A Comparative Overview of the ICC/ASHRAE 700-2015 National Green Building Standard & LEED v4 BD+C: New Construction

NAHB
National Association of Home Builders

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This document is intended to provide a comparative overview of the features, elements and key factors of two sustainability and green building rating systems: ICC/ASHRAE 700-2015 National Green Building Standard (NGBS), and the Leadership in Energy and Environmental Design Version 4 – New Construction (LEED-NC). It discusses the similarities and differences of the two rating systems, and provide information for parties interested in integrating above-code, voluntary sustainable design and construction practices and programs into single-family and multifamily buildings.

Rating Systems Overview

ICC/ASHRAE 700-2015 National Green Building Standard

The ICC/ASHRAE 700-2015 National Green Building Standard, commonly referred to as the "NGBS" or simply "the Standard", is a green building standard serving as a uniform national platform for the recognition and advancement of green residential construction and development. The 2015 edition of the NGBS is the third iteration of the Standard, building upon the previous 2012 and 2008 editions. All editions of the Standard were developed by Consensus Committees of industry and nonprofit individuals, and in partnership with the International Code Council (ICC) and the National Association of Home Builders (NAHB). The latest installment of the Standard introduced a new partner in the development process, the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE). Staff of these three organizations did not serve as members of the Consensus Committee, and aided only in the facilitation of meetings.

The Standard remains the only residential-specific green building rating system to undergo the full consensus process and receive approval from the American National Standards Institute (ANSI). ANSI approval is critical as it serves as third-party confirmation of balance, representation, openness, consensus, and due process in the Standard's development process. The Consensus Committee that developed the 2015 version of the Standard was comprised of 42 individuals representing a variety of government agencies, municipalities, home building industry stakeholders, and non-profit organizations, including but not limited to:

- Habitat for Humanity International
- National Multifamily Housing Council
- National Institute of Standards & Technology
- Northeast Energy Efficiency Partnerships
- Texas A&M University
- U.S. Department of Energy (DOE)
- U.S. Department of Housing & Urban Development (HUD)
- American Institute of Architects (AIA)
- City of Des Moines

The Standard is a point-based system, wherein a single-family or multifamily building(s) can attain certification depending on the sustainable and green practices included in design and construction, and planned for its operation and maintenance. Projects can

qualify for four certification levels (Bronze, Silver, Gold, or Emerald) by earning the required number of points for each level. Conformance with the NGBS is verified through construction documents, plans, specifications, in-field inspection reports, and other data that demonstrate compliance with the points being pursued. Furthermore, Green Verifiers, who serve as independent, in-field representatives of the NGBS Green certification system, perform rough and final construction inspections to ensure compliance. All relevant information is provided to an Adopting Entity, such as the Home Innovation Research Labs, for technical review, verification, and finally certification.

As of the time of this report, there are over 100,000 homes certified to the National Green Building Standard. This includes over 11,000 single-family homes and units in more than 2,000 multifamily buildings.

LEED v4 BD+C: New Construction

LEED v4 BD+C: New Construction is a green building certification program to help building owners and operators be environmentally responsible and use resources efficiently. LEED-NC was developed by the United States Green Building Council (USGBC), and Version 4 is the fourth iteration of this program.

Like NGBS, LEED-NC is a point-based system, wherein a building can attain certifications depending on the green practices included in its design and construction. Conformance is verified through construction documents, plans, specifications, inspection reports, and other data which demonstrate conformance with points being pursued. The Green Business Certification Inc. (GBCI) administers the LEED certification program, performing third-party technical reviews and verification of LEED-registered projects to determine if they have met the standards set forth by the LEED rating system.

The LEED-NC focuses on multifamily high-rises and commercial buildings, and buildings that do not primarily serve K-12 educational, retail, data centers, warehouses and distribution centers, hospitality or healthcare uses. A separate rating system called “LEED v4 BD+C: Homes” is used for multifamily buildings below nine stories as well as single-family homes. This rating system varies greatly from the LEED-NC rating system as far how points are achieved and targeted green practices. It is important to differentiate these two rating systems. Please see the report “A Comparative Overview of the ICC/ASHRAE 700-2015 National Green Building Standard & LEED v4 BD+C: Homes and Multifamily Lowrise” for an overview of LEED-NC and how it relates to the NGBS.

Although the development of LEED-NC was developed by industry professionals and involved a public comment period, it is not approved as an ANSI national standard by a national standards-making body.

Per the Project Directory on the USGBC website, there are over 12,000 projects certified under the LEED-NC program. There is no public data available about how many are specifically multifamily high-rise projects.

NGBS & LEED-NC Scopes

Building Types

The standard was designed specifically for residential construction, development and renovation, while LEED-NC is intended for use by both commercial office buildings and multifamily high-rise residential buildings having eight stories or more. While commercial and multifamily buildings may share construction types and methods, the occupancy and use of the building is essential to its sustainability and overall functionality. The sole focus on design, construction and operation of residential buildings allows NGBS to be uniquely suited to residential occupancy.

Project Types Eligible for NGBS Certification

- Single-family homes (new construction and remodels)
- Low-rise multifamily
- High-rise multifamily
- Residential areas of mixed-use buildings
- Land developments (*not covered in this report*)
- Renovations of existing homes and multifamily buildings (*not covered in this report)*
- Renovations of functional areas (*not covered in this report*)

Project Types Eligible for LEED-NC Certification

- High-rise multifamily residential (9 stories or more)
- Major renovations of existing commercial and multifamily high-rise
- Buildings that do not primarily serve K-12 educational, retail, data centers, warehouses and distribution centers, hospitality, or healthcare uses

Categories of Green Practices

NGBS and LEED both have practices in five similar categories:

- Water Efficiency
- Energy Efficiency
- Location and Site Development
- Material and Resource Efficiency
- Indoor Environmental Quality

The Standard has an additional category for “Building Operation, Maintenance, and Building Owner Education”, emphasizing the importance of the end users’ and occupants’ education of and interaction with the building and building systems. It contains such practices as mandatory hands-on training of homeowners and building operators, as well as preparation of O&M materials.

LEED-NC has an additional category, “Integrative Process”, which contains one practice

for one additional points. This emphasizes the importance of integrated design and construction practices within the project team, completing design charettes, and training trade professionals in how they contribute to LEED certification.

LEED-NC offers a separate category for "Innovation in Design", where a project team can earn points by either using an innovative and effective green practice not listed in LEED, completing a practice listed in the USGBC's LEED Pilot Credit Library, or achieving exemplary performance in an existing LEED v4 prerequisite or credit. There is also a point available for having a LEED-Accredited Professional (LEED-AP) on the project team within this category.

The Standard alternatively recognizes innovative green practices within each of its six categories, in lieu of creating a separate category.

Lastly, LEED-NC offers points for "Regional Priority", which awards additional points by project location (zip code) for achieving specified credits in one or more of the previously mentioned categories. USGBC members for each region select which practice merit additional points depending on the region. No additional work is required by the project team to be awarded these points. The Standard also recognizes the importance and influence of a project location on sustainability practices, and provides flexibility for architects and developers to recognize regional priorities through an expansive and climate-specific point system.

Table 1: Green Practice Categories within the NGBS and LEED-NC

NGBS	LEED-NC
The NGBS has six green practice categories: • Lot Design, Preparation, and Development • Resource Efficiency • Energy Efficiency • Water Efficiency • Indoor Environmental Quality • Operation, Maintenance, and Building Owner Education	LEED-NC has nine green practice categories: • Integrative Process(1) • Location and Transportation(1) • Sustainable Sites(1) • Water Efficiency • Energy and Atmosphere • Materials & Resources • Indoor Environmental Quality • Regional Priority • Innovation(2)

(1) These LEED-NC categories are similar to the NGBS "Lot Design, Preparation, and Development" category.

(2) LEED-NC offers a separate category titled "Innovation". The NGBS alternatively recognizes innovative green practices within each of its six categories, instead of creating a separate category.

Certification Levels

ICC/ASHRAE 700-2015 NGBS Certification Levels

Under the NGBS, single-family homes and multifamily buildings can attain one of four potential certification levels: **Bronze, Silver, Gold, or Emerald.** This is achieved by earning a minimum number of points at each certification level, as can be seen in Table 2 below. There are a total of 1,100 points available within the rating system. In addition to earned points, every building certified under the Standard must comply with all of the relevant mandatory provisions.

The Standard was specifically designed so that a project team must take a balanced and multifaceted approach to green building. Therefore, the Standard requires that a project achieve a minimum number of points in each green practice category to be certified, as well as earn a minimum number of additional points from any category it chooses. This prevents project teams from obtaining all of its points by focusing on a handful of categories, and ignoring other categories due to difficulty. This requirement ensures that the NGBS is a rigorous green rating system in respect to achieving certification.

A building's highest rating depends upon the lowest threshold met by any of the six categories. For example, if a project missed the threshold for Emerald in one category by a single point, it will still only achieve Gold certification even if it reached the required number of points for Emerald certification in all other categories.

Furthermore, for dwelling units greater than 4,000 square feet, the number of total points required to receive certification levels increases by one point for every additional 100 square feet. This makes it more challenging for larger dwellings to receive the same certification as smaller dwellings to account for the larger environmental impact of larger dwelling spaces.

Table: 2 NGBS Threshold Point Ratings for Certification

Green Practice Categories		Number of Mandatory Practices	Minimum Points Required Per Rating Level [1] [2]			
			BRONZE	SILVER	GOLD	EMERALD
1.	Lot Design, Preparation, and Development	0	50	64	93	121
2.	Resource Efficiency	11	43	59	89	119
3.	Energy Efficiency	13	30	45	60	70
4.	Water Efficiency	2	25	39	67	92
5.	Indoor Environmental Quality	11	25	42	69	97
6.	Operation, Maintenance, & Building Owner Ed.	2	8	10	11	12
7.	Additional Points from Any Category[2]	-	50	75	100	100
	Total Points Needed	-	231	334	489	611
	Percentage of Total Available Points	-	21%	30%	45%	56%

(1) In addition to the threshold number of points in each category, all mandatory provisions must be implemented.

(2) For dwelling units greater than 4,000 square feet, the number of points in Category 7 shall be increased by 1 point for every additional 100 sf. The "Total Points" shall be increased by the same number of points.

LEED-NC Certification Levels

Similar to NGBS, LEED-NC has certification levels based on the total number of points earned by the project team. Buildings can attain one of four certification levels: **Certified, Silver, Gold** or **Platinum**. There are 110 points available. LEED also includes mandatory prerequisites for all projects considered for certification. Furthermore, LEED-NC contains three Minimum Project Requirements:

1) The project must be in a permanent location on existing land.
2) The boundary of the project must be reasonable, including all contiguous land that is associated with the project and supports its typical operations.
3) The project must be defined as a "dwelling unit" by all applicable codes.

The two rating systems differ in that LEED does not require that a minimum number of points be achieved in each green building category. This enables project teams to obtain certification by receiving a majority of points in the categories they see best, as will be observed in a following section. This can also create the opportunity for a project to not address some areas of sustainability while still receiving overall certification.

Table 3: LEED-NC Threshold Point Ratings for Certification

Green Practice Categories		Number of Mandatory Practices	Minimum Points Required Per Rating Level(1)			
			CERTIFIED	SILVER	GOLD	PLATINUM
1.	Integrative Process(2)	-	-	-	-	-
2.	Location & Transportation(2)	-	-	-	-	-
3.	Sustainable Sites(2)	1	-	-	-	-
4.	Water Efficiency	3	-	-	-	-
5.	Energy & Atmosphere	4	-	-	-	-
6.	Materials & Resources	2	-	-	-	-
7.	Indoor Environmental Quality	2	-	-	-	-
8.	Regional Priority	-	-	-	-	-
9.	Innovation in Design	-	-	-	-	-
	Total Points Needed:	N/A	40	50	60	80
	Percentage of Total Available Points	N/A	36%	45%	55%	72%

(1) In addition to the threshold number of points in each category, all prerequisites must be implemented.

(2) Credits in these LEED-NC categories are comparable to those in the NGBS 2015 "Lot Design, Preparation, and Development" category.

Example Project Comparisons

In the sections below, four example projects are provided to demonstrate the various pathways of achieving certification through the two rating systems. Two of the example projects have met the requirements to successfully achieve LEED-NC Silver, and the other two have achieved NGBS Silver. In all four cases, Silver Certification is the second highest rating a project can achieve, above the basic level of "certified" in the case of LEED and "bronze" in the case of the NGBS.

Project A – NGBS Silver

Table 4 below provides an example of a project achieving NGBS Silver certification by achieving all of the points required within each category at the Silver level, as well as the total additional points required from any category of the team's choice. The mean achieved only the minimum points required, but did so in all categories and therefore are awarded Silver. Figure 1 shows the percentage of points achieved in each category compared to the total points achieved.

