

NYStretch-Energy Commercial Code Development

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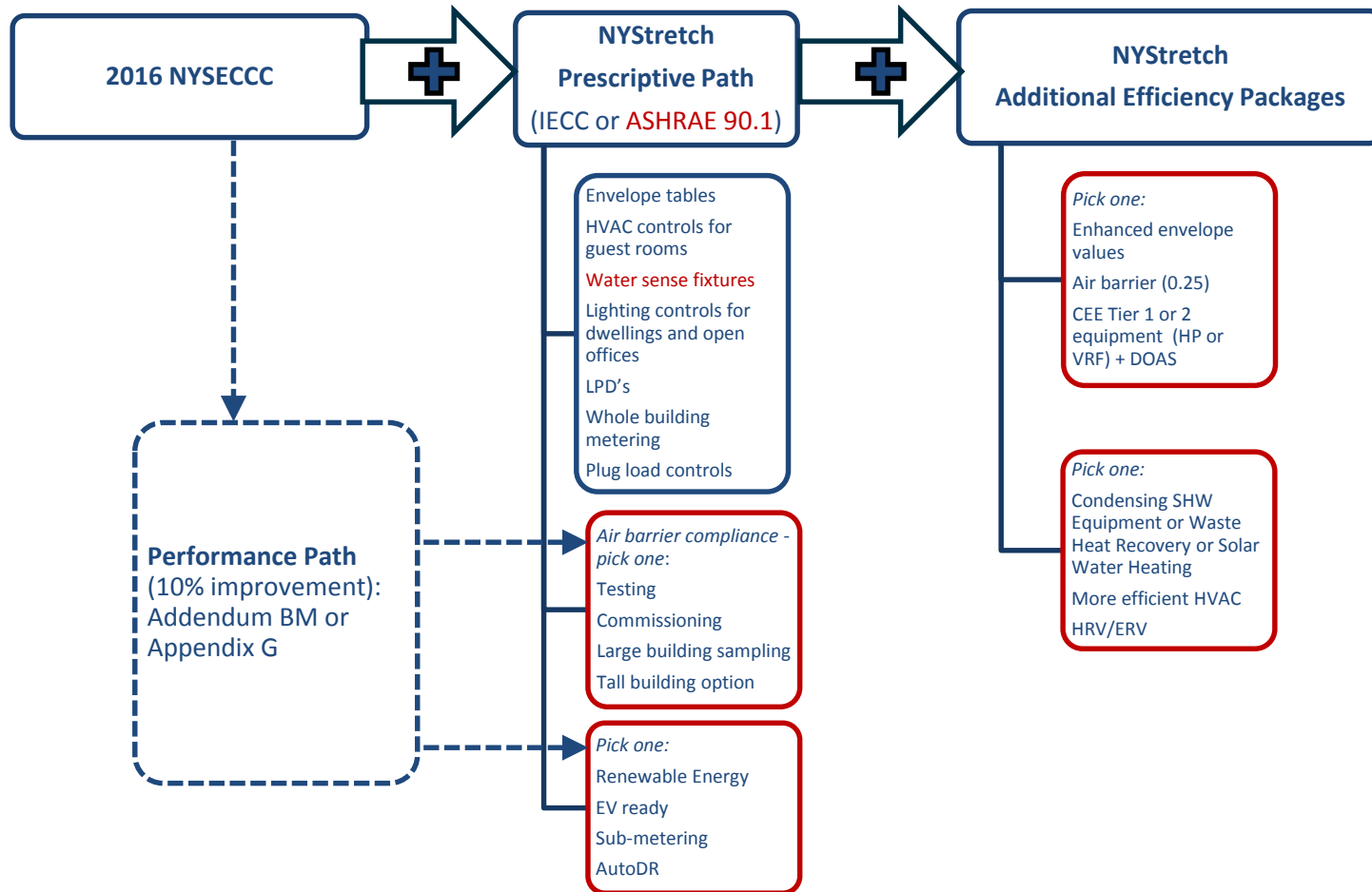
Commercial Topics

- Commercial workgroup process
- Code structure diagrams
- Overview of draft code content (clarifying questions)
- Code Measures Analyzed
- Prototypes Analyzed and Results
- Weighted Results
- Discussion of sections

