2021 IECC Review

State Building Code Council

2023-07-18

Background

- Permitted Interaction Group
  - Five online meetings in March - May 2023
  - Reviewed potential amendments and BIA proposals
  - Participants included County of Hawaii, BIA members, LURF, Hawaii LECET, ASHRAE, HPM, Hawaii Energy
- Working group
  - Four meetings in June 2023
  - Reviewed significant changes between 2018 and 2021 IECC

Agenda

- Permitted Interaction Group findings
  - Potential amendments
- Summary of Working Group review of significant changes & potential amendments
  - Commercial and high-rise residential envelope
  - Commercial and high-rise residential mechanical
  - Commercial and high-rise residential electrical
  - Low-rise residential

Permitted Interaction Group Findings

Commercial and high-rise residential

Section	Description	Discussion
C402.1.3	Continuous insulation exception for wood-framed walls and mass walls	Some would like an additional exception for mass walls ≥6 inches thick, which is included in the current County codes
C402.3	Minimum low-slope roof solar reflectance increased	OK
C402.4	Jalousies exempt from SHGC requirement	OK
C402.4.3.4	Area-weighted average SHGC allowed	OK
C403.7.6.1	Lanai door AC interlock for hotel, motel, timeshare	OK
C405.2.1	Lighting occupancy sensor controls, add exception for residential common areas	OK
C405.2.4	Automatic interior lighting daylight control exception for low power (LPD<80%)	OK
C405.12	End use energy monitoring exemption for high-rise residential	OK
C405.13	Tenant submetering	OK
C503.2.1	Roof replacement exceptions	OK

Permitted Interaction Group Findings

Low-rise residential

Section	Description	Discussion
R401.4	Sampling allowed for airflow testing, for duct and blower door testing	OK
R402.1.3	Mass wall insulation exceptions: solar reflectance ≥0.39, light reflectance value ≥ 0.64 or overhang PF ≥0.30	Some would like an additional exception for mass walls ≥6 inches thick, which is included in the current County codes
R402.1.3	Jalousies exempt from SHGC requirement	OK
R402.1.3	No insulation required for raised floor	OK
R402.1.3	Point system alternative allowed for walls and roof	OK
R403.5.4	Solar water heating per State requirements	OK
R403.13	Ceiling fan or whole-house fan; rough-in only allowed	OK
R407	Tropical climate – elevation, window, roof, opening area	OK
R409	Point system	OK
R503	Roof replacement exceptions	OK

Working group review summary

Commercial and high-rise residential

Section	Description	Discussion
C401.3	Thermal envelope certificate required	No comments
C402.1.1.1	Envelope requirements for greenhouses added	No comments
C402.1, C402.2	R-13 for raised framed floors, increased from R-0	Cost is roughly $1.50-$2.00 per square foot
C402.1.4	Lower opaque door U-factor requirement	No comments
C402.4	Window SHGC lowered	Might affect distributor cost and lead time
C402.4	U-factor lowered for operable windows and glazed entrance doors	Might affect distributor cost and lead time
C402.5.1.5	Envelope air leakage verification process	No comments
C402.5.2 & C402.5.3	Envelope air leakage testing alternative added (optional)	No comments
C402.5.11 & C403.14	Operable opening AC interlock for openings >40ft^2	Concerns about how this would apply to double doors, which might be larger than 40ft^2

Working group review summary

Commercial and high-rise residential (continued)

Section	Description	Discussion
C403.1.2	Data center cooling requirements	Noted that these can apply to a computer room within a building
C403.2.3	Fault detection and diagnostics for new HVAC systems serving >100,000 ft2	No comments
C403.3.2	Updated HVAC equipment cooling efficiency requirements	No comments
C403.6.5	Supply air temperature reset, now system required to be capable of reset while dehumidification is required.	Will not apply to most commercial buildings because they do not use reheat, but would apply in some cases such as hospitals and labs with high airflow requirements. May add system cost in those cases.
C403.4.2.3	Automatic stop control requirement for systems with DDC to zones	Might be available as standard option from control vendors, but not currently common
C403.7.1	Demand control ventilation requirement updated	No comments
C403.7.2	Parking garage ventilation updated; CO and NO2 sensors, exception dropped to 8,000 cfm	No comments

Working group review summary

Commercial and high-rise residential (continued)

Section	Description	Discussion
C403.7.4.1	Energy recovery required for non-transient dwelling >500 ft2	This is unlikely to be cost effective in Hawaii's climate. Suggest removing.
C403.7.4.2	Energy recovery for other spaces; no significant change	While there is no significant change, there was discussion about the fact that addition of heat recovery increases fan energy and that the net energy savings might not justify the added system cost
C403.8.3	Change from Fan Efficiency Grade (FEG) to Fan Efficiency Index (FEI)	No comments
C403.8.5	Low-capacity ventilation fans	No comments
C403.9	Large-diameter ceiling fans labeled	No comments
C403.11	Updates to refrigeration efficiency requirements	No comments

Working group review summary

Commercial and high-rise residential (continued)

Section	Description	Discussion
C405.1	Data center electrical systems	No comments
C405.2.1	Lighting occupancy sensor controls includes corridors	No comments
C405.2.3	Updates to light reduction controls	No comments
C405.2.4	Updates to daylight-responsive controls	No comments
C405.2.8	Parking garage lighting control with occupancy sensor or time switch	No comments
C405.3.2	Interior lighting power allowance updates	No comments
C405.4	Lighting for interior plant growth	No comments
C405.11	Automatic receptacle control	Some discussion regarding added construction costs
C405.12	End use energy monitoring for new buildings ≥25,000 ft2	See amendment proposed by P.I.G.
C406.1	Updated additional efficiency requirements	No comments

Working group review summary

Low-rise residential

Section	Description	Discussion
R403.3.5	Ducts within thermal envelope no longer exempt from testing	No comments
R403.6.3	New testing for ventilation airflow rate (e.g. bathroom exhaust fans)	Question about why the energy code includes airflow testing when the purpose is air quality rather than energy efficiency
R404.1	100% high efficacy lighting required in 2021 IECC up from 90% in 2018 IECC	No comments
R404.1.1 & R404.3	New exterior lighting power and control requirements (exceptions for detached one- and two-family and for townhouses)	Perhaps add language to clarify that exterior lighting associated with accessories to detached one- and two-family homes and townhouses is also exempt
R404.2	Interior lighting controls required: dimmer, motion sensor or other (some exceptions)	Discussion about whether controls should be required in cases where there are multiple lighting systems serving the same space, e.g. for a kitchen with general lighting and task lighting
R406	Lower Energy Rating Index (ERI) limit	No comment

Working group review summary

Low-rise residential (continued)

Section	Description	Discussion
R408	New energy efficiency package requirements. Options: 1. Enhanced envelope performance 2. More efficient HVAC equipment performance 3. Reduced energy used in service water heating 4. More efficient duct thermal distribution system 5. Improved air sealing and efficient ventilation system	Discussion about the fact that homes following the prescriptive path that do not have AC would be effectively limited to option 3 for water heating efficiency.

Significant changes 2018 IECC to 2021 IECC

Commercial & high-rise residential

Envelope

Thermal Envelope Certificate (C401.3)

- Permanent certificate
- On wall in mechanical room, utility room or approved location
- Includes
  - R-values of insulation
  - U-factors and SHGC of fenestration
  - Air leakage test results (if applicable)

New in 2021 IECC

Energy Efficiency Certificate

Code edition	
Compliance path	

Insulation Rating		*R* -Value		*R* -Value
Ceiling/Roof		*R*-		*R*-
Walls	Frame	*R*-	Mass	*R*-
	Basement	*R*-	Crawl space	*R*-
Floors	Over unconditioned space	*R*-	Slab edge	*R*-
Ducts	Attic	*R*-	Other	*R*-

Air Leakage Test Results					
Envelope testing		ACH _____ Pa.	Duct testing		cfm/100 ft^2

Fenestration Rating	NFRC U-Factor	NFRC SHGC
Window	*U*-	
Opaque door	*U*-	
Skylight	*U*-	
Weighted average	*U*-	

Designer/builder		Date	

This Certificate is to be posted in accordance with Section C401.3 of the International Energy Conservation Code.

Source: ICC, Significant Changes to the IECC 2021 Edition

Greenhouses (C402.1.1.1)

- If mechanically heated or cooled
  - Meet envelope requirements
- Exception
  - Low energy greenhouses < 1 watt/ft^2 energy for space conditioning

Floor insulation (Table C402.1.3)

Type	2018	2021
Mass	R-0	R-0
Joist/framing	R-0	R-13

Changed in 2021 IECC

Opaque Door U-factor (Table C402.1.3)

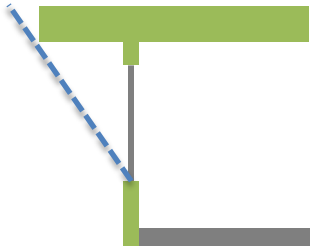
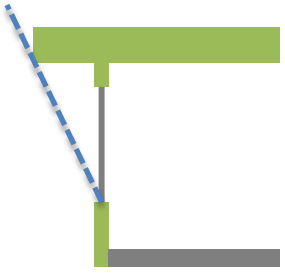
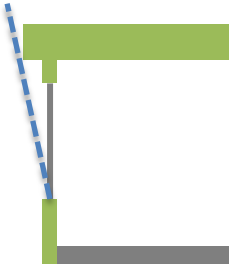
Type	2018	2021
Nonswinging door	No requirement	U-0.31
Swinging door	U-0.61	U-0.37
Garage door <14% glazing	U-0.31	U-0.31 U-0.44 (if single row glazing and between 14% and 25%)

Changed in 2021 IECC

https://www.trudoor.com

https://raynor.com/

Window maximum solar heat gain coefficient (SHGC) (C402.4)

		Large overhang	Medium overhang	Small overhang
				
		PF ≥ 0.5	0.20 ≤ PF < 0.50	PF < 0.20
2018	E/S/W	0.40	0.30	0.25
	North	0.40	0.37	0.33
2021	Fixed	0.37	0.28	0.23
	Operable	0.34	0.25	0.21

Changed in 2021 IECC

Window maximum U-factor (C402.4)

Type	2018	2021
Fixed fenestration	U-0.50	U-0.50
Operable fenestration	U-0.65	U-0.62
Entrance doors	U-1.10	U-0.83

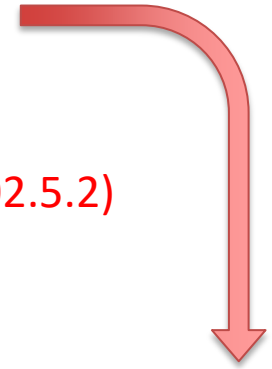
Area-weighted average U-factor allowed

Changed in 2021 IECC

Envelope air leakage (C402.5)

Air barrier compliance options (C402.5.1.2)

1. Materials (C402.5.1.3) + verification (C402.5.1.5)
2. Assemblies (C402.5.1.4) + verification (C402.5.1.5)
3. Testing
   - Dwelling and sleeping unit enclosure testing (C402.5.2)
   - Building thermal envelope testing (C402.5.3)



Verification

- Review of construction documents
- Inspection during construction
- Commissioning report

Changed in 2021 IECC

Operable openings interlock (C402.5.11)

- Operable openings >40 ft2
  - Interlock with HVAC
  - Raise cooling setpoint to 90F
  - Within 10 minutes of opening
- Exceptions
  - Food preparation areas
  - Warehouses with overhead doors
  - First entrance door in vestibule

New in 2021 IECC

Potential Amendment

C402.5.11 Operable openings interlocking.
Where occupancies utilize operable openings to the outdoors that are larger than 40 square feet (3.7 m2) in area, such openings shall be interlocked with the heating and cooling system so as to raise the cooling setpoint to 90°F (32°C) and lower the heating setpoint to 55°F (13°C) whenever the operable opening is open. The change in heating and cooling setpoints shall occur within 10 minutes of opening the operable opening.