Table 4: Example 'Project A' Achieving NGBS 2015 Silver Certification

Green Building Categories		Points Achieved	Points Required for Silver
1.	Lot Design, Preparation, and Development	50	50
2.	Resource Efficiency	43	43
3.	Energy Efficiency	30	30
4.	Water Efficiency	25	25
5.	Indoor Environmental Quality	25	25
6.	Operation, Maintenance, and Building Owner Education	8	8
7.	Additional Points from Any Category	50	50
	Total Points :	231	231

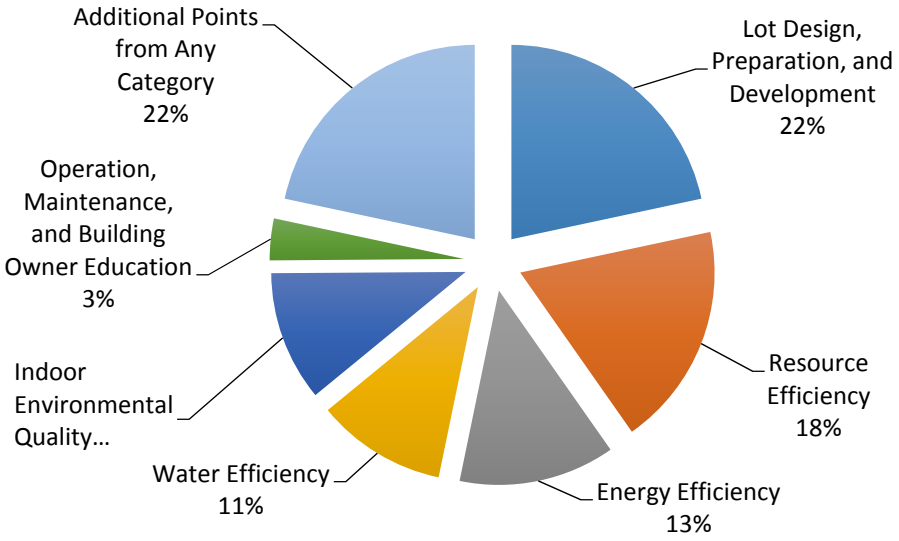


Figure 1: Distribution of Points Achieved for Example 'Project A'

Project B – LEED Silver

While a minimum number of total points are required for each certification tier, LEED-NC does not require minimum point thresholds to be achieved in each green building category. Project teams can obtain certification by achieving points in any of the nine available categories, as observed in Table 5 below. The project team earned LEED-NC Silver Certification without earning points within the Energy & Atmosphere category. In this example, the project team deemed the already above-code mandatory requirements of the category sufficient to the needs of the project. These mandatory practices will be reviewed in greater detail in later sections of the report.

Table 5: Example 'Project B' Achieving LEED-NC Silver Certification

Green Building Categories		Points Achieved	Points Required for Silver
1.	Integrative Process	1	N/A
2.	Location & Transportation	16	N/A
3.	Sustainable Sites	8	N/A
4.	Water Efficiency	9	N/A
5.	Energy & Atmosphere	0	N/A
6.	Materials & Resources	4	N/A
7.	Indoor Environmental Quality	6	N/A
8.	Regional Priority	2	N/A
9.	Innovation	4	N/A
	Total Points :	50	50

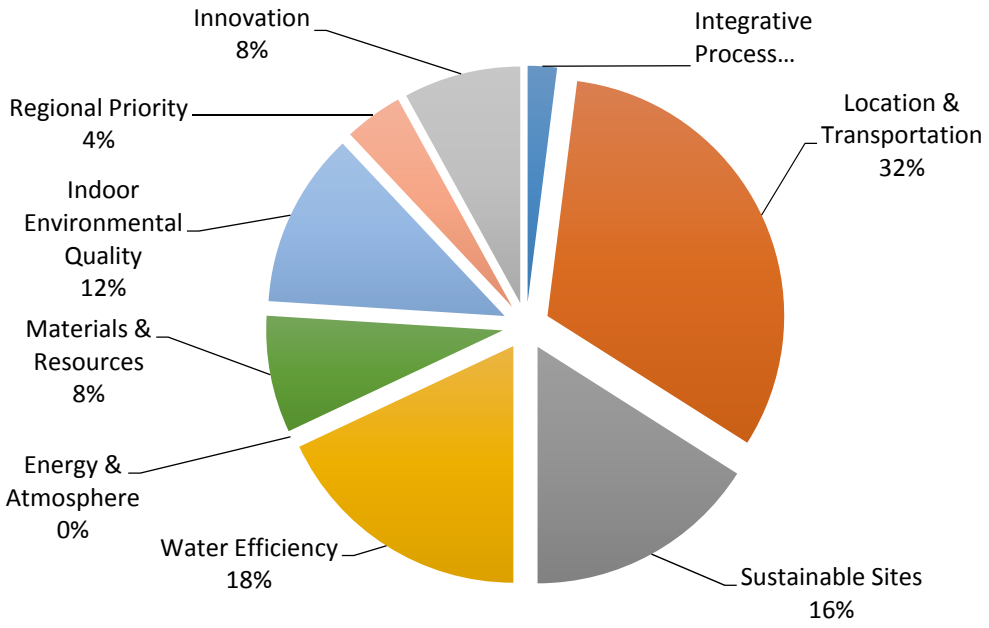


Figure 2: Distribution of Points Achieved for Example 'Project B'

Project C – NGBS Silver

In Example 'Project C' below, the project team earned enough total points within the NGBS required for Gold Certification, as well as earned more than enough minimum points in each category except for one, Water Efficiency. Even though the project exceeded the minimum number of points required in multiple sections, the fact that the project did not meet the 67 points in Water Efficiency required for Gold means the entire project can only achieve Silver Certification.

Table 6: Example 'Project D' Achieving NGBS Silver Certification

Green Building Categories		Points Achieved	Points Required for Gold
1.	Lot Design, Preparation, and Development	95	93
2.	Resource Efficiency	91	89
3.	Energy Efficiency	62	60
4.	Water Efficiency	66	67
5.	Indoor Environmental Quality	69	69
6.	Operation, Maintenance, and Building Owner Education	11	11
7.	Additional Points from Any Category	103	100
	Total Points :	497	489

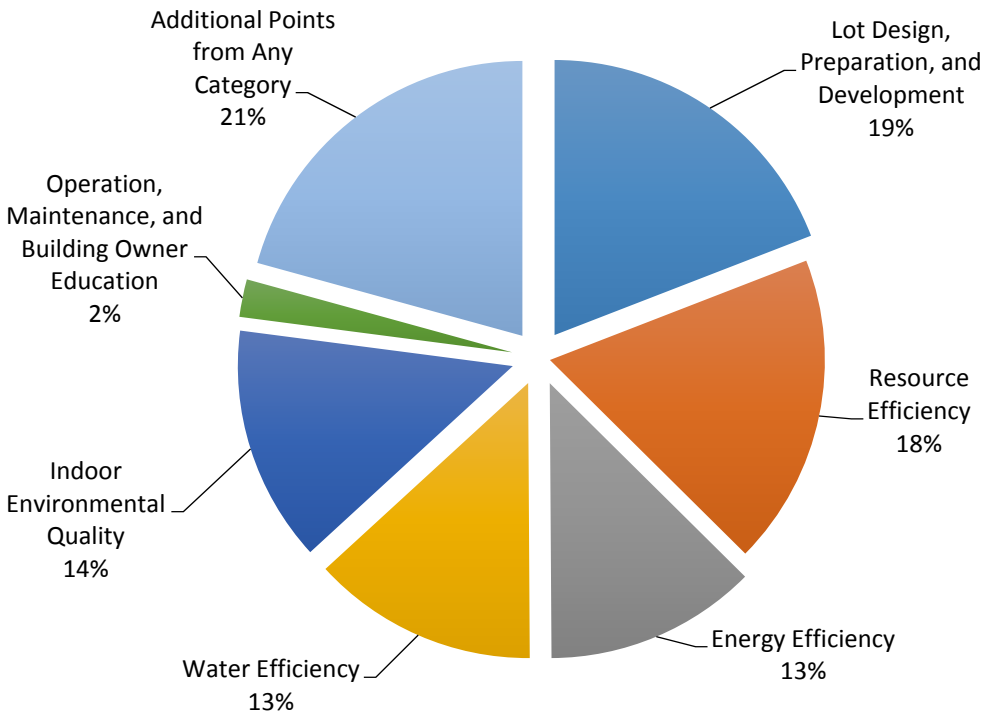


Figure 3: Distribution of Points Achieved for Example 'Project C'

Project D – LEED Silver

In Example 'Project D' below, the project team earned LEED-NC Silver Certification while opting to not pursue points in the Water Efficiency and Materials & Resources categories. Based on the client needs and any other variables involved in the project, the team selected the Energy Efficiency and Location & Transportation categories to be their main points of focus. Since LEED-NC only requires them to meet the mandatory prerequisites of categories, they were able to apply more focus on certain individual categories to achieve certification.

Table 6: Example 'Project D' Achieving LEED-NC Silver Certification

Green Building Categories		Points Achieved	Points Required for Silver
1.	Integrative Process	1	N/A
2.	Location & Transportation	16	N/A
3.	Sustainable Sites	1	N/A
4.	Water Efficiency	0	N/A
5.	Energy & Atmosphere	23	N/A
6.	Materials & Resources	0	N/A
7.	Indoor Environmental Quality	5	N/A
8.	Regional Priority	1	N/A
9.	Innovation	3	N/A
	Total Points :	50	50

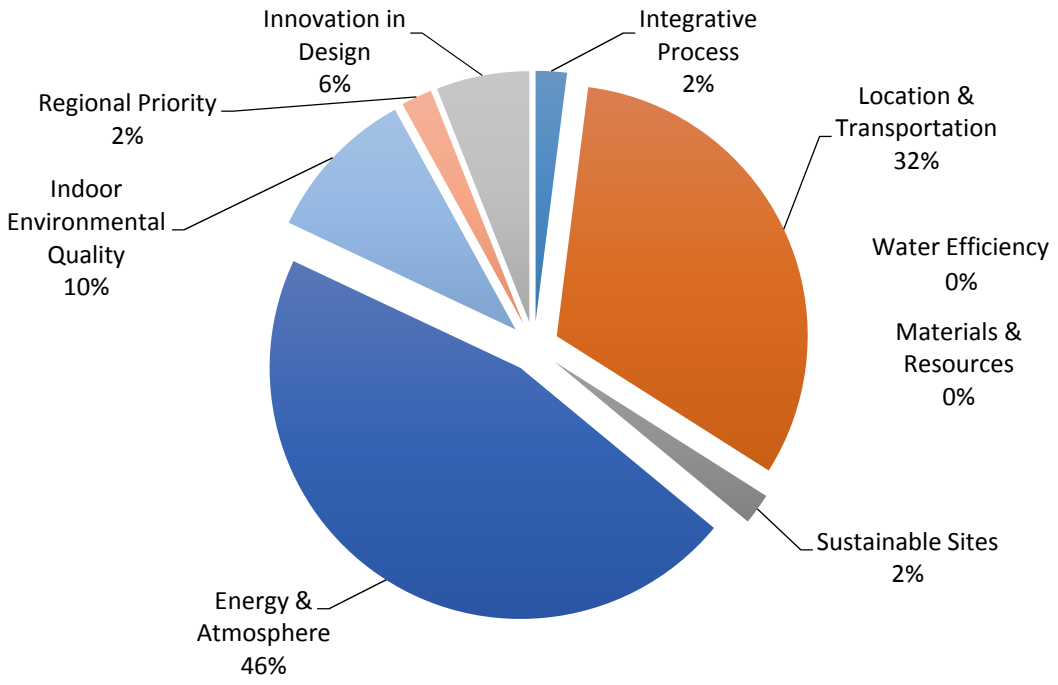


Figure 4: Distribution of Points Achieved for Example 'Project D'

The Certification Process

ICC/ASHRAE 700-2015 NGBS

Conformance with the NGBS is verified through construction documents, plans, specifications, inspection reports, and other data that demonstrates conformance with the points being pursued. All NGBS project teams must include a NGBS Green Verifier, who serves as an independent, in-field representatives of the NGBS Green certification system. Verifiers work with project teams to perform the rough and final construction inspections described below. To achieve certification, these inspection reports, along with relevant information regarding pursued practices, are provided to Home Innovation Labs for technical review and verification.

Every project is subject to two independent, mandatory, third-party verification inspections. The accredited Verifier is responsible for the visual inspection of every green building practice in the building. The verifier must perform a rough inspection before the drywall is installed in order to observe the wall cavities in every apartment, and a final inspection of every apartment once the project is complete. The required verification imbues a high level of rigor, continuity, and quality assurance to the system and to the projects that are certified.

Home Innovation Research Labs

Home Innovation Research Labs is a 53-year old, internationally-recognized, accredited product testing and certification laboratory located in Upper Marlboro, Maryland. Their work is solely focused on the residential construction industry and their mission is to improve the affordability, quality, performance, and durability of housing by helping overcome barriers to innovation. Their core competency is as an independent, third-party product testing and certification lab.

Home Innovation qualifies, trains, and accredits building professionals to provide independent verification services for builders participating in the NGBS Green Certification system. Verifiers must demonstrate they possess experience in residential construction and green building before they are eligible to take the verifier training. Many verifiers are also HERS Raters, LEED-NC Green Raters, or LEED Accredited Professionals. Potential verifiers must complete thorough training on exactly how to verify every NGBS practice. After completing the training, verifiers must pass a written exam before receiving Home Innovation accreditation. Accreditation must be renewed annually.

Home Innovation reviews every rough and final inspection report to ensure national consistency and accuracy in the verification reports. Furthermore, they regularly audit Verifiers and the verifications they perform as part of an internal quality assurance system.

