# Building Energy Codes 101: The Basics of Building Energy Codes and Standards

Building energy codes and standards (energy codes) are an effective policy tool for improving a building's energy efficiency, moderating energy system costs, enhancing energy reliability and resilience by reducing system stresses, and decreasing greenhouse gas and other pollutant emissions from both electricity generation and onsite fuel use. Energy codes establish the minimum legal energy efficiency level to which a new building can be built and existing buildings must achieve following major renovations, repairs, or changes in occupancy in a jurisdiction (which may be a state, city, county, or town, depending on political structures of a state).

This document introduces the basics of energy codes and standards, State Energy Office roles, and briefly address how codes and standards apply to manufactured and modular housing. This introductory document on energy codes is the first in a series of NASEO documents that will cover specific elements of energy codes in more detail.

**About this series**
This is the first document in a series of short explainers about building energy codes and standards. It is intended for use by State and Territory Energy Office[1] Directors, staff, and others who wish to learn more about energy codes. The series will provide readers with a basic understanding of energy codes, the role of State Energy Offices and other state or local government entities, and opportunities and limitations for using building energy codes to achieve state energy efficiency and pollution reduction goals.

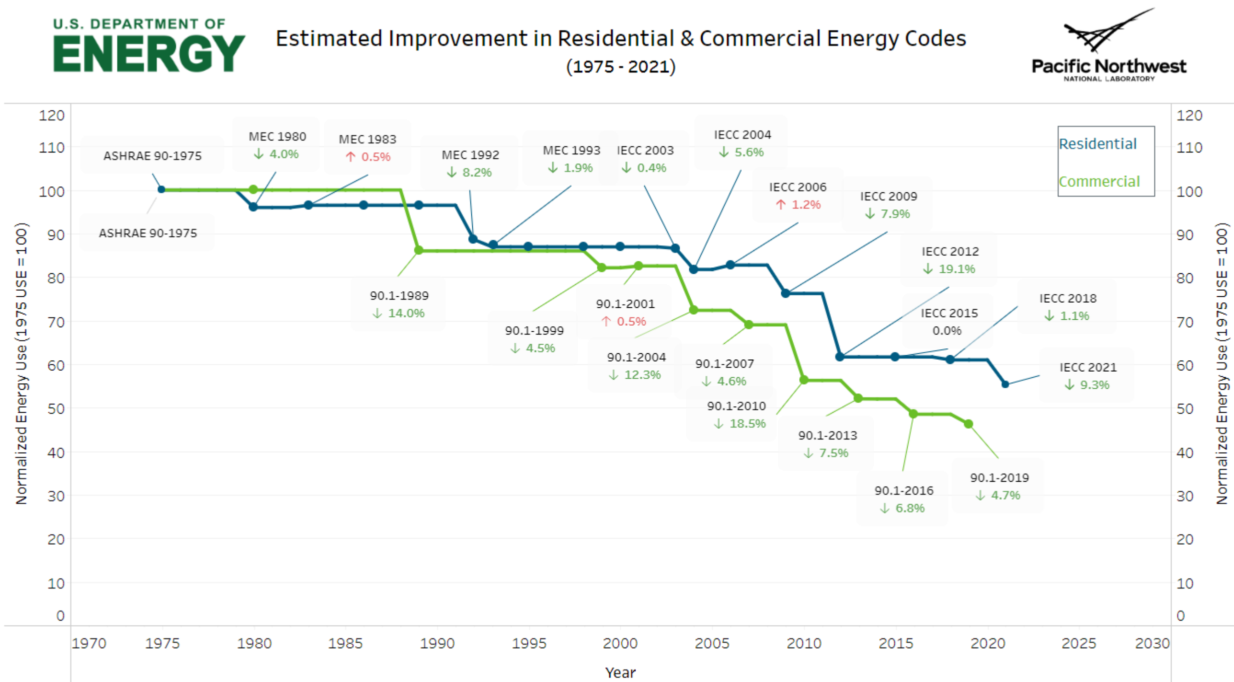
## Model Energy Codes and Standards

There are two primary energy codes and standards used in the United States the ***International Energy Conservation Code (IECC)***[1] and ***ANSI/ASHRAE/IES Standard 90.1 (ASHRAE 90.1)***[2]. The IECC is one of fifteen International Codes (I-Codes) published by the ***International Code Council (ICC)***, which steers and appoints a volunteer committee of energy code stakeholders to develop the code provisions. ASHRAE Standard 90.1 is published by ***ASHRAE***, a professional association of heating, cooling, ventilation, and refrigeration industry members that similarly supports a volunteer standards development committee (SSPC 90.1) comprising of licensed professionals and industry experts. In addition to Standard 90.1, ASHRAE publishes a variety of building and equipment standards and guidelines, such as for indoor air quality ***(ANSI/ASHRAE Standards 62.1 and 62.2)*** and green construction

[1] Terms in ***bold and italics*** are defined in the glossary of this document. Only the first incidence of the term will be bold and italicized.
[2] American National Standards Institute/ASHRAE/Illuminating Engineering Society. Nearly always written as "ASHRAE 90.1".

