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SUBJECT: State Energy Code Adoption
Adopting the 2021 International Energy Conservation Code
(IECC) and Amendments

The attached document is the proposed Hawai'i State Energy Code Amendments to the 2021 IECC to be reviewed by the State Building Code Council in accordance with HRS 107-24.

The design of all State building construction must comply with the 2021 IECC and attached amendments to the code, in accordance with HRS 107-27.

Each county in the State of Hawai'i must amend and adopt the 2021 IECC and attached amendments to the code, in accordance with HRS 107-28(a).

State Building Code Council

Attached: Hawai'i State Energy Code Amendments to the 2021 IECC

Hawai'i State Energy Code

**Amendments to the
2021 International Energy Conservation Code**

State Building Code Council

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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. **C101.1 Title** 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. **C103 General**

IECC sections C103 through C105 are hereby deleted in their entirety.

Justification: Requested by building code officials.

8. **C402.1.1 Low-energy buildings and greenhouses** is amended to read as follows:

The following low-energy buildings, or portions thereof separated from the remainder of the building by *building thermal envelope* assemblies complying with this section, shall be exempt from the *building thermal envelope* provisions of Section C402.

1. Those with a peak design rate of energy usage less than 3.4 Btu/h × ft² (10.7 W/m²) or 1.0 watt per square foot (10.7 W/m²) of floor area for space conditioning purposes.
2. Those that do not contain [~~conditioned space~~] habitable space.

Justification: Uninsulated spaces often rise to uncomfortable temperatures and require the installation of air conditioning systems.

9. **Table C402.1.3 Opaque thermal envelope components minimum R-value method. Footnote h** is added to read 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 + R-11 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	R-13 + 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 or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-20	R-13 + R-3.8ci or R-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	NR	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, wood-framed and other walls, may be substituted with an area-weighted average solar reflectance of >0.39 or when an overhang of 0.3 or greater projection factor is provided.

Justification: An eight-inch uncoated masonry wall has an R-value of 1.11. Requiring a moderate, area-weighted solar reflectance will provide heat mitigation.

Source: Solar Reflective “Cool” Wall Benefits, Technologies, and implementation. Lawrence Berkeley Laboratories, October 2017, <https://www.energy.ca.gov/publications/2019/solar-reflective-cool-walls-benefits-technologies-and-implementation>, pp. 11-12, Final Project Report

Source: Mark McGinley Alternative Energy Code Compliant Designs for Single Wythe. https://www.masonryhawaii.com/download/presentations/2020_03-session_1-energy_code_compliance.pdf, slides 45-46

10. **Table C402.3, Minimum solar reflectance and emittance values, low-sloped roofs** is amended to read as follows:

Three-year-aged solar reflectance ^b of [55] <u>63</u> and 3-year aged thermal emittance of 0.75
Three-year-aged solar reflective index ^d of [64] <u>75</u>

Justification: The current reflectance values were written in 2014. Reflective coatings have since improved significantly to reduce heat gain and are readily available at moderate prices. The current values reflect the values of California’s 2021 Title 24.

Source: Cool Walls Manhattan Project https://coolroofs.org/documents/Ronnen-Levinson_2022-AGM-Presentation.pdf, slide 3

Available cool roof products listed with Cool Roof Rating Council: <https://coolroofs.org/directory>

11. **Table C402.4 Building Envelope Fenestration Maximum U-Factor and SHGC Requirements** is amended to read as follows:

Exemption: Jalousie windows are exempted from U-factor and SHGC requirements.

Justification: This provision is included in Hawai’i’s 2018 IECC. Jalousie windows offer nearly 100 percent free ventilation area and afford occupants the opportunity to cool with natural ventilation.

12. **C402.4.3.4. Area-weighted U-factor** is amended to read as follows:

Area-weighted averages 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.

Justification: In Hawai'i, SHGC is commonly used as the fenestration performance measure to mitigate heat transfer from solar radiation.

- 13. C403.7.6.1 Temperature setpoint controls** is amended by adding control #4, as follows:

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."

Justification: Exterior doors to lanais are very common in Hawai'i's high rise residential units. Occupants often tend to leave them open, allowing in hot humid air. Establishing a high setpoint motivates guests to promptly close exterior doors.

- 14. C405.2.4 Daylight-responsive controls** is amended by adding controls option #4 as follows:

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.

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

(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.