LEED-NC

Conformance with LEED-NC is verified through construction documents, plans, specifications, inspection reports, and other data that demonstrate compliance with the credits being pursued. It is recommended, but not required, that a LEED-AP be a member of the project team. An additional point is awarded to the project if a LEED-AP is included

on the project team. The project team will need to hire a Commissioning Agent to complete commissioning practices described in later sections of this report.

In order to achieve certification, all relevant plans and information regarding pursued green practices are provided to the Green Business Certification Inc. (GBCI) for a third-party technical review and verification. No visual inspections by the GBCI or independent third-party are required for achieving LEED-NC certification. Project teams can opt to have a single review, called a "Combined Design and Construction" review completed on their provided information. The GBCI will review all information at the same time, from design through construction. Alternatively, projects may opt to have "Split" reviews, wherein the GBCI will review the design practices and construction practices separately. This strategy allows a project to predict how many design-related points they will achieve, and adjust the number of construction points pursued to meet their target certification.

The Green Business Certification Institute

The GBCI is a nonprofit organization developed in 2008 with the support of the USGBC, and operates as the certification and credentialing organization for all LEED-related systems. Credentialing exams and designations administered by the GBCI include the LEED Green Associate, LEED AP with specialty, and LEED Fellow, among others. Since its initial development, the GBCI has expanded beyond LEED and now provides similar services for the International WELL Building Institute's WELL Building Standard, the Perfect Power Institute's PEER standard, and the Global Real Estate Sustainability Benchmark.

Registration & Certification Fees

The registration and certification fees for both the NGBS and LEED-NC systems are depicted in the table below. This does not include any fees charged by the third-party entities required for project certification. For the NGBS, this includes a Green Verifier required for on-site inspections. For LEED-NC, this can include a Commissioning Agent, Energy Modeler, and LEED-AP. These individuals and organizations set their own rates based on market prices.

Table 7: Registration and Certification Fees

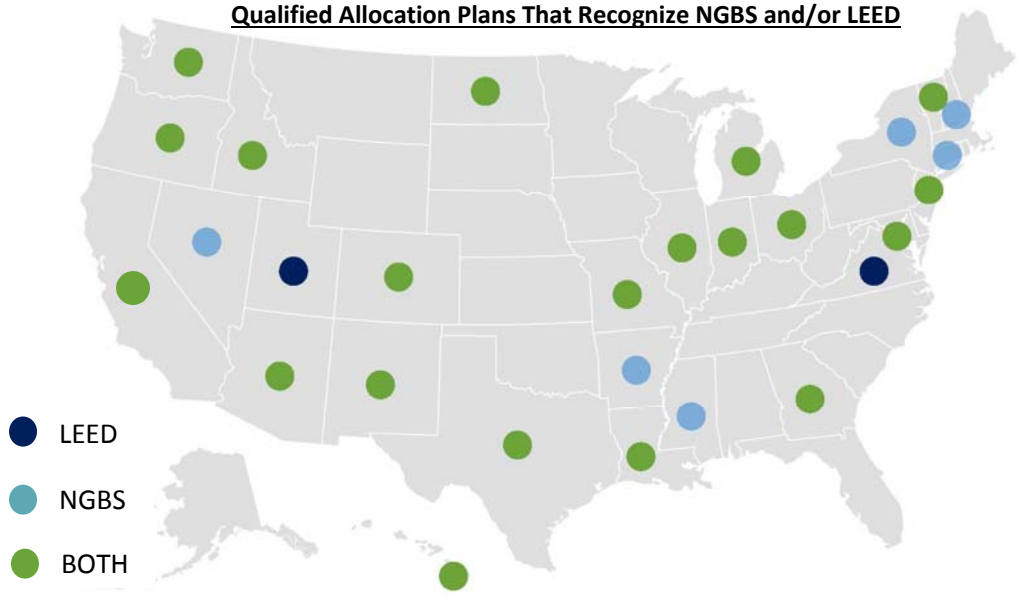
<table>
<tr><th colspan="3">NGBS 2015</th><th colspan="3">LEED-NC</th></tr>
<tr><td rowspan="2">Single-Family</td><td colspan="2">Registration: $0</td><td rowspan="2">Combined Certification</td><td colspan="2">Registration: $1,500</td></tr>
<tr><td colspan="2">Certification
$200/Home</td><td colspan="2">Design & Construction Review
● <$250k sqft: $0.068/sf ($3,420 min)
● $250,000-499,999 sqft: $0.066/sf ($17,100 min)
● $500,000-749,999 sqft: $0.060/sf ($33,000 min)
● ≥$750,000 sqft: Contact GBCI</td></tr>
<tr><td rowspan="3">Multi-family</td><td colspan="2">Registration : $0</td><td rowspan="3">Split Certification</td><td colspan="2">Registration: $1,500</td></tr>
<tr><td colspan="2">Certification
● 1-3 Stories: $200 base + $30/unit
● ≥4 Stories: $600 base + $30/unit</td><td colspan="2">Design Review
● <250k sqft: $0.055/sf ($2,740 min)
● 250,000-499,999 sqft: $0.053/sf ($13,760 min)
● 500,000-749,999 sqft: $0.049/sf ($26,625 min)
● ≥750,000 sqft: Contact GBCI</td></tr>
<tr><td colspan="2">Construction Review
● <250k sqft: $0.018/sf ($910 min)
● 250,000-499,999 sqft: $0.018/sf ($4,585 min)
● 500,000-749,999 sqft: $0.016/sf ($8,875 min)
● ≥750,000 sqft: Contact GBCI</td></tr>
<tr><td rowspan="2">Other Fees</td><td>Appeals</td><td>$0</td><td rowspan="2">Other Fees</td><td>Appeals</td><td>● Complex Credits: $800 per credit
● Simple Credits: $500 per credit</td></tr>
<tr><td>Inquiries</td><td>$0</td><td>Inquiries</td><td>$225 per credit</td></tr>
</table>

Legislative and Regulatory Inclusion

Both LEED and NGBS have been considered on par or more stringent than other green building rating systems for residential projects within a number of federal systems. The following systems and municipalities recognize both LEED and the NGBS:

- **HUD & USDA Energy Efficiency Standards:** NGBS is a recognized alternative compliance path for demonstrating that HUD- or USDA housing meets the agencies' energy-efficiency standards. HUD also recently adopted significant mortgage insurance premium reductions for green certified buildings and NGBS is one of the eligible systems. See more at www.gpo.gov/fdsys/pkg/FR-2015-05-06/pdf/2015-10380.pdf.
- **USDA Rural Development, Multifamily Housing Energy-Efficiency Initiative:** Applicants to several Rural Rental Housing, Farm Labor Housing, Housing Preservation Grants, and Multifamily Housing Revitalization grants and loans can receive additional points for new construction and rehabilitation projects that are certified to NGBS, LEED for Homes, Enterprise Green Communities, and/or Energy Star. See more at https://energy.gov/eere/solarpoweringamerica/rural-development-multi-family-housing-energy-efficiency-initiative.
- **U.S. Department of Army**: This department recognizes NGBS as a LEED equivalent for its military housing in several locations.
- **North Carolina:** The Housing Finance Agency Community Partners Loan Pool awards a $1,000 financial incentive to participating local governments and non-profits who obtain NGBS or LEED for Homes.
- **Delaware** Green for Green program offers rebates ranging between $1,000 and $2,500 to homebuyers of residences certified to the NGBS, LEED, RESNET, and Energy Star 3.0. NGBS homes must be Silver or higher.
- **Homes in New Mexico** certified to either the NGBS or LEED can qualify for the generous state tax credit.
- **State Qualified Allocation Plan**: Over 20 states mandate or incentivize NGBS and LEED certification through their Qualified Allocation Plans for the federal Low Income Housing Tax Credit program.

Qualified Allocation Plans That Recognize NGBS and/or LEED



Green Practice Categories

This section will provide an overview of the green practice categories featured in both LEED-NC and the NGBS, including mandatory practices, minimum point requirements, and green practices featured within the category.

Location and Site Development

ICC/ASHRAE 700-2015 NGBS - Lot Design, Preparation and Development

The "Lot Design, Preparation, and Development" green practice category pertains to key site-related green aspects, such as stormwater management, heat island reduction, high priority sites (brownfields, infills, etc.), green vehicles, and access to public transportation and bicycle facilities.

This category is more process-oriented than the other NGBS categories, since environmentally sensitive strategies differ depending on locale, topography, climate, and other regional factors. Regardless, the Standard requires a minimum number of points from this category to be earned in order to receive any level of certification. See the chart below for the required number of points for this category.

Mandatory Practices:

NGBS does not have any mandatory practices in this category.

Minimum Point Requirements:

Table 8: Lot Design, Preparation, and Development Minimum Point Requirements

Green Building Categories	Minimum Points Required			
	BRONZE	SILVER	GOLD	EMERALD
Lot Design, Preparation, and Development	50	64	93	121

LEED-NC - Location & Transportation and Sustainable Sites

LEED-NC has two categories that focus on the location and site development of the project. The "Location and Transportation" category focuses on minimizing the environmental impact of the overall project based on location, such as building on high-priority sites (such as brownfields and infills) and providing access to public transportation. The second category, "Sustainable Sites," pertains more to the development of the lot itself and includes environmental practices like rainwater management, heat island reduction and sustainable site development.

Mandatory Practices:

- Create and implement an erosion and sedimentation control plan for all construction activities

Minimum Point Requirements:

LEED does not require projects to obtain a minimum number of points per category.

Analysis

Green practices in the "Lot Design, Preparation, and Development" category of NGBS are similar to the "Location and Transportation" and "Sustainable Sites" categories of LEED-NC. Both rating systems include many similar practices in these categories. One notable exception is the LEED practice "Light Pollution Reduction." NGBS 2015 does offer points for outdoor lighting techniques that take into consideration local wildlife.

LEED also requires a Construction Activity Pollution Plan to be implemented to comply with the Sustainable Sites category, regardless of project size or area of disturbance (See Figure 5 below). NGBS awards points for activities in accordance with a Storm Water Pollution Prevention Plan or other applicable construction plan. However, it does not require a plan to be made unless also required by the local jurisdiction based on area of project disturbance.

In these categories, NGBS has fewer mandatory practices but more overall available practices than LEED. To receive any NGBS certification, a minimum number of points must be obtained in the category. NGBS was designed to apply to a wide range of residential sites, from the rural single-family home, to a neo-traditional neighborhood townhouse, to the high-rise apartment building. As a result, some practices may not be relevant to a particular site seeking NGBS certification. An architect designing a downtown Miami apartment building, for example, will likely be able to claim NGBS points for increased density and public transportation access, but will not be able to claim points for slope disturbance minimization (being flat terrain) and some of the natural resource preservation points (being a greyfield and infill site).

Figure 5: Location and Site Development Practices

	ICC/ASHRAE 700-2015 NGBS		Points Possible
Lot Design, Preparation and Development	501.1(1)	**NGBS Certified Neighborhood** The project is located in a NGBS Certified Site or equivalent	15
	503.7	**Avoid Environmentally Sensitive Areas** ● The lot does not contain any environmentally sensitive area disturbed during construction (4 pts) ● Mitigation and/or restoration is conducted to preserve ecosystem functions lost through development/construction (4 pts)	4
	501.1(2b)	**Greyfield** The lot selected is a greyfield (previously developed).	10
	501.1(2a)	**Infill** The lot selected is an infill lot with adjacent existing development and infrastructure.	10
	501.1(2c)	**Brownfield** The lot selected is an EPA-recognized brownfield	15
	501.2(1)	**Mass Transit** The project is located within 1/2-mile of pedestrian access to a mass transit system	6
	501.2(2)	**Mass Transit with Parking** The project is located within 5 miles of a mass transit system with available parking	3
	501.2(4)	**Community Resources** The project is located with 1/2-mile of six or more community resources, such as a supermarket, a place of worship, a bank, a school, a medical/dental office, a recreational facility, a park, etc.	4
	501.2(5)	**Dedicated Bicycle Lanes** The project is located within an community that has right-of-way, dedicated bicycle paths or lanes, or on an infill lost located within 1/2 -mile of a bicycle lane designated by the jurisdiction.	5
	501.2(6)	**Bicycle Parking** Dedicated bicycle parking and racks are provided for mixed-use and multifamily buildings: *Path 1:* Minimum of 1 bike space per 3 residential units (2 pts) *Path 2:* Minimum of 1 bike space per 2 residential units (4 pts) *Path 3:* Minimum of 1 bike space per 1 residential units (6 pts)	6

