NGBS vs. IECC PERFORMANCE COMPARISON – RESIDENTIAL

Home Innovation
NGBS GREEN CERTIFIED™

The International Energy Conservation Code (IECC) provides an alternative compliance option for energy efficiency programs deemed to be equivalent. Alternative code compliance options are beneficial to local jurisdictions and builders alike, as they provide compliance flexibility without compromising energy efficiency performance.

> R102.1.1 Above code programs
> The code official or other authority having jurisdiction shall be permitted to deem a national, state, or local energy-efficiency program to exceed the energy efficiency required by this code. Buildings approved in writing by such an energy-efficiency program shall be considered to be in compliance with this code where such buildings also meet the requirements identified in Table R405.2 and the building thermal envelope is greater than or equal to the levels of the efficiency and solar heat gain coefficients in Table 402.1.1 and 402.1.3 of the 2009 *International Energy Conservation Code*.

OVERVIEW

The ICC-700 *National Green Building Standard*® (NGBS) is an ANSI-approved green building standard within the International Code Council's (ICC) suite of building codes. Like most ICC codes, the NGBS is updated on a three-year cycle, and each NGBS version sets a performance baseline based on a specific version of the International Residential Code (IRC), International Building Code (IBC), and IECC. The NGBS mandatory practices are largely derive from these baseline I-codes.

There are two significant benefits resulting from NGBS alignment with the ICC suite of I-codes. First, buildings seeking NGBS Green certification have a minimum baseline performance that can be tied to specific ICC code versions. Second, because NGBS practices are written in ICC code language, code officials, builders, architects, and contractors find the NGBS requirements familiar and easily understand how a building is compliant with any given NGBS practice.

Once the NGBS's mandatory requirements are met, a building can attain a rating of Bronze, Silver, Gold, or Emerald, depending on the number of green features included in the building's design and construction.

The NGBS is comprehensive and has six categories of green practices:

- Lot & Site Development
- Resource Efficiency
- Energy Efficiency
- Water Efficiency
- Indoor Environmental Quality
- Homeowner Education

The NGBS requires a building to obtain a minimum number of points **for each category**, and, to go up in certification level, the building must earn more points in every category. That means that a building certified at the Silver level will have more green practices and be expected to perform at a higher level in every category than a Bronze certified building.

Many NGBS practices address the same building performance concepts as the building code. Across nearly all code requirements, the NGBS requires an equivalent or higher level of performance than that NGBS version's baseline of the building code.

ABOUT HOME INNOVATION & NGBS GREEN

Home Innovation Research Labs serves as Certification Agency and provides certification services to the NGBS. Home Innovation Labs is a 57-year-old, internationally recognized, accredited product testing and certification laboratory located in Upper Marlboro, Maryland. Our work is solely focused on the residential construction industry and our mission is to improve the affordability, performance, and durability of housing. Our core competency is as an independent, third-party product testing and certification lab, making us uniquely suited to administer a green certification program for residential buildings.

NGBS Green, Home Innovation's certification program to confirm a buildings conformance with the NGBS is presently the leading green building certification for residentially-used buildings in the United States and Caribbean. NGBS Green is recognized by federal agencies such as the U.S. Department of Housing and Urban Development (HUD), the U.S. Army, the Veterans Administration, and the U.S. Department of Agriculture for their Rural Housing programs. NGBS Green is also recognized by Fannie Mae, Freddie Mac, the Federal Housing Finance Agency (FHFA), and nearly thirty State Housing Finance Agencies for preferred financing or tax incentives. Numerous local jurisdictions also either require or recognize NGBS Green certification for code compliance, including the City of Baltimore, Montgomery County, the City of Rockville, and the City of Annapolis.

NGBS GREEN CERTIFICATION OF CONFORMANCE

NGBS Green certification requires that a qualified, independent third-party Verifier inspect the building and confirm all NGBS design or construction practices are incorporated correctly. Most projects require at least two inspections. The Verifier must inspect the building before drywall is installed to observe completed wall cavities and must also inspect the building when construction is complete. Multifamily properties typically require multiple inspections at the rough stage. The required on-site verification imbues an elevated level of rigor and quality assurance to certified buildings. Construction issues identified during the inspection get remedied before it is too late. For example, Verifiers often find the insulation installation to fall short of Grade I, but at the rough inspection the Verifier will ensure that the insulation contractor fixes any installation issues so that it meets Grade I before the drywall is hung.