Justification: *Lighting controls add to upfront costs and often yield minimal energy savings. Lowering the lighting power density by twenty percent guarantees savings for the duration of the time of use, including during peak demand hours.*

Source: LED Lighting | Department of Energy

<https://www.energy.gov/energysaver/led-lighting>, p.1-2

15. C405.12.2 End-use metering categories is amended to read as follows:

Meters or other approved measurement devices shall be provided to collect energy use data for each end-use category indicated in Table C405.12.2. Where multiple meters are used to measure any end-use category, the data acquisition system shall total all of the energy used by that category. Not more than 5 percent of the measured load for each of the end-use categories indicated in Table C405.12.2 shall be permitted to be from a load that is not within that category.

Exceptions:

1. HVAC and water heating equipment serving only an individual dwelling unit shall not require end-use metering.
2. End-use metering shall not be required for fire pumps, stairwell pressurization fans or any system that operates only during testing or emergency.
3. End-use metering shall not be required for an individual tenant space having a floor area not greater than ~~[2,500]~~ 1,000 square feet ~~[232-m²]~~ 93.2 m² where a dedicated source meter complying with Section C405.12.3 is provided.

Justification: Requiring submetering to 1,000 sq. ft. units ensures that more tenants will be responsible for their energy consumption and be motivated to reduce consumption accordingly.

16. C406.3.1, C406.3.2 and C406.3.3 are amended to read as follows:

C406.3.1 Reduced lighting power by more than ~~[10]~~20 percent

The total connected interior lighting power calculated in accordance with Section C405.3.1 shall be less than ~~[90]~~ 80 percent of the total lighting power allowance calculated in accordance with Section C405.3.2.

C406.3.2 Reduced lighting power by more than ~~[15]~~25 percent

Where the total connected interior lighting power calculated in accordance with Section C405.3.1 is less than ~~[85]~~ 75 percent of the total lighting power allowance calculated in accordance with Section C405.3.2, additional energy efficiency credits shall be determined based on Equation 4-13, rounded to the nearest whole number.

$$\begin{aligned} AEEC_{LPA} &= AEEC_{10} \times 10 \times (LPA - LPD) / LPA \\ AEEC_{LPA} &= AEEC_{20} * 5 * (LPA - LPD) / LPA \end{aligned}$$

(Equation 4-13)

where:

$AEEC_{LPA}$ = Section C406.3.2 additional energy efficiency credits.

$AEEC_{\pm 0} 20$ = Section C406.3.1 credits from Tables C406.1(1) through C406.1(5).

LPA = Total lighting power allowance calculated in accordance with Section C405.3.2.

LPD = Total connected interior lighting power calculated in accordance with Section C405.3.1.

C406.3.3 Lamp efficacy

Not less than 95 percent of the permanently installed lighting, excluding kitchen appliance light fixtures, serving dwelling units and sleeping units shall be provided by lamps with an efficacy of not less than ~~[65]~~ 75 lumens per watt or luminaires with an efficacy of not less than ~~[45]~~ 55 lumens per watt. Standard tubular four-foot lamps shall have an efficacy of not less than 120 lumens per watt.

***Justifications for C406.3, C406.3.2 and C406.3.3:** LED efficacy has improved steadily, rendering the higher efficacy specifications readily achievable at no additional cost.*

Source: LED Lighting | Department of Energy

<https://www.energy.gov/energysaver/led-lighting>. pp. 1-2

DOE proposal more than doubles minimum efficacy of general service lamps

[https://www.ledsmagazine.com/manufacturing-services-testing/article/14287756/doe-proposal-more-than-doubles-minimum-efficacy-of-general-service-lamps?utm_source=LED+News+%26+Insights&utm_medium=email&utm_campaign=CPS230103043&o_eid=6767F4112945F3Z&rdx.ident\[pull\]=omeda|6767F4112945F3Z&oly_enc_id=6767F4112945F3z](https://www.ledsmagazine.com/manufacturing-services-testing/article/14287756/doe-proposal-more-than-doubles-minimum-efficacy-of-general-service-lamps?utm_source=LED+News+%26+Insights&utm_medium=email&utm_campaign=CPS230103043&o_eid=6767F4112945F3Z&rdx.ident[pull]=omeda|6767F4112945F3Z&oly_enc_id=6767F4112945F3z)