	LEEDv4-NC	Points Possible
Location & Transportation	**LEED for Neighborhood Development** Locate the project in within the boundary of a development certified under LEED for Neighborhood Development (ND): - Certified ND: 8 pts - Silver ND: 10 pts - Gold ND: 12 pts - Platinum ND: 16 pts *Note:* Projects attempting this credit are not eligible to earn points under other Location and Transportation credits.	16
	Sensitive Land Protection *Option 1* Locate the development footprint on land that has been previously developed. -OR- *Option 2* Do not locate the development on prime farmland, floodplains, habitats of threatened or endangered species, within 100' of water bodies, or with 50' of wetlands.	2
	High Priority Site *Option 1:* Locate the project on an infill location in a historic district. -OR- *Option 2:* Locate the project on one of the following: EPA National Priorities listed site, Federal Empowerment Zone site, Federal Enterprise Community site, Federal Renewal Community site, Qualified Low-Income Community, Qualified Census Tract (QCT) or Difficult Development Area (DDA), or local equivalent -OR- *Option 3:* Locate on a brownfield where soil or groundwater contamination has been identified.	1
	Access to Quality Transit Locate any functional entry of the project within a ¼-mile walking distance of existing or planned bus, streetcar, or informal transit stops, or within a ½-mile walking distance of existing or planned bus rapid transit stops, light or heavy rail stations, commuter rail stations or ferry terminals. Points awarded are dependent on daily transit service.	5
	Surrounding Density and Diverse Uses *Option 1:* Locate the site where the surrounding density within ¼-mile radius has a density of 22,000 sqft/acre (2 pts) or 35,000 sqft/acre (3 pts). -AND/OR- *Option 2:* Locate the site within a ½-mile walking distance of the main entrance of 4-7 (1pt) or 8 or more (2 pts) existing diverse uses, such as a supermarket, a place of worship, a bank, a school, a medical/dental office, a recreational facility, a park, etc.	5
	Bicycle Facilities Locate the functional entry and/or bicycle storage area within a 200-yard walking or bicycling distance from a bicycle network that connects to either 10 diverse uses, a school or office (if project is 50% or more residential by sqft), or a mass transit station. *For residential projects:* ● Provide short-term bike storage for 2.5% of all peak visitors (4 spaces/building min.) ● Provide long-term bike storage for 30% of all regular occupants (1 space/unit min.)	1

Figure 5: Location and Site Development Practices

	ICC/ASHRAE 700-2015 NGBS		Points Possible		LEEDv4-NC	Points Possible
Lot Design, Preparation and Development	505.6 / 706.8	**Electric Vehicle Charging Stations** Plug-in electric vehicle charging capability (Level 2) is provided for 1% or more of parking stalls. Stalls are equipped with either Level 2 charging AC grounded outlets or Level 2 charging stations.	4	Location & Transportation	**Green Vehicles** Designate 5% of all parking spaces used by the project as preferred parking for green vehicles. -AND- Install electrical vehicle supply equipment (EVSE) in 2% of all parking spaces used by the project. -OR- Install liquid or gas alternative fuel fueling facilities or a battery switching station capable of refueling a number of vehicles per day equal to at least 2% of all parking spaces.	1
	505.1	**Driveways and Parking Reduction** Impervious areas are minimized by one or more of the following: ● Off-street parking and driveways are shared (5 pts) ● For multifamily, parking does not exceed local minimums (5 pts) ● Structured parking is use or reduce footprint by 25% (4 pts), 50% (5 pts), or greater than 75% (6 pts) ● Water permeable surfacing is used to reduce impervious driving and parking surfaces by 10% (1 pt), 25% (2 pts), and greater than 75% (3 pts)	16		**Reduced Parking Footprint** Do not exceed the minimum local code requirements for parking capacity. -AND- Provide parking capacity that is a 20-40% below the base ratios recommended by the Parking Consultants Council, depending on if the "Surrounding Density and Diverse Uses" credit or "Access to Quality Transit" is achieved.	1
	504.3	**Soil Erosion and Soil Implementation** Soil disturbance and erosion is minimized by using one or more of the following practices in accordance with the SWPPP: ● Sediment/erosion controls installed per SWPPP (5 pts) ● Limits of clearing/grading staked out (5 pts) ● "No disturbance" zones created to protect veg. and sensitive areas (5 pts) ● Topsoil stockpiled and stabilized for later use (5 pts) ● Distribute weight of equipment to reduce soil compaction (4 pts) ● Disturbed areas to be left unworked for 21 days are stabilized with 14 days (3 pts) ● Soil is improved with organic amendments and mulch ● Utilities are installed by alternative means, such as tunneling (5 pts) ● Inspection reports of best practices are available (3 pts)	38	Sustainable Sites	**Construction Activity Pollution Prevention** Create and implement an erosion and sedimentation control plan for all construction activities, conforming with the 2012 U.S. Environmental Protection Agency (EPA) Construction General Permit (CGP) or local more-stringent equivalent, regardless of size.	**Mandatory**
	503.1	**On-site Existing Natural Resources** ● A natural resource inventory is completed under the direction of a qualified professional (5 pts) ● A plan is implemented to conserve the elements identified by the natural resource inventory (6 pts)	11		**Site Assessment** Complete and document a site survey or assessment that includes all items listed in LEED, including but not limited to topography, flood hazard areas, wetlands, solar exposure primary vegetation types, tree mapping, soils delineation, prime farmland, transportation infrastructure, proximity or vulnerable populations, and adjacent physical activity opportunities.	1

Figure 5: Location and Site Development Practices

	ICC/ASHRAE 700-2015 NGBS		Points Possible
Lot Design, Preparation and Development	503.6	**Wildlife Habitat** At least two of the following practices must be selected to earn this credit: ● Plants and garden are selected that encourage wildlife, such as bird and butterfly gardens (3 pts) ● Include a certified "backyard wildlife" program (3 pts) ● The lot is designed in regard to wildlife corridors, fish and game parks, and preserved areas (3 pts) ● Outdoor lighting techniques are utilized with regard to wildlife (3 pts)	12
		Tree and Vegetation Preservation Trees and vegetation are preserved by one ore more of the following: ● Fencing is installed to protect trees and other vegetation (3 pts) ● Trenching, significant changes of grade, and soil compaction in "tree save" areas are avoided (5 pts) ● Damage to existing trees and vegetation is mitigated during construction (4 pts)	12
	504.2	**Landscape Plan** A landscaping plan is developed with one ore more of the following: ● A plan is implemented that protects, restores, or enhances natural vegetation for 12% (1 pt), 25% (2 pts), 50% (3 pts), or 100% (4 pts) of the lot. ● Only non-invasive native or regionally appropriate plants selected to promote biodiversity. (7 pts) ● To improve pollinator habitat, 10% or more of planted area are non-invasive flowering and nectar producing plants. (3 pts)	14
	505.5	**Community Gardens** A portion of the site is established as a community garden, available to all occupants, to provide for local food production.	3
	503.4	**Stormwater Management** Complete one or more of the following: ● Implement a plan to maintain the natural site hydrology by preserving important permeable soils, natural drainage ways, and other water features. (7 pts) ● Design stormwater management system so that post-construction runoff rate, volume, and duration do not exceed pre-development (natural, stable) conditions. (10 pts) ● Use LID and Green Infrastructure to manage the 80th percentile (5 pts), 90th percentile, (8 pts), or 95th percentile (10 pts) storm event. ● Permeable materials are used for less than 25% (5 pts), 25-50% (8 pts), or greater than 50% (10 pts) of surfaces.	37
	505.2	**Heat Island Mitigation** ● 50% or more of the hardscape area is either shaded with vegetation, paving with high SRI (SRI 29 or greater), or permeable. (5 pts) ● 75% or more of the roof area is vegetated with noninvasive plants. (5 pts)	10

	LEEDv4-NC	Points Possible
Sustainable Sites	**Site Development - Protect/Restore Habitat** Preserve and protect from all development and construction activity 40% of the greenfield area on the site, if available. -AND- *Option 1:* Restore 30% (including the building footprint) of all portions of the site identified as previously disturbed using native or adaptive species. (2 pts) -OR- *Option 2:* Provide financial support equivalent to at least $0.40 per square foot for the total site area (including the building footprint) to a nationally or locally recognized land trust or conservation organization within the same EPA Level III ecoregion or the project's state. (1 pt)	2
	Open Space Provide outdoor pedestrian-oriented, recreation-oriented , garden, or native habitat space that is at least 30% of the total site area (including building footprint). A minimum of 25% of that outdoor space must be vegetated (not including turf grass) or have overhead vegetated canopy.	1
	Rainwater Management *Option 1:* Use on-site LID and green infrastructure to manage rainfall from the 95th percentile (2 pts) or 98th percentile (3 pts) storm event. If Zero lot line project in urban areas, only 85th percentile storm event required. -OR- *Option 2:* Manage on site the annual increase in runoff volume from the natural land cover condition to the postdeveloped condition. (3pts)	3
	Heat Island Reduction *Option 1:* Use a combination of strategies to reduce heat-island effect, including but not limited to shading from trees, vegetated structures, and architectural devices, paving with SRI above 28 (after 3 years), open grid pavement, vegetated roofs, and roofing materials with high SRI values (82 for low-sloped and 39 for high-sloped). -OR- *Option 2:* Place a minimum of 75% of parking spaces under cover with roof that is vegetated, High SRI (39 at time of installation), or covered by energy generation systems.	2

Figure 5: Location and Site Development Practices

Other NGBS 2015 Credits

	ICC/ASHRAE 700-2015 NGBS		Points Possible
Lot Design, Preparation and Development	501.2(3)	**Walkability and Pedestrian Access** Design walkways, street crossings, and entrances to promote pedestrian activity and are connect to existing sidewalks or areas of development.	5
	503.1	**Natural Resources (cont'd)** ● Listed items are protected under direction of qualified professional. (4 pts) ● Basic training on resource protection provided to on-site supervisor. (4 pts) ● Tree pruning conducted by certified arborist. (3 pts) ● Vegetation maintenance in accordance with TCIA A300. (4 pts) ● Protection plan of adjacent common areas implemented. (5 pts)	20
	503.2	**Slope Disturbance** Use practices to minimize slope disturbance, including but not limited to terrain adaptive architecture, soil stability studies, aligning pavements with natural topography, among others.	27
	503.3	**Limiting Soil Disturbance** Soil disturbance and erosion is minimized by using one or more of the following: ● Disturbed soil stabilized within 14 days (5 pts) ● 75% or more of utility installation is tunneled, in shared trenches, under pavement, or use equipment uses geomats (5 pts) ● Limits of clearing and grading demarcated in plans (5 pts)	15
	503.5	**Landscape Plan (Cont'd)** A landscaping plan is developed with one ore more of the following: ● EPA WaterSense Water Budget Tool used to implement mas % of turf area (2 pts) Path 5: Max % of vegetated areas that are turf is 0% (5 pts), less than 20% (4 pts), less than 40% (3 pts), less than 60% (2 pts) ● Plants with similar watering needs are grouped (5 pts) ● 30% or more of building walls shaded in summer by plants (5 pts) ● Vegetative wind breaks/channels designed to protect lot (5 pts) ● On-site or community tree trimmings of native trees used as mulch (3 pts) ● Integrated pest management plan developed to minimize chemical use in pesticides and fertilizers (4 pts) ● Developer creates a plan to remove or contain invasive plants from disturbed areas of the site (3 pts) ● Developer creates a plan to remove or contain invasive plants from undisturbed areas of the site (6 pts)	36
	503.8	**Demolition of Existing Building** A demolition waste management plan is implemented to recycle and/or salvage a minimum of 50% of nonhazardous demolition waste. One additional point awarded for every 10% above 50%.	5-10
	504.1	**On-site Supervision of Green Practices** On-site supervision is provided during clearing, grading, trenching, paving, an utility installation to ensure green practices are implemented	4
	505.3	**Density** Construct or renovate a building that meets the following density : ● 7-14 units/acre (4 pts) ● 14-20 units/acre (5 pts) ● 21-34 units/acre (6 pts) ● 35-69 units/acre (7 pts) ● 70 or more units/acre (8 pts)	8
	505.4	**Mixed-Use Development** The lot contains a mixed-use building.	8

Other LEEDv4-NC Credits

	LEEDv4-NC	Points Possible
Integrative Process	**Integrative Process** Perform a preliminary "simple box" energy modeling analysis and water budget analysis before the completion of schematic design that explores how to reduce energy and water use in the building. Document how the analyses informed building and site design decisions in the project's OPR and BOD.	1
Sustainable Sites	**Light Pollution Reduction** Meet uplight and light trespass requirements, using either the backlight-uplight-glare (BUG) method or calculation method provided within LEED.	1

Materials & Resource Efficiency

ICC/ASHRAE 700-2015 NGBS - Resource Efficiency

The "Resource Efficiency" green practice category is focused on minimizing the environmental impact of buildings by incorporating environmentally efficient building systems and materials, and reducing waste generated both during construction and after occupation of the home. This includes products and systems with enhanced durability and reduced maintenance, as well as reused, recycled, regional, or salvaged materials.

Mandatory Practices:

- For dwelling units greater than 4,000 ft^2 , the number of overall project points required for certification shall be increased by 1 point for every additional 100 ft^2.
- A capillary break and vapor retarder must be installed at concrete slabs in accordance with ICC IRC or IBC codes referenced in the Standard.
- Where required, exterior drain tile installed.
- Crawlspaces:
    - Damp proof wall are provided below grade
    - 6-mil PE sheeting or Class I Vapor retarded installed
- Insulation in cavities is dry
- Where required, water resistive barrier or drainage plane system installed behind exterior veneer/siding.
- Flashing installed at all locations listed in Figure 6.
- Tile backing materials installed under tiled surfaces in wet areas.
- Where required, an ice barrier is installed at roof eaves of pitched roofs.
- All horizontal ledgers are sloped away to provide gravity drainage.
- Finished grades at all sides of a building provide a min of 6" of all within 10' of the building for proper drainage.

