



Energy Building Codes: *Next Steps for High Performing Glass and Facades*



Tom Culp Owner and Consultant Birch Point Consulting

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Outline

- Today's Energy Codes
- Future Energy Codes 2021 IECC and ASHRAE 90.1-2019
- What's going on in New York City, Washington State, ...?



COMMERCIAL ENERGY CODE ADOPTION



LOCAL CODES MAY VARY!!!

Meets or exceeds ASHRAE 90.1-2016 or equivalent (2)
 Meets or exceeds ASHRAE 90.1-2013 or equivalent (19)
 Meets or exceeds ASHRAE 90.1-2010 or equivalent (10)
 Meets or exceeds ASHRAE 90.1-2007 or equivalent (13)
 Meets or exceeds ASHRAE 90.1-2004 or equivalent (1)
 No statewide code or predates ASHRAE 90.1-2004 (11)
 Home-rule states with significant local adoptions

Courtesy of BCAP Building Codes Assistance Program bcapcodes.org



RESIDENTIAL ENERGY CODE ADOPTION



LOCAL CODES MAY VARY!!!

	Meets or exceeds the 2018 IECC or equivalent (2)
	Meets or exceeds the 2015 IECC or equivalent (17)
	Meets or exceeds the 2012 IECC or equivalent (8)
	Meets or exceeds the 2009 IECC or equivalent (16)
	No statewide code or precedes the 2006 IECC (12)
С	Home-rule states with significant local adoptions

Courtesy of BCAP Building Codes Assistance Program bcapcodes.org



Commercial Vertical Fenestration U-factors, 2009-2018

Climate Zone	0	1	2	3	4	5	6	7	8	
		1.20	0.75	0.65	0.40	0.35	0.35	0.35	0.35	90.1-2010, 2009 IECC
Nonmetal	0.32	0.50	0.40	0.35	0.35	0.32	0.32	0.32	0.32	90.1-2013
framing	0.32	0.50	0.37	0.33/0.35	0.31	0.31	0.30	0.28	0.25	90.1-2016
		-	2012, '15, '18 IECC							
		1.20	0.70	0.60	0.50	0.45	0.45	0.40	0.40	90.1-2010, 2009 IECC
Metal framing,	0.50	0.57	0.57	0.50	0.42	0.42	0.42	0.38	0.38	90.1-2013
fixed	0.50	0.57	0.54	0.45/0.49	0.38	0.38	0.36	0.33	0.29	90.1-2016
		0.50	0.50	0.46	0.38	0.38	0.36	0.29	0.29	2012, '15, '18 IECC
		1.20	0.75	0.65	0.55	0.55	0.55	0.45	0.45	90.1-2010, 2009 IECC
Metal framing,	0.65	0.65	0.65	0.60	0.50	0.50	0.50	0.40	0.40	90.1-2013
operable	0.65	0.65	0.65	0.60	0.46	0.46	0.45	0.40	0.35	90.1-2016
		0.65	0.65	0.60	0.45	0.45	0.43	0.37	0.37	2012, '15, '18 IECC
		1.20	1.10	0.90	0.85	0.80	0.80	0.80	0.80	90.1-2010, 2009 IECC
Metal framing,	0.83	1.10	0.83	0.77	0.77	0.77	0.77	0.77	0.77	90.1-2013
entrance door	0.83	1.10	0.83	0.77	0.68	0.68	0.68	0.68	0.68	90.1-2016
		1.10	0.83	0.77	0.77	0.77	0.77	0.77	0.77	2012, '15, '18 IECC



As the code advances and is adopted, the market has adjusted too ...



Increased use of low-e glass, thermally broken frames



Historical Ducker data courtesy of AAMA

Commercial Vertical Fenestration SHGC, 2009 - 2018

Climate Zone	0	1	2	3	4	5	6	7	8		
										90.1-2007	2009 IECC
		0.25	0.25	0.25	0.40	0.40	0.40	0.45	0.45	90.1-2010	2012 IECC
SHGC										90.1-2013	2015 IECC
	0.22	0.25	0.25	0.25	0.36	0.38	0.40	0.45	0.45	90.1-2016	2018 IECC

- These are the main SHGC requirements for the overall building, but there are variations based on *external shading* and *orientation*.
- Both 90.1 and IECC give credit towards SHGC for exterior shading from overhangs, sun shades based on *projection factor* (PF).
- Both ASHRAE and IECC have allowances for *north-facing glazing*.
- ASHRAE has extra provisions to encourage lower SHGC or shading on *east / west sides*.