Exceptions:

1. Separately zoned areas associated with the preparation of food that contain appliances that contribute to the HVAC loads of a restaurant or similar type of occupancy.
2. Warehouses that utilize overhead doors for the function of the occupancy, where approved by the code official.
3. ~~The first entrance doors where located in the exterior wall and are part of a vestibule system.~~ Doors with automatic closers.

Significant changes 2018 IECC to 2021 IECC

Commercial & high-rise residential

Mechanical

Data centers (C403.1.2)

- Data center definition
  - ITE load > 10kW and > 20 watts/ft^2
- Comply with ASHRAE Standard 90.4-2016, Sections 6 and 8
  - Mechanical load component (MLC)
  - At 50% and 100% ITE load

$$Design\ MLC = \frac{kW_{cooling} + kW_{pumps} + kW_{cooling\ tower} + kW_{AHU\ fans}}{kW_{ITE\ equipment}} \leq 0.23$$

$$Annual\ MLC = \frac{kWh_{cooling} + kWh_{pumps} + kWh_{cooling\ tower} + kWh_{AHU\ fans}}{kWh_{ITE\ equipment}} \leq 0.18$$

Fault detection and diagnostics (C403.2.3)

- Individual HVAC systems that serve conditioned floor area ≥ 100,000 ft^2
- Requirements
  - Permanently installed sensors
  - Sample period ≤ 15 minutes
  - Automatically detect faults and notify operator
  - Automatically recommend repair
  - Be capable of transmitting to remote location
- Exception for R-1 and R-2 occupancy

HVAC efficiency (C403.3.2)

Table C403.3.2 – Minimum efficiency requirements

Changed in 2021 IECC

Example

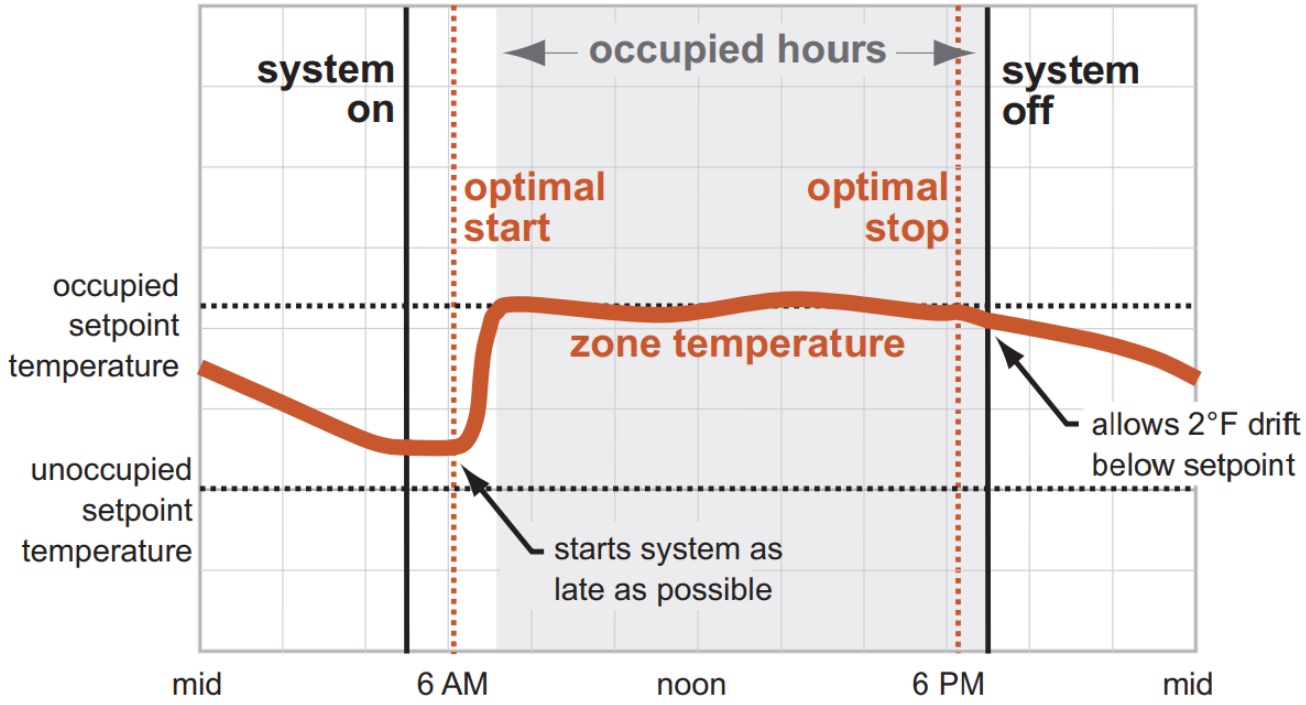
Air conditioners – air-cooled

Capacity (Btu/hr)	2018 IECC	2021 IECC
< 65,000	13.0 SEER	13.4 SEER2
65,000 – 135,000	11.2 EER 12.8 IEER	11.2 EER 14.8 IEER
135,000 – 240,000	11.0 EER 12.4 IEER	11.0 EER 14.2 IEER
240,000 – 760,000	10.0 EER 11.6 IEER	10.0 EER 13.2 IEER
>760,000	9.7 EER 11.2 IEER	9.7 EER 12.5 IEER

Automatic stop control (C403.4.2.3)

- Automatic start for each HVAC system (existing in 2018 IECC)
  - Adjusts daily start time to bring space to desired temperature immediately prior to occupancy
- Automatic stop for systems with DDC control of zones (new in 2021 IECC)
  - Increase cooling setpoint by ≥ 2°F before scheduled unoccupied period

Changed in 2021 IECC



https://www.trane.com/content/dam/Trane/Commercial/global/products-systems/education-training/engineers-newsletters/control-systems-electrical-considerations/admapn022en_1006.pdf

Supply air temperature reset (C403.6.5)

- For multiple-zone HVAC systems
- Automatic reset by 25% of [room T – design supply T] (existing in 2018 IECC)
  - e.g. reset SAT from 55F to at least 60F, with 75F room T
- Exceptions:
  - Systems without reheat
  - Outdoor air <3,000 cfm
  - Outdoor air > 80% with energy recovery
- Design shall allow SAT reset while dehumidification is provided

Changed in 2021 IECC

Demand control ventilation (C403.7.1)

Required for these spaces:

- > 500 ft², and
- ≥ 15~~25~~ **people**/1000 ft² of floor area, and
- Served by systems with > 3,000 cfm outdoor airflow

Theater, auditorium, ballroom, conference room, etc.

Changed in 2021 IECC

Enclosed parking garage ventilation controls (C403.7.2)

Automatic exhaust fan control

- Contaminant sensors
  - Carbon monoxide + nitrogen dioxide
- Automatically reduce flow
  1. Stage or modulate fans to 50% or less flow
  2. Operate intermittently for 20% or less of occupied time

Changed in 2021 IECC

Exceptions:
- < 8,000 ~~22,500~~ cfm
- > 1,125 cfm/hp

Energy recovery ventilation systems (C403.7.4)

Nontransient dwelling units

- Enthalpy recovery ratio **≥ 50%**
- Exception
  - Dwelling units ≤ 500 ft^2

New in 2021 IECC

Energy recovery ventilation systems (C403.7.4)

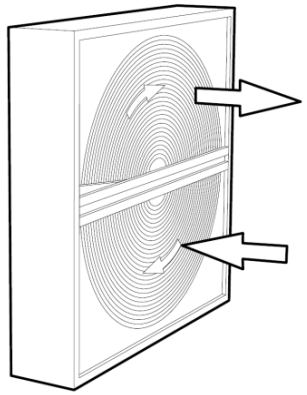
- Enthalpy recovery ratio **≥ 50%**
- If design supply air flow exceeds limit (some exceptions)

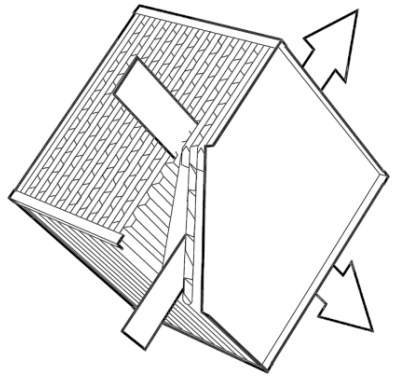
Table C403.7.4 (excerpt)

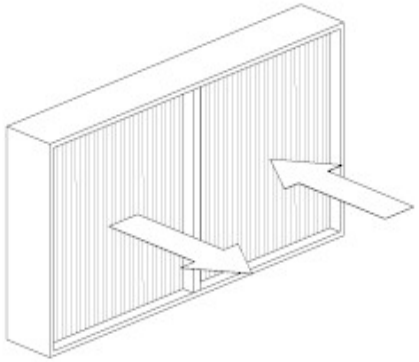
Design outdoor airflow	Fan Operates < 8,000 hrs/yr	Fan Operates ≥ 8,000 hrs/yr
≥ 10% and <20%	≥26,000 cfm	≥2,500 cfm
≥ 20% and <30%	≥16,000 cfm	≥2,000 cfm
≥ 30% and <40%	≥5,500 cfm	≥1,000 cfm
≥ 40% and <50%	≥4,500 cfm	≥500 cfm
≥ 50% and <60%	≥3,500 cfm	>140 cfm
≥ 60% and <70%	≥2,000 cfm	>120 cfm
≥ 70% and <80%	≥1,000 cfm	>100 cfm
≥ 80%	>120 cfm	>80 cfm

Common options

- Air-to-air heat exchanger
- Heat pipe
- Heat wheel
- Run-around coils







Potential amendment

C403.7.4 Energy recovery systems.
Energy recovery ventilation systems shall be provided as specified in ~~either Section C403.7.4.1 or~~ C403.7.4.2~~, as applicable~~.