17. C409 Electric Vehicle Efficiency is added to read as follows:

"C409 Electric vehicle infrastructure. All newly created parking stalls for newly constructed residential multi-unit and commercial buildings must comply with one of the electric vehicle readiness compliance pathways specified in Section C409.1 (Prescriptive) or Section C409.2 (Point-based). For purposes of Section C409.1, Section C409.2, and Tables C409.1 and C409.2, the following apply:

1. **"Common area stall"** means any parking stall that is not intended to be assigned, sold, leased, or attached contractually to a specific dwelling unit or commercial establishment.
2. **"Dedicated stall"** means any parking stall that is intended to be assigned, sold, leased, or attached contractually to a specific dwelling unit or commercial establishment; and
3. When computation of the number of required vehicle charger ready stall results in a fractional number with a fraction of 0.5 or greater, the number of required vehicle charger ready stalls required will be the next highest whole number.

C409.1 Baseline percentage electric vehicle readiness compliance path.

Newly constructed parking stalls for residential multi-unit buildings that add eight or more new parking stalls must be electric vehicle charger ready for at least 25 percent of the newly added parking stalls. Newly constructed parking stalls for commercial buildings that add 12 or more new parking stalls must be electric vehicle charger ready for at least 25 percent of the newly added parking stalls. Construction Plans must reflect these developments.

Exceptions:

1. For retail uses, the total number of newly-added parking stalls that must be electric vehicle charger ready is reduced by 20 percent, rounding up to the next whole number.
2. For affordable housing units offered for sale, the total number of newly-added parking stalls that must be electric vehicle charger is reduced by 20 percent, rounding up to the next whole number.
3. For affordable housing units offered for rent, none of the total number of newly-added parking stalls are required to be electric vehicle charger ready.

Table C409.1
CHARGE METHODS ELECTRICAL RATING

<u>Charge Method</u>	<u>Normal Supply Voltage (Volts)</u>	<u>Maximum Current (Amps - Continuous)</u>	<u>Supply power</u>
<u>AC Level 2 (enclosed attached residential garages only)</u>	<u>208 to 240V AC, 1-phase</u>	<u>Minimum 16A</u>	<u>208/240V AC/20-100A (16-80A continuous)</u>
<u>AC Level 2</u>	<u>208 to 240V AC, 1-phase</u>	<u>Minimum 32A</u>	<u>208/240V AC/40-100A (32-80A continuous)</u>

C409.2 Points-based electric vehicle readiness compliance path. Newly constructed parking stalls for residential multi-unit buildings that add eight or more parking stalls must be equipped to achieve no less than one point for every four parking stalls based on the EV charger capacity requirements and values listed in Table C409.2. Newly constructed parking stalls for commercial buildings that add twelve or more parking stalls must be equipped to achieve no less than one point for every four parking stalls based on the capacity requirements and values listed in Table C409.2. Construction plans must demonstrate that the stalls are equipped to achieve no less than one point for every four parking stalls based on the capacity requirements and values listed in Table C409.2. Retail establishments, as defined in ROH Chapter 21, may only qualify for compliance points under Table C409.2 in the following two categories:

1. Dedicated EV Ready Stalls, or

2. Common Area Stall with EV Charging Equipment Installed

Exceptions:

1. For retail uses, the total number of points that would otherwise be required to comply with the points-based requirements under this subsection will be reduced by 20 per cent.
2. For affordable housing units offered for sale, the total number of points that would otherwise be required to comply under this subsection will be reduced by 20 per cent. 3. For affordable housing units offered for rent, no points under this subsection will be required.

Table C409.2
ELECTRIC VEHICLE READINESS POINT-BASED COMPLIANCE VALUES

<u>Electric Vehicle Charger Capacity Level</u>	<u>Charging Rate (kW) at 208 Vac</u>	<u>Time to charge 50 kW battery (hrs)</u>	<u>Compliance Points</u>		
			<u>Dedicated EV Ready Stalls</u>	<u>Common Area EV Ready Stalls</u>	<u>Common Area Stall w/ EV Charging Equipment Installed</u>
<u>Level 2, Minimum 16A</u>	<u>3.4</u>	<u>15</u>	<u>1</u> <u>(in enclosed attached garage)</u>	<u>N/A</u>	<u>N/A</u>
<u>Level 2, Minimum 32A</u>	<u>6.7</u>	<u>7.5</u>	<u>1</u>	<u>4</u>	<u>7</u>
<u>Level 2, 64A to 80A</u>	<u>13.3</u>	<u>3.8</u>	<u>1</u>	<u>7</u>	<u>14</u>
<u>DCFC 50 kW (480/277 Vac 3-phase)</u>	<u>50.0</u>	<u>1.0</u>	<u>1</u>	<u>25</u>	<u>50</u>

Justification: The shift from gasoline-burning vehicles to electric vehicles is essential to achieving a carbon-free economy. Installing electric-vehicle-ready connections at the time of construction costs a fraction of post-construction installations. Allowance is made for low-income residences. Modeled on City and County of Honolulu Ordinance 20-10, 2020.