(***International Green Construction Code® powered by ANSI/ASHRAE/ICC/USGBC/IES Standard 189.1***), which is jointly published and developed with ICC among other partnering organizations. Both ICC and ASHRAE update their model codes using similar processes in three-year cycles, though their triennial publication cycles are not aligned. Different editions of the codes and standards are typically referred to by the year in which the edition was published, such as IECC 2021 and ASHRAE 90.1-2022. Although the IECC and standards developed through ASHRAE cover residential and commercial buildings alike, the Energy Conservation and Production Act (ECPA), as amended, established the IECC as the national residential model energy code (for low-rise residential buildings, defined as residential buildings three stories or less) and ASHRAE Standard 90.1 as the commercial model energy code (for commercial and multifamily high-rise residential buildings, defined as buildings four or more stories tall).

ECPA requires that the U.S. Department of Energy (DOE) analyze each new model energy code and issue a determination as to whether a new code version is more efficient than its predecessor. In July 2021, DOE's determination found the IECC 2021-Residential and ASHRAE 90.1-2019 to be 9.4 percent and 4.7 percent more efficient, respectively, than the last code editions (IECC 2018 and 90.1-2016).




These two codes are called the "model codes" because States, Territories and, in some cases (depending on law), cities or other local jurisdictions can modify or amend the model codes to meet policy goals, jurisdictional needs, or stakeholder preferences. Codes may be amended to improve or reduce minimum energy efficiency requirements or adopted with no modifications. Some states are required by state law to adopt the most recent model code within a short period of time (e.g., 18 months) after it is published, while some states have enacted legislation that permit code updates no more than once every six years. When the U.S. Department of

Energy (DOE) refers to the latest model code, it refers to the most recent model code for which an energy saving determination has been published. For this reason, the DOE "latest model code" may be different than the most recently published code for a period of time while analysis and public comment periods are conducted to inform DOE energy saving determinations as instructed by statute.

The IECC is considered a chapter of both the ***International Residential Code (IRC)*** and ***International Building Code (IBC)***. The IRC is used for residential buildings and the IBC is used for commercial buildings.[3] Residential codes typically apply to residential buildings up to three stories tall. Commercial codes are used for low- and high-rise commercial buildings and all buildings four or more stories tall, including high-rise multifamily and mixed-use buildings. Many jurisdictions use ASHRAE 90.1 as the energy code for commercial buildings and multifamily buildings greater than 3 stories, although the IECC Commercial chapter may be used for commercial and multifamily buildings.

ASHRAE 90.1 is typically (but not always) adopted "by reference" into the building code as a supplement to or replacement for the commercial chapter of the IECC. The IECC commercial chapter also identifies ASHRAE 90.1 as an alternative compliance pathway. ASHRAE 90.1 is also the energy code used for multifamily buildings greater than 3 stories tall. There is an ASHRAE Standard for low-rise residential buildings called ***ANSI/ASHRAE/IES Standard 90.2 (ASHRAE 90.2)*** that is rarely adopted in the United States.