C403.7.4.1 ~~Nontransient dwelling units.~~ Not used.
~~Nontransient dwelling units shall be provided with outdoor air energy recovery ventilation systems with an enthalpy recovery ratio of not less than 50 percent at cooling design condition and not less than 60 percent at heating design condition.~~

~~Exceptions:~~

- ~~Nontransient dwelling units in Climate Zone 3C.~~
- ~~Nontransient dwelling units with not more than 500 square feet (46 m2) of conditioned floor area in Climate Zones 0, 1, 2, 3, 4C and 5C.~~
- ~~Enthalpy recovery ratio requirements at heating design condition in Climate Zones 0, 1 and 2.~~
- ~~Enthalpy recovery ratio requirements at cooling design condition in Climate Zone 4, 5, 6, 7 and 8.~~

C403.7.4.2 Spaces other than nontransient dwelling units.

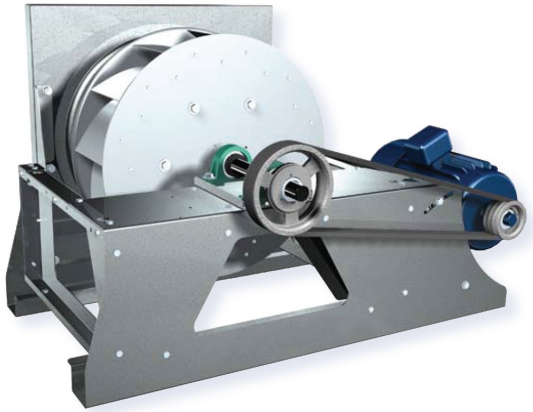
…

Fan power & efficiency (C403.8.1 - C403.8.4)

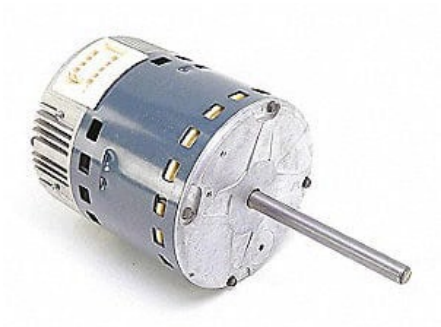
Fan power & efficiency (C403.8.1 - C403.8.4)

- When fan system power > 5 hp
  - Allowable fan horsepower limit
  - Motor nameplate HP limit
  - Fan efficiency requirement
    - ~~Fan efficiency~~ grade ≥ 67
    - Fan energy index ≥ 1 (or ≥ 0.95 for VAV systems)

Changed in 2021 IECC



- Fractional hp fan motors
  - Electronically commutated motors required for 1/12 hp – 1 hp
  - Some exceptions



Low-capacity ventilation fans (C403.8.5)

- Ventilation system fans <1/12 hp
- Some exceptions

New in 2021 IECC

TABLE C403.8.5 LOW-CAPACITY VENTILATION FAN EFFICACY[a]

FAN LOCATION	AIRFLOW RATE MINIMUM (CFM)	MINIMUM EFFICACY (CFM/WATT)	AIRFLOW RATE MAXIMUM (CFM)
HRV or ERV	Any	1.2 cfm/watt	Any
In-line fan	Any	3.8 cfm/watt	Any
Bathroom, utility room	10	2.8 cfm/watt	< 90
Bathroom, utility room	90	3.5 cfm/watt	Any

Large-diameter ceiling fans (C403.9)

- For fans > 7 ft diameter
- Labeled per AMCA 230

New in 2021 IECC

Refrigeration equipment performance (C403.11)

Changes to efficiency requirements

- Commercial refrigerators and refrigerator-freezers, and refrigeration
- Walk-in coolers and walk-in freezer

Changed in 2021 IECC

Operable openings interlock (C402.5.11 & C403.14)

- Operable openings >40 ft2
  - Interlock with HVAC
  - Within 10 minutes of opening
    - Raise cooling setpoint to 90F
    - Shut off system if outdoor temperature below 90F
- Exceptions
  - Food preparation areas
  - Warehouses with overhead doors
  - First entrance door in vestibule

New in 2021 IECC

Significant changes 2018 IECC to 2021 IECC

Commercial & high-rise residential

Electrical

Data centers (C405.1)

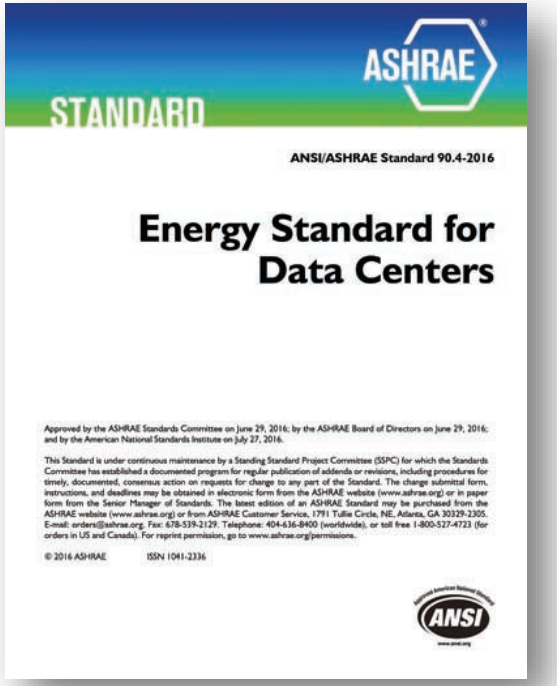
Data center definition

- ITE load > 10kW and > 20 watts/ft^2

Comply with ASHRAE Standard 90.4-2016, Section 8

- Electrical loss component (ELC)
- Calculated at 50% and 100% ITE load

New in 2021 IECC



Segment	Maximum loss
Incoming service	10-15%
UPS	6.5-13.5%
ITE distribution system	3-6%
Total ELC	18.9-26.5%

Occupant Sensor Controls (C405.2.1)

Required space types

1. Classrooms/lecture/training rooms
2. Conference/meeting/multipurpose
3. Copy/print rooms
4. Lounges/break rooms
5. Enclosed offices
6. Open plan office areas
7. Restrooms
8. Storage rooms
9. Locker rooms
10. Corridors
11. Other spaces ≤300 ft2 with floor-to-ceiling partitions
12. Warehouse storage areas

New for 2021

Permitted Interaction Group proposed an exception for R-2 common areas

Warehouse storage areas
- Each aisle separately
- Reduce to 50% or less

Open office areas
- Control zones ≤600 ft^2
- Reduce to 80% or less

Corridors
- Reduce to 50% or less
- Within 20 minutes

All other spaces
1. Manual on, or
2. Auto-on to ≤50% power

Exceptions
- Security or emergency areas
- Exit stairways, ramps and passageways

Changed in 2021 IECC

Light-reduction controls (C405.2.3)

Light reduction controls (C405.2.2.2)

- Required where occupant sensors not provided
- Manual control with uniform illumination
  - Continuous dimming to <20% power
  - Switch all luminaires to between 30% and 70% power
  - Switch alternate luminaires or rows for between 30% and 70% power
- Exceptions
  - Daylight-responsive controls
  - Special application controls
  - Spaces with one luminaire < 60 watts
  - Spaces with <0.45 watt/ft^2
  - Corridors, lobbies, electrical rooms and mechanical rooms.

Changed in 2021 IECC

Daylight-responsive controls (C405.2.3)

Required in spaces with:

- >150W of general lighting in primary sidelit daylight zones
- >300W of general lighting in sidelit daylight zones
- >150W of general lighting in toplit daylight zones

Changed in 2021 IECC

Exceptions

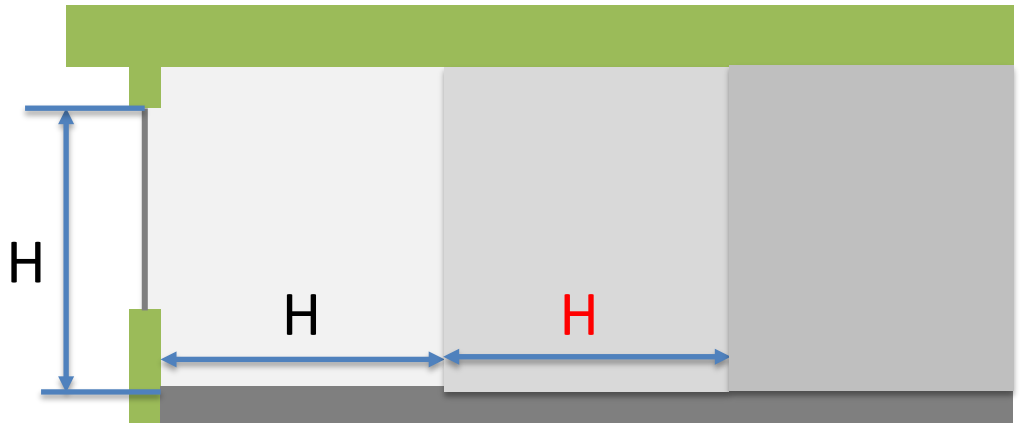
- Patient care
- Dwelling units & sleeping units
- Display and accent lighting
- Display case lighting
- First floor sidelight zone in A-2 and M occupancies
- Total building lighting power ≤ LPD_{adj}

$$LPA_{adj} = LPA_{norm} \times \underbrace{\left(1 - \frac{0.4 \times Uncontrolled\ daylight\ zone\ floor\ area}{Total\ floor\ area}\right)}_{= 0.6 \text{ to } 1.0}$$

Daylight-responsive controls (C405.2.3)

Changed in 2021 IECC

Sidelit daylight zone



Primary sidelit daylight zone

Secondary sidelit daylight zone

Window area ≥24 ft^2

Glazing light transmission ≥0.20

Overhang projection factor:

≤1.0 north

≤1.5 other

More details in the code

Parking garage lighting control (C405.2.8)

- Occupant sensor or time switch required
- Reduce power by ≥30%
  - When no activity for 20 minutes
  - In zones ≤ 3,600 ft^2
  - Exception <1.5 footcandles
- Lighting for eye adaption at entries/exits
  - Automatically reduces by ≥50% between sunset and sunrise
- Luminaires within 20 ft of perimeter openings
  - Reduce power by ≥ 50% in response to daylight
  - With some exceptions

New in 2021 IECC

Interior lighting power (Table C405.3.2(1))

TABLE C405.3.2(1)
INTERIOR LIGHTING POWER ALLOWANCES: BUILDING AREA METHOD

Building Area Method

Changed in 2021 IECC

BUILDING AREA TYPE	2018 LPD (w/ft^2)	2021 LPD (w/ft^2)
Automotive facility	0.71	0.75
Convention center	0.76	0.64
Courthouse	0.90	0.79
Dining: bar lounge/leisure	0.90	0.80
Dining: cafeteria/fast food	0.79	0.76
Dining: family	0.78	0.71
Dormitory[a, b]	0.61	0.53
Exercise center	0.65	0.72
Fire station[a]	0.53	0.56
Gymnasium	0.68	0.76
Health care clinic	0.82	0.81
Hospital[a]	1.05	0.96
Hotel/Motel[a, b]	0.75	0.56
Library	0.78	0.83

Interior lighting power (Table C405.3.2(1))