Source: Resilience Office, City and County of Honolulu
<https://static1.squarespace.com/static/5e3885654a153a6ef84e6c9c/t/6139768b7192cb11bb99ce90/1631155852707/EV-Ready+Compliance+Guide+%26+FAQ+Combined+%28September+2021%29.pdf>

18. **C501.2 Compliance**, is amended to read as follows:

~~[Additions, alterations, repairs, and changes of occupancy to, or relocation of, existing buildings and structures shall comply~~

~~with Sections C502, C503, C504 and C505 of this code, as applicable, and with the provisions for alterations, repairs, additions and changes of occupancy or relocation, respectively, in the International Building Code, International Existing Building Code, International Fire Code, International Fuel Gas Code, International Mechanical Code, International Plumbing Code, International Property Maintenance Code, International Private Sewage Disposal Code and NFPA 70. Changes where unconditioned space is changed to conditioned space shall comply with Section C502.~~

~~Exception: Additions, alterations, repairs or changes of occupancy complying with ANSI/ASHRAE/IESNA 90.1.]~~

C501.2 Alterations, repairs, additions, and changes of occupancy to, or relocation if, existing buildings and structures shall comply with the provisions and regulations for alterations, repairs, additions and changes of occupancy or relocations as adopted by the authorities having jurisdiction.

Justification: Requirements from Hawai'i's 2018 IECC amendments.

19. C503.2.1 Existing Buildings

Roof replacement is amended to read 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
5. One or more exceptions in Section C402.3

Justification: Reflective coatings have increased in performance and decreased in price. Offering the option of specifying high reflectance values lowers construction costs while achieving substantial energy savings. Exceptions 2, 3, 4 and 5 replicated from Hawai'i's 2018 IECC.

Source: Cool Roofs | Department of Energy

<https://www.energy.gov/energysaver/cool-roofs>, pp. 1-2

20. R401.4 Sampling is added as follows:

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.

Justification: *Replicated from Hawai'i's 2018 IECC.*

21. R402.1 General

Building thermal envelope shall comply with the requirements of Sections R402.1.1 through R402.1.5.

Exceptions: R402.1 is amended to read as follows:

1. The following low-energy *buildings*, or portions thereof, separated from the remainder of the building by *building thermal envelope* assemblies complying with this section shall be exempt from the *building thermal envelope* provisions of Section R402.
 - 1.1 Those with a peak design rate of energy usage less than 3.4 Btu/h × ft² (10.7 W/m²) or 1.0 watt/ft² of floor area for space-conditioning purposes.
 - 1.2 Those that do not contain [~~conditioned~~] habitable space.
2. Log homes designed in accordance with ICC 400.

Justification: *Uninsulated residences often become sufficiently uncomfortable to justify the installation of air conditioning systems and commensurate increase in energy use.*

Source: *The Importance Of Thermal Insulation In Hot Climates*
<https://almanaratain.com/the-importance-of-thermal-insulation-in-hot-climates/>, pp. 1-2

22. Table R402.1.3 Insulation minimum R-values and fenestration requirements by component is amended by adding Footnotes "i" (mass walls) "j" (jalousie windows) "k" (floor insulation) and "l" (Section 407).

TABLE R402.1.3
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT^a

CLIMATE ZONE	FENESTRATION U-FACTOR ^b	SKYLIGHT ^b U-FACTOR	GLAZED FENESTRATION SHGC ^{b,e}	CEILING R-VALUE	WOOD FRAME WALL R-VALUE	MASS WALL R-VALUE	FLOOR R-VALUE	BASEMENT WALL R-VALUE	SLAB ^d R-VALUE & DEPTH	CRAWL SPACE WALL R-VALUE
0-1	NR	0.75	0.25 ^j	30 ^l	13 ^l	$\frac{3}{4}$ or NR ^{i,1}	NR ^k	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 13+10 13+5 ⁵	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 13+10 13+5 ⁵	19/21	30 ^g	15/19	10, 4 ft	15/19

For SI: 1 foot = 304.8 mm.