Minimum Point Requirements:

Table 9: Resource Efficiency Minimum Point Requirements

Green Building Categories	Minimum Points Required			
	BRONZE	SILVER	GOLD	EMERALD
Resource Efficiency	43	59	89	119

LEED-NC - Materials & Resources

The "Material & Resources" category of LEED-NC focuses on the environmental performance of products and materials pertaining to green building, as well as diverting

material waste from landfills and incineration facilities. Practices in this category include building life-cycle assessments, product disclosures, construction waste management planning and the use of recycled and regional materials.

Mandatory Practices:

- Implement a construction and demolition waste management plan, identifying at least 5 materials targeted for diversion and providing final waste stream reports.
- Provide dedicated areas within the building for collection and storage of recyclable materials.

Minimum Point Requirements:

LEED does not require projects to obtain a minimum number of points per category.

Analysis

As seen in Figure 6 below, NGBS and LEED include several similar practices in their Materials and Resources categories. LEED-NC has two mandatory practices, including developing and implementing a construction and demolition waste management (CWM) plan. However, no minimum diversion rates are required. Points are awarded in another CWM credit for actual diversion rates achieved. While NGBS does not mandate a CWM plan, it does award points for projects that divert 50% of construction and demolition waste away from landfills, the same as LEED-NC. Additionally, the project must be sure to divert at least 95% of all e-waste from any existing building being demolished from landfills.

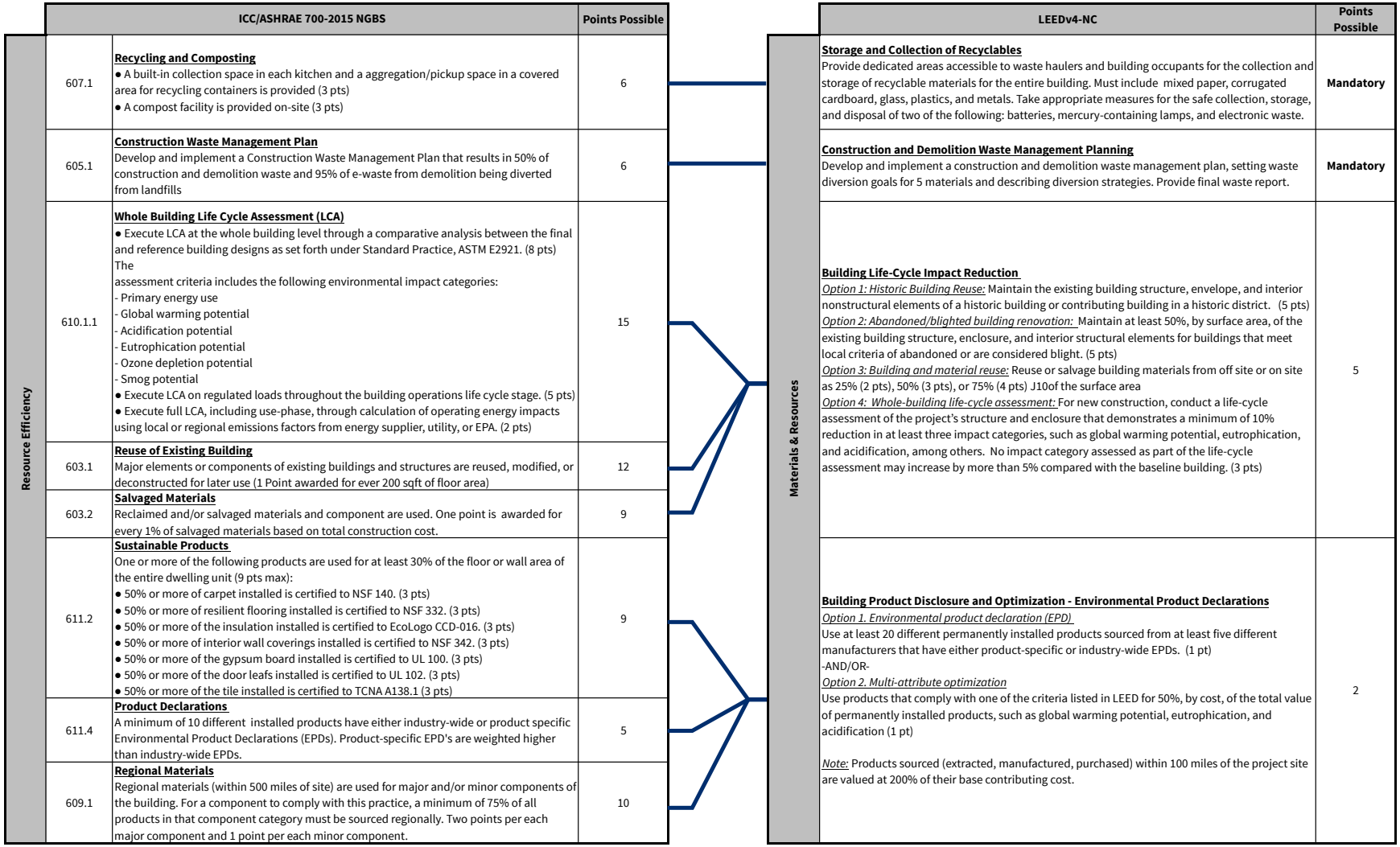
The second requirement in LEED-NC is providing dedicated areas in the building for collection and storage of recyclable materials. While this practice is not mandatory in NGBS, it is awarded with points. Furthermore, providing a compost facility on-site can earn a project additional points in the NGBS.

Where the rating systems diverge is the standard's plethora of mandatory construction-related practices in the Resource Category, resulting in high-quality construction with reduced maintenance. These practices are focused on increased durability and protection from the elements. This is an essential part of long-term sustainability because it reduces the amount of resources used over the life of the building due to preventable repairs and replacement.

Both systems encourage environmentally preferable materials, such as salvaged and recycled materials, as well as products having product-specific or industry-wide Environmental Product Declarations. Both systems also encourage whole-building life-cycle assessments to demonstrate environmental responsibility.

NGBS has a long list of additional practices available for a project to earn points. These include universal design practices that can reduce the need for future retrofits of the building, as well as reducing the size of the home or residential units to reduce the environmental impact associated with larger dwelling spaces.

Figure 6: Material Resource Efficiency Green Practices



	ICC/ASHRAE 700-2015 NGBS		Points Possible
Resource Efficiency	607.1	**Recycling and Composting** ● A built-in collection space in each kitchen and a aggregation/pickup space in a covered area for recycling containers is provided (3 pts) ● A compost facility is provided on-site (3 pts)	6
	605.1	**Construction Waste Management Plan** Develop and implement a Construction Waste Management Plan that results in 50% of construction and demolition waste and 95% of e-waste from demolition being diverted from landfills	6
	610.1.1	**Whole Building Life Cycle Assessment (LCA)** ● Execute LCA at the whole building level through a comparative analysis between the final and reference building designs as set forth under Standard Practice, ASTM E2921. (8 pts) The assessment criteria includes the following environmental impact categories: - Primary energy use - Global warming potential - Acidification potential - Eutrophication potential - Ozone depletion potential - Smog potential ● Execute LCA on regulated loads throughout the building operations life cycle stage. (5 pts) ● Execute full LCA, including use-phase, through calculation of operating energy impacts using local or regional emissions factors from energy supplier, utility, or EPA. (2 pts)	15
	603.1	**Reuse of Existing Building** Major elements or components of existing buildings and structures are reused, modified, or deconstructed for later use (1 Point awarded for ever 200 sqft of floor area)	12
	603.2	**Salvaged Materials** Reclaimed and/or salvaged materials and component are used. One point is awarded for every 1% of salvaged materials based on total construction cost.	9
	611.2	**Sustainable Products** One or more of the following products are used for at least 30% of the floor or wall area of the entire dwelling unit (9 pts max): ● 50% or more of carpet installed is certified to NSF 140. (3 pts) ● 50% or more of resilient flooring installed is certified to NSF 332. (3 pts) ● 50% or more of the insulation installed is certified to EcoLogo CCD-016. (3 pts) ● 50% or more of interior wall coverings installed is certified to NSF 342. (3 pts) ● 50% or more of the gypsum board installed is certified to UL 100. (3 pts) ● 50% or more of the door leafs installed is certified to UL 102. (3 pts) ● 50% or more of the tile installed is certified to TCNA A138.1 (3 pts)	9
	611.4	**Product Declarations** A minimum of 10 different installed products have either industry-wide or product specific Environmental Product Declarations (EPDs). Product-specific EPD's are weighted higher than industry-wide EPDs.	5
	609.1	**Regional Materials** Regional materials (within 500 miles of site) are used for major and/or minor components of the building. For a component to comply with this practice, a minimum of 75% of all products in that component category must be sourced regionally. Two points per each major component and 1 point per each minor component.	10

	LEEDv4-NC	Points Possible
Materials & Resources	**Storage and Collection of Recyclables** Provide dedicated areas accessible to waste haulers and building occupants for the collection and storage of recyclable materials for the entire building. Must include mixed paper, corrugated cardboard, glass, plastics, and metals. Take appropriate measures for the safe collection, storage, and disposal of two of the following: batteries, mercury-containing lamps, and electronic waste.	**Mandatory**
	Construction and Demolition Waste Management Planning Develop and implement a construction and demolition waste management plan, setting waste diversion goals for 5 materials and describing diversion strategies. Provide final waste report.	**Mandatory**
	Building Life-Cycle Impact Reduction *Option 1: Historic Building Reuse:* Maintain the existing building structure, envelope, and interior nonstructural elements of a historic building or contributing building in a historic district. (5 pts) *Option 2: Abandoned/blighted building renovation:* Maintain at least 50%, by surface area, of the existing building structure, enclosure, and interior structural elements for buildings that meet local criteria of abandoned or are considered blight. (5 pts) *Option 3: Building and material reuse:* Reuse or salvage building materials from off site or on site as 25% (2 pts), 50% (3 pts), or 75% (4 pts) J10of the surface area *Option 4: Whole-building life-cycle assessment:* For new construction, conduct a life-cycle assessment of the project's structure and enclosure that demonstrates a minimum of 10% reduction in at least three impact categories, such as global warming potential, eutrophication, and acidification, among others. No impact category assessed as part of the life-cycle assessment may increase by more than 5% compared with the baseline building. (3 pts)	5
	Building Product Disclosure and Optimization - Environmental Product Declarations *Option 1. Environmental product declaration (EPD)* Use at least 20 different permanently installed products sourced from at least five different manufacturers that have either product-specific or industry-wide EPDs. (1 pt) -AND/OR- *Option 2. Multi-attribute optimization* Use products that comply with one of the criteria listed in LEED for 50%, by cost, of the total value of permanently installed products, such as global warming potential, eutrophication, and acidification (1 pt) *Note:* Products sourced (extracted, manufactured, purchased) within 100 miles of the project site are valued at 200% of their base contributing cost.	2

Figure 6: Material Resource Efficiency Green Practices

	ICC/ASHRAE 700-2015 NGBS		Points Possible
Resource Efficiency	611.1	**Manufacturer's Environmental Management System Concepts** Product manufacturer's operations and business practices include environmental management system concepts, and the production facility is registered to ISO 14001. One point is awarded for every 1% of materials from ISO 14001 facilities based on total construction cost.	10
	606.2	**Wood-based Products** At least two major and/or minor components are made of certified wood or wood-based products, including Forest Stewardship Council (FSC) or Sustainable Forestry Initiativeâ Program (SFI), among others.	7
	606.3	**Manufacturing Energy** Materials manufactured using a minimum of 33% of manufacturing process energy from renewable or combustible waste sources, or renewable energy credits. Two points are awarded per material.	6
	609.1	**Regional Materials** See "Regional Materials" above	See Above
	610.1.2	**Product and/or Building Assembly Life Cycle Assessment (LCA)** Select products and/or building assemblies that have completed a LCA using the following environmental impact measures: - Primary energy use - Global warming potential - Acidification potential - Eutrophication potential - Ozone depletion potential - Smog potential	10
	608.1	**Resource-Efficient Materials** Products containing fewer materials are used to achieve the same end-use requirements as conventional products, including but not limited to lighter, thinner brick, engineered wood or engineered steel products, roof or floor trusses. (3 pts per material)	9
	601.2	**Material Usage** Structural systems are designed or construction techniques are implemented that reduce and optimize material usage, including choosing minimum structural member sizes in accordance with advanced framing techniques, selecting higher-grade or higher-strength materials and reducing sizes accordingly, and using performance-based structural design to optimize lateral force-resisting systems.	9
	603.2	**Salvaged Materials** Reclaimed and/or salvaged materials and component are used. One point is awarded for every 1% of salvaged materials based on total construction cost	9
	604.1	**Recycled Content** Building materials with recycled content are used for two minor and/or two major components of the building. Point are based on the percentage of recycled content, with a minimum of 25%.	9
	609.1	**Regional Materials** See "Regional Materials" above	See Above

