



NYSERDA

NYStretch Code – Energy 2018

Development Overview

Reforming the Energy Vision (REV)

REV is a comprehensive strategy to build a clean, resilient, and affordable energy system for all New Yorkers, with a focus on three core approaches to drive transformation

- **Regulatory Reform** (PSC) – reshaping NY’s electric industry and utility business practice to encourage the cleanest, most advanced, and efficient power system operation
- **Market Activation** (NYSERDA) – addressing market barriers and gaps; redesigning NY programs to accelerate clean energy market growth and unlock private clean energy investment
- **Leading by Example** (NYPA) - deploying innovative energy solutions across State-owned buildings, university campuses, and State vehicle fleets

REV Clean Energy Goals for 2030

ny.gov/REV4NY

40% **Reduction**
in greenhouse gas emissions from 1990 levels

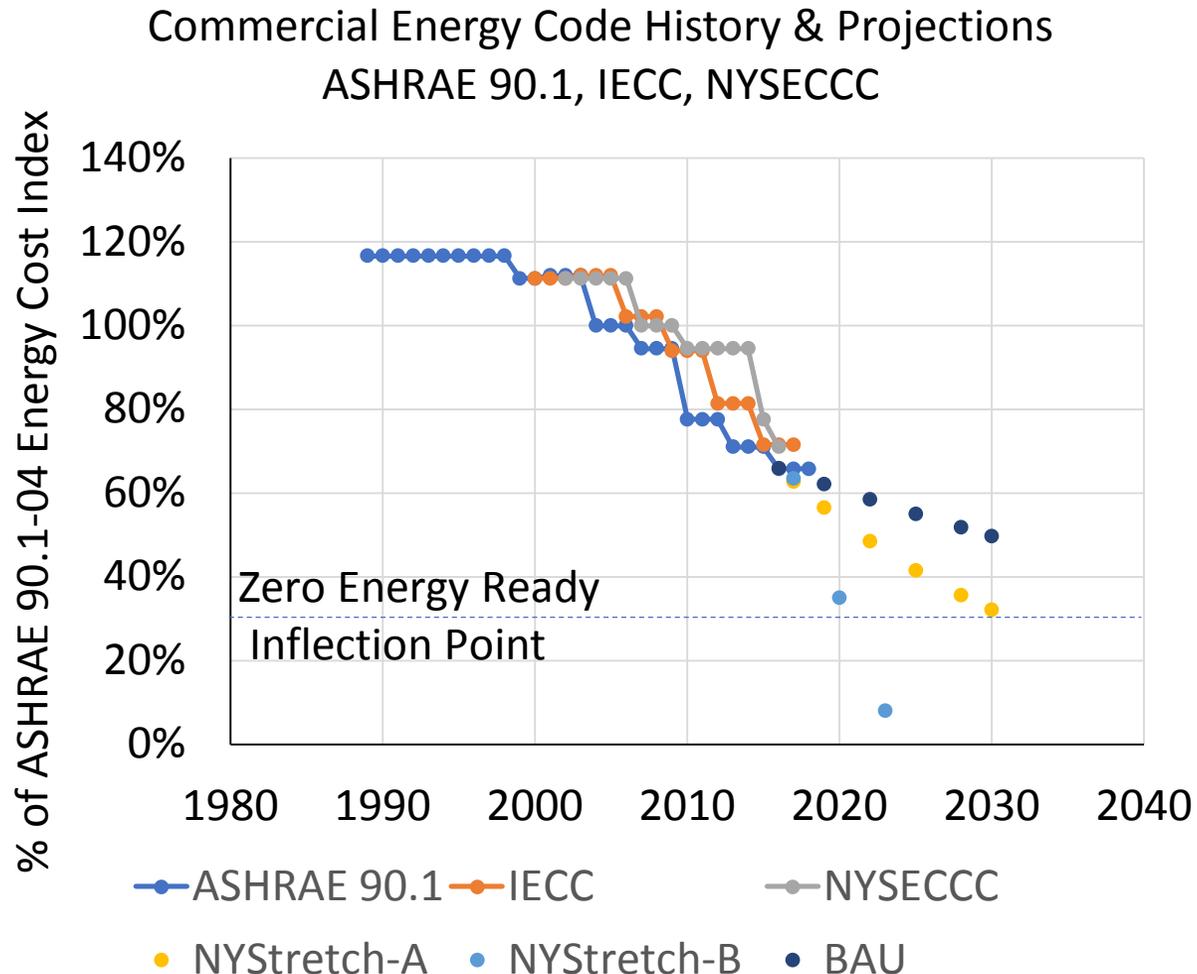
50% **Generation**
of New York State's electricity must come from renewable energy sources

23% **Decrease**
in energy consumption of buildings from 2012 levels

Stretch Energy Code Concept

- Mandatory or voluntary mechanisms
 - Adopted by cities
 - Used for public buildings
 - Tax or other incentive programs
- Results in more energy savings than a base energy code
- Signals where future codes are going
- Can work in tandem with utility programs - regulatory, timing, and savings

Stretch Code Strategies



“One-Cycle Stretch”

- Build on national model codes
- NYStretch-Energy
 - 2015 version this year
 - 2018 version next year
 - 2021 version by 2021

“Stretch-to-Zero”

- Test approaches for towards zero codes in New York State
- Address unregulated loads
- Address onsite generation

Stretch Codes in Context

Part of NYSERDA's suite of code-related activities:

- ✓ Improving compliance
- ✓ Strengthening enforcement
- ✓ Accelerating adoption
- ✓ Supporting enactment

<https://www.nyserra.ny.gov/All-Programs/Programs/Energy-Code-Training>

One-Cycle Stretch: What is NYStretch-Energy?

“Overlay” code, or alternative compliance path,
for local adoption

- + More rigorous than base energy code
- + Results in buildings that achieve greater energy savings and reduced GHG emissions
- + Anticipates successor code advancements, culminating in a statewide Net Zero Energy code by 2028/30



One-Cycle Stretch: 2018 NYStretch–Energy Objective

- Provide readily-adoptable code language for local governments that will deliver energy efficiency performance significantly above anticipated 2019 Energy Conservation Construction Code of New York State
- Generally aiming for energy savings of 20% beyond ASHRAE 90.1-2013 / 2015 IECC

One-Cycle Stretch: 2018 NYStretch-Energy Development Process

- Advisory Group guidance - Make it rigorous but straightforward and achievable; backstop for best practices in building design/engineering
- Residential, Commercial and Multi-family Working Groups- Will review technical issues and help prepare detailed language
- Iterative energy modeling to predict savings and fine-tune
- Incremental cost analysis to understand cost-effectiveness
- Public comment period
- Toolkit to support adoption

NYSERDA's NYStretch Team

- Project lead: New Buildings Institute
- Support & planning: Institute for Building Technology & Safety
- Commercial & multifamily modeling: Pacific Northwest National Labs
- Residential modeling: Earth Advantage
- Guidance on local adoption: Pace Energy & Climate Center