Unlike site-built homes, manufactured and modular homes are constructed in factories and transported to the site where they are assembled or installed. Modular buildings, which are homes or multi-story buildings assembled onsite using factory-made components, must comply with state or local energy codes in the jurisdiction where the building will be located. Manufactured homes,[4] however, are not regulated under state or local building codes and are instead governed by a Federal Government code developed by the U.S. Department of Housing and Urban Development (HUD) and DOE, called the ***HUD code***. States may not implement additional energy efficiency requirements for manufactured homes due to federal preemption.

Building codes and standards can ensure that buildings are well constructed, healthy, safe, and provide a minimum level of energy performance. Building energy codes are adopted by states and jurisdictions to support energy policy goals such as energy affordability, reducing energy consumption, reducing air pollution, improving the resilience of structures to natural hazards such as earthquakes and high winds, and to ensure consistent practices in the building industry as a consumer protection measure.

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[3] Commercial buildings include "institutional" buildings such as government buildings, schools, colleges and university, health care facilities, and houses of worship that may not be "commercial" in the usual sense of the word.

[4] Manufactured homes are also known as "mobile homes", though the industry has shifted away from that term since 1976. The first federal standards for this housing category were introduced in 1976.

## State Energy Office Roles

State Energy Office involvement in the development, adoption, and implementation of energy codes within each state varies widely. In some states, the State Energy Office leads the development of energy codes or the stretch code and is deeply involved in standard setting, cost-effectiveness evaluation, and managing stakeholder involvement (e.g., California Energy Commission, Massachusetts stretch code). In other states, another state agency may have purview over energy codes or codes generally (e.g., Virginia Department of Housing and Community Development), and in some cases, the state building department is responsible for code development and the State Energy Office is granted an advisory seat on the code development committee (e.g., the Massachusetts base energy code[5]). Other states, known as ***home rule***, do not have authority to implement a statewide code, leaving code adoption responsibility to local jurisdictions (e.g., Arizona). And sometimes there are more complex state-local code relationships: many localities have no authority to alter state-adopted codes in ***min/max*** states; some can only exceed the state code by adopting the statewide ***stretch code*** (e.g., Massachusetts, New York); and some are able to exceed the efficiency requirements of statewide codes without restriction (e.g., Texas, Colorado, California).

In most states, local jurisdictions are responsible for code enforcement. State efforts to support enforcement may include virtual or in-person training for local code officials and builders on the latest code provisions and best practices for compliance. Some jurisdictions have leveraged state support and funding to establish help desks that field technical inquiries from design and construction professionals on code interpretations (e.g., Nevada, New Mexico, and others). To tailor energy code training programs around compliance weaknesses, jurisdictions might work with their State Energy Offices to conduct energy code field studies across newly constructed commercial and residential buildings that gather a baseline of compliance. Many jurisdictions make use of third party **energy raters** to support compliance efforts and bolster local capacity for enforcement.

Even where the State Energy Office does not lead energy code development and adoption, it may have formal or informal roles to advise on and review energy code development, adoption, implementation, and compliance. The State Energy Office can support code-related education, training, analyses, and technical assistance for builders, engineers, architects, and contractors. To ensure compliance with the latest state-or locally-adopted building energy codes, State Energy Offices can also conduct compliance studies and provide resources and technical assistance to building officials in reviewing and approving building permit applications and performing field inspections.

Once a state or in home rule states, a city or other jurisdiction, completes the adoption process, a phase in period is announced. Phase-in periods are commonly six months. During the phase in

[5] This is true for the Massachusetts base energy code. For the Massachusetts stretch code and "municipal opt-in specialized stretch energy code", the Department of Energy Resources (the State Energy Office) is responsible for code development. The Massachusetts Stretch Code has been adopted by 299 of 365 cities and towns in the Commonwealth.

period and after new codes come into effect, education and training for builders, building officials, energy raters, and construction trades are important to ensure that building practices called for in updated codes are implemented and result in energy savings. Resources from DOE that support state energy code compliance field studies can assist states in understanding areas where building practices are not aligned with code and where training may prove beneficial.