Verifiers record the results of their rough and final inspections on a verification report. Home Innovation reviews every rough and final inspection to ensure consistency and accuracy. Verifications are subject to both desktop and virtual audits for quality control (QC). All QC activities are completed ***before*** the building can earn certification. After the verification reports are, Home Innovation issues an NGBS Green certificate of conformance to the project.

Home Innovation Research Labs qualifies, trains, tests, and accredits NGBS Green Verifiers and maintains a current list on the Find A Verifier directory. Verifiers must possess experience in residential construction and green building. Many verifiers are Home Energy Rating System (HERS) raters and/or have earned ICC certification as code inspectors. Home Innovation trains Verifier candidates on how to verify every NGBS practice. This ensures nationwide consistency in verification determinations. After

completing the training, verifiers must pass an exam and carry sufficient insurance to earn accreditation. Verifiers renew their accreditation annually and retrain and retest with every NGBS version.

Home Innovation maintains strict rules to ensure verifiers remain independent and free of conflict-of-interest on the projects for which they provide verification services. Further, Home Innovation audits the verifiers and their verifications as part of our internal quality assurance program.

At any time during the certification process, Verifiers, builders, architects, and contractors can avail themselves of Home Innovation's deep building science expertise and NGBS knowledge. Technical assistance and interpretations are free, and we respond within one-business day to ensure there is not a delay.

BENEFITS OF THIRD-PARTY CODE COMPLIANCE

Code compliance determinations are expensive for local jurisdictions to undertake, and as the building code gets increasingly complex and focused on building attributes that extend beyond the traditional life and safety issues, compliance determinations can be more difficult for local code officials. Further, many energy efficiency practices are difficult for code officials to verify without additional training. Time spent on energy efficiency compliance also reduces the amount of time that code officials have available to spend on critical life, safety, and health compliance.

Acceptance of independent, third-party NGBS Green certification could significantly reduce a local jurisdiction's administrative cost of implementing the IECC. Cities and counties can feel confident in outsourcing code compliance, given Home Innovation's residential construction and green building knowledge and expertise as a third-party certification agency. Further, while most code officials inspect buildings using a pass/fail system, Verifiers inspect buildings with a goal of remedying compliance issues. For example, if a Verifier sees a wall section with less than Grade I insulation installation (a situation that is unfortunately all too common), the Verifier will ensure the insulation contractor *fixes the issue before the drywall is installed*. NGBS Green's on-site verification imbues an important quality assurance aspect that provides value to the local jurisdiction, the builder, and the buildings future residents.

An additional benefit of recognizing NGBS Green certification as an equivalent code compliant path is that the State and local jurisdictions benefit from the NGBS's comprehensive scope that extends beyond energy efficiency. IECC compliant buildings are energy efficient. NGBS Green certified buildings:

- Are energy efficient;
- Use less water;
- Provide improved indoor air quality;
- Have fewer environmental impacts because of site and land development considerations;
- Use fewer resources; and
- Have a training, operation, and maintenance plan to help ensure lasting building performance.

While all the above NGBS Green certification attributes are important, the last one is especially critical. Unlike commercially used buildings, homes and multifamily buildings are turned over to residents to operate these buildings, typically without benefit of building science expertise and knowledge. It is one thing to design and construct a high-performance building, it is another thing to operate and maintain one. Our experience shows us that residents that have been provided with detailed operation and

maintenance manuals and training are far more likely to help those homes and buildings meet or exceed their performance expectations in the future.

Recognizing NGBS Green as a code equivalent allows builders and developers to access a host of benefits that come with certification, such as preferred financing, recognition on the local multiple listing service, interest from investors looking for sustainable projects, FTC compliant green marketing, access to free technical and building science assistance, and higher appraisal valuations. This can be the "secret sauce" for a jurisdiction that wants higher performing buildings: adopt the 2021 IECC as code (the stick) but allow NGBS Green compliance as an equivalent (the carrot).