nbi new buildings
institute



Stakeholder Input

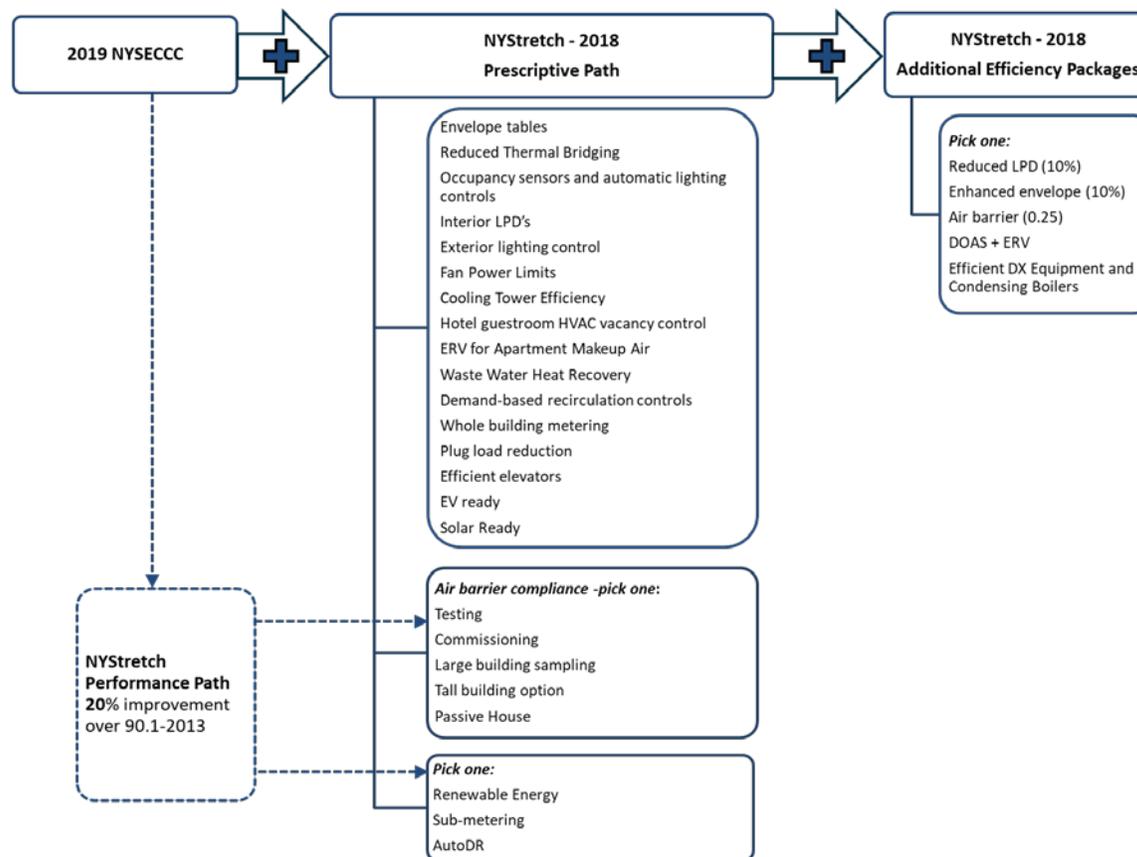
- Advisory Group Meetings
- Commercial, Multifamily and Residential Working Groups
- Project team and informal review nationally
- Multiple calls/discussions with stakeholders (NYSDOS, NYC Mayor's Office and DPD, MA DOER, Efficiency VT)
- Public Comment period

2018 NYStretch-Energy Timetable

MILESTONE	DATE
Kickoff	June 8, 2017
1 st Round Technical Working Group meetings	July 2017
NYStretch-Energy Advisory Committee (Meeting 2) PRESENT DRAFT ENERGY ANALYSIS	September 2017
2 nd Round of Technical Working Group Meetings	October 2017
NYStretch-Energy Advisory Committee (Meeting 3) PRESENT FINAL ENERGY ANALYSIS	December 2017
NYStretch-Energy draft	December 2017
Legal review	January 2018
Public comment	February/March 2018
Toolkit update	May 2018
Final NYStretch-Energy	May 2018

Overview of Commercial Modeling Methodology

Commercial Code Structure



Energy Targets: Site EUIs

NY Weighted Average - Site EUI	90.1-2013	90.1-2016 Prelimin	2015 IECC	2018 IECC Estimate	NYStretch 2016	NYStretch 2018
Clinic	116	109	118	114		92
Fast Food	612	607	628	626		490
High-rise Apartment (10 Stories)	51	49	51	50	42	40
Hospital	126	124	131	130		101
Large Hotel	89	85	88	86	80	71
Large Office	73	72	73	73	69	58
Medium Office	35	33	36	35		28
Mid-rise Apartment (4 Stories)	47	45	47	46		37
Primary School	56	49	57	53		45
Restaurant	395	390	400	397		316
Retail Store	45	41	47	45	41	36
Secondary School	40	35	42	39	37	32
Small Hotel	61	56	62	59		49
Small Office	29	26	29	28		23
Strip Mall	60	54	59	56		48
Warehouse	20	17	17	16		16
Weighted Average	57	53	57	56		45

Energy Targets: Source EUIs

NY Weighted Average - Source EUI	90.1-2013	90.1-2016 Preliminary	2015 IECC	2018 IECC Estimate	NYStretch 2016	NYStretch 2018
Clinic	308	291	361	353		247
Fast Food	1017	1009	1123	1119		814
High-rise Apartment (10 Stories)	116	112	121	118	97	93
Hospital	303	298	339	336		243
Large Hotel	191	182	202	198	177	153
Large Office	206	205	225	224	197	165
Medium Office	97	93	103	100		78
Mid-rise Apartment (4 Stories)	128	123	132	130		102
Primary School	135	117	160	151		108
Restaurant	720	710	764	759		576
Retail Store	121	111	138	133	105	97
Secondary School	108	94	130	123	102	87
Small Hotel	139	126	144	138		111
Small Office	88	77	92	87		70
Strip Mall	148	134	150	142		119
Warehouse	43	36	40	36		34
Weighted Average	139	130	152	148		111

New York Conversion Factors

New York		
Electricity	\$0.161	\$/kWh
Fossil Fuel	\$0.808	\$/therm
National Costs (PNNL)		
Electricity	\$0.103	\$/kWh
Gas	\$0.990	\$/therm

- Site to source conversion for electricity:
- Electricity Sales 3,412 Btu/kWh
- Electricity Generation 8,697 Btu/kWh
- (Three-year statewide weighted average annual heat rate for fossil-fueled power plants)
- NYSERDA Patterns and Trends report – October 2017
- <https://www.nyserda.ny.gov/About/Publications/EA-Reports-and-Studies/Patterns-and-Trends>

NYStretch Base Measures

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 EEMs

EEM #	Measure Description	Hotel	Office	School	Retail	10-story Apt	20-story Apt
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

EEM #	Measure Description	Hotel	Office	School	Retail	10-story Apt	20-story Apt
Efficiency Packages							
NYStretch	All Base Measures 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

Results Summary

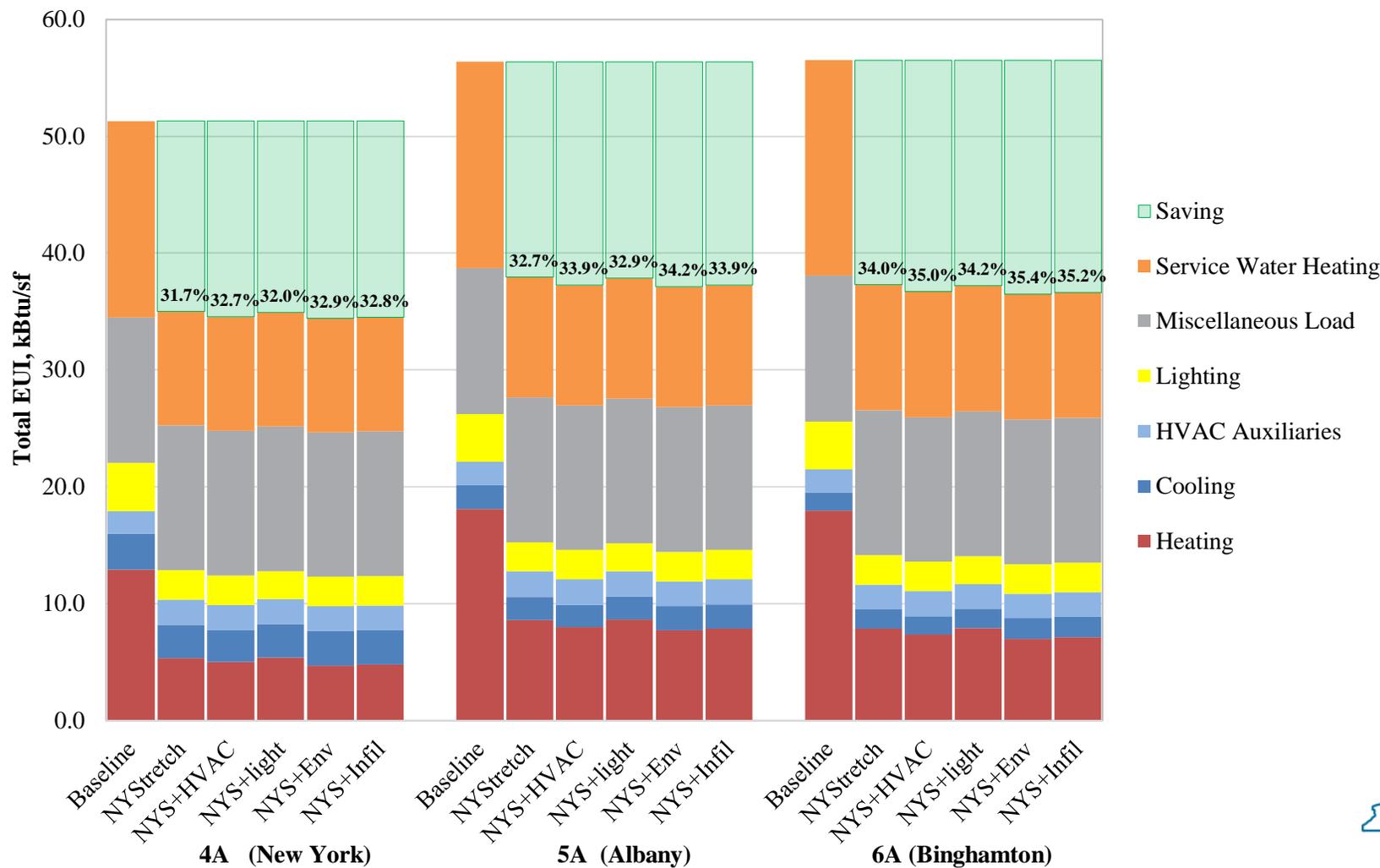
NYStretch Base Measures

NYStretch Base Measures (EEM 1-16)