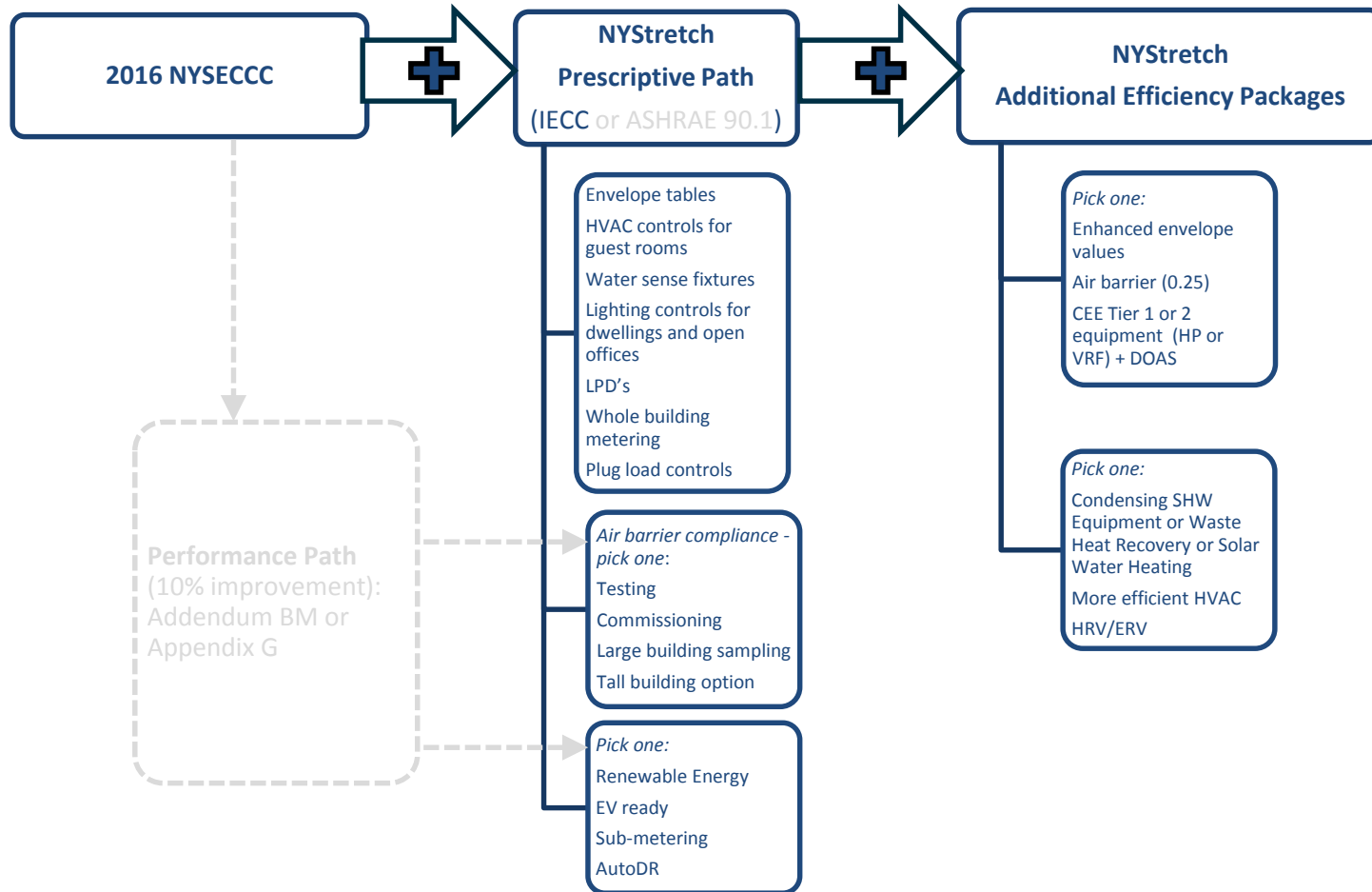
Commercial Workgroup

- Membership
- Three meetings
- Revisions to draft based on feedback
- Additional compliance options

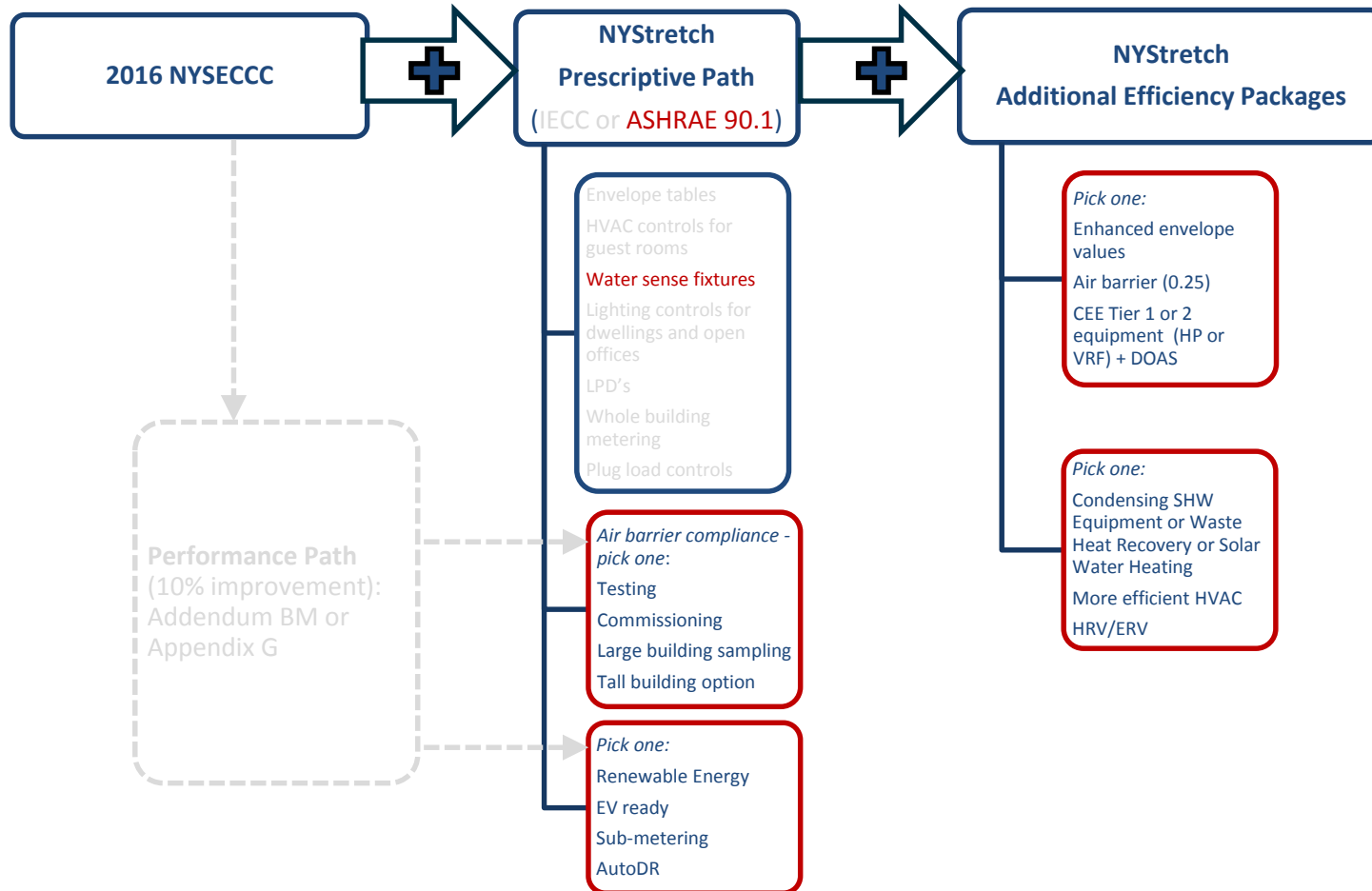
NYStretch-Energy: Commercial Buildings Code Structure