NGBS ENERGY EFFICIENCY COMPLIANCE

The 2020 NGBS Energy Efficiency Chapter uses the 2018 IECC as the energy efficiency baseline. For a building to attain 2020 NGBS Green certification at the Bronze level (the baseline level), the building must be at least 2018 IECC-compliant from an energy efficiency perspective.

As the NGBS Green certification level increases, the home's energy performance increases as well. In addition to meeting the 2018 IECC energy efficiency performance baseline, the NGBS requires a home to meet two additional energy efficiency practices before it can be certified. The additional practices are available in NGBS Section 705 and 706 and they offer an additional 1% – 2.5% energy savings above baseline, which means that any NGBS Green certified home will be more efficient than the 2018 IECC compliance level.

The NGBS provides three basic compliance paths for energy efficiency.

1. **Prescriptive Path.** This is a checklist approach and considered simpler. To earn Bronze, the building must meet the NGBS mandatory requirements (efficiency equivalent to the 2018 IECC) and then incorporate two additional efficiency practices (which yields an additional 1-2% higher efficiency over the baseline). For Silver and above, the building must incorporate successively more energy efficiency practices to meet the NGBS point requirements.[1]

2. **Performance Path/ERI.** This approach requires an energy model to demonstrate the building will meet an energy use target. Once the mandatory practices are met the model can allow the builder to make trade-offs to attain the energy target.

3. **Alternative Compliance Options**. This allows a building to be deemed compliant from an energy efficiency perspective if the building meets an energy compliance program like ENERGY STAR Single-Family New Homes or ENERGY STAR Multifamily New Construction.

PERFORMANCE ANALYSIS

The U.S. Department of Energy (DOE) **Preliminary Analysis Regarding Energy Efficiency Improvements in the 2021 International Energy Conservation Code (IECC)** found that the updated 2021 IECC will require higher energy efficiency in residential buildings as compared to the previous 2018 IECC edition.

[1] DOE and Home Innovation collaborated to determine that each NGBS certification point in Chapter 7: Energy Efficiency is roughly equivalent to 0.5% reduction in energy use. Therefore 10 NGBS Chapter 7 certification points is roughly equal to a 5% improvement in energy efficiency.

This increased performance level will offer an expected annual energy cost savings of 8.66 percent averaged nationwide.

The table below compares 2020 NGBS and 2015 NGBS energy efficiency with the 2021 IECC energy efficiency. A negative number indicates a level that is ***less energy efficient*** than the 2021 IECC while a positive number indicates a level that is ***more energy efficient*** than the 2021 IECC.

2020 NGBS	2021 IECC
BRONZE	-8.66
SILVER	-1.16
GOLD	6.34
EMERALD	11.34

2015 NGBS	2021 IECC
BRONZE	-10.66
SILVER	-3.16
GOLD	4.34
EMERALD	9.34

The IECC equivalency test has three parts.

First, the energy program must exceed the energy efficiency required by the 2021 IECC. The table above demonstrates that the 2020 NGBS at the Silver level is roughly equivalent to the 2021 IECC performance baseline. At the 2020 NGBS Gold certification level, compliance significantly surpasses the 2021 IECC by 6.34 percent, while the 2015 NGBS at the Gold certification level surpasses the 2021 IECC by 4.34 percent.

Second, buildings must also meet the requirements identified in 2021 IECC Table R405.2. See Table below. Many NGBS mandatory practices would meet the practices in 2021 IECC Table R405.2. For practices not deemed equivalent, a local jurisdiction has two options to declare the NGBS as equivalent: 1) Home Innovation can include verification of compliance 2021 IECC Table R405.2 practices that are not in the NGBS and include a separate certification of compliance, or 2) the local jurisdiction can continue to have code officials verify compliance for these practices.