Building Type	Prototype	Construction Weight [%]	Site Energy [kBtu/ft ² /yr]		% Energy Savings
			90.1-2013	NYStretch	NYStretch vs. 90.1-2013
Office	Large office	10.1%	60.91	57.25	6.0%
Retail	Standalone retail	16.9%	49.23	41.86	15.0%
Education	Secondary school	11.4%	39.87	32.73	17.9%
Lodging	Large hotel	9.0%	87.68	69.84	20.3%
Apartment	20-story apartment	25.3%	53.04	36.57	31.0%
	10-story apartment	27.6%	51.35	35.04	31.8%
Weighted Average (across all climate zones in NY)		100.0	54.51	41.81	23.3%

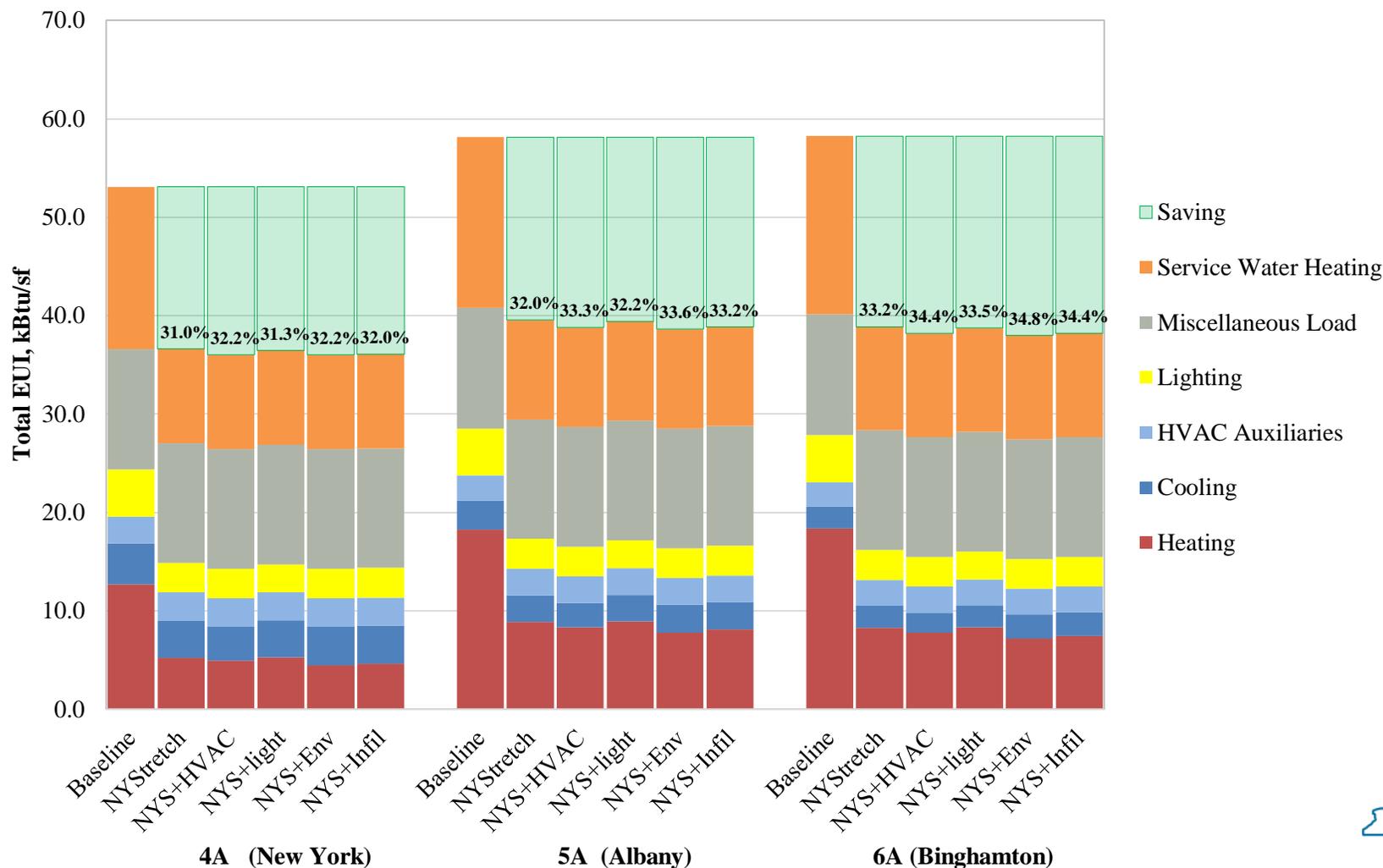
Efficiency Packages: 10-story Apt

10-story HighRise Apartment



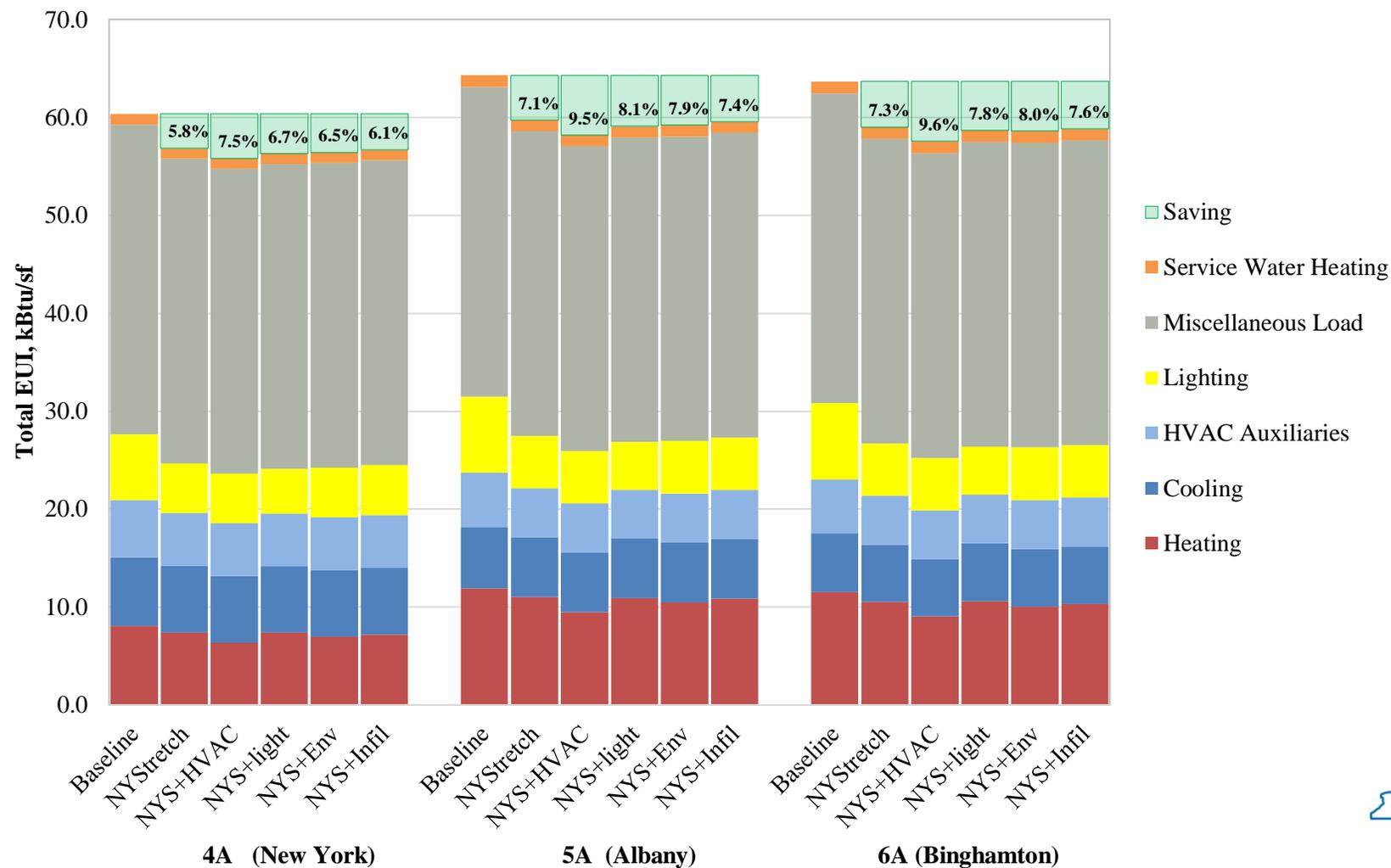
Efficiency Packages: 20-story Apt

20-story HighRise Apartment



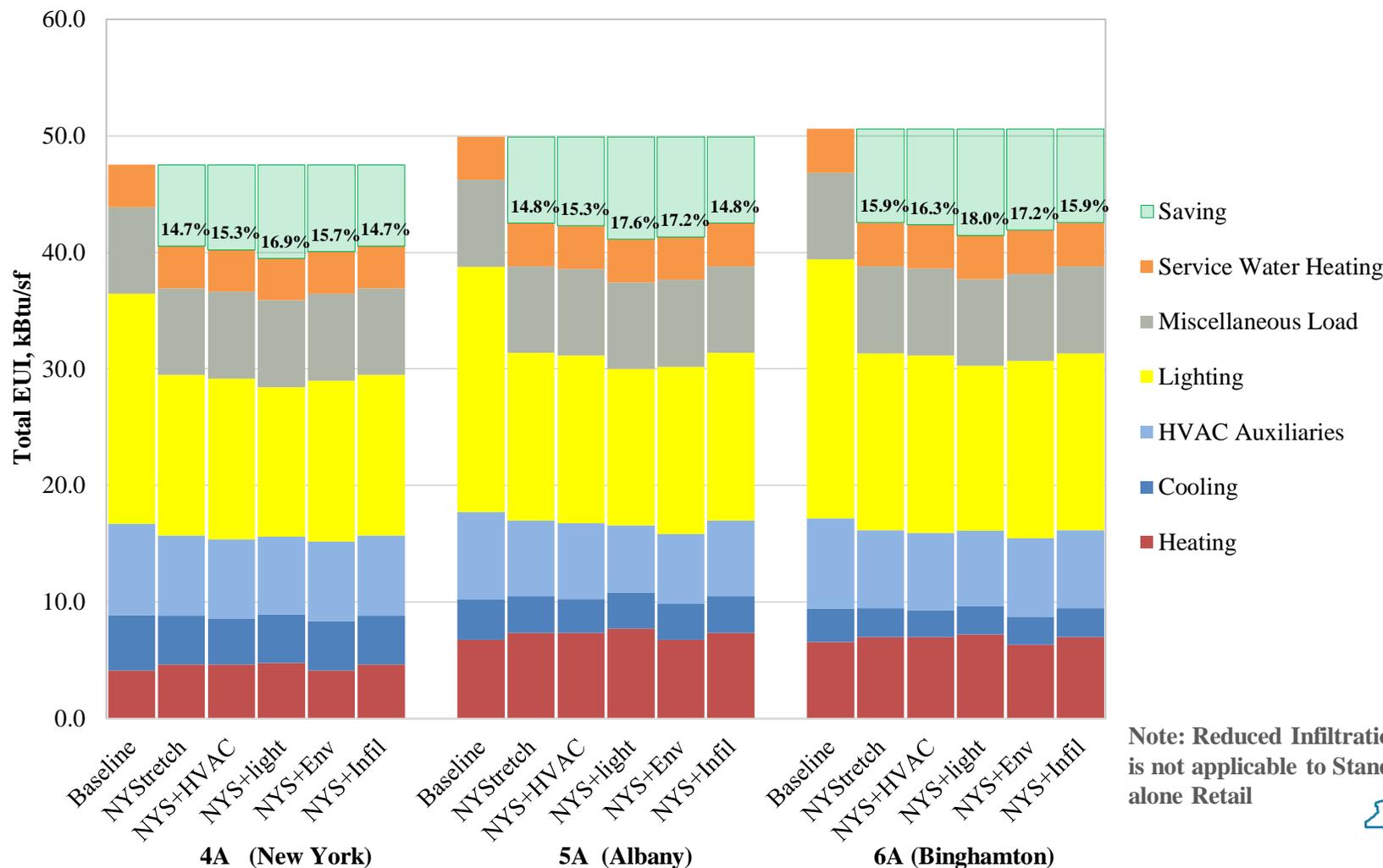
Efficiency Packages: Office

Large Office



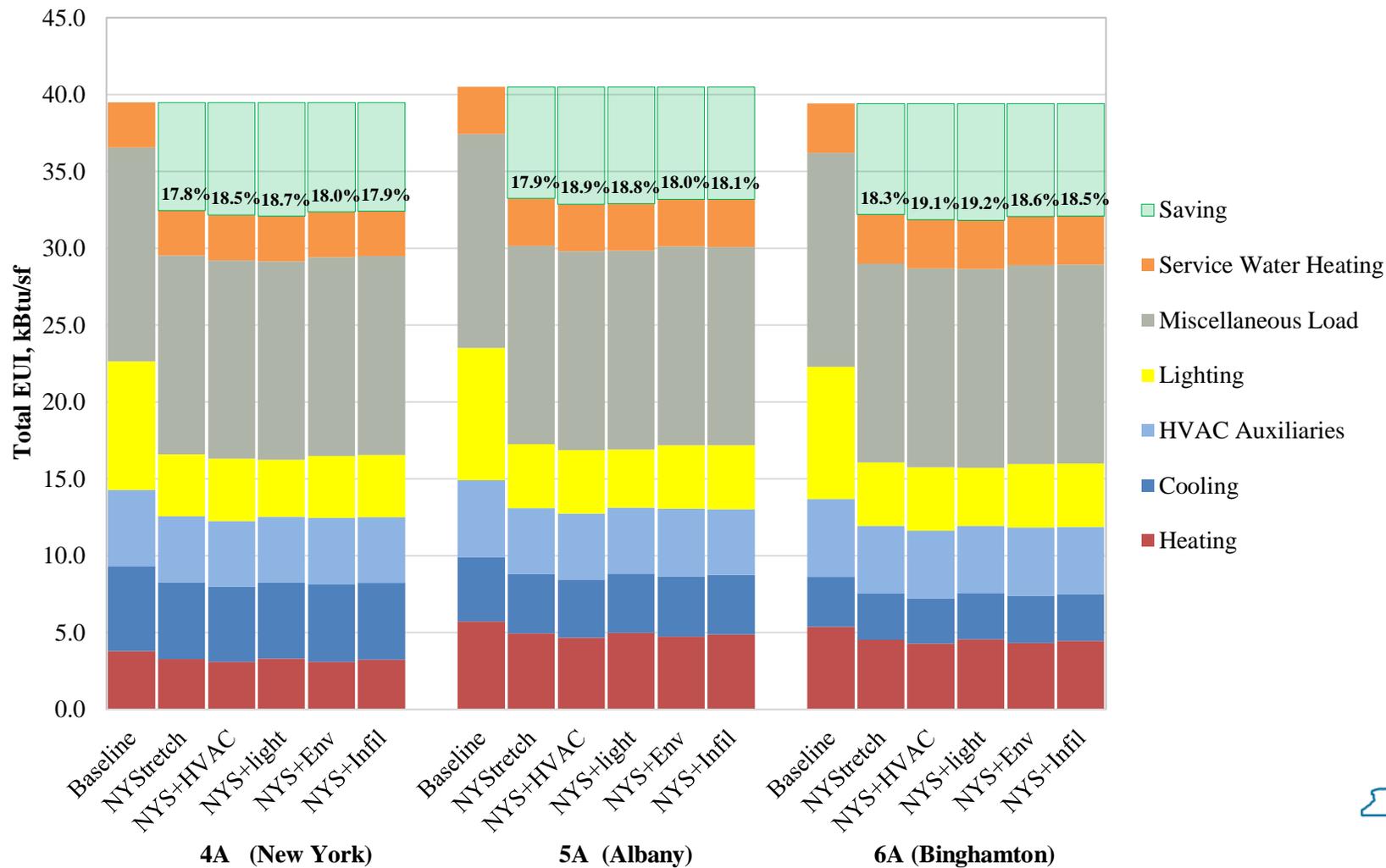
Efficiency Packages: Retail

Stand-alone Retail



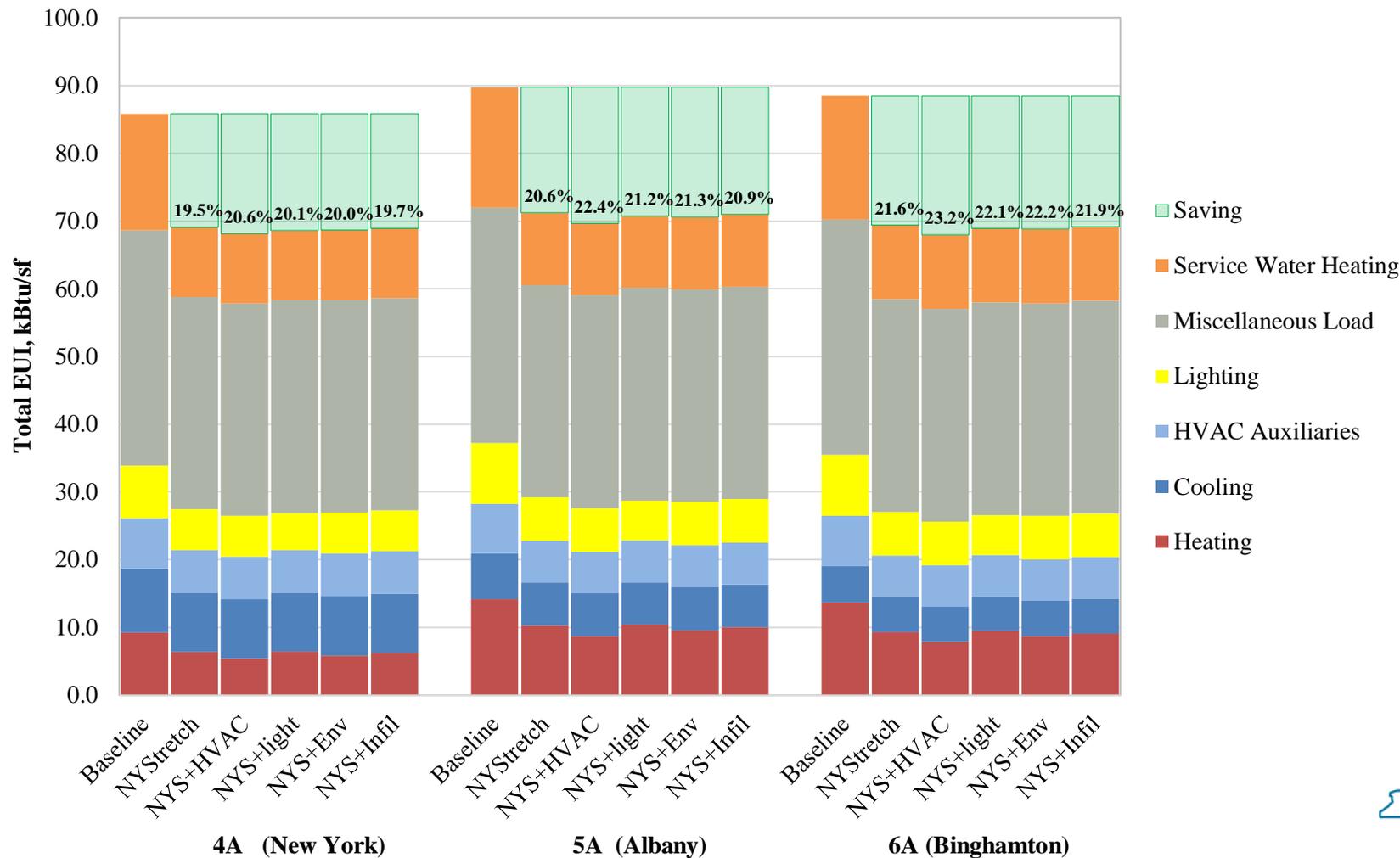
Efficiency Packages: School

Secondary School



Efficiency Packages: Hotel

Large Hotel



EEM Results: 10-story Apt

EEM #	Energy Design Measures	10-story Apartment		
		4A	5A	6A
		Site EUI Saving %		
	Baseline 90.1-2013	---	---	---
1	Enhanced insulation for roofs and walls	0.3%	0.3%	0.5%
2	Enhanced windows	1.0%	0.8%	1.4%
3	Air leakage testing for large buildings	4.9%	5.2%	5.4%