	LEEDv4-NC	Points Possible
Materials & Resources	**Building Product Disclosure and Optimization - Sourcing of Raw Materials** *Option 1. raw material source and extraction reporting* Use at least 20 different permanently installed products from at least five different manufacturers that have publicly released a report from their raw material suppliers. (1 pt) -AND/OR- *Option 2. Leadership extraction practices* Use products that meet the LEED responsible extraction criteria for at least 25%, by cost, of total value of permanently installed building products. (1 pt) *Note:* Products sourced (extracted, manufactured, purchased) within 100 miles of the project site are valued at 200% of their base contributing cost.	2
	Building Product Disclosure and Optimization - Materials Ingredients *Option 1. Material ingredient reporting* Use at least 20 different permanently installed products from at least five different manufacturers that use programs to demonstrate the chemical inventory of the product to at least 1000 ppm, such as GreenScreen v1.2 or Cradle to Cradle v2 Basic Level, among others (1 pt) -AND/OR- *Option 2. Material ingredient optimization* Use products that document their material ingredient optimization for at least 25%, by cost, of the total value of permanently installed products in the projects, such as GreenScreen v1.2 or Cradle to Cradle certification, among others (1 pt) -AND/OR- *Option 3. Product Manufacturer Supply Chain Optimization* Use building products for at least 25%, by cost, of the total value of permanently installed products in the project that meet the criteria set out in LEED, including being sources from manufacturers with 3rd party verification of the supply chain and who engage in validated and robust safety, health, hazard, and risk programs. *Note:* Products sourced (extracted, manufactured, purchased) within 100 miles of the project site are valued at 200% of their base contributing cost.	2

Figure 6: Material Resource Efficiency Green Practices

		ICC/ASHRAE 700-2015 NGBS	Points Possible
Resource Efficiency	605.1	**Construction Waste Management Plan** Develop and implement a Construction Waste Management Plan that results in 50% of construction and demolition waste and 95% of e-waste from demolition being diverted from landfills	6
	605.2	**On-Site Recycling** On-site recycling measures following are implemented, such as the following: ● Materials are ground or otherwise safely applied on-site as soil amendment or fill. At least of 50% (by weight) of construction and land-clearing waste is diverted from landfill. ● Compatible untreated biomass material are set aside for combustion if a solid fuel-burning appliance will be available for on-site renewable energy.	7
	605.3	**Recycled Construction Materials** Construction materials are recycled offsite. A minimum of two types of materials are recycled (3 pts), and one additional point is earned for each additional recycled material type.	6
	603.1	**Reuse of Existing Building** Major elements or components of existing buildings and structures are reused, modified, or deconstructed for later use (1 Point awarded for ever 200 sqft of floor area)	12
	603.3	**Scrap Materials** Sorting and reuse of scrap building material is facilitated.	4

	LEEDv4-NC	Points Possible
Materials & Resources	**Construction and Demolition Waste Management** *Option 1. Diversion:* Divert at least 50% (1 pt) or 75% (2 pts) of the total construction and demolition material, including at least three material streams. -OR- *Option 2. Reduction of total waste material:* Do not generate more than 2.5 pounds of construction waste per square foot of the building's floor area.	1

Figure 6: Material Resource Efficiency Green Practices

Other NGBS 2015 Resource Efficiency Credits

	ICC/ASHRAE 700-2015 NGBS		Points Possible
Resource Efficiency	601.1	**Conditioned Floor Area** Total finished floor area of a dwelling unit is limited to the following areas: ● ≤ 700 sqft: 14 points ● ≤ 1,000 sqft: 12 points ● ≤ 1,500 sqft: 9 points ● ≤ 2,000 sqft: 6 points ● ≤ 2,500 sqft: 3 points ● ≤ 4,000 sqft: **Mandatory:** No point awarded and for every 100 sqft over 4,000 sqft, one additional point is required to be earned elsewhere in the home for every level of certification. **Multifamily:** A weighted average of the individual unit sizes is used for this practice.	14 (**Mandatory** if over 4,000 sqft)
	601.3	**Building Dimensions and Layouts** Building dimensions and layouts are designed to reduce material cuts and waste. This practice is used for a minimum of 80 percent of the following areas: ● floor area (3 pts) ● wall area (3 pts) ● roof area (3 pts) ● cladding or siding area (3 pts) ● penetrations or trim area (1 pt)	13
	601.4	**Framing and Structural Plans** Detailed framing or structural plans, material quantity lists and on-site cut lists for framing, structural materials, and sheathing materials are provided.	4
	601.5	**Prefabricated Components** Precut or preassembled components, or panelized or precast assemblies are utilized for a minimum of 90 percent for the following system or building: ● floor system (4 pts) ● wall system (4 pts) ● roof system (4 pts) ● modular construction for the entire building located above grade (13 pts) ● manufactured home construction for the entire building located above grade (13 pts)	13
	601.6	**Stacked Stories** Stories above grade are stacked, with support floors at least 1/2 the size of ground floor and 7-foor ceiling. First stacked floor is worth 4 points, with 2 points for each additional floor, 8 points max.	8
	601.7	**Prefinished Materials** Prefinished building materials or assemblies, such as trim, walls, floors, ceilings, and fenestrations, have no additional site-applied finishing material are installed.	12
	601.8	**Foundations** The foundation system minimizes soil disturbance, excavation quantities, and material usage.	3
	601.9	**Above-Grade Wall Systems** Above-grade wall systems provide the structural and thermal characteristics of mass walls and are used for at least 75% of the gross exterior wall area of the building.	4
	602.1.1	**Capillary Breaks** ● **Mandatory**: A capillary break and vapor retarder are installed at concrete slabs in accordance with ICC IRC Sections R506.2.2 and R506.2.3 or ICC IBC Sections 1907 and 1805.4.1. ● A capillary break between the footing and the foundation wall is provided to prevent moisture migration into foundation wall. (3 pts)	**Mandatory** + 3 Points

Figure 6: Material Resource Efficiency Green Practices

Other NGBS 2015 Resource Efficiency Credits (cont'd)

	ICC/ASHRAE 700-2015 NGBS		Points Possible
Resource Efficiency	602.1.2	**Foundation Waterproofing** Enhanced foundation waterproofing is installed using one or both of the following: ● rubberized coating ● drainage mat	4
	602.1.3	**Foundation Drainage** ● **Mandatory:** Where required by the ICC IRC or IBC for habitable and usable spaces below grade, exterior drain tile is installed. ● Interior and exterior foundation perimeter drains are installed and sloped to discharge to daylight, dry well, or sump pit. (4 pts)	**Mandatory** + 4 Points
	602.1.4	**Crawlspaces** *For unconditioned and vented crawlspace:* ● **Mandatory:** Dampproof walls are provided below finished grade. ● Minimum 6-mil vapor retarder installed on the crawlspace floor and extended at least 6 inches up the wall and is attached and sealed to the wall. (6 pts) *For conditioned crawlspace:* ● **Mandatory:** 6-mil polyethylene sheeting, or other Class I vapor retarder installed in accordance with Section 408.3 or Section 506 of the IRC. ● A concrete slab over 6-mil polyethylene sheeting, or other Class I vapor retarder installed in accordance with Section 408.3 or Section 506 of the IRC. (8 pts)	**Mandatory** + 8 Points
	602.1.5	**Termite Barrier** *For areas of moderate to heavy termite infestation potential:* Install no or low-toxicity treatment measures (4 pts) *For areas of very heavy termite infestation potential:* Install above measures, as well as implement low toxicity bait and kill treatment plan. (4 pts)	4
	602.1.6	**Termite-resistant materials** *Slight to moderate termite infestation probability:* Install termite resistive materials for foundation, structural walls, floors, exterior decks, and exterior claddings 2 feet above top of foundation. (2 pts) *Moderate to heavy termite infestation probability:* Install termite resistive materials in all above areas as well as exterior claddings 4 feet above top of foundation. (4 pts) *Very heavy termite infestation probability:* Install termite resistive materials in all above areas as well as all exterior claddings. (6 pts)	6
	602.1.7	**Moisture Control Measures** ● **Mandatory:** Insulation in cavities is dry in accordance with manufacturer's instructions when enclosed (2 pts) ● **Mandatory:** Moisture content of subfloor, substrate, or concrete slabs is in accordance with the appropriate industry standard for the finish flooring to be applied. ● Building materials with visible mold are not installed or are cleaned or encapsulated prior to concealment and closing. (2 pts) ● The moisture content of lumber is sampled to ensure it does not exceed 19 percent prior to the surface and/or cavity enclosure. (4 pts) ● Building envelope assemblies are designed for moisture control based on documented hygrothermal simulation or field study analysis. (4 pts)	**Mandatory** + 14 Points

Figure 6: Material Resource Efficiency Green Practices

Other NGBS 2015 Resource Efficiency Credits (cont'd)

	ICC/ASHRAE 700-2015 NGBS		Points Possible
Resource Efficiency	602.1.8	**Water-Resistive Barrier** Where required by the ICC, IRC, or IBC, a water-resistive barrier and/or drainage plane system is installed behind exterior veneer and/or siding.	**Mandatory**
	602.1.9	**Flashing** ● **Mandatory:** Flashing is installed at all of the following locations, as applicable: (a) around exterior fenestrations, skylights, and doors (b) at roof valleys (c) at all building-to-deck, -balcony, -porch, and -stair intersections (d) at roof-to-wall intersections, at roof-to-chimney intersections, at wall-to-chimney intersections, and at parapets (e) at ends of and under masonry, wood, or metal copings and sills (f) above projecting wood trim (g) at built-in roof gutters, and (h) drip edge is installed at eave and rake edges. ● All window and door head and jamb flashing is either self-adhered flashing complying with AAMA 711-13 or liquid applied flashing complying with AAMA 714-15 and installed in accordance with fenestration or flashing manufacturer's installation instructions. (2 pts) ● Pan flashing is installed at sills of all exterior windows and doors. (3 pts) ● Seamless, preformed kickout flashing or prefabricated metal with soldered seams is provided at all roof-to-wall intersections. (3 pts) ● A rainscreen wall design is used for exterior wall assemblies. (4 pts) ● Through-wall flashing is installed at transitions between wall cladding materials or wall construction types. (2 pts) ● Flashing is installed at expansion joints in stucco walls. (2 pts)	**Mandatory** + 16 Points
	602.1.10	**Exterior Doors** Entries at exterior door assemblies, inclusive of side lights , are covered by installing a porch roof or awning, extending the roof overhang, recessing the exterior door, or installing a storm door. (2 pts per door, 6 pts max)	**6**
	602.1.12	**Roof Overhangs** Roof overhangs are provided over at least 90% of exterior walls to protect the envelope.	**4**
	602.1.13	**Ice Barrier** In applicable climates, an ice barrier is installed in accordance with the ICC IRC or IBC at roof eaves of pitched roofs and extends at least 24 inches inside the exterior wall line.	**Mandatory**
	602.1.14	**Architectural Features** ● **Mandatory:** All horizontal ledgers are sloped away to provide gravity drainage. (1 pt) ● No roof configurations create horizontal valleys in roof design. (2 pts) ● No recessed windows and architectural features trap water on horizontal surfaces. (2 pts)	**Mandatory** + 5 Points
	602.2	**Roof Surfaces** At least 90% of roof surfaces are comprised of one or more of the following: ● ENERGY STAR® cool roof certification or equivalent materials ● A vegetated roof system ● Materials with a minimum initial SRI of 78 for low-sloped roof (a slope less than 2:12) and a minimum initial SRI of 29 for a steep-sloped roof (a slope equal to or greater than 2:12). *Note:* Do not include roof area that is used for roof penetrations and associated equipment, on-site renewable energy systems such as photovoltaics or solar thermal energy collectors, or rooftop decks, amenities and walkways.	3

Figure 6: Material Resource Efficiency Green Practices

Other NGBS 2015 Resource Efficiency Credits (cont'd)

		ICC/ASHRAE 700-2015 NGBS	Points Possible
Resource Efficiency	602.3	**Roof Water Discharge** A gutter and downspout system or splash blocks and effective grading are provided to carry water a minimum of 5 feet away from perimeter foundation walls.	4
	602.4	**Finished Grade** ● **Mandatory:** Finished grade at all sides of a building is sloped to provide a minimum of 6 inches of fall within 10 feet of the edge of the building. Where there is not 10 feet available, the final grade is sloped away from the edge of the building at 2% or greater. ● Final grade is sloped away from the edge of the building at a minimum slope of 5%. (1 pt) ● Water is directed to drains or swales to ensure drainage away from the structure. (1 pt)	**Mandatory** + 2 Points
	611.3	**Universal Design Elements** Dwelling incorporates one or more of the following universal design elements. (12 pts max): ● Any no-step entrance into the dwelling which is accessible from a substantially level parking or drop-off area (no more than 2%) via an accessible path which has no individual change in elevation or other obstruction of more than 1-1/2 inches in height with the pitch not exceeding 1 in 12, and provides a minimum 32-inch wide clearance into the dwelling. (3 pts) ● Minimum 36-inch wide accessible route from the no-step entrance into at least one visiting room in the dwelling and into at least one full or half bathroom which has a minimum 32-inch clear door width and a 30-inch by 48-inch clear area inside the bathroom outside the door swing. (3 pts) ● Minimum 36-inch wide accessible route from the no-step entrance into at least one bedroom which has a minimum 32-inch clear door width. (3 pts) ● Blocking or equivalent installed in the accessible bathroom walls for future installation of grab bars at water closet and bathing fixture, if applicable. (1 pt) ● All interior and exterior door handles are levers rather than knobs. (1 pt) ● All sink faucet controls are single-handle controls of both volume and temperature. (1 pt) ● Interior convenience Power receptacles, communication connections and switches are placed between 15" and 48" above the finished floor. Additional switches to control devices and systems (such as alarms, home theaters and other equipment) not required by the local building code may be installed as desired. (1 pt) ● All light switches are rocker-type switches or other similar switches that can be operated by pressing them (with assistive devices). Toggle-type switches may not be used. (1 pt) ● Any of the following can be controlled with a (wireless) mobile device such as a smartphone, tablet or laptop computer: HVAC, lighting, alarm system or door locks. (1 pt)	12

Energy Efficiency

ICC/ASHRAE 700-2015 NGBS – Energy Efficiency

This green practice category of the NGBS is focused on design and construction practices that help increase the energy efficiency of a project while encouraging the use of renewable energies. There are multiple paths for a project to comply with this category, providing builders and project teams the flexibility to choose the best means of demonstrating an increased energy efficiency based on their local conditions and market. Regardless of the path selected, this category requires multiple mandatory practices to be implemented within the project to ensure a solid base of energy efficiency regardless of project type and location.