Third, the building thermal envelope must be greater than or equal to the levels of the efficiency and solar heat gain coefficients in Table 402.1.1 and 402.1.3 of the 2009 IECC. The NGBS 2020 Prescriptive Path uses IECC 2018 Envelope requirements as the baseline, which is clearly greater than the previous efficiency levels of the older 2009 IECC.

Importantly, an equivalency determination does not mandate that an energy program be **the same**. Equivalency requires that the IECC and energy program be comparable in the efficiency baseline. If the program had to be the same, there would be no reason to allow an equivalency decision.

The NGBS also requires mandatory practices above and beyond 2021 IECC Table R405.2:

1. **NGBS 701.4.1.2 Radiant and hydronic space heating**. Where installed as a primary heat source in the building, radiant or hydronic space heating system is designed, installed, and documented, using industry-approved guidelines and standards (e.g., ACCA Manual J, AHRI I=B=R, ACCA 5 QI, or an accredited design professional's and manufacturer's recommendation).
2. **NGBS 701.4.3.2.1 Grade I insulation installation**. Field-installed insulation products to ceilings, walls, floors, band joists, rim joists, conditioned attics, basements, and crawlspaces, except as specifically noted, are verified by a third-party as Grade I.

3. **NGBS 701.4.3.4 Fenestration air leakage**. Windows, skylights and sliding glass doors have an air infiltration rate of no more than 0.3 cfm per sq. ft. (1.5 L/s/m^2), and swinging doors no more than 0.5 cfm per sq. ft. (2.6 L/s/m^2), when tested in accordance with NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440 by an accredited, independent laboratory and listed and labeled. For site-built fenestration, a test report by an accredited, independent laboratory verifying compliance with the applicable infiltration rate shall be submitted to demonstrate compliance with this practice. This practice does not apply to field-fabricated fenestration products.

4. **701.4.3.5 Lighting in building thermal envelope**. Luminaires installed in the building thermal envelope which penetrate the air barrier are sealed to limit air leakage between conditioned and unconditioned spaces. All luminaires installed in the building thermal envelope which penetrate the air barrier are IC-rated and labeled as meeting ASTM E283 when tested at 1.57 psf (75 Pa) pressure differential with no more than 2.0 cfm (0.944 L/s) of air movement from the conditioned space to the ceiling cavity. All luminaires installed in the building thermal envelope which penetrate the air barrier are sealed with a gasket or caulk between the housing and the interior of the wall or ceiling covering.

The Table below demonstrates how the 2020 NGBS practices align with the 2021 IECC mandatory practices.

2021 IECC Table R405.2 Requirements Compared to the 2020 NGBS		
2021 IECC	**2020 NGBS**	**Equivalency Notes**
R401.2.5: Additional Energy Efficiency. 95% of the energy usage of the reference design	Met with NGBS Gold and Emerald certification.	**Exceeds.** 2020 NGBS requirements exceed this requirement.
R401.3 *Certificate of conformance*. A permanent certificate shall be completed by the builder or other approved party and posted on a wall in the space where the furnace is located, a utility room or an approved location inside the building.	Met with NGBS 1001.1 Homeowner's manual.	**Equivalent.** NGBS compliance is more stringent than the IECC. NGBS Green requires a homeowner's manual to include NGBS Green certificate with a web link and completion document, list of green building features and manufacturer's manuals or product data sheet for installed major equipment, fixtures, and appliances.
R402.1.1 *Vapor Retarder.* Wall assemblies in the building thermal envelope shall comply with the vapor retarder requirements of section R702.7	NGBS mandates a water resistive barrier (602.1.8) and flashing (602.1.9).	**Partially Equivalent.** Moisture barriers and vapor barriers are both building materials designed to prevent water from getting past the barrier. Some WRBs can serve as vapor retarders and be functionally equivalent.
R402.2.3 *Eave baffle.* For air permeable insulation in vented attics, a baffle shall be installed adjacent to soffit and eave vents.	The NGBS does not have an equivalent practice.	**None.**