4	Reduced LPD for interior lighting and high efficacy lights in dwelling units	2.2%	1.9%	1.8%
5	Occupancy sensors and automatic lighting controls including egress lighting	0.2%	0.2%	0.2%
6	Exterior lighting control	NA	NA	NA
7	Fan power limit: 0.8 W/cfm VAV and 0.65 W/cfm CAV	NA	NA	NA
8	Cooling towers in CZ 5 & 6	NA	NA	NA
9	Hotel guestroom HVAC vacancy control	NA	NA	NA
10	SWH waste heat recovery	13.1%	12.5%	13.1%
11	Plug load reduction	NA	NA	NA
12	Thermal bridging	2.7%	1.7%	1.8%
13	Exterior lighting power	NA	NA	NA
14	Elevator	0.2%	0.2%	0.2%
15	ERV for Apartment makeup air units	8.8%	10.9%	10.7%
16	Demand-based recirculated DHW controls	1.1%	1.0%	1.0%

EEM Results: 20-story Apt

EEM #	Energy Design Measures	20-story Apartment		
		4A	5A	6A
		Site EUI Saving %		
	Baseline 90.1-2013	---	---	---
1	Enhanced insulation for roofs and walls	0.2%	0.2%	0.3%
2	Enhanced windows	1.5%	1.2%	2.0%
3	Air leakage testing for large buildings	4.6%	5.0%	5.1%
4	Reduced LPD for interior lighting and high efficacy lights in dwelling units	2.7%	2.3%	2.2%
5	Occupancy sensors and automatic lighting controls including egress lighting	0.2%	0.2%	0.2%
6	Exterior lighting control	NA	NA	NA
7	Fan power limit: 0.8 W/cfm VAV and 0.65 W/cfm CAV	0.03%	0.01%	0.01%
8	Cooling towers in CZ 5 & 6	NA	NA	NA