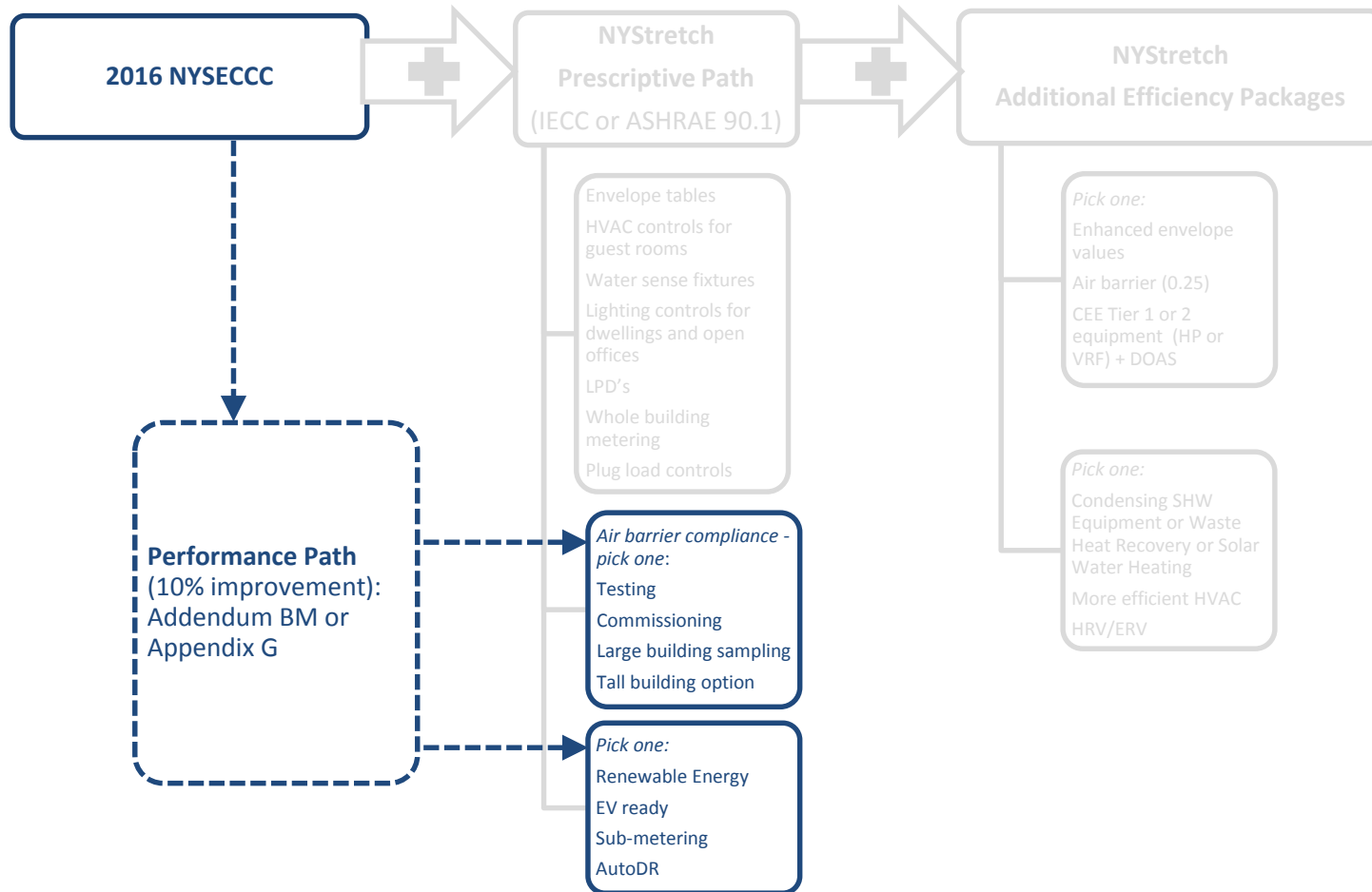
NYStretch-Energy Compliance: IECC Prescriptive Path



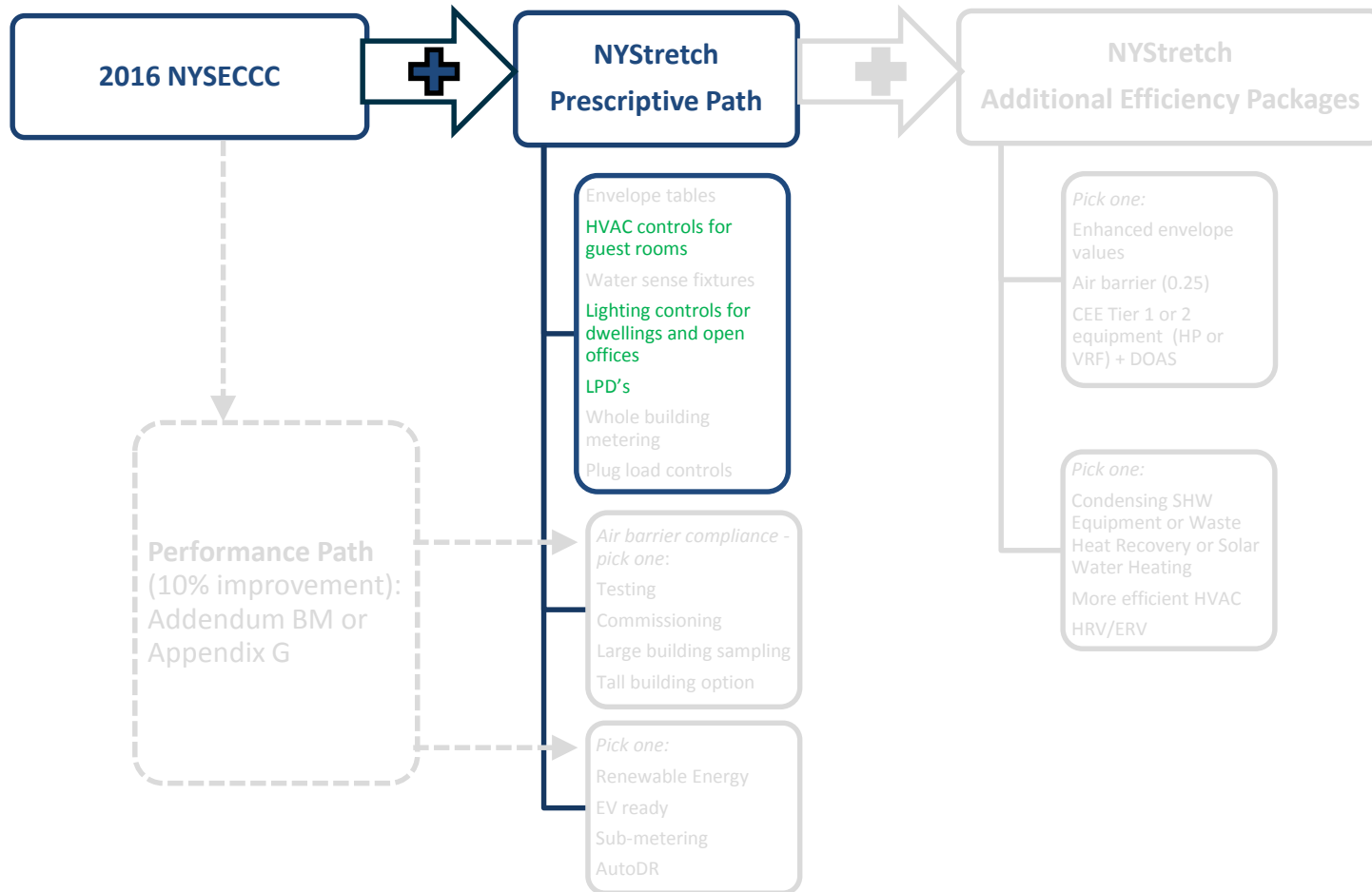
NYStretch-Energy Compliance: ASHRAE 90.1 Prescriptive Path