2021 IECC Table R405.2 Requirements Compared to the 2020 NGBS		
2021 IECC	**2020 NGBS**	**Equivalency Notes**
R402.2.4 *Access hatches and doors.* Access hatches and doors from conditioned to unconditioned spaces such as attics and crawl spaces shall be insulated to the same R-Value required by Table R402.1.3 or the wall or ceiling in which they are installed. (with exceptions)	Met with NGBS 701.4.3.2(2) and NGBS 701.4.3.1. Only Grade I Insulation Installation is allowed.	**Equivalent.**
R402.2.10 *Crawl space walls.* Crawl space walls shall be insulated in accordance with Table R402.1.3 (with exceptions)	Met with NGBS 701.4.3.2(2) and NGBS 701.4.3.1. Only Grade I Insulation Installation is allowed.	**Equivalent.**
R402.4.1.1: *Building Thermal Envelope.* The components of the *building thermal envelope* as indicated in Table R402.4.1.1 shall be installed in accordance with the manufacturer's instructions and the criteria indicated in Table R402.4.1.1, as applicable to the method of construction.	Met with NGBS 701.4.3.2(2) and NGBS 701.4.3.1. Only Grade I Insulation Installation is allowed. Verification and inspection required by third-party NGBS Green Verifiers.	**Equivalent.**
R402.4.1.2 *Testing.* The building or dwelling unit shall be tested and verified as having an air leakage rate not exceeding five air changes per hour in Climate Zones 1 and 2, and three air changes per hour in Climate Zones 3 through 8(with exceptions).	NGBS 701.4.3.2 requires testing, but there is no maximum ACH/ELR for climate zones. The NGBS Prescriptive Practice requires building envelope leakage in accordance with the IECC R402.4.1.2	**Partially Equivalent.**
R402.5 *Maximum fenestration U-factor and SHGC.* The area-weighted average maximum fenestration U-factor permitted using tradeoffs from section R402.1.5 or R405 shall be 0.48 in Climate Zones 4 and 5 and 0.40 in climate Zones 6 THROUGH 8 FOR VERTICAL Fenestration and 0.75 in climate Zones 4 through 8 for skylights (with exception).	NGBS Prescriptive 703.2.5 Fenestration	**Equivalent in Prescriptive Path; Equivalent Voluntary Practice for Performance Path.**
R403.1 *Controls.* Not less than one thermostat shall be provided for each separate heating and cooling system.	The NGBS does not require programmable thermostats; however, voluntary points are available under practice 706.1.	**Equivalent Voluntary Practice.**

2021 IECC Table R405.2 Requirements Compared to the 2020 NGBS		
2021 IECC	**2020 NGBS**	**Equivalency Notes**
R403.3.1 *Ducts.* Ducts located outside conditioned space shall be insulated to an R-value of not less than R-8 for ducts 3 inches (76 mm) in diameter and larger and not less than R-6 for ducts smaller than 3 inches (76 mm) in diameter.	Voluntary points available under NGBS 705.6.1 HVAC Installation and performance verification.	**Equivalent Voluntary Practice.**
R403.3.4 Sealing. Ducts, air handlers and filter boxes shall be sealed. Joints and seams shall comply with either the International Mechanical Code or International Residential Code, as applicable.	Met with NGBS 701.4.2.1 Duct air sealing. Ducts are air sealed. All duct sealing materials are in conformance with UL 181A or UL 181B specifications and are installed in accordance with manufacturer's instructions.	**Equivalent.**
R403.3.4.1 Sealed air handler. Air handlers shall have a manufacturer's designation for an air leakage of not greater than 2 percent of the design airflow rate when tested in accordance with ASHRAE 193.	Voluntary points available under NGBS 705.5.2 and 705.6.2.2 HVAC Performance Airflow Testing.	**Equivalent Voluntary Practice.**
R403.3.5 Duct testing. Ducts shall be pressure tested to determine air leakage by one of the following methods (with exceptions).	NGBS Performance Path does not require duct testing; however, NGBS Green mandates energy modeling software that requires duct testing data for duct systems in unconditioned spaces. Duct testing is mandatory for NGBS Prescriptive Path.	**Equivalent.**
R403.3.7 Building cavities Building framing cavities shall not be used as ducts or plenums.	Met with NGBS 701.4.2.2 Ducts and Plenums. Building framing cavities are not used as ducts or plenums	**Equivalent.**
R403.4 Mechanical system piping insulation Mechanical system piping capable of carrying fluids greater than 105°F (41°C) or less than 55°F (13°C) shall be insulated to an R-value of not less than R-3.	NGBS requires boiler pipe insulation in unconditioned space. NGBS 705.6.3 has points for hot water pipe insulation.	**Equivalent Voluntary Practice**.
R403.5.1 Heated water circulation and temperature maintenance systems	NGBS 705.6.3 has points for hot water pipes, demand control and recirculation system.	**Equivalent Voluntary Practice.**
R403.5.3 *Drain Water Heat Recover units.* Where installed, drain water heat recovery units shall comply with CSA B55.2	NGBS does not have an equivalent practice.	**None.**