## Energy Codes and Resilience

Building energy codes support resilience for individual buildings, communities, and the grid. For individual buildings, energy codes reduce the amount of energy consumed on-site and enable greater "**passive survivability**". For a structure without backup power, a more efficient, better insulated and air-sealed building envelope can provide the building occupants with shelter and maintain safe indoor air temperatures for a longer period than a structure without these features may be able to provide during outages and extreme weather. For facilities with on-site power generation, efficient buildings can more effectively use emergency power to provide more services or to provide services for a longer period of time (by using less natural gas or other fuels for a generator) during an outage. More efficient structures also reduce demand on the broader electric gird and natural gas system by consuming less fuel for normal operations during extreme weather conditions or periods of supply constraints.

## Sources of Funding for Building Energy Code Programs

Congress provides regular appropriations to the U.S. Department of Energy's Building Energy Codes Program, some of which may be issued as competitive grants to support energy code projects and programs. With the 2021 passage of the Infrastructure Investment and Jobs Act (IIJA) and the 2022 Inflation Reduction Act (IRA), more funding is available for building energy code updates than ever before.[6]

**U.S. Department of Energy Building Energy Codes Program**

The DOE Building Technologies Office's Building Energy Codes Program (BECP) supports energy codes programs and processes in several ways, including providing technical support and analysis for model code development processes, offering funding and technical assistance to states and jurisdictions, and developing key codes tools and resources. As one example, BECP creates and maintains DOE's building energy code resources such as RES*check* and COM*check*, which are software tools to simplify energy code compliance for architects, builders, designers, and contractors.[7] The program also provides building energy code technical support to states through DOE National Laboratories like the Pacific Northwest National Laboratory, and convenes the annual National Energy Codes Conference and other educational events. In addition to technical resources and events, the Building Energy Codes Program awards competitive grants to states, local governments, non-profit organizations, homebuilder organizations, and coalitions of groups to carry out a variety of educational and analytical activities that support decision makers on code development, implementation, adoption, and

[6] This information on federal funding programs is accurate as of April 2023, and may be subject to change as the programs or their requirements evolve over time.
[7] www.energycodes.gov/software-tools

enforcement to achieve practicable, cost-effective improvements in energy efficiency. The energycodes.gov webpage is the main hub for information about the DOE Building Energy Codes Program.

**Infrastructure Investment and Jobs Act**

Section 40511 of the IIJA, *Cost-Effective Codes Implementation for Efficiency and Resilience*, [8] allocates $225 million ($45 million per year) through a competitive process in support of cost-effective codes implementation of updated energy codes via the Resilient and Efficient Codes Implementation (RECI) funding program.[9] The RECI program funding is available through September 30, 2026. Per statute, "a relevant state agency" (e.g., State Energy Offices or state building departments) must be a part of any project team that responds to a competitive RECI funding opportunity announcement (FOA). RECI funding is available to support the implementation of more efficient energy codes, even if it is not the most recent updated code available. The 2023 RECI FOA did not require cost share.[10]

**Inflation Reduction Act**

Section 50131 of the IRA, *Assistance for Latest and Zero Building Energy Code Adoption*,[11] provides $1 billion for the Technical Assistance for the Adoption of the Latest and Zero Building Energy Codes or Standards grant program and is available through September 30, 2029. The funding will be available to states and units of local government that are eligible to adopt building codes. $330 million of these funds will be available to states and units of local government with the authority to adopt building codes:

> "**(1)** to adopt (A) a building code (or codes) that meets or exceeds the 2021 International Energy Conservation Code or achieves equivalent or greater energy savings (B) a building energy code (or codes) for commercial buildings that meets or exceeds the ANSI/ASHRAE/IES Standard 90.1-2019 or achieves equivalent or greater energy savings; or (C) any combination of [A or B] and **(2)** to implement a plan for the jurisdiction to achieve full compliance with any building energy code adopted under paragraph (1) in new and renovated residential or commercial buildings, as applicable, which plan shall include active training and enforcement programs and measurement of the rate of compliance each year."