Residential Vertical Fenestration, 2009-2018

Climate Zone	1	2	3	4	5	6	7	8	
	1.20	0.65*	0.50*	0.35	0.35	0.35	0.35	0.35	2009 IECC
	NR	0.40	0.35	0.35	0.32	0.32	0.32	0.32	2012 IECC
U-factor	NR	0.40	0.35	0.35	0.32	0.32	0.32	0.32	2015 IECC
	NR	0.40	0.32	0.32	0.30	0.30	0.30	0.30	2018 IECC
	0.40	0.40	0.30	0.30	0.27 ^x	0.27 ^x	0.27 ^x	0.27 ^x	Energy Star v6

* 2009 IECC: For impact rated fenestration, allow U-0.75 in zone 2 and U-0.65 in zone 3.
 ^x Energy Star: For northern zone, U up to 0.30 allowed with SHGC >= 0.42.

Climate Zone	1	2	3	4	5	6	7	8	
	0.30	0.30	0.30	NR	NR	NR	NR	NR	2009 IECC
	0.25	0.25	0.25	NR	NR	NR	NR	NR	2012 IECC
SHGC	0.25	0.25	0.25	0.40	NR	NR	NR	NR	2015 IECC
	0.25	0.25	0.25	0.40	NR	NR	NR	NR	2018 IECC
	0.25	0.25	0.25	0.40	NR ^x	NR ^X	NR ^x	NR ^x	Energy Star v6



Next steps ... 2021 IECC and ASHRAE 90.1-2019

- ASHRAE 90.1-2019 is complete, and will be published early Oct.
- 2021 IECC proposals went through first public hearing this spring; next hearing in Oct, then final online vote in Nov-Dec.
- General IECC preliminary hearing results:
 - Unanimous approval to align commercial fenestration requirements with ASHRAE 90.1.
 Other bad proposals disapproved (like unrealistically applying residential window U-factors to all commercial unit windows in all building types).
 - Small changes to residential fenestration requirements.
 - Continued expansion of daylighting better controls, more spaces.
 - Increased whole building air leakage testing, envelope commissioning.
 - Strongly increased focus on renewable energy, PV.
 - Climate zone map aligned with ASHRAE 90.1.



Updated Commercial Fenestration Requirements

- 90.1-2019 and 2021 IECC will continue to push improved framing, warm edge spacers, argon gas fill, and 4th surface low-e coatings while still being cost effective and practical
 - ... and with no reductions in window area.
 - 5-17% reduction in U-factor; only modest reductions in SHGC – but new criteria for fixed vs. operable SHGC.
 - In many cases, very roughly a "zone shift" between 90.1-2016 and 90.1-2019: what was required in Zone 7 will move to Zone 6, Zone 6 to Zone 5, etc.
 - 90.1 and IECC will use same product categories, without regard to material type.



2021 IECC and ASHRAE 90.1-2019 criteria – vertical fenestration





This assumes the values for 2021 IECC do not change in the fall hearing.



Commercial Vertical Fenestration U-factors, 2009-2021

Climate Zone	0	1	2	3	4	5	6	7	8	
Nonmetal	0.32	0.50	0.37	0.33/0.35	0.31	0.31	0.30	0.28	0.25	90.1-2016
framing			Sc	nme as metal j	framing fi	ixed or ope	erable			2018 IECC
			Sc	ime as metal j	framing fi	ixed or ope	erable			90.1-2019, 2021 IECC
Fixed	0.50	0.57	0.54	0.45/0.49	0.38	0.38	0.36	0.33	0.29	90.1-2016
		0.50	0.50	0.46	0.38	0.38	0.36	0.29	0.29	2018 IECC
	0.50	0.50	0.45	0.42	0.36	0.36	0.34	0.29	0.26	90.1-2019, 2021 IECC
Operable	0.65	0.65	0.65	0.60	0.46	0.46	0.45	0.40	0.35	90.1-2016
		0.65	0.65	0.60	0.45	0.45	0.43	0.37	0.37	2018 IECC
	0.62	0.62	0.60	0.54	0.45	0.45	0.42	0.36	0.32	90.1-2019, 2021 IECC
Entrance	0.83	1.10	0.83	0.77	0.68	0.68	0.68	0.68	0.68	90.1-2016
door		1.10	0.83	0.77	0.77	0.77	0.77	0.77	0.77	2018 IECC
	0.83	0.83	0.77	0.68	0.63	0.63	0.63	0.63	0.63	90.1-2019, 2021 IECC



only have fixed, operable, and entrance door categories Note: Starting with 90.1-2019, both 90.1 and IECC will that apply to both metal and nonmetal

ROUGHLY what is needed to meet U-factor for 90.1-2016?