- 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.
- 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.
- "15/19" means R-15 continuous insulation on the interior or exterior of the home or R-19 cavity insulation at the interior of the basement wall. "15/19" shall be permitted to be met with R-13 cavity insulation on the interior of the basement wall plus R-5 continuous insulation on the interior or exterior of the home. "10/13" means R-10 continuous insulation on the interior or exterior of the home or R-13 cavity insulation at the interior of the basement wall.
- 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. Therefore, as an example, "3/4" means R-4 cavity insulation is on the interior of the mass wall.
- i. Exception: R-values for mass walls are not required if mass walls meet one of the following requirements:
 - (1) have a solar reflectance ≥ 0.39 or greater,
 - (2) have overhangs with a projection factor ≥ 0.3 ,

Justification, footnote j: *An eight-inch uncoated masonry wall has an R-value of 1.11. Requiring a moderate, area-weighted solar reflectance will provide a moderately improved R-value.*

Source: Solar Reflective "Cool" Wall Benefits, Technologies, and implementation. Lawrence Berkeley Laboratories, October 2017,
<https://www.energy.ca.gov/publications/2019/solar-reflective-cool-walls-benefits-technologies-and-implementation>, pp. 11-12, Final Project Report

Source: Mark McGinley Alternative Energy Code Compliant Designs for Single Wythe.
https://www.masonryhawaii.com/download/presentations/2020_03-session_1-energy_code_compliance.pdf, slides 45-46

Source: *Insulating Concrete Block Concrete Construction*, July 1988

- j. Exemption: Jalousie windows are exempt from SHGC requirements.

Justification, footnote k: *Jalousie windows are included in Hawai'i's 2018 IECC. Jalousie windows offer nearly 100 percent free vent area and afford occupants the opportunity to ventilate at no energy cost.*

- k. Exception: Floor insulation is not required in climate zone 0 or 1.

Justification, footnote l: *Floor insulation is not necessary in Hawai'i where the outdoor/indoor temperature is on average some ten degrees F. Throw rugs or mats provide suitable comfort and the cost of construction is reduced.*

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

***Justification, footnote m:** Section R409 is an integral component of Hawai'i's amended IECC and offers a points-based option of compliance with roof and wall requirements.*

23. R402.3.2 Glazed Fenestration SHGC is amended to read as follows:

Exception: Jalousie windows are excepted from SHGC requirements.

***Justification:** The jalousie window provision is included in Hawai'i's 2018 IECC.*

24. R403.5.4 Solar water heating 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.

***Justification:** Included in Hawai'i revised statutes and incorporated into Hawai'i's 2021 IECC.*

https://www.capitol.hawaii.gov/hrscurrent/Vol03_Ch0121-0200D/HRS0196/HRS_0196-0006_0005.htm

25. R404 Electric Power and Light Systems

Solar conduit and electrical panel readiness is added to read as follows:

"R404.4 Solar conduit and electrical panel readiness. Requires new homes to include plans for solar PV equipment and install conduit and reserve panel capacity for future PV installation. Construction documents shall indicate a location for inverters, metering equipment, battery equipment, energy storage equipment, and other equipment necessary to interconnect a residence with on-site solar energy generation facilities with the electrical grid in compliance with applicable laws, statutes, and utility tariffs. Construction documents shall indicate a pathway for routing of conduit from the solar panel location to the point of interconnection with electrical service. New single-family detached dwellings, two-family detached dwellings, and duplexes shall install for each residence an electrical panel with reserved space to accommodate not less than a five Kilowatt (AC) photovoltaic system. New multifamily dwellings shall install an electrical panel that includes space reserved to accommodate a photovoltaic system: (1) sized to serve common area electrical loads, or (2) sized to the roof space available. The reserved space shall be clearly labeled as solar PV ready. All feeders and electrical distribution equipment, including switchgear, switchboards, and panel boards that will be fed simultaneously by the electrical grid and other power sources shall be sized to support the installation of future solar energy generation systems per the interconnection requirements of the Electrical Code. New residential buildings shall also install conduit not less than one and one-half inches to provide a pathway from the electrical panel to the inverter

location and from the inverter location to the underside of the roof sufficient to allow future installation of solar equipment. If conduits are to be installed between separate buildings or other structures, construction documents shall provide sufficient details to show that compliance with the Electrical Code's restrictions on the number of power supplies to each building or other structure has been examined."