In addition, $670 million will be available to states and units of local government with the authority to adopt buildings codes:

> "**(1)** to adopt a building energy code (or codes) for residential and commercial buildings that meets or exceeds the zero energy provisions in the 2021 International Energy Conservation Code or an equivalent stretch code; and **(2)** to implement a plan for the jurisdiction to achieve full compliance with any building code adopted under paragraph (1) in new and renovated residential and commercial buildings, which plan shall include

[8] https://www.congress.gov/bill/117th-congress/house-bill/3684/text

[9] [Resilient and Efficient Codes Implementation | Building Energy Codes Program](https://www.energycodes.gov/RECI) - https://www.energycodes.gov/RECI

[10] https://eere-exchange.energy.gov/Default.aspx#FoaId1ebf6711-062f-4ff1-a25f-e72bb3b1532f

[11] https://www.congress.gov/117/bills/hr5376/BILLS-117hr5376enr.pdf

> active training and enforcement programs and measurement of the rate of compliance each year."

There is no state match requirement for IRA funds.

**Federal Emergency Management Agency Building Resilient Infrastructure and Communities (BRIC)**

In 2018, the Disaster Recovery Reform Act was signed into law and created the BRIC program. The BRIC program provides states with grants to prepare for and mitigate future natural disasters, including through the adoption and implementation of updated building codes, among other eligible activities.[12] In FY2022, FEMA distributed up to $2.295 billion through the BRIC program, and $2.133 billion was available through a national competition to fund mitigation projects of all types, including those that support building code activities.[13] In FY2023, FEMA created the Building Code Plus Up program with $112 million of funding for states and territories and $25 million for federally recognized tribes. A maximum of $2 million per state is available for adoption and implementation of building codes to reduce risk, enhancing codes, and developing the building code workforce. Applications for these funds close on February 29, 2024.[14]

BRIC grants are available on a competitive basis and must be applied for by State Hazard Mitigation Officers or equivalent as the primary applicant. Building codes are eligible for BRIC funding through the Capability- and Capacity-Building (C&CB) Activities category.[15] FEMA states that "[e]ligible building code adoption, administration, and enforcement activities for the proposed BRIC program are activities that:

- Evaluate adoption and/or implementation of codes, specifications, and/or standards that reduce risk
- Enhance existing adopted codes, specifications, and/or standards to incorporate more current requirements or higher standards
- Develop professional workforce capabilities through technical assistance and training that capitalize on the use of virtual/electronic submission methodologies"[16]

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[12] U.S. Federal Emergency Management Agency. Building Resilient Infrastructure and Communities. https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities

[13] U.S. Federal Emergency Management Agency. Before You Apply for Building Resilient Infrastructure and Communities (BRIC) Funds. https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities/before-apply. March 10, 2023. Accessed July 31, 2023.

[14] U.S. Federal Emergency Management Agency. FEMA Fact Sheet: Notice of Funding Opportunity for Fiscal Year 2023 Building Resilient Infrastructure and Communities Program. https://www.fema.gov/sites/default/files/documents/fema_hma_bric-nofo-fact-sheet_102023.pdf. October 2023.

[15] U.S. Federal Emergency Management Agency. Before You Apply for Building Resilient Infrastructure and Communities (BRIC) Funds. https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities/before-apply

[16] U.S. Federal Emergency Management Agency. BRIC Building Code Activities. April 2022. https://www.fema.gov/sites/default/files/documents/fema_fy22-BRIC-building-code-activities_08082022_0.pdf.