- Zone 1: Low-e, double glazing
- **Zones 2-3:** Low-e double glazing, thermally broken frame
- **Zones 4-5:** Low-e, thermally broken frame and *pick 1*:
 - argon
 - high performance thermal break
 - two low-e coatings (#2 / #4)
- **Zone 6:** Low-e, thermally broken frame and *pick 2*:
 - argon
 - warm edge spacer
 - high performance thermal break
 - two low-e coatings (#2 / #4)
- **Zone 7:** Low-e, thermally broken frame and *pick 3*:
 - argon
 - warm edge spacer
 - high performance thermal break
 - two low-e coatings (#2 / #4)
- Zone 8: all of the above in double glazing, or more likely, go to triple



ROUGHLY what is needed to meet U-factor for 90.

- Zone 1: Low-e, double glazing + lower 0.23 SHGC
- *Thrm. improved + argon or WE (Z2)* • Zones 2-3: Low-e double glazing, thermally broken frame *Standard TB + air (Z2, Z3)*
- Zones 4-5: Low-e, thermally broken frame and pick-1:+ pick 2
 - argon
 - high performance thermal break
- two low-e coatings (#2 / #4)
 warm edge spacer
 Zone 6: Low-e, thermally broken frame and pick 2. + pick 3

 - argon
 - warm edge spacer
 - high performance thermal break
 - two low-e coatings (#2 / #4)
- Zone 7: Low-e, thermally broken frame and pick 3:
 - argon
 - warm edge spacer
 - high performance thermal break
 - two low-e coatings (#2 / #4)
- Zone 8: all of the above in double glazing, or more likely, go to triple

all of these in double glazing, or go to triple



Commercial Vertical Fenestration SHGC, 2009 - 2018

Climate Zone	0	1	2	3	4	5	6	7	8		
SHGC		0.25	0.25	0.25	0.40	0.40	0.40	0.45	0.45	90.1-2007 90.1-2010 90.1-2013	2009 IECC 2012 IECC 2015 IECC
	0.22	0.25	0.25	0.25	0.36	0.38	0.40	0.45	0.45	90.1-2016	2018 IECC
Fixed:	0.22	0.23	0.25	0.25	0.36	0.38	0.38	0.40	0.40	90 1-2019	2021 IECC
Operable:	0.20	0.21	0.23	0.23	0.33	0.33	0.34	0.36	0.36	50.1-2015	

- New SHGC requirements in 90.1-2019 and 2021 IECC have separate SHGC for fixed vs. operable products, similar to U-factor.
- In reality, changes are small, as both require the <u>same</u> glazing type it is just accounting for the higher frame-to-glass ratio in operable products.
- Only real change is zone 1, where 0.23/0.21 SHGC will require new lower SHGC triple silver products and/or tint with low-e.



2021 IECC Residential Fenestration Requirements

• Lots of debate about different performance-based compliance paths and envelope backstops, but only small changes to residential prescriptive requirements are shown in blue:

Climate Zone	1	2	3	4	5	6	7	8	
	NR	0.40	0.32	0.32	0.30	0.30	0.30	0.30	2018 IECC
U-factor	NR	0.35	0.30*	0.30*	0.30*	0.30*	0.30*	0.30*	2021 IECC prelim
	0.40	0.40	0.30	0.30	0.27 ^x	0.27 ^x	0.27 ^x	0.27 ^x	Energy Star v6

* New footnote allows up to U-0.32 in windborne debris regions or > 4000 ft elevation.

- All proposals to change SHGC were disapproved.
- One item of concern zone 2 U-factor goes beyond Energy Star.
 Compliant windows are available, but conflict with philosophy that Energy Star should be notch above code, so GICC, AAMA, WDMA filing comments.