Justification: *Achieving a decarbonized economy requires that photovoltaic systems be installed where economically feasible. Providing photovoltaic-ready connections at the time of construction costs a fraction of post-construction installation. Modeled on City and County of Honolulu Ordinance 20-10, 2020.*

Source: *City and County of Honolulu Ordinance 20-10.*
https://energy.hawaii.gov/wp-content/uploads/2020/07/HonoluluCounty_EnergyCode.pdf

26. R407 Tropical Climate Region Compliance Path

Sections R407.1 (4), (8), (11), and (12) are amended as follows:

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) above sea level.

R407.2 Tropical climate region is amended to read as follows:
Compliance with this section requires the following:

1. Not more than one-half of the dwelling unit is air conditioned.
2. The dwelling unit is not heated.
3. Solar, wind, or other renewable energy source supplies not less than 90 percent of the energy for service water heating.
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 as 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

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

5. Permanently installed lighting is in accordance with Section R404.
6. 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 minimum slope of ¼ inch per foot of run. 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.

Justification: Builders report that more tropical code-compliant homes would be specified if the ventilation area were 8 percent, provided that adequate ventilation is provided.

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

Justification: The installation of rough-ins or junction boxes for ceiling fans often result in only a fraction of homeowners installing fans and enjoying the savings achieved by using fans only during cool periods. Whole house fans are offered as an equally cost-effective option. Economic analysis attached.

Source: Cost-effectiveness Analysis, Ceiling Fans vs. Split Systems
<https://energy.hawaii.gov/wp-content/uploads/2023/01/PNNLHI-State-Tech-Assistance-request.pdf>

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.

Justification: Ensure tight sealing between conditioned and non-conditioned spaces.

27. **R409 Points option** is amended as follows:

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 R401.2.1 and R402.2.

R409.2 Requirements

Section R409.2 is added as follows: 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)] 2 (two) points.

As an alternative, above-grade walls and roof/ceilings are permitted to comply separately by scoring [~~0~~ (zero)] 2 (two) points or greater."

Table R409.1 Points Option

<u>Walls</u>		<u>Standard Home Points</u>	<u>Tropical Home Points</u>
<u>Wood Framed</u>			
	<u>R-13 Cavity Wall Insulation</u>	<u>0</u>	<u>1</u>
	<u>R-19 Roof/ceiling Insulation</u>	<u>-1</u>	<u>0</u>
	<u>R-19 Roof/ceiling Insulation + Cool roof membrane or Radiant Barrier³</u>	<u>0</u>	<u>1</u>
	<u>R-19 Roof/ceiling Insulation + Attic Venting²</u>	<u>0</u>	<u>1</u>
	<u>R-30 Roof/ceiling Insulation</u>	<u>0</u>	<u>1</u>
	<u>R-13 Wall Insulation + high reflectance walls⁴</u>	<u>1</u>	<u>2</u>
	<u>R-13 Wall insulation + 90% high efficacy lighting and Energy Star Appliances⁵</u>	<u>1</u>	<u>2</u>
	<u>R-13 Wall Insulation + exterior shading wpf=0.3⁶</u>	<u>1</u>	<u>2</u>
	<u>Ductless Air Conditioner</u>	<u>1</u>	<u>1</u>
	<u>1.071 X Federal Minimum SEER for Air Conditioner</u>	<u>1</u>	<u>1</u>
	<u>1.142 X Federal Minimum SEER for Air Conditioner</u>	<u>2</u>	<u>2</u>
	<u>No air conditioning installed</u>	<u>Not Applicable</u>	
	<u>House floor area ≤ 1,000 ft²</u>	<u>1</u>	<u>1</u>