Building Area Method

Changed in 2021 IECC

	2018	2021
Manufacturing facility	0.90	0.82
Motion picture theater	0.83	0.44
Multifamily[c]	0.68	0.45
Museum	1.06	0.55
Office	0.79	0.64
Parking garage	0.15	0.18
Penitentiary	0.75	0.69
Performing arts theater	1.18	0.84
Police station	0.80	0.66
Post office	0.67	0.65
Religious building	0.94	0.67
Retail	1.06	0.84
School/university	0.81	0.72
Sports arena	0.87	0.76
Town hall	0.80	0.69
Transportation	0.61	0.50
Warehouse	0.48	0.45
Workshop	0.90	0.91

Interior lighting power (Table C405.3.2(2))

	2018	2021
Locker room	0.48	0.52
Lounge/breakroom		
In a healthcare facility	0.78	0.42
Otherwise	0.62	0.59
Office		
Enclosed	0.93	0.74
Open plan	0.81	0.61
Parking area, interior	0.14	0.15
Pharmacy area	1.34	1.66
Restroom		
In a facility for the visually impaired (and not used primarily by the staff[b]	0.96	1.26
Otherwise	0.85	0.63
Sales area	1.22	1.05
Seating area, general	0.42	0.23
Stairway (see Space containing stairway)		
Stairwell	0.58	0.49
Storage room	0.46	0.38
Vehicular maintenance area	0.56	0.60
Workshop	1.14	1.26

Space-by-Space Method
Partial table

Changed in 2021 IECC

Lighting for plant growth and maintenance (C405.4)

≥ 95% of luminaires

- Photon efficiency ≥ 1.6 μmol/J
- Per ANSI/ASABE S640-2017

  Quantities And Units Of Electromagnetic Radiation For Plants (Photosynthetic Organisms)

New in 2021 IECC

RADIATION SOURCE	PPE (μmol/J)
Ceramic Metal Halide (315 W)	1.6
High Pressure Sodium (mogul base, 600 W)	1.6
High Pressure Sodium (double ended, 1,000 W)	1.7
LED (150–650 W)	1.5–3.0

Source: 2021 IECC Commentary

Automatic receptacle control (C405.11)

- Automatic receptable control required:
  1. ≥50% of 125V, 15- and 20-amp receptacles
     - enclosed offices
     - conference rooms
     - copy rooms
     - breakrooms
     - classrooms
     - individual workstations
  2. ≥ 25% of branch circuit feeders for modular furniture
- Function
  1. Split controlled receptacles, or controlled receptacle within 12 inches of each uncontrolled receptacle.
  2. Control options:
     - Time-of-day control device
     - Occupant sensor control
     - Automated signal
- Receptacles marked and uniformly distributed
- Plug-in devices do not comply

New in 2021 IECC

Exceptions: Automatic receptacles controls are not required for the following:

1. Receptacles requiring continuous operation
2. Safety or security
3. Spacing in modular office workstation up to 72”

Potential amendment

Section C405.11 Automatic receptacle control is deleted in its entirety.

Energy monitoring (C405.12)

- For new buildings >= 25,000 ft^2
  - Exceptions for R-2 occupancy and tenant spaces when < 5,000 ft^2
- End-use categories
  - Total HVAC
  - Interior lighting
  - Exterior lighting
  - Plug loads
  - Process loas
  - Other
- Automatically measure and store data for >= 36 months
- Graphical reporting system within building accessible to staff

Permitted Interaction Group proposed an exception for all R-2

Significant changes 2018 IECC to 2021 IECC

Commercial & high-rise residential

Additional efficiency

Additional efficiency requirements (C406)

10 credits from table based on occupancy type, for new buildings

Changed in 2021 IECC

Example:
All groups except for
Groups B, E, I, M and R

C406.2.1: 5% heating efficiency improvement	NA
C406.2.2: 5% cooling efficiency improvement	5
C406.2.3: 10% heating efficiency improvement	NA
C406.2.4: 10% cooling efficiency improvement	8
C406.3: Reduced lighting power	8
C406.4: Enhanced digital lighting controls	2
C406.5: On-site renewable energy	8
C406.6: Dedicated outdoor air system	3
C406.7.2: Recovered or renewable water heating[b]	10
C406.7.3: Efficient fossil fuel water heater[b]	5
C406.7.4: Heat pump water heater[b]	6
C406.8: Enhanced envelope performance	3
C406.9: Reduced air infiltration	3
C406.10: Energy monitoring	3
C406.11: Fault detection and diagnostics system	2

Significant changes 2018 IECC to 2021 IECC

Low-rise residential

Duct testing (R403.3.5)

Rough-in test or **Postconstruction test**

Changed in 2021 IECC

Leakage ≤ 4 cfm/100 ft^2

Leakage ≤ 3 cfm/100 ft^2
(without air handler)

Leakage ≤ 4 cfm/100 ft^2

~~Test **not** required if air handler and all ducts are within the thermal envelope~~

Mechanical ventilation - testing (R403.6.3)

- Mechanical ventilation per
  1. International Residential Code,
  2. International Mechanical Code, or
  3. Approved means
- Fan efficacy

FAN LOCATION	AIRFLOW RATE MINIMUM (CFM)	MINIMUM EFFICACY (CFM/WATT)
HRV, ERV	Any	1.2 cfm/watt
In-line supply or exhaust fan	Any	3.8 cfm/watt
Other exhaust fan	< 90	2.8 cfm/watt
Other exhaust fan	≥ 90	3.5 cfm/watt
Air-handler that is integrated to tested and *listed* HVAC equipment	Any	1.2 cfm/watt

Changed in 2021 IECC

- Ventilation systems flow rate test
  - Flow hood or box, flow grid or other device (or mfr recommendation)
  - Written report provided to code official
- Exception
  - Kitchen hoods
    - Ducted to the outside,
    - Duct ≥ 6” diameter, and
    - No more than one 90 degree elbow
- Does not apply to Tropical Climate compliance path

New in 2021 IECC

Lighting equipment (R404.1)

Changed in 2021 IECC

High efficacy
≥ ~~90%~~ 100% of lamps

Excludes kitchen appliance lighting

High efficacy definition

	Efficacy (lumens/watt)
Lamp	≥65
Luminaire	≥45

High efficacy examples

Source: DOE/NREL PIX17458

Full-size fluorescent

Source: DOE/NREL PIX20307

LED

Exterior lighting (R404.1.1)

Commercial exterior lighting requirements

Connected exterior lighting for residential buildings shall comply with Section C405.5

Exceptions:

1. Detached one- and two-family dwellings
2. Townhouses
3. Solar-powered lamps not connected to any electrical service
4. Luminaires controlled by a motion sensor
5. Lamps and luminaires that comply with Section R404.1

Potential amendment

R404.1.1 Exterior lighting.
Connected exterior lighting for residential buildings shall comply with Section C405.5.

Exceptions:

1. Detached one- and two-family dwellings and accessories.
2. Townhouses and accessories.
3. Solar-powered lamps not connected to any electrical service.
4. Luminaires controlled by a motion sensor.
5. Lamps and luminaires that comply with Section R404.1.

Exterior lighting (R404.1.1)

C405.5.2 Exterior lighting power allowance

1. Base site allowance
2. Power allowances for building exteriors
3. Additional exterior lighting power

   Limited to the fixtures serving specific applications

TABLE C405.5.2(1) EXTERIOR LIGHTING ZONES

LIGHTING ZONE	DESCRIPTION
1	Developed areas of national parks, state parks, forest land, and rural areas
2	Areas predominantly consisting of residential zoning, neighborhood business districts, light industrial with limited nighttime use and residential mixed-use areas
3	All other areas not classified as lighting zone 1, 2 or 4
4	High-activity commercial districts in major metropolitan areas as designated by the local land use planning authority

TABLE C405.5.2(2) LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS

	LIGHTING ZONES			
	Zone 1	Zone 2	Zone 3	Zone 4
Base Site Allowance	350 W	400 W	500 W	900 W

Exterior lighting (R404.1.1)

C405.5.2 Exterior lighting power allowance

1. Base site allowance
2. Power allowances for building exteriors
3. Additional exterior lighting power

   Limited to the fixtures serving specific applications

TABLE C405.5.2(2) LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS

	LIGHTING ZONES			
	Zone 1	Zone 2	Zone 3	Zone 4
Base Site Allowance	350 W	400 W	500 W	900 W
Uncovered Parking Areas				
Parking areas and drives	0.03 W/ft^2	0.04 W/ft^2	0.06 W/ft^2	0.08 W/ft^2
Building Grounds				
Walkways and ramps less than 10 feet wide	0.50 W/linear foot	0.50 W/linear foot	0.60 W/linear foot	0.70 W/linear foot
Walkways and ramps 10 feet wide or greater, plaza areas, special feature areas	0.10 W/ft^2	0.10 W/ft^2	0.11 W/ft^2	0.14 W/ft^2
Dining areas	0.65 W/ft^2	0.65 W/ft^2	0.75 W/ft^2	0.95 W/ft^2
Stairways	0.60 W/ft^2	0.70 W/ft^2	0.70 W/ft^2	0.70 W/ft^2
Pedestrian tunnels	0.12 W/ft^2	0.12 W/ft^2	0.14 W/ft^2	0.21 W/ft^2
Landscaping	0.03 W/ft^2	0.04 W/ft^2	0.04 W/ft^2	0.04 W/ft^2
Building Entrances and Exits				
Pedestrian and vehicular entrances and exits	14 W/linear foot of opening	14 W/linear foot of opening	21 W/linear foot of opening	21 W/linear foot of opening
Entry canopies	0.20 W/ft^2	0.25 W/ft^2	0.40 W/ft^2	0.40 W/ft^2
Loading docks	0.35 W/ft^2	0.35 W/ft^2	0.35 W/ft^2	0.35 W/ft^2
Sales Canopies				
Free-standing and attached	0.40 W/ft^2	0.40 W/ft^2	0.60 W/ft^2	0.70 W/ft^2
Outdoor Sales				
Open areas (including vehicle sales lots)	0.20 W/ft^2	0.20 W/ft^2	0.35 W/ft^2	0.50 W/ft^2
Street frontage for vehicle sales lots in addition to “open area” allowance	No allowance	7 W/linear foot	7 W/linear foot	21 W/linear foot

Exterior lighting (R404.1.1)