NYStretch-Energy Compliance: Performance Path



NYStretch-Energy: Existing Buildings Structure



Section 406 Reorganization

1. More efficient HVAC performance (C406.2)
 - **Options appear as C406.7 in NYStretch**
2. Reduced lighting power density (C406.3)
 - **Now mandatory in C405.4.1 Total connected interior lighting power in NYStretch**
3. Enhanced digital lighting controls (C406.4)
 - **Removed**
4. On-site supply of renewable energy (C406.6)
 - **Option in C409.2 Additional on-site renewable energy in NYStretch**
5. Provision of a dedicated outdoor air system (C406.6)
 - **Appears as an option in C406.2 More efficient HVAC equipment plus dedicated outdoor air system in NYStretch**
6. High-efficiency service water heating (C406.7)
 - **Option in C406.6 Reduced energy use in service water heating in NYStretch**

Savings Analysis

Stretch Code Modeled Measures

NYStretch Measures	High-rise Apartment	Large Hotel	Large Office	Secondary School	Stand-alone Retail
Enhanced envelope performance (2018 IECC) and air tightness (0.4 cfm/sf)	yes	yes	yes	yes	yes
Enhanced LPD (2018 IECC)	NA	yes	yes	yes	yes
Reduced parking lighting power (90.1-2016)	yes	yes	yes	yes	yes
Changed to low flow faucets for SWH	yes	yes	yes	yes	yes
Hotel guestroom control for HVAC (90.1-2016)	NA	yes	NA	NA	NA
Plugload control (90.1-2013)	NA	NA	yes	yes	NA
HVAC equipment efficiency CEE Tier 1	NA	NA	NA	yes	yes
HVAC equipment efficiency CEE Tier 2 and 94.5% eff boiler	yes	yes	yes	yes	yes
Enhanced lighting controls	NA	NA	yes	NA	NA
On-site renewable (2015 IECC C406.5)	yes	yes	yes	yes	yes
DOAS	TBD	TBD	yes	yes	TBD
SWH heat recovery or solar WH	yes	yes	NA	yes	NA
Enhanced envelope performance (Advanced Buildings New Construction Guide)	yes	yes	yes	yes	yes
Enhanced air tightness (0.25 cfm/sf)	yes	yes	yes	yes	yes
Enhanced envelope performance (2018 IECC) and air tightness (0.25 cfm/sf)	yes	yes	yes	yes	yes
High efficacy lamps (90%) in dwelling units	yes	NA	NA	NA	NA
All EEMs with CEE Tier 2 and 94.5% eff boiler	yes	yes	yes	yes	yes
All EEMs with on-site renewable (2015 IECC C406.5)	yes	yes	yes	yes	yes
All EEMs with enhanced envelope performance (Advanced Buildings New Construction Guide)	yes	yes	yes	yes	yes
All EEMs with enhanced air tightness (0.25 cfm/sf)	yes	yes	yes	yes	yes

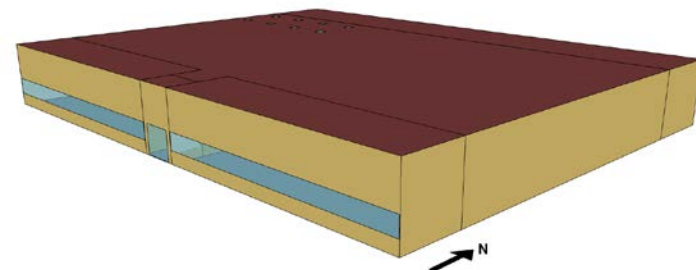
LPD Assumptions

LPD (w/sf) data for NYStretch code analysis			
	Baseline	Enhanced LPD (2018 IECC)	High efficacy lamps (90%) in dwelling units
	2015 IECC (including C406.3 Reduced lighting power density)	2018 IECC (including C406.3 Reduced lighting power density)	High efficacy lamps (90%) in dwelling units
Large Hotel	0.78	0.68	Same as baseline
High-rise Apartment (public space)	0.46	0.46	Same as baseline
High-rise Apartment (dwelling units)	0.18	same as baseline	0.13
Large Office	0.74	0.71	Same as baseline
Stand-alone Retail	1.13	0.95	Same as baseline
Secondary School	0.78	0.73	Same as baseline