## Conclusion

Building energy codes are an effective energy efficiency policy for new buildings when they are supported by enforcement and compliance measures. While the State Energy Office role varies from state to state, there is a spectrum of opportunities to leverage this policy tool in nearly every state, from adoption of new codes to supporting implementation through code compliance field studies and workforce training programs. States that seek to improve the energy efficiency and resilience across their new and existing buildings can look to building energy codes and access a variety of technical assistance[17] from the U.S. DOE Building Energy Codes Program,[18] including training modules, help desk support, publications, impact analyses, compliance tools and software, and access to a national technical assistance network.[19]

In addition to resources available from NASEO, U.S. DOE resources are available for state technical assistance and describing the benefits of energy codes for energy resilience.

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[17] U.S. Department of Energy. Building Energy Codes Program Technical Assistance. https://www.energycodes.gov/technical-assistance. Accessed June 28, 2023.
[18] U.S. Department of Energy. Building Energy Codes Program. https://www.energycodes.gov/. Accessed April 18, 2023.
[19] U.S. Department of Energy. Building Energy Codes Program Resources. https://www.energycodes.gov/sites/default/files/2022-12/20221202_BECP_Resources.pdf. Accessed June 28, 2023.

**Glossary of abbreviations and terms commonly encountered while working with building energy codes (not all terms are used above)**

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| ASHRAE | Formerly the American Society of Heating, Refrigeration, and Air-Conditioning Engineers. Now officially known as "ASHRAE". |
| ASHRAE 90.1 | ANSI/ASHRAE/IES Standard 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings. Typically shown with the publication year following (e.g. 90.1-2019 or 90.1-2016). ASHRAE standards use ".1" for commercial standards and ".2" for residential standards. |
| ACH | Number of Air Changes per Hour, typical at 50 pascals of pressure differential. Describes the air tightness of a structure. Sometimes estimated in older code editions, more recent editions require testing with specialized tools known as "blower doors."[20] Expressed as 5 ACH50 for 5 air changes per hour, or 3 ACH50 for 3 air changes per hour. |
| AHJ | Authority having jurisdiction |
| Climate Zone | ASHRAE and ICC divide the United States into eight zones based on the average temperature and subdivided as moist, dry or marine zones. The 2021 climate zones changed from prior editions in a very small number of U.S. counties. 2021 Map (PNNL).[21] |
| COMCheck | Software developed by the DOE Building Energy Codes Program and PNNL for checking code compliance of commercial buildings.[22] |
| Energy Raters | Energy raters serve as third party energy code compliance verifiers. Energy raters must obtain certifications such as those offered by the Residential Energy Services Network (RESNET). Certified raters are "trained …to inspect, test, and evaluate a home's energy features, prepare a home energy rating and make recommendations for improvements…"[23] |
| ERI | Energy Rating Index. Similar but not the same as the RESNET Home Energy Rating System Index.[24] Used to measure code compliance. |
| Home Rule | Home rule is defined as the ability of a local government to act and make policy in all areas that have not been designated to be of statewide interest through general law, state constitutional provisions, or initiatives and referenda. Within the context of energy codes, a home rule state is one where codes are adopted and enforced at the local level. Some home rule states have a mandate that jurisdictions can go above code but also have to meet a certain minimum code.[25] |

[20] U.S. Department of Energy. Energy Saver: Blower Door Tests. https://basc.pnnl.gov/images/climate-zone-map-iecc-2021. Accessed April 18, 2023.
[21] U.S. Department of Energy. Climate Zone Map from IECC 2021. https://basc.pnnl.gov/images/climate-zone-map-iecc-2021. Accessed April 18, 2023.
[22] U.S. Department of Energy. COMcheck. https://www.energycodes.gov/comcheck. Accessed April 18, 2023.
[23] Residential Energy Services Network. How to become a certified home energy rater. https://www.resnet.us/raters/hers-raters/become-rater/. Accessed September 12, 2023.
[24] RESNET. What is the HERS Index. https://www.hersindex.com/hers-index/what-is-the-hers-index/. Accessed April 18, 2023.
[25] U.S. Department of Energy. State Portal. https://www.energycodes.gov/state-portal. Accessed April 5, 2023.