Other hot topics

- Air leakage and envelope commissioning
 - 90.1 has air leakage testing <u>or</u> air barrier inspection.
 - IECC preliminary hearings passed air leakage testing <u>and</u> envelope commissioning (this will be controversial, and uncertain whether it will survive rest of process).
 - Either way, increased focus on air barrier continuity and wall / window intersection.
- Daylighting
 - 90.1 and IECC requiring better controls, more controls in more spaces (and IECC went further).
 - Better / more controls = more daylighting savings = more value from windows.
- Renewable Energy (including PV, BIPV)
 - 90.1 has addendum to prescriptively require miniumum amount of on-site renewable energy, but will not make it into 2019.
 - Similar proposal made to IECC, but unlikely to make it into 2021 IECC.
 - IECC did approve increased incentives for renewable energy, and voluntary appendices for solar PV and net-zero buildings.

Thermal Bridging

• 90.1 still working on big proposal limiting thermal bridges in opaque areas and at wall/window interface. Will not be in 2019.

What's Going on in New York City??? (and Washington State, and ...)

De Blasio's Green New Deal will ban 'classic glass and steel skyscrapers'

By Ruth Brown

April 22, 2019 | 1:29pm | Upd







What's Going on in New York City??? (and Washington State, and ...)



When US administration announced intention to leave Paris Climate Agreement, it opened the door for cities and states to act locally on their own. - Somewhat chaotic, regional vs. national, but also opportunity

New York City

- Poor rhetoric is not helpful and potential threat to highly glazed buildings.
 - Ignores contribution of high performance glazing to energy efficiency, daylighting, occupant health and well-being.
 - Focus should be on poor performing facades and value engineering, not window area.
- Opportunity #1 new buildings: promote high performance facades with advanced framing, glazing, shading systems.
 - New Stretch Code requirements do not actually "ban glass".
 - U-0.36, SHGC-0.36 is not that difficult.
 (e.g. thermally broken frame, low-e, argon, warm edge spacer)
 - New envelope "backstop" still allows up to ~ 70% WWR / 30% spandrel with U-0.36, SHGC-0.36 in the performance path, and up to maybe 90% WWR with good orientation and higher performance windows.
 - New buildings instantly become existing buildings, so existing building limits will *help reduce short-term value-engineering* out of high performance facades ...

New York City

Opportunity #2 – existing buildings: retrofit, replace, and add glazing

- Overall target: reduce city's carbon emissions by 40% by 2030 (compared to 2005)
- Carbon emissions limits will be established by 2023 for existing buildings over 25,000 ft² (excluding low rise residential).
- Starting 2024, building owners must report energy usage annually, and pay substantial fines (carbon tax) for exceeding limits or not reporting.
- Limits will affect 20% most carbon-intensive buildings in 2024, 75% in 2030.
- Large incentive to upgrade existing buildings; Fines will improve economics of envelope retrofits.
 - Glazing and window replacement
 - Secondary glazing systems
- Option to purchase renewable energy credits (including PV, BIPV)



Emissions Distribution of Covered Properties

Washington State

- Based on similar climate change goals, new law passed setting aggressive targets for reducing building energy use (HB 1257).
- New buildings requires 70% reduction in energy use by 2031 (compared to 2006)
 - U-0.38, SHGC-0.38 is not difficult.
 - Envelope backstop a little more stringent than NYC. With daylighting, allows up to ~ 51% WWR in performance path with U-0.38, up to 71% WWR with U-0.29.
- *Existing buildings* similar to NYC except energy use limits instead of carbon.
 - Fines for exceeding energy use limits; incentive credits for performance beyond target.
 - Applies to buildings >220,000 ft² in June 2026, >90,000 ft² in June 2027, >50,000 ft² in June 2028.
- Similar to NYC, threats to window area, but also opportunities for high performance systems and retrofits.



There is a curse which says "May he live in interesting times." Like it or not, we live in interesting times.

They are times of danger and uncertainty; but they are also the most creative of any time in the history of mankind.

– Robert F. Kennedy, 1966



The Conversation Happens HERE

Atlanta, GA September 17-19,2019

Register now at GlassBuild.com



Registration

Open!

FALL CONFERENCE CONFERENCE AUGUST 13-15, 2019 RENAISSANCE TOLEDO DOWNTOWN HOTEL Join us in Glass City

Solve fabricating challenges Explore trends and innovations Learn from the "Old Guard" of glass fabrication

Register now at glass.org



Thirsty ThursdayJuly 18, 2019

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