	NYStretch Measures	High-rise Apartment	Large Hotel	Large Office	Secondary School	Stand-alone Retail
EEM02	Enhanced LPD (2018 IECC)	NA	yes	yes	yes	yes
C406_Stretch_09	High efficacy lamps (90%) in dwelling units	yes	NA	NA	NA	NA

Prototype: Standalone Retail

Specifications	Description
Total Floor Area (sq feet)	24,695 (178 ft x 139 ft)
Aspect Ratio	1.28
Number of Floors	1
Window Fraction (Window-to-Wall Ratio)	7.1% (Window Dimensions: 82.136 ft x 5 ft, 9.843 ft x 8.563 ft and 82.136 ft x 5 on the street facing facade)
Floor to floor height (feet)	N/A
Floor to ceiling height (feet)	20
Glazing sill height (feet)	5 ft (top of the window is 8.73 ft high with 3.74 ft high glass)
Exterior walls construction	Concrete Block Wall: 8 in. CMU+Wall Insulation+0.5 in. gypsum board
HVAC configurations	
Heating type	Gas furnace inside the packaged air conditioning unit for back_space, core_retail, point_of_sale, and front_retail. Standalone gas furnace for front_entry.
Cooling type	Packaged air conditioning unit for back_space, core_retail, point_of_sale, and front_retail; No cooling for front_entry.
Distribution and terminal units	Constant air volume air distribution 4 single-zone roof top units serving four thermal zones (backspace, core retail, point of sale, and front retail)



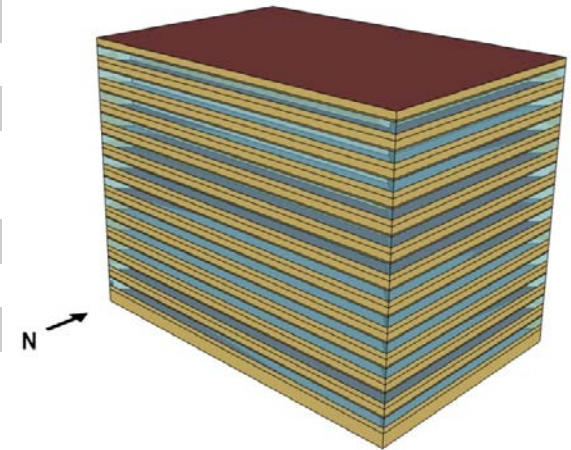
Source: PNNL, Richland, WA

Results - Retail

Stand-alone Retail		CZ 4A	CZ 5A	CZ 6A
Modeled Sq.Ft.:	24,695			
	ENERGY DESIGN MEASURE	Site EUI Saving %	Site EUI Saving %	Site EUI Saving %
Baseline IECC 2015	Baseline IECC 2015	----	----	----
EEM01	Enhanced envelope performance (2018 IECC) and air tightness (0.4 cfm/sf)	1.4%	2.0%	1.4%
EEM02	Enhanced LPD (2018 IECC)	4.7%	3.8%	3.1%
EEM03	Reduced parking lighting power (90.1-2016)	0.8%	0.8%	0.8%
EEM04	Changed to low flow faucets for SWH	0.2%	0.2%	0.2%
EEM05	Hotel guestroom control for HVAC (90.1-2016)	NA	NA	NA
EEM06	Plugload control (90.1-2013)	NA	NA	NA
C406_Stretch_01A	HVAC equipment efficiency CEE Tier 1	0.5%	0.4%	0.2%
C406_Stretch_01B	HVAC equipment efficiency CEE Tier 2 and 94.5% eff boiler	0.9%	0.6%	0.4%
C406_Stretch_03	Enhanced lighting controls	NA	NA	NA
C406_Stretch_04	On-site renewable (2015 IECC C406.5)	TBD	TBD	TBD
C406_Stretch_05	DOAS	TBD	TBD	TBD
C406_Stretch_06	SWH heat recovery or solar WH	NA	NA	NA
C406_Stretch_07	Enhanced envelope performance (Advanced Buildings New Construction Guide)	1.8%	2.6%	2.2%
C406_Stretch_08	Enhanced air tightness (0.25 cfm/sf)	1.1%	1.7%	1.8%
C406_Stretch_09	High efficacy lamps (90%) in dwelling units	NA	NA	NA
All EEMs with C406_Stretch_01B	All EEMs with CEE Tier 2 and 94.5% eff boiler	7.9%	7.5%	6.1%
All EEMs with C406_Stretch_04	All EEMs with on-site renewable (2015 IECC C406.5)	TBD	TBD	TBD
All EEMs with C406_Stretch_07	All EEMs with enhanced envelope performance (Advanced Buildings New Construction Guide)	8.1%	8.2%	8.6%
All EEMs with C406_Stretch_08	All EEMs with enhanced air tightness (0.25 cfm/sf)	7.3%	7.2%	6.1%

Prototype: Large Office

Specifications	Description
Total Floor Area (sq feet)	498,600 (240 ft x 160 ft)
Aspect Ratio	1.5
Number of Floors	12 (plus basement)
Window Fraction (Window-to-Wall Ratio)	40% of above-grade gross walls 37.5% of gross walls (including the below-grade walls)
Floor to floor height (feet)	13
Floor to ceiling height (feet)	9
Glazing sill height (feet)	3 ft
Exterior walls construction	Mass (pre-cast concrete panel): 8 in. Heavy-Weight Concrete + Wall Insulation + 0.5 in. gypsum board
HVAC configurations	
Heating type	Gas boiler
Cooling type	Water-source DX cooling coil with fluid cooler for datacenter and IT closets and Two water-cooled centrifugal chillers for the rest of the building
Distribution and terminal units	VAV terminal box with damper and hot-water reheating coil except non-datacenter portion of the basement and IT closets that are served by CAV units. Zone control type: minimum damper positions are determined using the multizone calculation method.