Table 10 below shows the pathways available to a project in order to demonstrate compliance with this category. Also listed are the corresponding levels of certification a project can achieve by selecting the various pathways. For example, a project selecting an EnergyStar 3.0 Certified Home label as the compliance method can only achieve NGBS Bronze Certification, while only a project pursuing the Performance Path can achieve the highest level of Certification, Emerald.

Table 10: NGBS Energy Efficiency Compliance Paths

Energy Performance Compliance Path	Summary	Rating Levels Achievable
Performance Path	Meet or surpass ICC IECC 2015 baseline performance, and include at least two additional energy efficiency practices, such as occupancy sensors & lighting controls. Two points are earned for every percentage point above IECC 2015	• Bronze • Silver • Gold • Emerald
Prescriptive Path	Obtain at least 30 points through prescriptive practices detailed in the ICC/ASHRAE-700 2015, and include at least two additional energy efficiency practices, such as occupancy sensors & lighting controls.	• Bronze • Silver • Gold
HERS Index	Complete EPA HERS Index Target Procedure with final value equal to or less than EPA HERS Index Target, and include at least two additional energy efficiency practices, such as occupancy sensors & lighting controls.	• Bronze • Silver • Gold
ENERGY STAR Version 3.0	Qualify as an ENERGY STAR Version 3.0 Certified Home or ENERGY STAR Multifamily High Rise Version 1.0 Rev 03	• Bronze Only
ENERGY STAR Version 3.1	Qualify as an ENERGY STAR Version 3.1 Certified Home or ENERGY STAR Multifamily High Rise Version 1.0 Rev 03 (with a baseline at ASHRAE 90.1-2010)	• Silver Only

Mandatory Practices:

- One of the available compliance pathways from Table 10 above must be selected.
- All installation of insulation must meet Grade 1 standards.
- Building envelope tightness must be tested in accordance with ASTM E-779 using a blower door at 1.05 psf (50 Pa).
- Building thermal envelope must be durably sealed to limit infiltration. All openings, penetrations, joints, seams, connections, common walls, and other sources of infiltration are caulked, gasketed, weather-stripped, or otherwise sealed with an air barrier material, suitable film, or solid material
- HVAC system must be sized per load calculations using ACCA Manual J.
- Radiant and hydronic space heating systems must be designed, installed, and documented using industry-approved guidelines and standards.
- All ducts must be air sealed with materials in conformance with UL 181A or UL 181B.
- Framing cavities cannot be used as ducts or plenums.
- Duct systems must be sized and designed in accordance with ACCA Manual D (or equal).
- Fenestrations, such as windows, must not have an infiltration rate of 0.3 cfm per square foot, while swinging doors must not exceed 0.5 cfm per square foot.
- Recessed luminaries installed in the thermal envelope must be sealed to limit air leakage, must be IC-rated and labeled as meeting ASTM E283, and sealed with a gasket or caulk.
- Dwelling unit(s) must either have a minimum of 75% of total hard-wired lighting fixtures or bulbs qualify as high efficacy, or the lighting power density be 1.1 watts/square foot or less.
- Any boiler supply piping in unconditioned space must be insulated.

Minimum Point Requirements:

Table 11: Energy Efficiency Minimum Point Requirements

Green Building Categories	Minimum Points Required			
	BRONZE	SILVER	GOLD	EMERALD
Energy Efficiency	30	45	60	70

LEED-NC – Energy Efficiency

The "Energy Efficiency" category of LEED-NC is also focused on design and construction practices that help increase the energy efficiency of a project while encouraging the use of renewable energies. To comply with this category, projects have the option of performing an energy model (Performance Path), using ANSI/ASHRAE/IESNA Standard 90.1–2010, Appendix G, with errata as the baseline building performance, or selecting the Prescriptive Path, using either the ASHRAE 50% Advanced Energy Design Guide or Advanced Buildings Core Performance Guide.

Beyond completing an energy model to verify building performance or completing required prescriptive practices, LEEDv4-NC also requires all buildings seeking certification to undergo fundamental commissioning and verification. This entails a Commissioning Agent verifying the development of the Basis of Design and Owner's Project Requirements, as well as completing standard commissioning tasks listed within the credit description. This helps ensure the design, construction and eventual operation of a project meets the owner's project requirements for energy, water, indoor environmental quality and durability.

<u>Mandatory Practices:</u>

- Select one of the following compliance paths:
    - Performance Path: Demonstrate an improvement of 5% for new construction, 3% for major renovations, or 2% for core and shell projects in the proposed building performance rating compared with the baseline building performance rating per ANSI/ASHRAE/IESNA Standard 90.1–2010, Appendix G, with errata
    - Comply with the mandatory and prescriptive provisions of ANSI/ASHRAE/IESNA Standard 90.1–2010, with errata, as well as the HVAC and service water heating requirements in Chapter 4, Design Strategies and Recommendations by Climate Zone, for the appropriate ASHRAE 50% Advanced Energy Design Guide and climate zone
    - Comply with the mandatory and prescriptive provisions of ANSI/ASHRAE/IESNA Standard 90.1-2010, with errata, as well as Section 1: Design Process Strategies, Section 2: Core Performance Requirements, and the following three strategies from Section 3: Enhanced Performance Strategies, as applicable: 3.5 Supply Air Temperature Reset (VAV), 3.9 Premium Economizer Performance, 3.10 Variable Speed Control
- Complete commissioning (Cx) process activities required by LEEDv4 for mechanical, electrical, plumbing, and renewable energy systems and assemblies.
- Install building-level energy meters, or submeters that can be aggregated to provide building-level data representing total building energy consumption. Commit to sharing with USGBC the resulting

energy consumption data and electrical demand data for a 5-year period.
- Do not use or phase out existing chlorofluorocarbon (CFC)-based refrigerants in new heating, ventilating, air-conditioning, and refrigeration (HVAC&R) systems.

Minimum Point Requirements:

LEED does not require projects to obtain a minimum number of points per category.

Analysis

As observed in Figure 8 below, a number of energy efficiency practices are similar in the two green building rating systems. There are three LEEDv4-NC practices that do not have a similar NGBS practice available for comparison: Advanced Energy Metering, Fundamental Refrigerant Management, and Enhanced Refrigerant Management. Fundamental Refrigerant Management requires projects to not use or phase out existing chlorofluorocarbon (CFC)-based refrigerants in new heating, ventilating, air-conditioning, and refrigeration (HVAC&R) systems. CFCs have been phased out of production under the Montreal Protocol, which became effective in 1989. As such, the consensus committee of NGBS 2015 did not include this as a green practice category, as it is already required nationally.

LEED-NC also requires fundamental commissioning and verification of building systems, a valuable asset to a project owner in ensuring the building systems are installed properly and operate to their requirements. While NGBS does not require the hiring of a commissioning agent, verification of HVAC and thermal envelope systems is required by the independent, third-party verifier, who performs the inspections pre-drywall and post-construction. Points are also available for further verification of building systems, such as verifying start-up procedures of HVAC equipment per the manufacturer's instructions.

ICC IECC 2015 and ASHRAE 90.1-2010

The energy performance compliance paths also differ between the rating systems in that they use two different standards. LEEDv4-NC uses ANSI/ASHRAE/IESNA Standard 90.1–2010, Appendix G, with errata as the baseline performance for energy modeling of a building, while the NGBS uses the ICC IECC 2015.

Both standards are common across the country. According to the report "Energy and Energy Cost Savings Analysis of the 2015 IECC for Commercial Buildings," produced by the Pacific Northwest National Laboratory for the Department of Energy, "while Standard 90.1 is the national model energy standard for commercial buildings, many states have historically adopted the International Energy Conservation Code (IECC) for both residential and commercial buildings." This deems it more appropriate for NGBS, which is focused on residential projects and not applicable to commercial buildings.

Per Figure 7a below from the Pacific Northwest National Laboratory report "National

Average Energy Cost Index for Standard 90.1 and IECC Prototypes," the 2015 IECC is nearly on par with the ASHRAE 90.1-2013. On a national average basis for all prototypes combined, the 2015 IECC and Standard 90.1-2013 are within 1% for both energy use and energy costs. For mid- and high-rise multifamily residences, the variation is between 1%-2%.

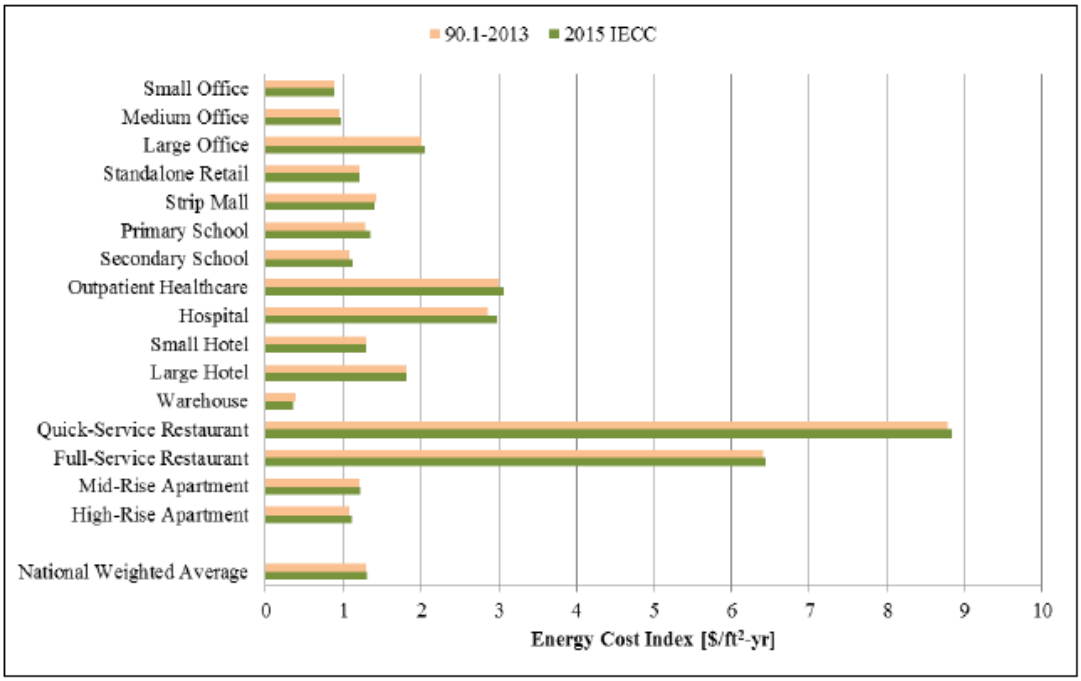


Figure B.2. National Average Energy Cost Index for Standard 90.1 and IECC Prototypes

Figure 7a: Figure B.2 from "Energy and Energy Cost Savings Analysis of the 2015 IECC for Commercial Buildings"

LEEDv4-NC uses ANSI/ASHRAE/IESNA Standard 90.1–2010, not the 2013 version. As of the date of this report, no direct comparison of ASHRAE 90.1-2010 to IECC 2015 produced by a national laboratory or equivalent body was found. However, Pacific Northwest National Laboratory also produced a report for the Department of Energy titled, "National Cost-effectiveness of ANSI/ASHRAE/IES Standard 90.1-2013," which compared the 2013 version to the previous 2010. As seen in Figure 7b below, on average, buildings constructed to ASHRAE 90.1-2013 saw increased energy savings across all climate zones, with the exception of gas usage, compared to the 2010 version. For mid- and high-rise multifamily residences, the total increase in energy savings from 2010 to 2013 by climate zone ranged from 4% to over 7%.