9	Hotel guestroom HVAC vacancy control	NA	NA	NA
10	SWH waste heat recovery	12.4%	11.9%	12.5%
11	Plug load reduction	NA	NA	NA
12	Thermal bridging	NA	NA	NA
13	Exterior lighting power	NA	NA	NA
14	Elevator	0.2%	0.2%	0.2%
15	ERV for Apartment makeup air units	8.3%	10.2%	10.1%
16	Demand-based recirculated DHW controls	1.0%	0.9%	0.9%

EEM Results: Office

EEM #	Energy Design Measures	Large Office		
		4A	5A	6A
		Site EUI Saving %		
	Baseline 90.1-2013	---	---	---
1	Enhanced insulation for roofs and walls	0.1%	0.1%	-0.1%
2	Enhanced windows	0.9%	1.0%	1.3%
3	Air leakage testing for large buildings	1.2%	1.2%	1.2%
4	Reduced LPD for interior lighting and high efficacy lights in dwelling units	1.5%	1.5%	1.1%
5	Occupancy sensors and automatic lighting controls including egress lighting	1.0%	0.9%	0.9%
6	Exterior lighting control	0.01%	0.6%	0.6%
7	Fan power limit: 0.8 W/cfm VAV and 0.65 W/cfm CAV	0.4%	0.4%	0.4%
8	Cooling towers in CZ 5 & 6	NA	0.2%	0.1%
9	Hotel guestroom HVAC vacancy control	NA	NA	NA
10	SWH waste heat recovery	NA	NA	NA
11	Plug load reduction	0.4%	0.4%	0.3%
12	Thermal bridging	NA	NA	NA
13	Exterior lighting power	0.02%	1.0%	1.1%
14	Elevator	0.3%	0.3%	0.3%
15	ERV for Apartment makeup air units	NA	NA	NA
16	Demand-based recirculated DHW controls	0.1%	0.1%	0.1%