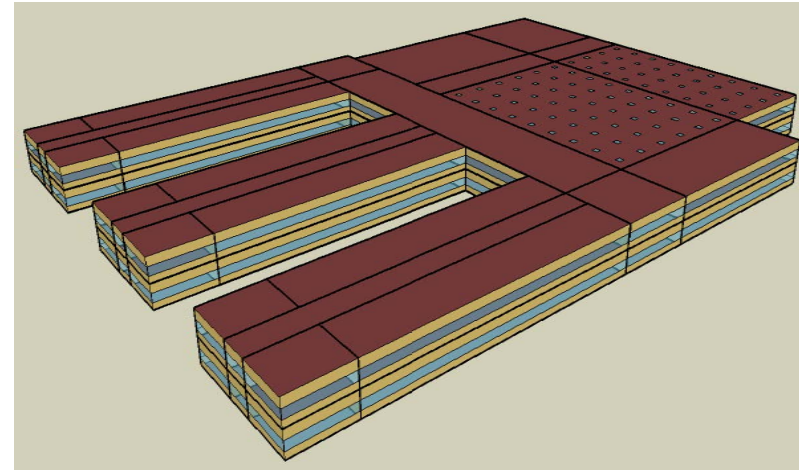
Source: PNNL, Richland, WA

Results – Large Office

Large Office		CZ 4A	CZ 5A	CZ 6A
Modeled Sq.Ft.:	498,638			
	ENERGY DESIGN MEASURE	Site EUI Saving %	Site EUI Saving %	Site EUI Saving %
Baseline IECC 2015	Baseline IECC 2015	----	----	----
EEM01	Enhanced envelope performance (2018 IECC) and air tightness (0.4 cfm/sf)	0.7%	1.1%	1.0%
EEM02	Enhanced LPD (2018 IECC)	0.3%	0.3%	0.2%
EEM03	Reduced parking lighting power (90.1-2016)	0.8%	0.8%	0.8%
EEM04	Changed to low flow faucets for SWH	0.1%	0.1%	0.1%
EEM05	Hotel guestroom control for HVAC (90.1-2016)	NA	NA	NA
EEM06	Plugload control (90.1-2013)	2.5%	2.1%	1.9%
C406_Stretch_01A	HVAC equipment efficiency CEE Tier 1	NA	NA	NA
C406_Stretch_01B	HVAC equipment efficiency CEE Tier 2 and 94.5% eff boiler	1.0%	1.8%	1.9%
C406_Stretch_03	Enhanced lighting controls	0.5%	0.5%	0.4%
C406_Stretch_04	On-site renewable (2015 IECC C406.5)	TBD	TBD	TBD
C406_Stretch_05	DOAS	TBD	TBD	TBD
C406_Stretch_06	SWH heat recovery or solar WH	NA	NA	NA
C406_Stretch_07	Enhanced envelope performance (Advanced Buildings New Construction Guide)	1.5%	2.0%	0.7%
C406_Stretch_08	Enhanced air tightness (0.25 cfm/sf)	0.8%	1.4%	1.3%
C406_Stretch_09	High efficacy lamps (90%) in dwelling units	NA	NA	NA
All EEMs with C406_Stretch_01B	All EEMs with CEE Tier 2 and 94.5% eff boiler	5.4%	6.0%	6.1%
All EEMs with C406_Stretch_04	All EEMs with on-site renewable (2015 IECC C406.5)	TBD	TBD	TBD
All EEMs with C406_Stretch_07	All EEMs with enhanced envelope performance (Advanced Buildings New Construction Guide)	5.9%	6.3%	4.9%
All EEMs with C406_Stretch_08	All EEMs with enhanced air tightness (0.25 cfm/sf)	4.5%	4.6%	4.4%

Prototype: Secondary School

Specifications	Description
Total Floor Area (sq feet)	210,900 (340 ft x 460 ft)
Aspect Ratio	1.4
Number of Floors	2
Window Fraction (Window-to-Wall Ratio)	33% Ribbon window across all facades on both floors
Floor to floor height (feet)	13
Floor to ceiling height (feet)	13
Glazing sill height (feet)	3.6 (top of the window is 8.1 ft high with 4.5 ft high glass)
Exterior walls construction	Steel-Framed Walls (2X4 16IN OC) 0.4 in. Stucco+5/8 in. gypsum board + wall Insulation+5/8 in
HVAC configurations	
Heating type	1. Gas furnaces inside packaged air conditioning units 2. Gas-fired boiler
Cooling type	1. Packaged air conditioner 2. Air-cooled Chiller
Distribution and terminal units	1. CAV system: direct air from the packaged unit 2. VAV System: VAV terminal box with damper and hot water reheating coil Zone Control Type: minimum supply air at 30% of the zone design peak supply air