C405.5.2 Exterior lighting power allowance

1. Base site allowance
2. Power allowances for building exteriors
3. Additional exterior lighting power

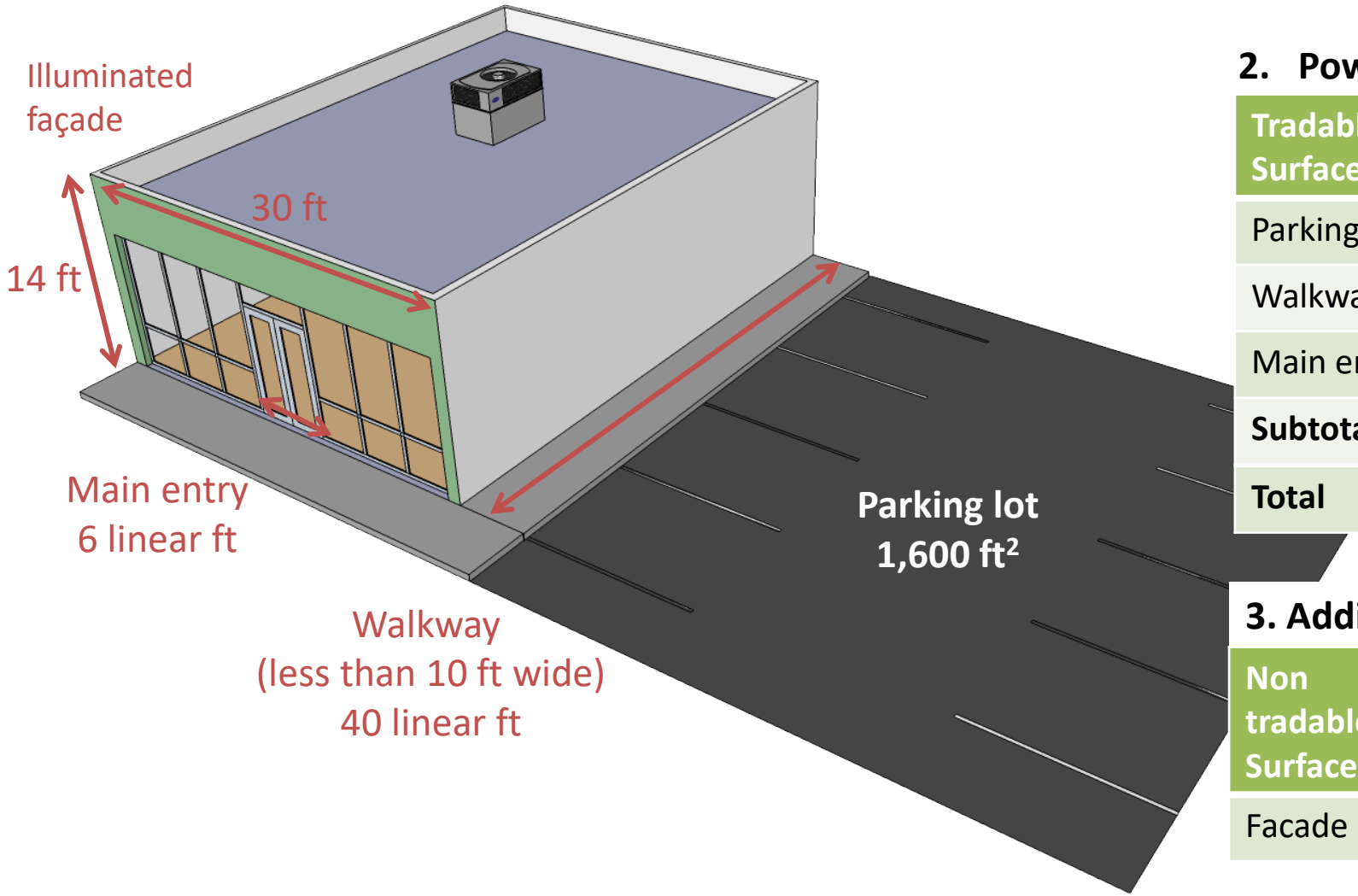
   Limited to the fixtures serving specific applications

TABLE C405.5.2(3) INDIVIDUAL LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS

LIGHTING ZONES				
	Zone 1	**Zone 2**	**Zone 3**	**Zone 4**
Building facades	No allowance	0.075 W/ft^2 of gross above-grade wall area	0.113 W/ft^2 of gross above-grade wall area	0.15 W/ft^2 of gross above-grade wall area
Automated teller machines (ATM) and night depositories	135 W per location plus 45 W per additional ATM per location			
Uncovered entrances and gatehouse inspection stations at guarded facilities	0.50 W/ft^2 of area			
Uncovered loading areas for law enforcement, fire, ambulance and other emergency service vehicles	0.35 W/ft^2 of area			
Drive-up windows and doors	200 W per drive through			
Parking near 24-hour retail entrances.	400 W per main entry			

Small Commercial Example

What is allowed exterior lighting power?



Located in
exterior lighting zone #3

1. Base site allowance

Base site allowance (zone 3)	**500 W**

2. Power allowances for building exteriors

Tradable Surfaces	Area/ length	Unit Allowance	Allowance
Parking lot	1,600 ft²	0.06 W/ft²	96W
Walkway	40 ft	0.6 W/ft	24W
Main entry	6 ft	21 W/ft	126W
Subtotal			**246W**
Total			**746W**

3. Additional exterior lighting power

Non tradable Surface	Area/ length	Unit Allowance	Allowance
Facade	420 ft²	0.113 W/ft²	47W

Interior lighting controls (R404.2)

Permanently installed lighting fixtures shall be controlled with either a dimmer, an occupant sensor control or other control that is installed or built into the fixture.

Exception: Lighting controls shall not be required for the following:

1. Bathrooms
2. Hallways
3. Exterior lighting fixtures
4. Lighting designed for safety or security

New in 2021 IECC

Potential amendment

R404.2 Interior lighting controls.
Permanently installed lighting fixtures shall be controlled with either a dimmer, an occupant sensor control or other control that is installed or built into the fixture.

Exception: Lighting controls shall not be required for the following:

1. Bathrooms.
2. Hallways.
3. Exterior lighting fixtures.
4. Lighting designed for safety or security.
5. Lighting fixtures where other separately switched lighting fixtures that serve the same area have the required controls.

Exterior lighting controls (R404.3)

Where total exterior lighting >30 watts:

1. Manual on and off switch which permits automatic shut off actions.
   Exception: Lighting serving multiple dwelling units.
2. Automatically shut off when daylight is present.
3. Override not allowed unless automatically returns to its normal operation within 24 hours

Energy Rating Index Compliance (R406)

Compliance

- Mandatory requirements
- Envelope performance ≥ 2009 IECC
- Energy Rating Index ≤ ~~57~~ 52
- Verification by approved third party

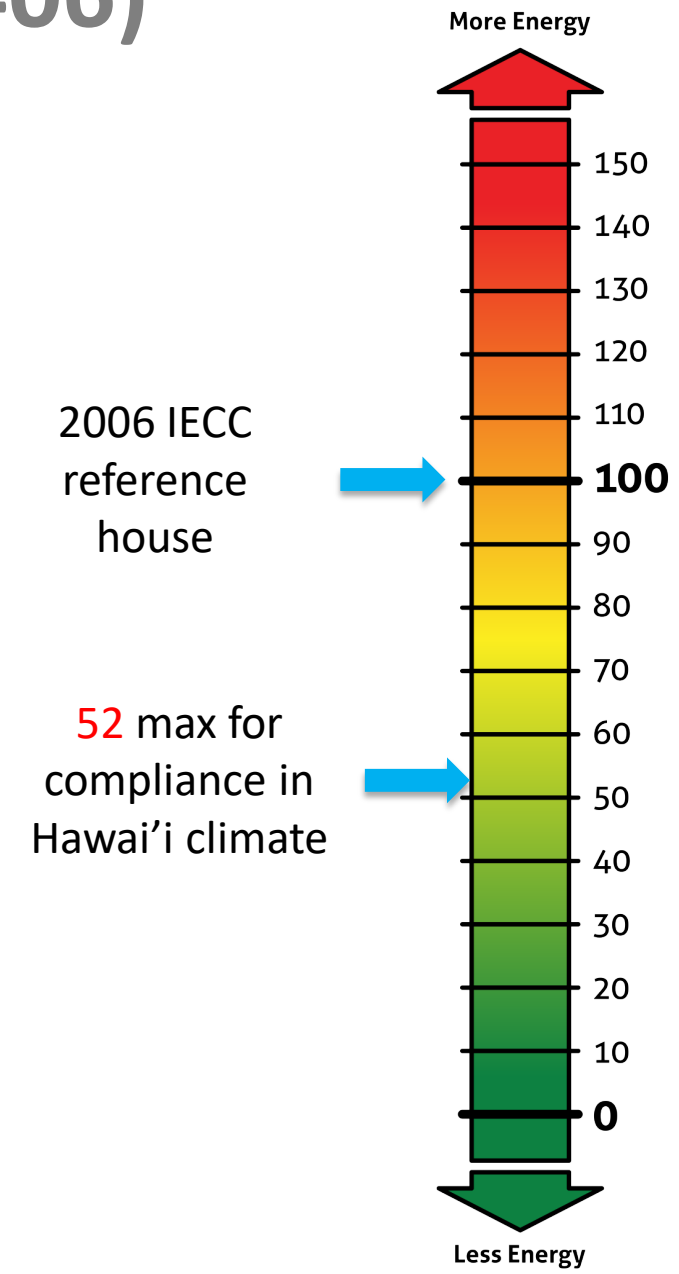
Accredited providers

https://www.resnet.us/providers/accredited-providers/accredited-rating-providers/

Accredited software tools (June 2023)

https://www.resnet.us/providers/accredited-providers/hers-software-tools/

- Ekotrope
- EnergyGauge USA
- REM/Rate



Additional Efficiency Package Options (R408)

Options (choose 1)

1. Enhanced envelope performance
   - 5% reduction in overall U-factor + 5% reduction in window SHGC
2. More efficient HVAC equipment performance
   - ≥16 SEER
3. Reduced energy used in service water heating
   - ≥82 energy factor fossil fuel heater,
   - ≥2.0 energy factor electric water heater, or
   - ≥0.4 solar fraction
4. More efficient duct thermal distribution system
   - 100% within thermal envelope/conditioned space
5. Improved air sealing and efficient ventilation system
   - ≤3.0 air-changes/hour leakage test + energy recovery ventilator

Potential Amendments to the 2021 International Energy Conservation Code

These potential amendments are provided for discussion during the July 18, 2023 SBCC meeting.

SUBCHAPTER 1
RULES OF GENERAL APPLICABILITY

1. Purpose

The purpose of this chapter is to adopt the state energy conservation code as required by section 107-25, Hawai‘i Revised Statutes (HRS).

2. Scope

This chapter sets forth minimum requirements for the design and construction of buildings for the effective use of energy and is intended to provide flexibility to allow the use of innovative approaches and techniques to achieve the effective use of energy.

3. Definitions

In this chapter, unless the context otherwise requires:
"ICC" means the International Code Council.
"IECC Section" means a section of a chapter of the *International Energy Conservation Code.*
"IECC" means the ICC, *International Energy Conservation Code,* 2021 edition, as copyrighted by the International Code Council.

4. Adoption of the International Energy Conservation Code

The International Energy Conservation Code, 2021 Edition as copyrighted and published in 2021 by International Code Council, Incorporated, 500 New Jersey Avenue, 6th Floor, Washington, DC 20001, is adopted by reference and made a part of this chapter. This incorporation by reference includes all parts of the International Energy Conservation Code subject to the amendments hereinafter set forth.

5. Permit authorization

Each county may, by ordinance, require that a permit be obtained from the building official for any area regulated by this chapter.

SUBCHAPTER 2

The 2018 Energy Conservation Code of the State of Hawai'i shall be deleted in its entirety and replaced by the 2021 International Energy Conservation Code with the proposed amendments.