EEM Results: Retail

EEM #	Energy Design Measures	Standalone Retail		
		4A	5A	6A
		Site EUI Saving %		
	Baseline 90.1-2013	---	---	---
1	Enhanced insulation for roofs and walls	0.2%	0.6%	0.7%
2	Enhanced windows	0.2%	1.0%	1.0%
3	Air leakage testing for large buildings	NA	NA	NA
4	Reduced LPD for interior lighting and high efficacy lights in dwelling units	11.8%	10.2%	11.1%
5	Occupancy sensors and automatic lighting controls including egress lighting	1.7%	1.5%	1.5%
6	Exterior lighting control	0.2%	0.5%	0.5%
7	Fan power limit: 0.8 W/cfm VAV and 0.65 W/cfm CAV	0.4%	0.4%	0.4%
8	Cooling towers in CZ 5 & 6	NA	NA	NA
9	Hotel guestroom HVAC vacancy control	NA	NA	NA
10	SWH waste heat recovery	NA	NA	NA
11	Plug load reduction	NA	NA	NA
12	Thermal bridging	NA	NA	NA
13	Exterior lighting power	0.3%	1.8%	1.7%
14	Elevator	NA	NA	NA
15	ERV for Apartment makeup air units	NA	NA	NA
16	Demand-based recirculated DHW controls	NA	NA	NA

EEM Results: School

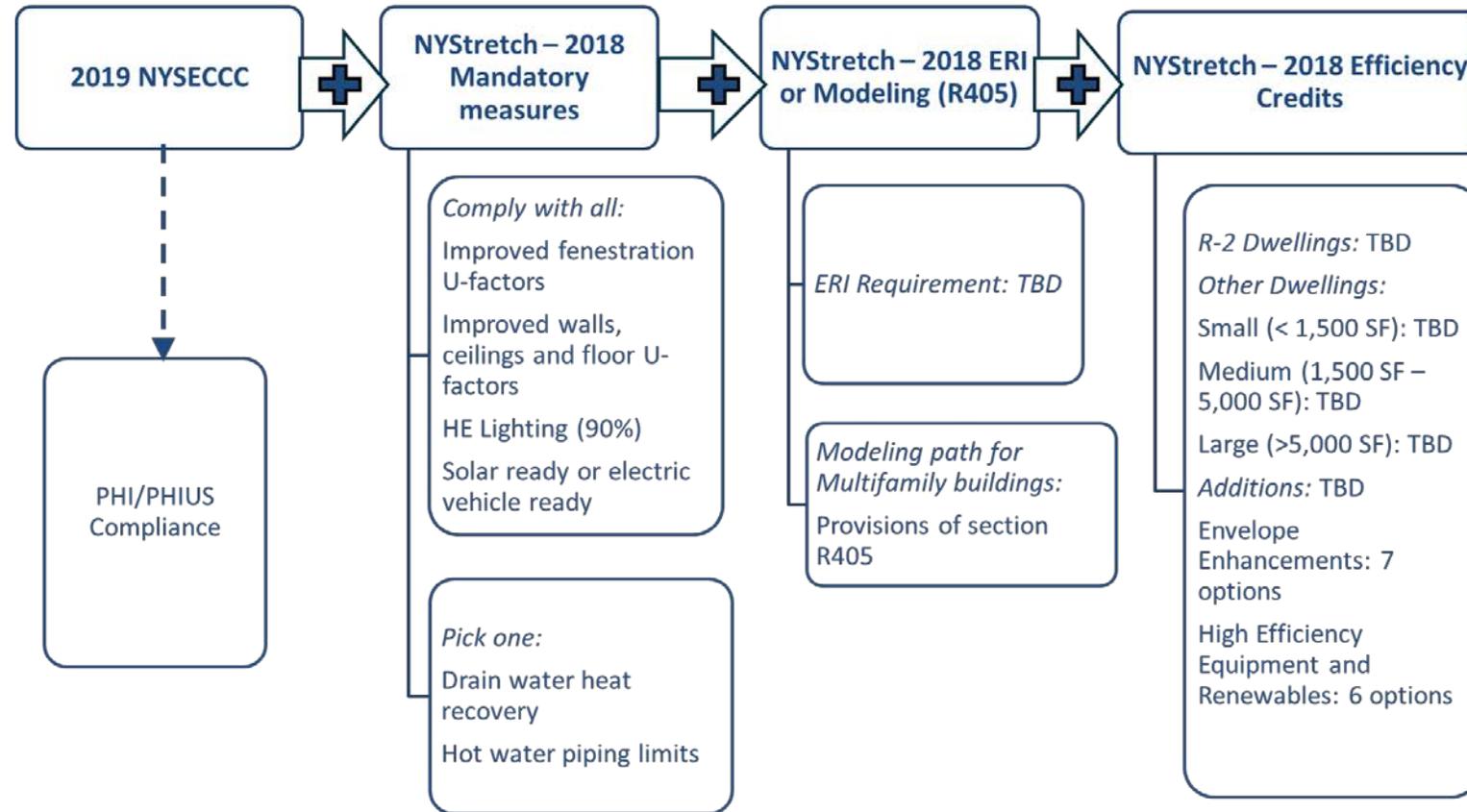
EEM #	Energy Design Measures	Secondary School		
		4A	5A	6A
		Site EUI Saving %		
	Baseline 90.1-2013	---	---	---
1	Enhanced insulation for roofs and walls	0.2%	0.4%	0.4%
2	Enhanced windows	1.4%	1.5%	1.5%
3	Air leakage testing for large buildings	0.4%	0.7%	0.7%
4	Reduced LPD for interior lighting and high efficacy lights in dwelling units	5.0%	4.5%	4.7%
5	Occupancy sensors and automatic lighting controls including egress lighting	8.0%	7.0%	7.2%
6	Exterior lighting control	0.1%	0.2%	0.3%
7	Fan power limit: 0.8 W/cfm VAV and 0.65 W/cfm CAV	1.0%	0.9%	1.0%
8	Cooling towers in CZ 5 & 6	NA	NA	NA
9	Hotel guestroom HVAC vacancy control	NA	NA	NA
10	SWH waste heat recovery	NA	NA	NA
11	Plug load reduction	3.7%	3.4%	3.5%
12	Thermal bridging	NA	NA	NA
13	Exterior lighting power	0.2%	0.5%	0.5%
14	Elevator	NA	NA	NA
15	ERV for Apartment makeup air units	NA	NA	NA
16	Demand-based recirculated DHW controls	0.0%	0.0%	0.0%

EEM Results: Hotel

EEM #	Energy Design Measures	Large Hotel		
		4A	5A	6A
		Site EUI Saving %		
	Baseline 90.1-2013	---	---	---
1	Enhanced insulation for roofs and walls	0.2%	0.2%	0.3%
2	Enhanced windows	0.9%	0.7%	1.3%
3	Air leakage testing for large buildings	1.1%	1.4%	1.4%
4	Reduced LPD for interior lighting and high efficacy lights in dwelling units	1.8%	1.2%	1.5%
5	Occupancy sensors and automatic lighting controls including egress lighting	0.2%	0.1%	0.1%
6	Exterior lighting control	NA	0.3%	0.3%
7	Fan power limit: 0.8 W/cfm VAV and 0.65 W/cfm CAV	0.6%	0.5%	0.5%
8	Cooling towers in CZ 5 & 6	NA	NA	NA
9	Hotel guestroom HVAC vacancy control	3.0%	3.9%	4.0%
10	SWH waste heat recovery	8.0%	7.9%	8.2%
11	Plug load reduction	3.7%	3.4%	3.4%
12	Thermal bridging	0.4%	0.6%	0.6%
13	Exterior lighting power	0.04%	0.8%	0.8%
14	Elevator	0.4%	0.4%	0.4%
15	ERV for Apartment makeup air units	NA	NA	NA
16	Demand-based recirculated DHW controls	NA	NA	NA

Residential Modeling Results

Residential Code Structure



Mandatory Measures Modeled

	IECC 2015 (CZ 4)	IECC 2015 (CZ 5/6)	NYStretch
Window U-factor	0.35	0.32	0.27
Door U-factor	0.35	0.32	0.30
Skylight U-factor	0.55	0.55	0.50

- **“Base” prescriptive measures**

- Improved fenestration
- Improved opaque assemblies
- High-efficacy lighting
- Ducted HVAC system within conditioned space
- Efficient hot water distribution or drain water heat recovery

