code LPDs by 10%

Affected Prototypes: All prototypes

Option 3 Enhanced envelope performance

Exceed Stretch Code of building thermal envelope to be 10% more efficient to the U-factor requirements of the opaque and fenestration components.

Affected Prototypes: All prototypes

Option 4 Reduced air infiltration

0.25 cfm/sf @75 Pa

Affected Prototypes: All except standalone retail

Option 5 DOAS

Option 6 On-site supply of renewable energy

Provide at least 6.0 kBtu/sf for single story buildings and at least 10 kBtu/sf times the gross roof area for all other buildings (ASHRAE 189.1)

Appendix A

Addendum AV to 189.1-2004 (1st and 2nd public review drafts)

189 1 av1stpprdraft 25october16.pdf

189 1 av isc 2nd pprdraft 2-28-17.pdf