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| HUD Code | A manufactured home (sometimes called a mobile home) is built to the Manufactured Home Construction and Safety Standards (HUD Code) and displays a red certification label on the exterior of each transportable section. Manufactured homes are built in the controlled environment of a manufacturing plant and are transported in one or more sections on a permanent chassis.[26] |
| IBC | International Building Code. Typically shown with the publication year following (e.g., IBC 2021, IBC 2018). |
| ICC | International Code Council |
| I-Codes | Shorthand for the full suite of the international building codes published by the International Code Council. |
| IECC | International Energy Conservation Code. Typically shown with the publication year following when referring to a specific edition of the code (e.g. IECC 2021, IECC 2018). |
| IgCC and ASHRAE Standard 189.1 | International Green Construction Code powered by ASHRAE 189.1®. Typically shown with the adoption year following when referring to a specific edition of the code (e.g. IgCC 2021, IgCC 2018). |
| IRC | International Residential Code. Typically shown with the adoption year following when referring to a specific edition of the code (e.g. IRC 2021, IRC 2018). |
| Min/Max | Min/max energy codes are those adopted statewide that set the energy efficiency levels of buildings for each city, town, county, or any other local jurisdiction in the state without allowances for amendments that weaken or augment requirements within the statewide code provisions. |
| Passive Survivability | The ability to maintain safe indoor conditions in the event of extended energy outage or loss of energy supply. In practice, passive survivability enables safe indoor thermal conditions, relying on building design measures that require no energy. As a measure of a building's thermal performance, passive survivability offers an integrated assessment of both energy efficiency and resilience.[27] |
| Performance path | Code compliance is demonstrated through energy modeling tools. The building as a whole must meet a specific level of energy performance. Certain elements may be less efficient. |
| PNNL | Pacific Northwest National Laboratory |
| Prescriptive Path | Each element of the building must be built to a specific standard established by the building energy code. |

[26] U.S. Department of Housing and Urban Development. Manufactured Housing and Standards - Frequently Asked Questions. https://www.hud.gov/program_offices/housing/rmra/mhs/faqs. Accessed April 5, 2023.
[27] U.S. Department of Energy, Building Energy Codes Program. Energy Resilience. https://www.energycodes.gov/energy-resilience. Accessed July 31, 2023.

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| R-Value | Describes a materials thermal resistance to conductive heat flow. Higher numbers indicate greater energy efficiency (DOE).[28] |
| RESCheck | Software developed by the DOE Building Energy Codes Program and PNNL for checking code compliance of residential buildings.[29] |
| SHGC | Solar Heat Gain Coefficient. It is the fraction of solar radiation admitted through a window, door, or skylight -- either transmitted directly and/or absorbed, and subsequently released as heat inside a building. Optimal SHGC depends on the climate zone and orientation of the building and window location. In a cold climate, more solar heat gain may be preferred, while in a hot climate, less may be preferred. (DOE)[30] |
| Stretch Code | A stretch code is a code adopted by a state or local government that goes beyond the base or model code to “stretch” for a goal such as higher energy efficiency, lower emissions of air pollutants, or another goal. In some states, there is a statewide stretch code, (e.g., Massachusetts and New York). In other states, cities are allowed to develop stretch codes, as long as they are more efficient that the base code (e.g., California). In other states, local governments are not allowed to adopt stretch codes. |
| U-factor | A value that describes a materials effectiveness as an insulator. Lower values indicate greater energy efficiency. Often used to describe the efficiency of windows and doors (DOE).[31] |

[28] U.S. Department of Energy. Energy Saver: Insulation. https://www.energy.gov/energysaver/insulation. Accessed April 18, 2023.

[29] U.S. Department of Energy. RESCheck. https://www.energycodes.gov/rescheck. Accessed April 18, 2023.

[30] U.S. Department of Energy. Energy Saver: Energy Performance Ratings for Windows, Doors, and Skylights. https://www.energy.gov/energysaver/energy-performance-ratings-windows-doors-and-skylights. Accessed April 18, 2023.

[31] Ibid.