AMENDMENTS TO THE 2021 IECC INTERNATIONAL ENERGY CONSERVATION CODE

6. Section C101.1 is amended to read as follows:

C101.1 Title. This code shall be known as the Energy Conservation Code of the State of Hawai'i and shall be cited as such. It is referred to herein as "this code."

7. **Section C103 Construction Documents, Section C104 Fees,** and **Section C105 Inspections** are deleted in their entirety.

8. Table C402.1.3 is amended to add footnote h as follows:

TABLE C402.1.3
OPAQUE THERMAL ENVELOPE INSULATION COMPONENT MINIMUM REQUIREMENTS, *R*-VALUE METHOD[a]

CLIMATE ZONE	0 AND 1		2		3	
	All other	Group R	All other	Group R	All other	Group R
Roofs						
Insulation entirely above roof deck	R-20ci	R-25ci	R-25ci	R-25ci	R-25ci	R-25ci
Metal buildings[b]	R-19 +R-11 LS	R-19 +R-11 LS	R-19 +R11 LS	R-19 +R-11 LS	R-19 +R-11 LS	R-19 +R-11 LS
Attic and other	R-38	R-38	R-38	R-38	R-38	R-38
Walls, above grade						
Mass[f]	R-5.7ci[c,h]	R-5.7ci[c,h]	R-5.7ci[c]	R-7.6ci	R-7.6ci	R-9.5ci
Metal building	R-13 +R-6.5ci	R-13 +R-6.5ci	R13 +R-6.5ci	R-13 +R-13ci	R-13 +R-6.5ci	R-13 +R-13ci
Metal framed	R-13 +R-5ci	R-13 +R-5ci	R-13 +R-5ci	R-13 +R-7.5ci	R-13 +R-7.5ci	R-13 +R-7.5ci

Wood framed and other	R-13 +R-3.8ci or R-20[h]	R-13 +R-3.8ci or R-20[h]	R-13 +R-3.8ci orR-20	R-13 +R-3.8ci orR-20	R-13 +R-3.8ci orR-20	R-13 +R-3.8ci orR-20
Below-grade wall[d]	NR	NR	NR	NR	NR	NR
Mass[e]	NR	NR	R-6.3ci	R-8.3ci	R-10ci	R-10ci
Joist/framing	R-13	NR	R-30	R-30	R-30	R-30
Unheated slabs	NR	NR	NR	NR	NR	R-10 for 24″ below
Heated slabs[g]	R-7.5 for 12″ below+ R-5 full slab	R-7.5 for 12″ below+ R-5 full slab	R-7.5 for 12″ below+ R-5 full slab	R-7.5 for 12″ below+ R-5 full slab	R-10 for 24″ below+ R-5 full slab	R-10 for 24″ below+ R-5 full slab

h. In climate zones 0 and 1, the continuous insulation requirements for mass walls and for wood-framed and other walls may be substituted with an area-weighted average solar reflectance ≥0.39 or an area-weighted average light reflectance value ≥0.64 or with an overhang with projection factor ≥0.3.

9. Table C402.3 is amended to read as follows:

TABLE C402.3 MINIMUM ROOF REFLECTANCE AND EMITTANCE OPTIONS

Three-year-aged solar reflectance index (b) of ~~55~~ 63 and 3-year aged thermal emittance of 0.75
Three-year-aged solar reflective index (d) of ~~64~~ 75

10. Table C402.4 is amended to add a footnote:

TABLE C402.4 BUILDING ENVELOPE FENESTRATION MAXIMUM U-FACTOR AND SHGC REQUIREMENTS[a]

…

a. Exception: Jalousie windows.

11. Section C402.4.3.4 is amended to read as follows:

C402.4.3.4 Area-weighted U-factor and SHGC
An area-weighted average shall be permitted to satisfy the U factor and SHGC requirements for each fenestration product category listed in Table C402.4. Individual fenestration products from different fenestration product categories listed in Table C402.4 shall not be combined in calculating area-weighted average U factor and SHGC.

12. Section C403.7.6.1 is amended by adding control #4, as follows:

C403.7.6.1 Temperature setpoint controls
Controls shall be provided on each HVAC system that are capable of and configured with four modes of temperature control.

1. When the guestroom is rented but unoccupied, the controls shall automatically raise the cooling setpoint and lower the heating setpoint by not less than 4°F (2°C) from the occupant setpoint within 30 minutes after the occupants have left the guestroom.
2. When the guestroom is unrented and unoccupied, the controls shall automatically raise the cooling setpoint to not lower than 80°F (27°C) and lower the heating setpoint to not higher than 60°F (16°C). Unrented and unoccupied guestroom mode shall be initiated within 16 hours of the guestroom being continuously occupied or where a *networked guestroom control system* indicates that the guestroom is unrented and the guestroom is unoccupied for more than 20 minutes. A *networked guestroom control system* that is capable of returning the thermostat setpoints to default occupied setpoints 60 minutes prior to the time a guestroom is scheduled to be occupied is not precluded by this section. Cooling that is capable of limiting relative humidity with a setpoint not lower than 65 percent relative humidity during unoccupied periods is not precluded by this section.
3. When the guestroom is occupied, HVAC setpoints shall return to their occupied setpoints once occupancy is sensed.
4. Opaque and glass doors opening to the outdoors in hotel and motel sleeping units, guest suites and time-share condominiums, shall be provided with controls that disable the mechanical cooling, or reset the cooling setpoint to 90°F or greater within five minutes of the door opening. Mechanical cooling may remain enabled if the outdoor air temperature is below the space temperature.

13. Section C405.2.1 is amended to read as follows:

C405.2.1 Occupant Sensor Controls.
Occupant sensor controls shall be installed to control lights in the following space types:

1. Classrooms/lecture/training rooms.
2. Conference/meeting/multipurpose rooms.
3. Copy/print rooms.
4. Lounges/breakrooms.
5. Enclosed offices.
6. Open plan office areas.
7. Restrooms.
8. Storage rooms.
9. Locker rooms.
10. Corridors
11. Warehouse Storage areas.
12. Other spaces 300 square feet (28 m2) or less that are enclosed by floor-to-ceiling height partitions.

Exceptions:

1. Luminaires that are required to have specific application controls in accordance with Section C405.2.5.
2. Luminaires in multi-family building common areas.

14. Section C405.2.4 is amended by adding exception #4 as follows:

C405.2.4 Daylight-responsive controls
Daylight-responsive controls complying with Section C405.2.4.1 shall be provided to control the general lighting within *daylight zones* in the following spaces:

1. Spaces with a total of more than 150 watts of *general lighting* within primary side lit daylight zones complying with Section C405.2.4.2.
2. Spaces with a total of more than 300 watts of *general lighting* within side lit daylight zones complying with Section C405.2.4.2.
3. Spaces with a total of more than 150 watts of *general lighting* within top lit daylight zones complying with Section C405.2.4.3.

Exceptions: Daylight responsive controls are not required for the following:

1. Spaces in health care facilities where patient care is directly provided.
2. Sidelit daylight zones on the first floor above grade in Group A-2 and Group M occupancies.
3. New buildings where the total connected lighting power calculated in accordance with Section C405.3.1 is not greater than the adjusted interior lighting power

allowance (LPA_{adj}) calculated in accordance with Equation 4-9.

$$LPA_{adj} = [LPA_{norm} \times (1.0 - 0.4 \times UDZFA / TBFA)]$$

(Equation 4-9)

where:

LPA_{adj} = Adjusted building interior lighting power allowance in watts.
LPA_{norm} = Normal building lighting power allowance in watts calculated in accordance with Section C405.3.2 and reduced in accordance with Section C406.3 where Option 2 of Section C406.1 is used to comply with the requirements of Section C406.
UDZFA = Uncontrolled daylight zone floor area is the sum of all sidelit and toplit zones, calculated in accordance with Sections C405.2.4.2 and C405.2.4.3, that do not have daylight responsive controls.
TBFA = Total building floor area is the sum of all floor areas included in the lighting power allowance calculation in Section C405.3.2.

4. Spaces with lighting power densities no greater than 80 percent of the allowed lighting power density.

15. Section C405 is amended by adding an exception as follows:

C405.12 Energy monitoring.
New buildings with a gross *conditioned floor area* of 25,000 square feet (2322 m^2) or larger shall be equipped to measure, monitor, record and report energy consumption data in compliance with Sections C405.12.1 through C405.12.5.

Exceptions:
1. ~~R-2 occupancies and individual~~ Individual tenant spaces are not required to comply with this section provided that the space has its own utility services and meters and has less than 5,000 square feet (464.5 m2) of *conditioned floor area*.
2. R-2 occupancies are not required to comply with this section.

…

16. Section C405.13 is added:

C405.13 Sub-metering.
In new buildings with tenants, metering shall be collected for the entire building and individually for each tenant occupying 1,000 ft^2 (total enclosed and unenclosed) (93 m^2) or more. Tenants shall have access to data collected for

their space. A tenant is defined as "one who rents or leases from a landlord".

17. Section C503.2.1 is amended as follows:

C503.2.1 Roof replacement
Roof replacements shall comply with Section C402.1.3, C402.1.4, C402.1.5 or C407 where the existing roof assembly is part of the building thermal envelope and contains insulation entirely above the roof deck. In no case shall the R-value of the insulation be reduced, or the U-value of the roof assembly be increased as part of the roof replacement.

Exceptions:

1. Roof membrane aged solar reflectance of ≥0.63 and thermal emittance of 0.75 or an aged SRI of ≥ 75, or
2. Radiant barrier, or
3. Attic ventilation via solar fan(s), ridge ventilation or gable vents, or
4. Roof areas covered by photovoltaic panels or solar thermal collectors, or
5. One or more exceptions in Section C402.3

18. Section R401.4 is added as follows:

R401.4 Sampling
For builders of multiple single family and multi-family units of similar construction type and envelope systems (i.e. production home building)air infiltration/duct testing may be completed by following Chapter 6 of ("standard for Sampled Ratings"), or the current Residential Energy Service Network (RESNET) National Energy rating System Standards.