2021 IECC Table R405.2 Requirements Compared to the 2020 NGBS		
2021 IECC	**2020 NGBS**	**Equivalency Notes**
R403.6 Mechanical ventilation. The building shall be provided with ventilation that complies with the requirements of the IRC or IMC, as applicable or with other approved means of ventilation. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating. HRV or ERV is required for climate zone 7 and 8	NGBS 902.2.1 Building Ventilation Systems.	**Partially Equivalent.** NGBS 902.2.1 requires compliance with ASHRAE Standard 62.2-2010 Section 4 for whole-building ventilation when infiltration is below 5ACH50. ASHRAE 62.2 2010 ventilation equation and table is the same as the IRC M1505.
R403.7 Equipment sizing (Mandatory). Heating and cooling equipment shall be sized in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J or other approved heating and cooling calculation methodologies	Met with NGBS 701.4.1.1(HVAC System Sizing) & NGBS 701.4.2.3 Duct System Sizing.	**Equivalent.**
R403.7 Efficiency rating (Mandatory). New or replacement heating and cooling equipment shall have an efficiency rating equal to or greater than the minimum required by federal law for the geographic location where the equipment is installed.	The NGBS does not set minimum efficiency ratings for heating and cooling systems, but NGBS Performance Path requires home to meet the energy baseline when compared to the IECC Reference home. (Points are available for heating and cooling efficiency within the Prescriptive Path.)	**Partially Equivalent.**
R403.8 Systems serving multiple dwelling units (Mandatory).	NGBS does not have an equivalent practice.	**None.**
R403.9 Snow melt and ice system controls.	NGBS does not have an equivalent practice.	**None.**
R403.10 Pools and permanent spa energy consumption (Mandatory).	NGBS does not have an equivalent practice.	**None.**
R403.11 Portable spas. The energy consumption of electric-powered portable spas shall be controlled by the requirements of APSP 14.	NGBS does not have an equivalent practice.	**None.**
R403.12 *Residential Pools and permanent residential spas*. Where installed, the energy consumption of residential swimming pools and permanent spas shall be controlled in accordance with the requirements of APSP 15	NGBS does not have an equivalent practice.	**None.**

2021 IECC Table R405.2 Requirements Compared to the 2020 NGBS		
2021 IECC	**2020 NGBS**	**Equivalency Notes**
R404.1 *Lighting equipment*. All permanently installed lighting fixtures excluding kitchen appliances and lighting fixtures, shall contain only high efficacy lighting sources (with exceptions)	NGBS 701.4.4 requires a minimum of 75% high efficacy lighting, and NGBS Performance Path requires home to meet energy baseline when compared to the IECC Reference home.	**Partially Equivalent. NGBS allows max of 25% of lighting to be non-high efficacy.**
R404.2 *Interior lighting controls.* Permanent installed lighting fixtures shall be controlled with either a dimmer, an output sensor or other control that is installed or built into the fixture (with exceptions)	NGBS 705.2.1 Occupancy controls.	**Equivalent Voluntary Practice.**

CONCLUSION

Recognizing 2020 NGBS Green certification at the Silver level as an equivalent to the 2021 IECC will provide tangible benefits to state and local jurisdictions. At the same time, the increased compliance flexibility can help reduce builder's compliance costs and allow them to leverage private and federal incentives for building high performance buildings.