Mandatory Measures Modeled

	IECC 2015 (CZ 4/5)	IECC 2015 (CZ 6)	NYStretch (CZ 4/5)	NYStretch (CZ 6)
Ceiling U-factor	0.026	0.026	0.026	0.026
Wood Frame Wall U-factor	0.06	0.045	0.056	0.045
Mass Wall U-factor	0.098/0.082	0.060	0.056	0.056
Floor U-factor	0.047/0.033	0.033	0.029	0.029
Below Grade Wall U-factor	0.05	0.05	0.042	0.042

- **“Base” prescriptive measures**

- Improved fenestration
- Improved opaque assemblies
- High-efficacy lighting
- Ducted HVAC system within conditioned space
- Efficient hot water distribution or drain water heat recovery

Mandatory Measures Modeled

- **High-efficacy lighting for 90% of all permanently installed lighting fixtures**
 - 65 lumens per watt for lamps over 40 watts
 - 45 lumens per watt for lamps over 15 watts to 40 watts
 - 30 lumens per watt for lamps over 5 watts to 15 watts

- **“Base” prescriptive measures**
 - Improved fenestration
 - Improved opaque assemblies
 - High-efficacy lighting
 - Ducted HVAC system within conditioned space
 - Efficient hot water distribution or drain water heat recovery

Mandatory Measures Modeled

- **All heating and cooling system requirements installed inside the conditioned space.**
- **“Base” prescriptive measures**
 - Improved fenestration
 - Improved opaque assemblies
 - High-efficacy lighting
 - Ducted HVAC system within conditioned space
 - Efficient hot water distribution or drain water heat recovery

Mandatory Measures Modeled

- **Pick one:**

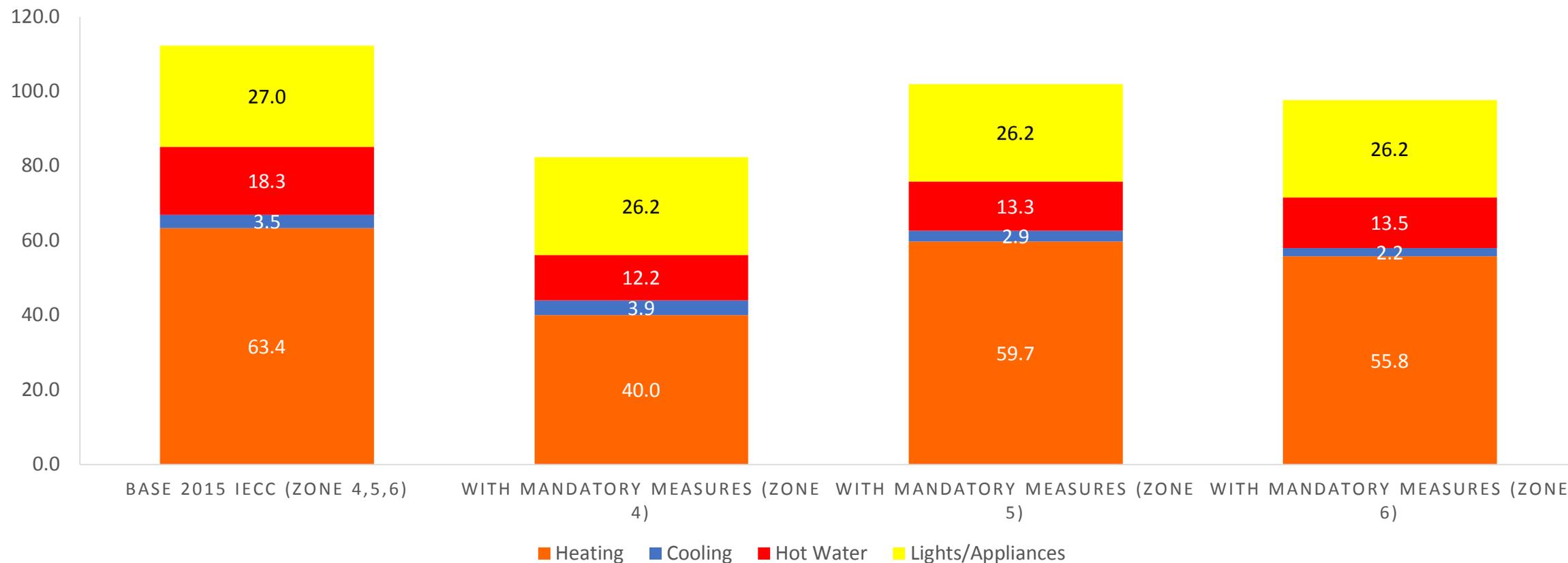
- Drain water heat recovery unit which captures heat from at least the master bathroom shower or from all other showers
- Maximum distance between a water heater and plumbing fixtures

- **“Base” prescriptive measures**

- Improved fenestration
- Improved opaque assemblies
- High-efficacy lighting
- Efficient hot water distribution or drain water heat recovery