19. Table R402.1.3 shall be amended as follows:

TABLE R402.1.3
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

CLIMATE ZONE	FENESTRATION U-FACTOR[b,i]	SKYLIGHT U-FACTOR[b]	GLAZED FENESTRATION SHGC[b,e]	CEILING R-VALUE[l]	WOOD FRAME WALL R-VALUE[g,l]	MASS WALL R-VALUE[h]	FLOOR R-VALUE	BASEMENT WALL R-VALUE[c,g]	SLAB[d] R-VALUE & DEPTH	CRAWL SPACE WALL R-VALUE
0-1	NR	0.75	0.25[k]	30[l]	13[l] or 0 and 10ci[l]	¾ or NR[j,l]	NR[l]	0	0	0
2	0.40	0.65	0.25	38	13 or 0 and 10ci	4/6	13	0	0	0
3	0.35	0.55	0.25	38	20 or 13+5[h]	8/13	19	5/13[f]	0	5/13
4 except Marine	0.35	0.55	0.40	49	20 or 13+5[h]	8/13	19	10/13	10, 2 ft	10/13
5 and Marine 4	0.32	0.55	NR	49	20 or 13+5[h]	13/17	30[g]	15/19	10, 2 ft	15/19
6	0.32	0.55	NR	49	20+5[h] or 13+10[h]	15/20	30[g]	15/19	10, 4 ft	15/19
7 and 8	0.32	0.55	NR	49	20+5[h] or 13+10[h]	19/21	30[g]	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U*-factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R*-value of the insulation shall not be less than the *R*-value specified in the table.

b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration. Exception: Skylights may be excluded from glazed fenestration SHGC requirements in climate zones 1 through 3 where the SHGC for such skylights does not exceed 0.30.

c. "5ci or 13" means R-5 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "10ci or 13" means R-10 continuous insulation (ci) on the interior or exterior surface of the wall or R-13 cavity insulation on the interior side of the wall. "15ci or 19 or 13&5ci" means R-15 continuous insulation (ci) on the interior or exterior surface of the wall; R-19 cavity insulation on the interior side of the wall; or R-13 cavity insulation on the interior of the wall in addition to R-5 continuous insulation on the interior or exterior surface of the wall.

d. R-5 shall be added to the required slab edge R-values for heated slabs. Insulation depth shall be the depth of the footing or 2 feet, whichever is less in Climate Zones 1 through 3 for heated slabs.

e. There are no SHGC requirements in the Marine Zone.

f. Basement wall insulation is not required in warm-humid locations as defined by Figure R301.1 and Table R301.1.

g. The first value is cavity insulation, the second value is continuous insulation. Therefore, an example,"13+5" means R-13 cavity insulation plus R-5 continuous insulation.

h. Mass walls shall be in accordance with Section R402.2.5. The second R-value applies where more than half of the insulation is on the interior of the mass wall.

i. A maximum U-factor of 0.32 shall apply in Climate Zones 3 through 8 to vertical fenestration products installed in buildings located either

1. Above 4,000 feet in elevation, or

2. In windborne debris regions where protection of openings is required by Section F301.2.1.2 of the International Residential Code.

j. Exception: Insulation for mass walls is not required if mass walls meet one of the following requirements:

(1) have an area weighted average solar reflectance ≥ 0.39

(2) have an area weighted average light reflectance value≥ 0.64

(3) have overhangs with a projection factor ≥ 0.3

k. Exception: Jalousie windows are exempt from SHGC requirements.

l. Exception: Above-grade walls and roof/ceilings shall be permitted to comply with Section R409.

20. Section R403.5.4 is added to read as follows:

R403.5.4 Solar water heating.
Solar water heating systems are required for new single-family residential construction pursuant to section 196-6.5 HRS.

21. Section R403.13 is added as follows:

R403.13 Ceiling fan or whole-house fan

A ceiling fan or ceiling fan rough-in is provided for bedrooms and the largest space that is not used as a bedroom, or a whole-dwelling fan is provided.

22. Section R407 to be amended as follows:

R407 Tropical Climate Region Compliance Path

R407.1 Scope
This section establishes alternative criteria for residential buildings in the tropical region at elevations less than ~~2,400 feet (731.5 m)~~ 5,000 feet (1,524 m)above sea level.

R407.2 Tropical climate region
Compliance with this section requires the following:

1. Not more than one-half of the ~~occupied space~~ *dwelling unit* is air conditioned.
2. The ~~occupied space~~ *dwelling unit* is not heated.
3. ~~Solar, wind, or other renewable energy source supplies not less than 80 percent of the energy for service water heating.~~ Solar water heating systems provided pursuant to section 196-6.5 HRS.
4. Glazing in ~~conditioned spaces~~ dwelling units has a *solar heat gain coefficient* (SHGC) of less than or equal to ~~0.40, or has an overhang with project factor equal to greater than 0.30~~ the values specified in Table 407.2.

Exceptions:

4.1 Jalousie windows are exempt from SHGC requirements.

4.2 Windows in north-facing walls are exempt from SHGC requirements.

Table R407.2 Glazing SHGC requirements

Projection Factor of overhang from base of average windowsill	SHGC
< .30	.25
.30 - .50	.40
≥.50	N/A

5. Permanently installed lighting is in accordance with Section R404.
6. ~~The exterior roof surface complies with one of the options of Table C402.3 of the *International Energy Conservation Code* – Commercial Provisions or the ceiling has an R-value of R-15 or greater. Where attics are present, attics above the insulation are vented and attics below the insulation are unvented.~~ The roof/ceiling complies with one of the following

options:

a. Comply with one of the roof surfaces options in Table C402.3.
b. Install R-19 insulation or greater.

7. Roof surfaces have a slope of not less than ¼ unit vertical in 12 units horizontal (21-percent slope). The finished roof does not have water accumulation areas.
8. Operable fenestration provides a ventilation area of not less than ~~14~~ 8 percent of the floor area in each room. Alternatively, equivalent ventilation is provided by a ventilation fan.
9. Bedrooms with exterior walls facing two different directions have operable fenestration on exterior walls facing two directions.
10. Interior doors to bedrooms are capable of being secured in the open position.
11. A ceiling fan or ceiling fan rough-in is provided for bedrooms and the largest space that is not used as a bedroom, or a whole-dwelling fan is provided.
12. Walls, floors and ceilings separating air-conditioned spaces from non-air-conditioned spaces shall be constructed to limit air leakage in accordance with the requirements of R402.4.1.1.

23. Section R409 is added as follows:

R409 Points option

R409.1 General Above-grade walls and roof/ceiling assemblies are permitted to comply with the points option as an alternative to complying with Sections R402.1.2, R402.1.3, and R407.

R409.2 Requirements
One or more efficiency measures shall be selected for roof/ceiling and above-grade wall systems from Table 409.1 that cumulatively equal or exceed 0 (zero) points

As an alternative, *above-grade walls* and roof/ceilings are permitted to comply separately by scoring 0 (zero) points or greater.

Table R409.1 Points Option

Walls		Standard Home Points	Tropical Home Points
Wood Framed			
	R—13 Cavity Wall Insulation	0	1
	R—19 Roof/ceiling Insulation	-1	0

	R—19 Roof/ceiling Insulation + Cool roof membrane or Radiant Barrier [3]	0	1
	R—19 Roof/ceiling Insulation + Attic Venting[2]	0	1
	R—30 Roof/ceiling Insulation	0	1
	R—13 Wall Insulation + high reflectance walls[4]	1	2
	R—13 Wall insulation + 90% high efficacy lighting and Energy Star Appliances[5]	1	2
	R—13 Wall Insulation + exterior shading wpf=O.3[6]	1	2
	Ductless Air Conditioner	1	1
	1.071 X Federal Minimum SEER for Air Conditioner	1	1
	1.142 X Federal Minimum SEER for Air Conditioner	2	2
	No air conditioning installed	Not Applicable	2
	House floor area ≤ 1,000 ft^2	1	1
	House floor area ≥ 2,500 ft^2	-1	-1
	Energy Star Fans[8]	1	1
	Install 1 kW or greater of solar electric	1	1
Metal Framed			
	R—13 +R 3 Wall Insulation	0	1
	R—13 cavity Wall insulation + R-0	-1	0
	R—13 Wall Insulation + high reflectance walls[4]	0	1
	R-13 wall insulation+ 90% high efficacy lighting and Energy Star Appliances[5]	1	2
	R-13 Wall Insulation + exterior shading wpf=0.3[6]	0	1
	R-30 Roof/ceiling Insulation	0	1
	R-19 Roof/ceiling Insulation	-1	0
	R-19 + Cool roof membrane[1] or Radiant Barrier[3]	0	1
	R-19 Roof/ceiling Insulation + Attic Venting[2]	0	1
	Ductless Air Conditioner[7]	1	1
	1.071 X Federal Minimum SEER for Air Conditioner	1	1
	1.142 X Federal Minimum SEER for Air Conditioner	2	2

	No air conditioning installed	Not Applicable	2
	House floor areas ≤ 1,000 ft^2	1	1
	House floor areas ≥ 2,500 ft^2	-1	-1
	Energy Star Fans[8]	1	1
	Install 1 kW or greater of solar electric	1	1
	Mass Walls		
	R- 3/4 Wall Insulation	0	1
	R-0 Wall Insulation	-1	0
	R-0 Wall Insulation + high reflectance walls[4]	0	1
	R-0 Wall Insulation + 90% high efficacy lighting and Energy Star Appliances[5]	1	2
	R-0 Wall Insulation + exterior shading WPF = 0.3[6]	0	1
	R-19 Roof/ceiling Insulation	-1	0
	R-19 Roof/ceiling Insulation + Cool roof membrane[1] or Radiant Barrier[3]	0	1
	R-19 Roof Insulation + Attic Venting	0	1
	R-30 Roof Insulation	0	1
	Ductless Air Conditioner[7]	1	1
	1.071 X Federal Minimum SEER for Air Conditioner	1	1
	1.142 X Federal Minimum SEER for Air Conditioner	2	2
	No air conditioning installed	Not Applicable	2
	House floor area ≤ 1,000 ft^2	1	1
	House floor area ≥ 2,500 ft^2	-1	-1
	Energy Star Fans[8]	1	1
	Install 1 kW or greater of solar electric	1	1

1. Cool roof with three-year aged solar reflectance of 0.63 and 3-year aged thermal emittance of 0.75 or 3-year aged solar reflectance index of 75.
2. One cfm/ft^2 attic venting.
3. Radiant barrier shall have an emissivity of no greater than 0.05 as tested in accordance with ASTM E-408. The radiant barrier shall be installed in accordance with the manufacturer's installation instructions.
4. Walls with covering with an area-weighted average solar reflectance of ≥ 0.39 or light reflectance value ≥ 0.64.

5. Energy Star rated appliances include refrigerators, dishwashers, and clothes washers and must be installed for the Certificate of Occupancy.
6. The wall projection factor is equal to the horizontal distance from the surface of the wall to the farthest most point of the overhang divided by the vertical distance from the first-floor level to the bottom most point of the overhang.
7. All air conditioning systems in the house must be ductless to qualify for this credit.
8. A ceiling fan is provided for bedrooms and the largest space that is not used as a bedroom or a whole-house fan.

24. Section R503.1.1 is amended to read as follows:

R503.1.1 Building envelope.
Building envelope assemblies that are part of the *alteration* shall comply with Section R402.1.2 or R402.1.4, Sections R402.2.1 through R402.2.12, R402.3.1, R402.3.2, R402.4.3 and R402.4.5.

Exception: The following alterations shall not be required to comply with the requirements for new construction provided that the energy use of the building is not increased:

1. Storm windows installed over existing fenestration.
2. Existing ceiling, wall or floor cavities exposed during construction provided that these cavities are filled with insulation.
3. Construction where the existing roof, wall or floor cavity is not exposed.
4. Roof recover.
5. Roofs without insulation in the cavity and where the sheathing or insulation is exposed during reroofing shall be insulated either above or below the sheathing.