	<u>House floor area $\geq 2,500 \text{ ft}^2$</u>	<u>-1</u>	<u>-1</u>
	<u>Energy Star Fans⁸</u>	<u>1</u>	<u>1</u>
	<u>Install 1 kW or greater of solar electric</u>	<u>1</u>	<u>1</u>
<u>Metal Framed</u>			
	<u>R-13 +R 3 Wall Insulation</u>	<u>0</u>	<u>1</u>
	<u>R-13 cavity Wall insulation + R-0</u>	<u>-1</u>	<u>0</u>
	<u>R-13 Wall Insulation + high reflectance walls⁴</u>	<u>0</u>	<u>1</u>
	<u>R-13 wall insulation+ 90% high efficacy lighting and Energy Star Appliances⁵</u>	<u>1</u>	<u>2</u>
	<u>R-13 Wall Insulation + exterior shading wpf=0.3⁶</u>	<u>0</u>	<u>1</u>
	<u>R-30 Roof/ceiling Insulation</u>	<u>0</u>	<u>1</u>
	<u>R-19 Roof/ceiling Insulation</u>	<u>-1</u>	<u>0</u>
	<u>R-19 + Cool roof membrane¹ or Radiant Barrier³</u>	<u>0</u>	<u>1</u>
	<u>R-19 Roof/ceiling Insulation + Attic Venting²</u>	<u>0</u>	<u>1</u>
	<u>Ductless Air Conditioner⁷</u>	<u>1</u>	<u>1</u>
	<u>1.071 X Federal Minimum SEER for Air Conditioner</u>	<u>1</u>	<u>1</u>
	<u>1.142 X Federal Minimum SEER for Air Conditioner</u>	<u>2</u>	<u>2</u>
	<u>No air conditioning installed</u>	<u>Not Applicable</u>	<u>2</u>
	<u>House floor areas $\leq 1,000 \text{ ft}^2$</u>	<u>1</u>	<u>1</u>
	<u>House floor areas $\geq 2,500 \text{ ft}^2$</u>	<u>-1</u>	<u>-1</u>
	<u>Energy Star Fans⁸</u>	<u>1</u>	<u>1</u>
	<u>Install 1 kW or greater of solar electric</u>	<u>1</u>	<u>1</u>
<u>Mass Walls</u>			
	<u>R- 3/4 Wall Insulation</u>	<u>0</u>	<u>1</u>
	<u>R-0 Wall Insulation</u>	<u>-1</u>	<u>0</u>
	<u>R-0 Wall Insulation + high reflectance walls⁴</u>	<u>0</u>	<u>1</u>
	<u>R-0 Wall Insulation + 90% high efficacy lighting and</u>	<u>1</u>	<u>2</u>

	<u>Energy Star Appliances⁵</u>		
	<u>R-0 Wall Insulation + exterior shading WPF = 0.3⁶</u>	<u>0</u>	<u>1</u>
	<u>R-19 Roof/ceiling Insulation</u>	<u>-1</u>	<u>0</u>
	<u>R-19 Roof/ceiling Insulation + Cool roof membrane¹ or Radiant Barrier³</u>	<u>0</u>	<u>1</u>
	<u>R-19 Roof Insulation + Attic Venting</u>	<u>0</u>	<u>1</u>
	<u>R-30 Roof Insulation</u>	<u>0</u>	<u>1</u>
	<u>Ductless Air Conditioner⁷</u>	<u>1</u>	<u>1</u>
	<u>1.071 X Federal Minimum SEER for Air Conditioner</u>	<u>1</u>	<u>1</u>
	<u>1.142 X Federal Minimum SEER for Air Conditioner</u>	<u>2</u>	<u>2</u>
	<u>No air conditioning installed</u>	<u>Not Applicable</u>	<u>2</u>
	<u>House floor area $\leq 1,000 \text{ ft}^2$</u>	<u>1</u>	<u>1</u>
	<u>House floor area $\geq 2,500 \text{ ft}^2$</u>	<u>-1</u>	<u>-1</u>
	<u>Energy Star Fans⁸</u>	<u>1</u>	<u>1</u>
	<u>Install 1 kW or greater of solar electric</u>	<u>1</u>	<u>1</u>

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/ft² 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 .
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.

Justification: *Building technologies have improved since the section was written. Achieving two points is readily achievable in a cost-effective manner.*

28. R503 Building Alterations

R503.1.1.(5) is amended to read as follows:

"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:

- 1.1 Energy Star compliant roof covering,
- 1.2 Radiant barrier,
- 1.3 Attic ventilation via solar attic fans or ridge ventilation of gable ventilation; or
- 1.4 A minimum of one exception listed in C402.3.

Justification: *Technological improvements allow achievement of two points or more at little or no cost.*

- 5.2. Shake roofs on battens that are replaced with materials that result in equal or improved energy efficiency."

Justification: *According to the Hawaii Roofing Contractors Association, additional insulation measures are not feasible for shake roofs on battens.*