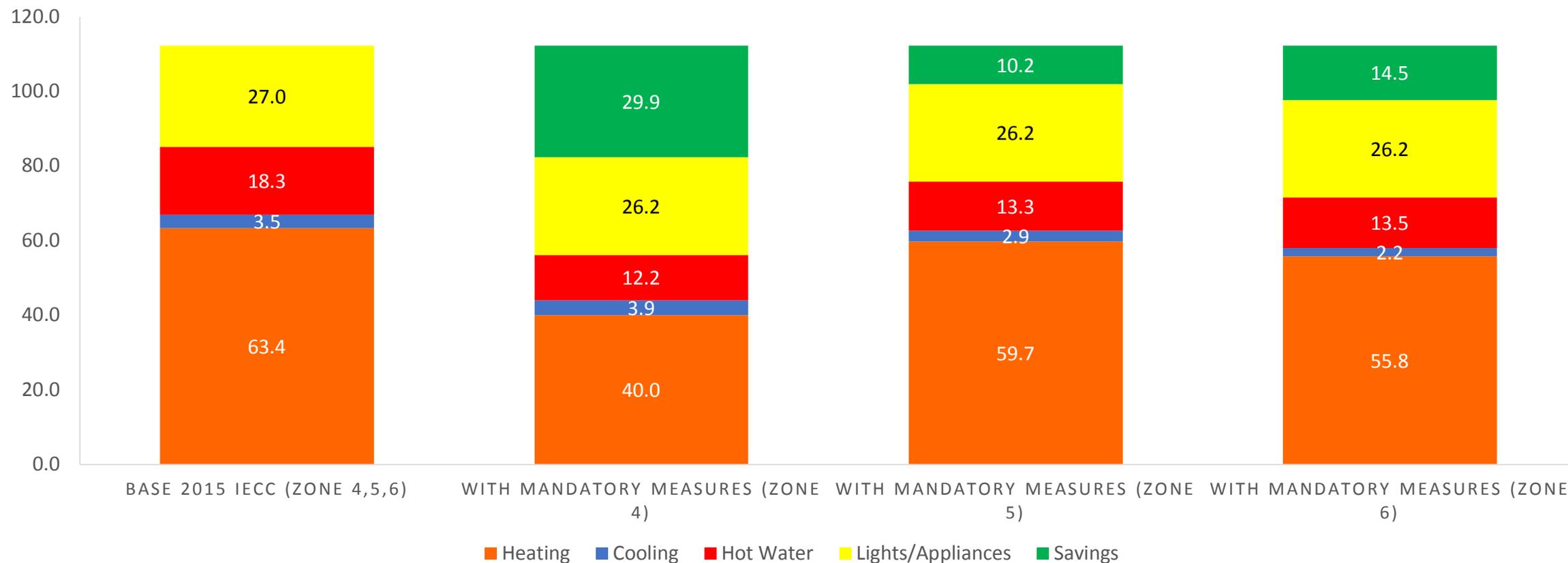
Weighted Fuel Consumption Single Family

MBTU/Year



Weighted Fuel Consumption Single Family

MBTU/Year

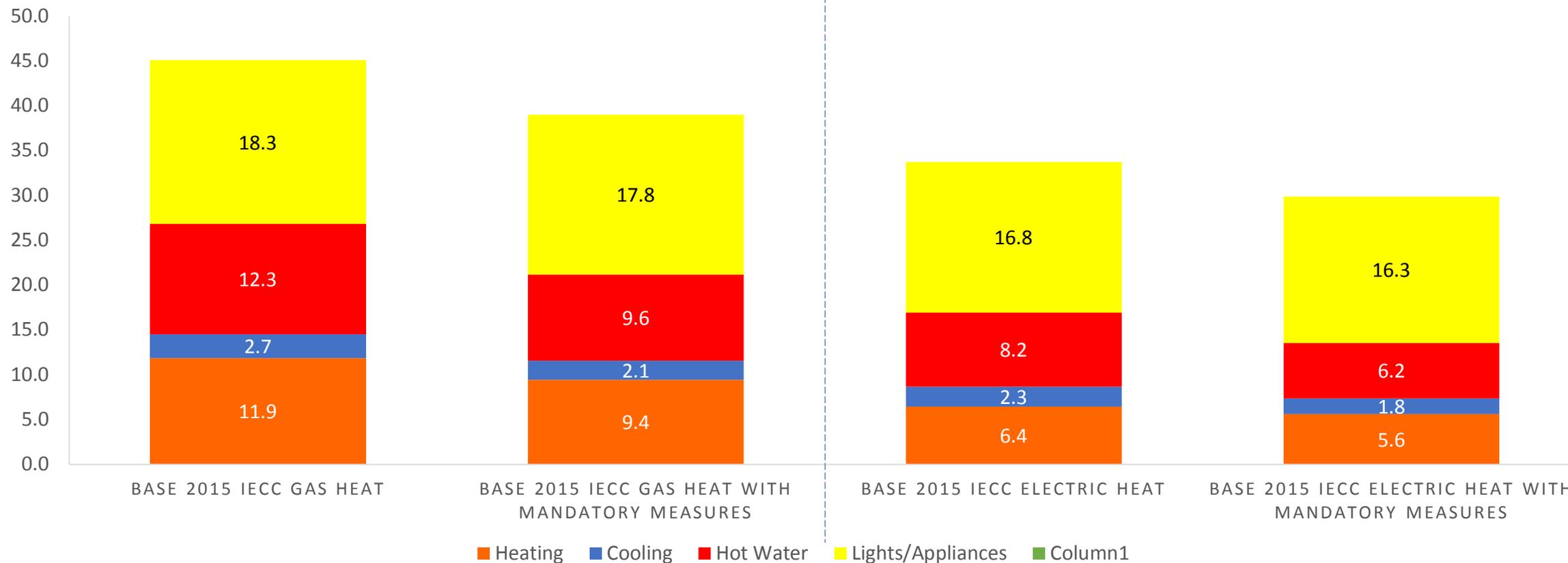


Weighted Fuel Consumption Multifamily Unit

MBTU/Year

Gas Heat

Electric Heat

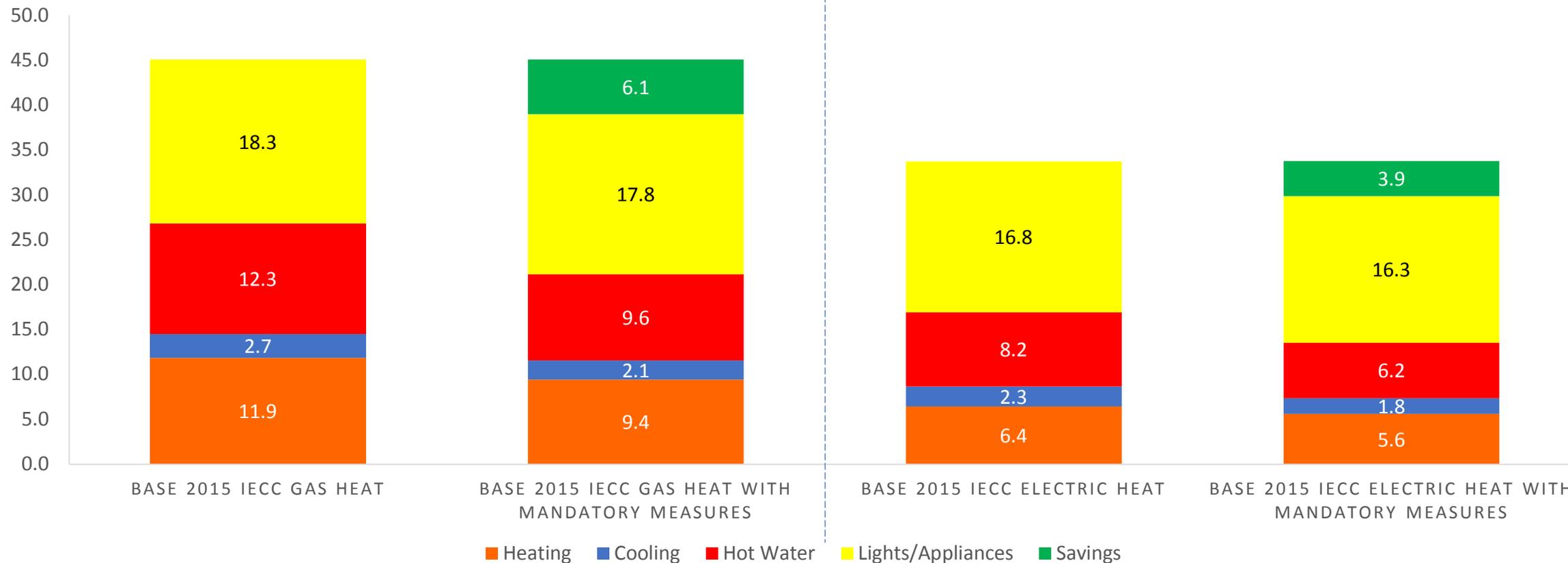


Weighted Fuel Consumption Multifamily Unit

MBTU/Year

Gas Heat

Electric Heat



Additional Efficiency Packages

- High Efficiency Envelope Options:
 1. High efficiency walls and windows
 2. High efficiency walls
 3. High efficiency ceilings and windows
 4. High efficiency envelope – 15% improved UA
 5. High efficiency windows
 6. 2.0 ACH plus efficient ventilation fan
 7. 2.0 ACH plus efficient ventilation fan plus HRV

Additional Efficiency Packages

- High Efficiency Equipment and Renewables
 1. High efficiency furnace/boiler or air source heat pump
 2. Ductless heat pump
 3. High efficiency gas/propane water heater (UEF 0.90) or electric heat pump water heater (UEF 2.0)
 4. Super efficient gas/propane water heater (UEF 0.97) or electric heat pump water heater (UEF 2.6)
 5. Solar water heating
 6. Solar PV

% Savings From Options Based on Mbtu/yr

Measure Description	Single Family	Multifamily
HE Envelope 1: High efficacy walls and windows	2.9%	2.0%
HE Envelope 2: High efficiency walls	3.9%	2.6%
HE Envelope 3: High efficiency ceiling and windows	1.9%	1.5%
HE Envelope 4: Proposed UA is 15% lower than Code UA	7.3%	3.5%
HE Envelope 6: High performance windows (U=0.24)	1.3%	0.9%
HE Envelope 7: Air leakage control and efficient ventilation	3.2%	1.6%
HE Envelope 8: Air leakage control and efficient ventilation with HRV	5.4%	5.3%
HE Equipment 1: High Efficiency Equipment	7.6%	3.7%
HE Equipment 2: Ductless Heat Pump (electric only)	2.2%	4.2%
HE Equipment 3: High Efficiency Water Heater	2.8%	7.0%
HE Equipment 4: Super High Efficiency Water Heater	3.4%	8.3%

3 Single Family Multi-Measure Scenarios

- HE Equipment 1 and HE Envelope 2 = 10.9% beyond mandatory bundle
- HE Equipment 1 and HE Equipment 2 = 10.5% beyond mandatory bundle
- HE Equipment 1, HE Equipment 2 and HE Envelope 2 and = 13.8% beyond mandatory bundle

- Note: Weighted average of all 36 prototypes

2015 IECC Base Home ERI differences

REM/Rate 14.6.3 used for modeling in 2016 IBTS/NBI energy analysis

REM/Rate 15.4.1 was used for this round of modeling

REM/Rate version 15.4.1 incorporates the RESNET/ANSI 301 Standard in the software update from the previous version REM/Rate 14.6.3.

This software update resulted in a higher ERI in all 2015 IECC base models. ERI increased by an average of 6 points compared to the 2016 IBTS/NBI energy analysis.

Lighting Energy

- REM/Rate provides an input for percentage of high efficiency lighting (CFL or LED) when used for HERS ratings. All models were set to use 90% high efficiency lighting.
- REM/Rate provides *Audit* feature with inputs for lighting power densities but this feature is only applicable when using REM/Rate for energy modeling as a design tool, etc. The *Audit* feature does not affect HERS ratings.