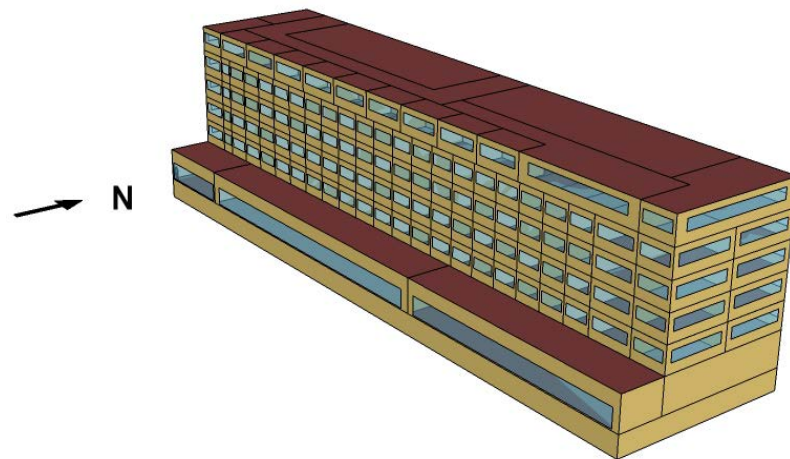
Source: PNNL, Richland, WA

Results – Secondary School

Secondary School		CZ 4A	CZ 5A	CZ 6A
Modeled Sq.Ft.:	210,907			
	ENERGY DESIGN MEASURE	Site EUI Saving %	Site EUI Saving %	Site EUI Saving %
Baseline IECC 2015	Baseline IECC 2015	----	----	----
EEM01	Enhanced envelope performance (2018 IECC) and air tightness (0.4 cfm/sf)	1.5%	2.9%	3.5%
EEM02	Enhanced LPD (2018 IECC)	1.5%	1.4%	1.4%
EEM03	Reduced parking lighting power (90.1-2016)	0.2%	0.2%	0.2%
EEM04	Changed to low flow faucets for SWH	0.1%	0.1%	0.1%
EEM05	Hotel guestroom control for HVAC (90.1-2016)	NA	NA	NA
EEM06	Plugload control (90.1-2013)	2.3%	2.0%	1.9%
C406_Stretch_01A	HVAC equipment efficiency CEE Tier 1	0.2%	0.2%	0.1%
C406_Stretch_01B	HVAC equipment efficiency CEE Tier 2 and 94.5% eff boiler	0.8%	1.1%	1.3%
C406_Stretch_03	Enhanced lighting controls	NA	NA	NA
C406_Stretch_04	On-site renewable (2015 IECC C406.5)	TBD	TBD	TBD
C406_Stretch_05	DOAS	TBD	TBD	TBD
C406_Stretch_06	SWH heat recovery or solar WH	TBD	TBD	TBD
C406_Stretch_07	Enhanced envelope performance (Advanced Buildings New Construction Guide)	4.1%	5.6%	6.6%
C406_Stretch_08	Enhanced air tightness (0.25 cfm/sf)	0.5%	1.1%	1.4%
C406_Stretch_09	High efficacy lamps (90%) in dwelling units	NA	NA	NA
All EEMs with C406_Stretch_01B	All EEMs with CEE Tier 2 and 94.5% eff boiler	6.4%	7.6%	8.2%
All EEMs with C406_Stretch_04	All EEMs with on-site renewable (2015 IECC C406.5)	TBD	TBD	TBD
All EEMs with C406_Stretch_07	All EEMs with enhanced envelope performance (Advanced Buildings New Construction Guide)	8.7%	10.3%	11.1%
All EEMs with C406_Stretch_08	All EEMs with enhanced air tightness (0.25 cfm/sf)	5.8%	6.9%	7.4%

Prototype: Large Hotel

Specifications	Description
Total Floor Area (sq feet)	122,132
Aspect Ratio	Ground floor: 3.79 (284 ft x 75 ft) All other floors: 5.07 (284 ft x 56 ft)
Number of Floors	6 above-ground floors plus one basement (284 ft x 75 ft)
Window Fraction (Window-to-Wall Ratio)	South: 36.7%, East: 24.5%, North: 26.0%, West: 24.5% Total: 30.2%
Floor to floor height (feet)	Basement: 8 ft Ground floor: 13 ft 2nd - 6th floors: 10 ft
Floor to ceiling height (feet)	same as above
Glazing sill height (feet)	6 in. in ground floor, 3.6 ft. in upper floors
Exterior walls construction	Mass Wall: 8 in. CMU, wall insulation and 0.5 in. gypsum board
HVAC configurations	
Heating type	One gas-fired boiler
Cooling type	One air-cooled chiller
Distribution and terminal units	Public spaces on ground floor and top floor: VAV with hot water reheating coils; Guest Rooms: dedicated outside air system + four-pipe fan-coil units.



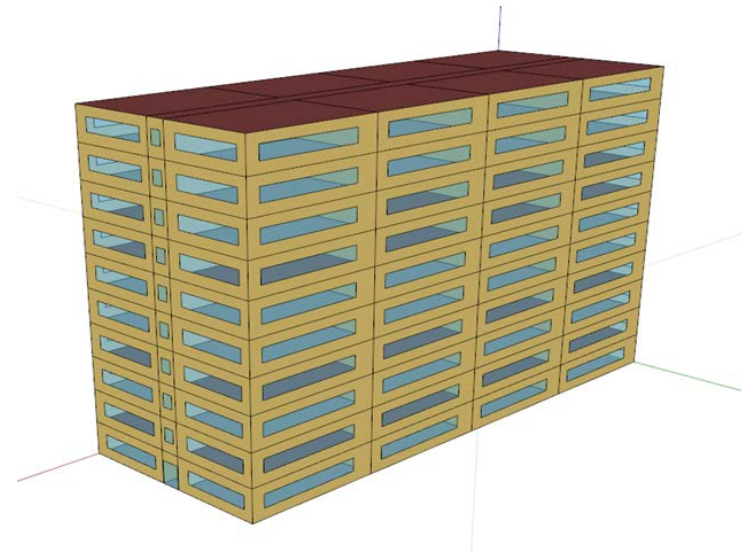
Source: PNNL, Richland, WA

Results – Large Hotel

Large Hotel		CZ 4A	CZ 5A	CZ 6A
Modeled Sq.Ft.:	122,132			
	ENERGY DESIGN MEASURE	Site EUI Saving %	Site EUI Saving %	Site EUI Saving %
Baseline IECC 2015	Baseline IECC 2015	----	----	----
EEM01	Enhanced envelope performance (2018 IECC) and air tightness (0.4 cfm/sf)	1.0%	1.4%	1.5%
EEM02	Enhanced LPD (2018 IECC)	1.3%	1.1%	1.1%
EEM03	Reduced parking lighting power (90.1-2016)	0.7%	0.7%	0.7%
EEM04	Changed to low flow faucets for SWH	0.7%	0.8%	0.8%
EEM05	Hotel guestroom control for HVAC (90.1-2016)	2.1%	3.5%	3.7%
EEM06	Plugload control (90.1-2013)	NA	NA	NA
C406_Stretch_01A	HVAC equipment efficiency CEE Tier 1	NA	NA	NA
C406_Stretch_01B	HVAC equipment efficiency CEE Tier 2 and 94.5% eff boiler	1.2%	1.9%	2.0%
C406_Stretch_03	Enhanced lighting controls	NA	NA	NA
C406_Stretch_04	On-site renewable (2015 IECC C406.5)	TBD	TBD	TBD
C406_Stretch_05	DOAS	TBD	TBD	TBD
C406_Stretch_06	SWH heat recovery or solar WH	TBD	TBD	TBD
C406_Stretch_07	Enhanced envelope performance (Advanced Buildings New Construction Guide)	2.0%	2.2%	2.0%
C406_Stretch_08	Enhanced air tightness (0.25 cfm/sf)	1.3%	1.7%	1.8%
C406_Stretch_09	High efficacy lamps (90%) in dwelling units	NA	NA	NA
All EEMs with C406_Stretch_01B	All EEMs with CEE Tier 2 and 94.5% eff boiler	6.6%	8.5%	8.9%
All EEMs with C406_Stretch_04	All EEMs with on-site renewable (2015 IECC C406.5)	TBD	TBD	TBD
All EEMs with C406_Stretch_07	All EEMs with enhanced envelope performance (Advanced Buildings New Construction Guide)	7.6%	9.3%	9.2%
All EEMs with C406_Stretch_08	All EEMs with enhanced air tightness (0.25 cfm/sf)	6.0%	7.5%	7.8%