   Exceptions:

   5.1 Meet two or more of the following:

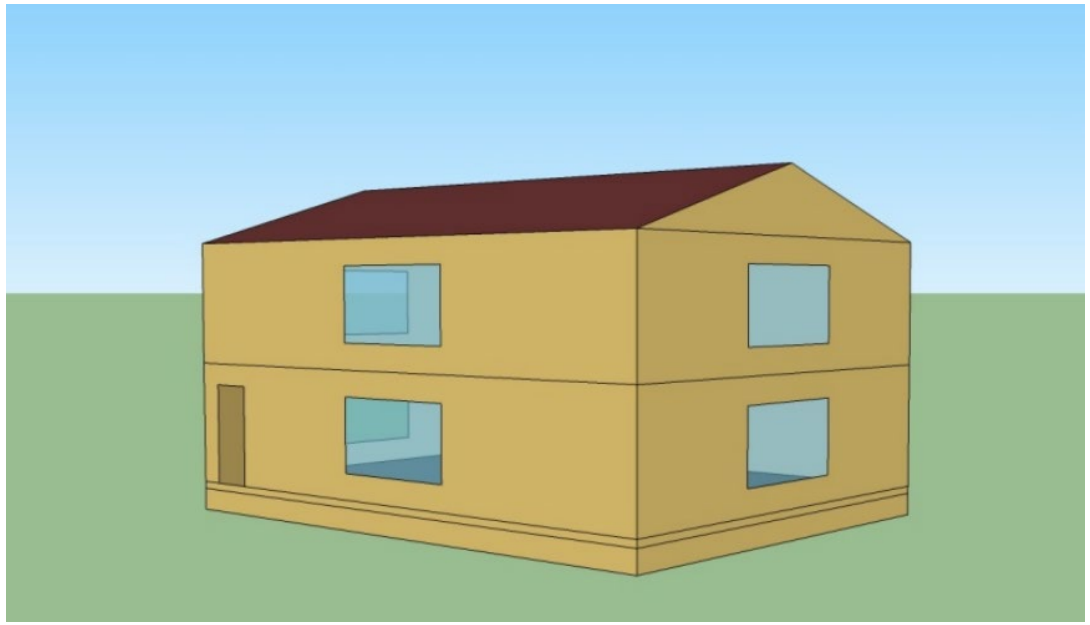
   1. Energy Star compliant roof covering,
   2. Radiant barrier,
   3. Attic ventilation via solar attic fans or ridge ventilation of gable ventilation; or
   4. A minimum of one exception listed in C402.3.

6. Surface-applied window film installed on existing single-pane fenestration assemblies to reduce solar heat gain

provided that the code does not require the glazing or fenestration assembly to be replaced.

2021 IECC single-family prototype

Conditioned floor area	2,376 ft^2
Gross exterior wall area	2,380 ft^2
Window area	15% of floor area
Floor type	Slab on grade
Internal gains	86,761 Btu/day
Cooling system	Central electric air conditioning SEER 14

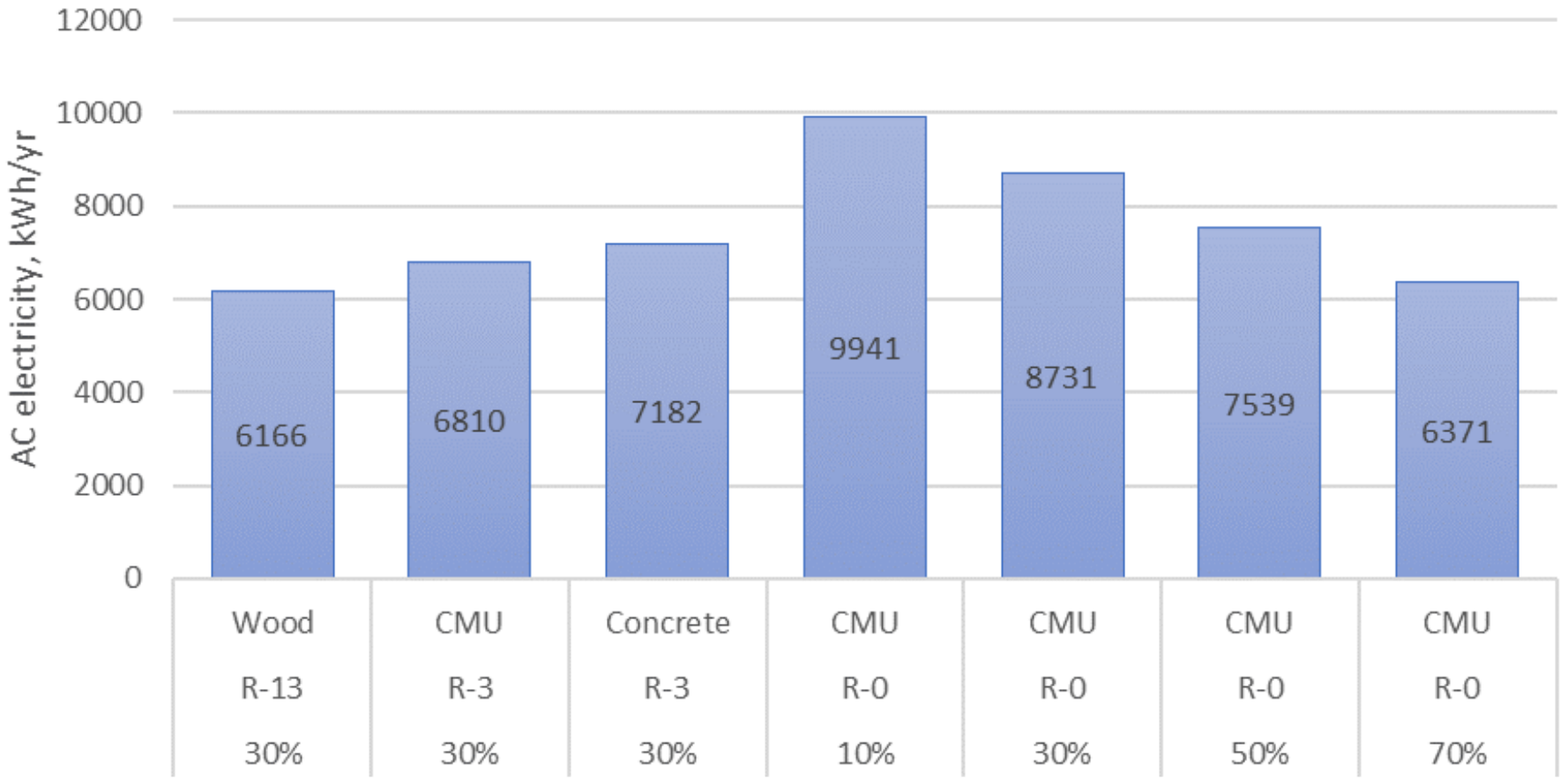


Exterior wall alternatives

Construction	Insulation	U-factor	Solar Reflectance
Wood frame	R-13 cavity	0.087	30%
8” CMU, partially grouted	R-3 exterior	0.197	30%
6” concrete	R-3 exterior	0.233	30%
8” CMU, partially grouted	None	0.483	10%
8” CMU, partially grouted	None	0.483	30%
8” CMU, partially grouted	None	0.483	50%
8” CMU, partially grouted	None	0.483	70%

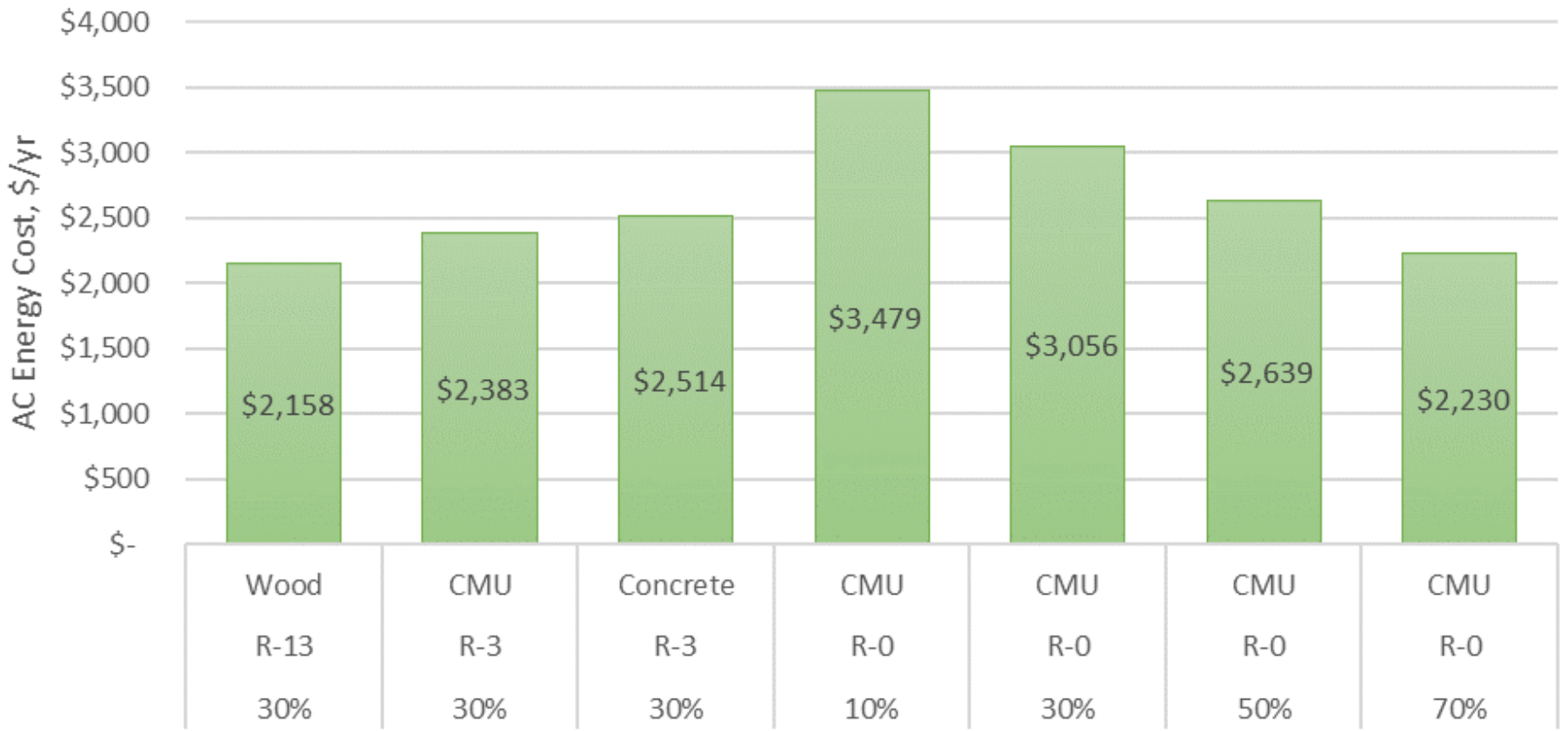
Simulated air conditioning electricity

With Honolulu TMY3 weather



Simulated air conditioning energy cost (@$0.35/kWh)

With Honolulu TMY3 weather



Simulated air conditioning energy cost (@$0.35/kWh)

With Honolulu TMY3 weather