Prototype: High Rise Apartment

Specifications	Description
Total Floor Area (sq feet)	84,360 (152 ft x 55.5 ft)
Aspect Ratio	2.75
Number of Floors	10
Window Fraction (Window-to-Wall Ratio)	South: 30%, East: 30%, North: 30%, West: 30% Average Total: 30%
Floor to floor height (feet)	10
Floor to ceiling height (feet)	10 (No drop-in ceiling plenum is modeled)
Glazing sill height (feet)	3 ft (14 ft wide x 4 ft high)
Exterior walls construction	Steel-Frame Walls (2X4 16IN OC) 0.4 in. Stucco+5/8 in. gypsum board + wall Insulation+5/8 in. gypsum board
HVAC configurations	
Heating type	Water Source Heat Pumps
Cooling type	Water Source Heat Pumps
Distribution and terminal units	Constant volume



Source: PNNL, Richland, WA

Results - Apartment

High-Rise Apartment		CZ 4A	CZ 5A	CZ 6A
Modeled Sq.Ft.:	84,359			
	ENERGY DESIGN MEASURE	Site EUI Saving %	Site EUI Saving %	Site EUI Saving %
Baseline IECC 2015	Baseline IECC 2015	----	----	----
EEM01	Enhanced envelope performance (2018 IECC) and air tightness (0.4 cf/m ²)	4.7%	7.6%	7.5%
EEM02	Enhanced LPD (2018 IECC)	NA	NA	NA
EEM03	Reduced parking lighting power (90.1-2016)	1.4%	1.3%	1.3%
EEM04	Changed to low flow faucets for SWH	3.7%	3.4%	3.5%
EEM05	Hotel guestroom control for HVAC (90.1-2016)	NA	NA	NA
EEM06	Plugload control (90.1-2013)	NA	NA	NA
C406_Stretch_01A	HVAC equipment efficiency CEE Tier 1	NA	NA	NA
C406_Stretch_01B	HVAC equipment efficiency CEE Tier 2 and 94.5% eff boiler	1.6%	2.9%	3.2%
C406_Stretch_03	Enhanced lighting controls	NA	NA	NA
C406_Stretch_04	On-site renewable (2015 IECC C406.5)	TBD	TBD	TBD
C406_Stretch_05	DOAS	NA	NA	NA
C406_Stretch_06	SWH heat recovery or solar WH	TBD	TBD	TBD
C406_Stretch_07	Enhanced envelope performance (Advanced Buildings New Construction Guide)	6.7%	7.2%	11.0%
C406_Stretch_08	Enhanced air tightness (0.25 cf/m ²)	5.8%	8.3%	8.3%
C406_Stretch_09	High efficacy lamps (90%) in dwelling units	0.2%	0.2%	0.2%
All EEMs with C406_Stretch_01B	All EEMs with CEE Tier 2 and 94.5% eff boiler	11.0%	14.3%	14.7%
All EEMs with C406_Stretch_04	All EEMs with on-site renewable (2015 IECC C406.5)	TBD	12.3%	12.3%
All EEMs with C406_Stretch_07	All EEMs with enhanced envelope performance (Advanced Buildings New Construction Guide)	16.8%	18.9%	22.2%
All EEMs with C406_Stretch_08	All EEMs with enhanced air tightness (0.25 cf/m ²)	11.0%	13.9%	13.9%

Prototypes

	4A	5A	6A	Weights by Building Type
Small Office	1.1%	1.4%	0.2%	2.7%
Medium Office	1.6%	1.7%	0.4%	3.7%
Large Office	5.5%	0.7%	0.2%	6.4%
Standalone Retail	3.6%	5.2%	1.9%	10.6%
Strip Mall	2.0%	1.2%	0.2%	3.3%
Primary School	0.7%	0.6%	0.1%	1.4%
Secondary School	3.7%	2.7%	0.8%	7.2%
Outpatient Healthcare	1.5%	1.8%	0.7%	4.1%
Hospital	1.3%	0.7%	0.2%	2.2%
Small Hotel	0.6%	0.7%	0.6%	1.9%
Large Hotel	2.6%	1.8%	1.3%	5.7%
Warehouse	1.8%	2.8%	0.9%	5.5%
Quick-Service Restaurant	0.1%	0.3%	0.0%	0.4%
Full-Service Restaurant	0.1%	0.2%	0.1%	0.4%
Mid-Rise Apartment	9.8%	1.2%	0.1%	11.1%
High-Rise Apartment	33.3%	0.1%	0.1%	33.5%
Sum of the Weights for Selected 5	48.7%	10.5%	4.1%	63.3%
Sum of the Weights for All 16	69.4%	22.9%	7.7%	100.0%
The selected five building types are highlighted in bold				

Source: PNNL, Richland, WA

Weighted results

Measures	Weighted Average Savings
Base Stretch plus C406.2 More efficient HVAC Equipment*	9.1%
Base Stretch plus C406.3 Reduced air infiltration	8.4 %
Base Stretch plus C406.4 Enhanced envelope performance	12.8 %

*this measure also requires a DOAS system which we were unable to model due to the varying baselines and possible configurations. Analysis conducted by PNNL indicates that efficient equipment plus DOAS can provide 6% - 8% total savings beyond a building with a code level VAV system.

Note: This analysis does not include energy generated by on-site renewable energy sources (a minimum of 3% of regulated loads).

Discussion of Draft