C.1 Energy Cost and Savings Summary with Plug and Process Loads, 90.1-2010 and 90.1-2013

Energy Cost Saving Results for ASHRAE Standard 90.1, $ per Square Foot per Year

Climate Zone:	2A				3A				3B			
Code:	90.1-2010	90.1-2013	Savings		90.1-2010	90.1-2013	Savings		90.1-2010	90.1-2013	Savings	
Small Office												
Electricity	$1.053	$0.903	$0.150	14.2%	$1.001	$0.887	$0.114	11.4%	$0.954	$0.885	$0.069	7.2%
Gas	$0.000	$0.000	$0.000	-	$0.002	$0.002	$0.000	0.0%	$0.000	$0.001	$0.000	-
Totals	$1.053	$0.903	$0.150	14.2%	$1.003	$0.889	$0.114	11.4%	$0.954	$0.885	$0.069	7.2%
Large Office												
Electricity	$2.158	$2.055	$0.102	4.7%	$2.062	$1.989	$0.073	3.5%	$2.107	$2.036	$0.071	3.4%
Gas	$0.018	$0.020	-$0.002	-11.1%	$0.033	$0.051	-$0.019	-57.6%	$0.016	$0.017	-$0.001	-6.3%
Totals	$2.176	$2.076	$0.100	4.6%	$2.094	$2.040	$0.054	2.6%	$2.123	$2.053	$0.070	3.3%
Stand-Alone Retail												
Electricity	$1.408	$1.246	$0.162	11.5%	$1.324	$1.168	$0.156	11.8%	$1.321	$1.209	$0.112	8.5%
Gas	$0.055	$0.045	$0.010	18.2%	$0.077	$0.063	$0.014	18.2%	$0.067	$0.061	$0.006	9.0%
Totals	$1.462	$1.290	$0.172	11.8%	$1.401	$1.231	$0.169	12.1%	$1.388	$1.270	$0.118	8.5%
Primary School												
Electricity	$1.481	$1.266	$0.216	14.6%	$1.366	$1.193	$0.172	12.6%	$1.314	$1.080	$0.234	17.8%
Gas	$0.118	$0.117	$0.002	1.7%	$0.152	$0.155	-$0.002	-1.3%	$0.106	$0.112	-$0.006	-5.7%
Totals	$1.600	$1.382	$0.217	13.6%	$1.518	$1.348	$0.170	11.2%	$1.420	$1.193	$0.228	16.1%
Small Hotel												
Electricity	$1.259	$1.133	$0.126	10.0%	$1.215	$1.106	$0.108	8.9%	$1.168	$1.057	$0.111	9.5%
Gas	$0.203	$0.203	$0.000	0.0%	$0.218	$0.218	-$0.001	-0.5%	$0.209	$0.209	$0.000	0.0%
Totals	$1.462	$1.336	$0.126	8.6%	$1.432	$1.325	$0.108	7.5%	$1.377	$1.267	$0.111	8.1%
Mid-rise Apartment												
Electricity	$1.284	$1.193	$0.091	7.1%	$1.236	$1.170	$0.065	5.3%	$1.243	$1.179	$0.064	5.1%
Gas	$0.012	$0.011	$0.001	8.3%	$0.039	$0.043	-$0.004	-10.3%	$0.010	$0.011	-$0.002	-20.0%
Totals	$1.296	$1.203	$0.092	7.1%	$1.275	$1.214	$0.061	4.8%	$1.253	$1.190	$0.063	5.0%

Energy Cost Saving Results for ASHRAE Standard 90.1, $ per Square Foot per Year

Climate Zone:	4A				5A			
Code:	90.1-2010	90.1-2013	Savings		90.1-2010	90.1-2013	Savings	
Small Office								
Electricity	$0.957	$0.855	$0.102	10.7%	$0.956	$0.862	$0.094	9.8%
Gas	$0.004	$0.003	$0.001	25.0%	$0.013	$0.010	$0.003	23.1%
Totals	$0.961	$0.858	$0.103	10.7%	$0.969	$0.872	$0.097	10.0%
Large Office								
Electricity	$1.991	$1.944	$0.048	2.4%	$1.976	$1.935	$0.041	2.1%
Gas	$0.054	$0.067	-$0.013	-24.1%	$0.098	$0.111	-$0.013	-13.3%
Totals	$2.046	$2.011	$0.035	1.7%	$2.074	$2.046	$0.028	1.4%
Standalone Retail								
Electricity	$1.265	$1.107	$0.158	12.5%	$1.247	$1.077	$0.169	13.6%
Gas	$0.102	$0.075	$0.027	26.5%	$0.144	$0.106	$0.038	26.4%
Totals	$1.367	$1.182	$0.184	13.5%	$1.390	$1.183	$0.207	14.9%
Primary School								
Electricity	$1.297	$1.134	$0.163	12.6%	$1.261	$1.106	$0.155	12.3%
Gas	$0.173	$0.178	-$0.005	-2.9%	$0.207	$0.206	$0.001	0.5%
Totals	$1.470	$1.312	$0.158	10.7%	$1.468	$1.312	$0.156	10.6%
Small Hotel								
Electricity	$1.190	$1.083	$0.107	9.0%	$1.240	$1.133	$0.107	8.6%
Gas	$0.236	$0.237	-$0.001	-0.4%	$0.255	$0.255	$0.000	0.0%
Totals	$1.426	$1.320	$0.106	7.4%	$1.495	$1.389	$0.106	7.1%
Mid-rise Apartment								
Electricity	$1.227	$1.178	$0.049	4.0%	$1.224	$1.176	$0.048	3.9%
Gas	$0.063	$0.057	$0.006	9.5%	$0.121	$0.108	$0.014	11.6%
Totals	$1.290	$1.235	$0.055	4.3%	$1.345	$1.284	$0.062	4.6%

Figure 7b: Tables C.1 and C.2 from "National Cost-effectiveness of ANSI/ASHRAE/IES Standard 90.1-2013"

Based on the data provided by these research papers, the following graphic demonstrates the relative comparison of the various editions of the IECC and ASHRAE 90.1.

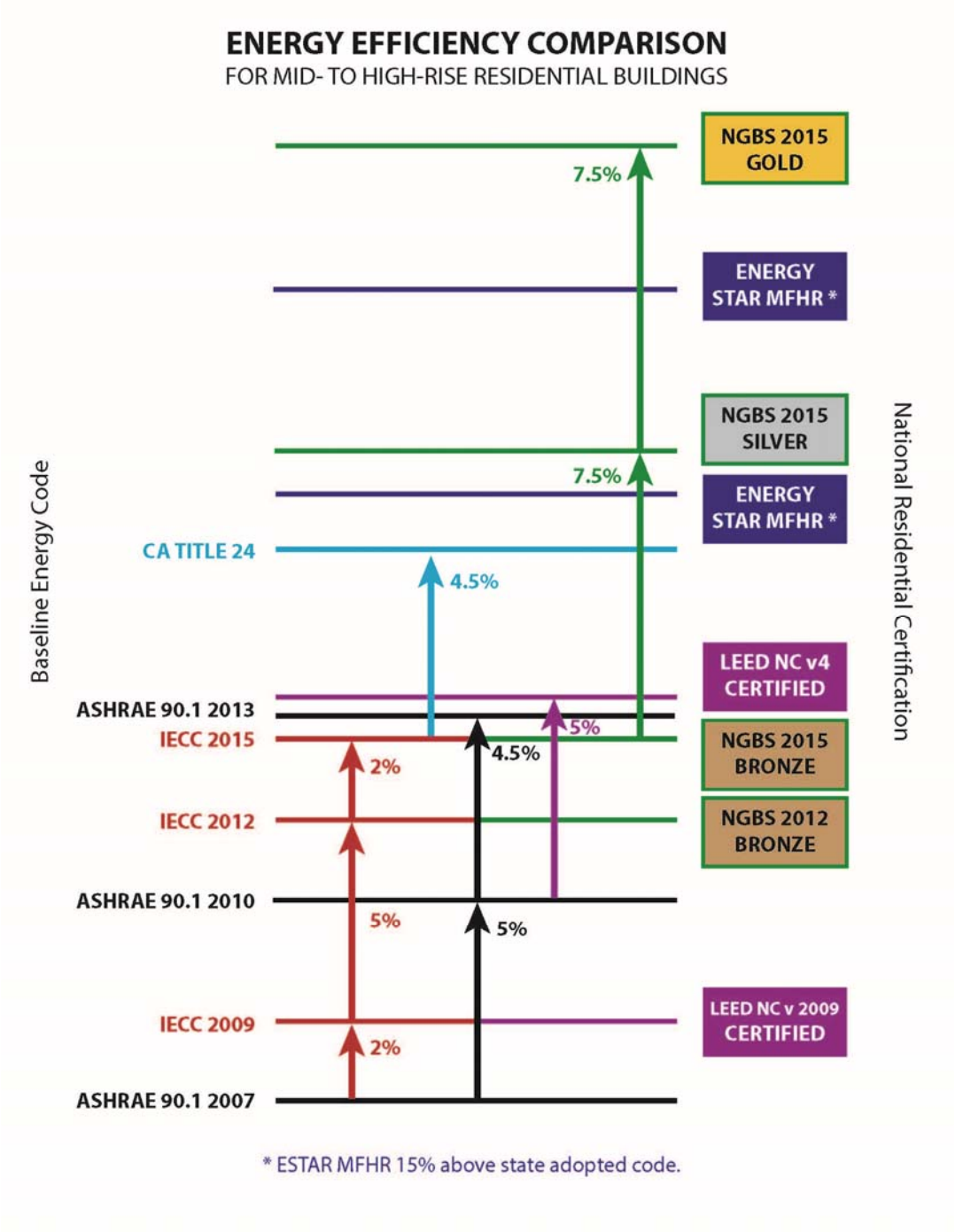


Figure 7c: Relative Comparison of Energy Efficiency for ASHRAE 90.1 and IECC Standards

Reference for Figure 7c

Hart, Athalye, Rosenberg, Loper, Halverson, & Richman. (2015). *National Cost-effectiveness of ANSI/ASHRAE/IES Standard 90.1-2013*. Richland: Pacific Northwest National Laboratory.

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Figure 8: Energy Efficiency Practices

	ICC/ASHRAE 700-2015 NGBS		Points Possible
Energy Efficiency	701.4.3.2	**Air Sealing & Insulation Testing** ● Building envelope tightness must be tested with blower door per ASTM E-779. ● Air barrier and insulation must be field verified by Green Verifier pre-drywall and post-construction. ● Insulation must be installed to Grade 1 standards and visually inspected by Green Verifier before installation of drywall.	**Mandatory**
	703.1.2	**Building Envelope Leakage** Building thermal envelope must be in accordance with 2015 IECC R402.4.1.2 or C402.5	**Mandatory** (Prescriptive)
	703.1.3	**Duct Testing** The duct system must be in accordance with 2015 IECC R403.3.2 or R403.3.5	**Mandatory** (Prescriptive)
	701.1.1 & 702	**Minimum Performance Path Requirements (IECC 2015)** Demonstrate through energy modeling that the proposed building performance is equal to or better than the baseline building performance. Calculate the baseline building performance according to ICC IECC 2015.	**Mandatory (Option 1)**
	701.1.2 & 703	**Minimum Prescriptive Path Requirements (ICC/ASHRAE 700-2015 & ICC IECC 2015)** Comply with all mandatory requirements, as well as obtain a minimum of 30 pts, within Section 703 of the ICC/ASHRAE 700-2015. *Note:* All projects must also include two additional energy conservation practices listed in Section 705 of the ICC/ASHRAE 700-2015, such as occupancy sensors & lighting controls.	**Mandatory (Option 2)**
	701.1.3	**EPA HERS Index Target Path** The building must complete the EPA HERS Index Target Procedure with the final value equal to or less than EPA HERS Index Target. *Note:* All projects must also include two additional energy conservation practices listed in Section 705 of the ICC/ASHRAE 700-2015, such as occupancy sensors & lighting controls.	**Mandatory (Option 3)**
	701.1.4	**ENERGY STAR Version 3.0 Certified Home** A project that qualifies as an ENERGY STAR Version 3.0 Certified Home or ENERGY STAR Multifamily High Rise Version 1.0 Rev 03 can satisfy the Energy Efficiency category, but **can only achieve Bronze Certification.** A project that qualifies as an ENERGY STAR Version 3.1 Certified Home or ENERGY STAR Multifamily High Rise Version 1.0 Rev 03 (with the baseline as AHSRAE 90.1-2010) can satisfy the Energy Efficiency category, but **can only achieve Silver Certification.**	**Mandatory (Option 4)**
	705.5	**HVAC Design and Installation** ● HVAC Contractor and service technician are certified by nationally/regionally recognized program (e.g., Building Performance Institute) (1 pt) ● Performance of system is verified by HVAC contractor, including start-up procedure refrigerant charge, air handler speed, and total airflow, among others. (3 pts)	4
	705.6	**Installation and Performance Verification** Third-party onsite inspections are conducted pre-drywall and post-construction to verify proper duct installation and sealing, building envelope sealing, and all fenestration sealing, in addition to Green Verifier inspection.	3
	705.6.2.1	**Air Leakage Validation of Building or Dwelling Units** If not required by IECC 2015, blower door testing (3 pts or third party verification (5 pts) is completed.	5
	705.6.2.2	**HVAC Airflow Testing** Balanced airflows are demonstrated by a third-party. Test results are in accordance with ACCA 5 QI-2010, Section 5.2	5
	705.6.2.3	**HVAC Duct Leakage Testing** If not required by IECC 2015, duct leakage is tested in accordance with IECC R403.3.3 and R403.3.4 (3 pts). An additional 2 points can be earned if conducted by independent third party.	5

	LEEDv4-NC	Points Possible
Energy Efficiency	**Fundamental Commissioning & Verification** Complete commissioning (Cx) process activities required by LEEDv4 for mechanical, electrical, plumbing, and renewable energy systems and assemblies, in accordance with ASHRAE Guideline 0-2005 and ASHRAE Guideline 1.1–2007 for HVAC&R Systems, including: ● Develop a Basis of Design and Owner's Project Requirements. ● Engage a commissioning authority to do the following:. - Review the OPR, BOD, and project design. - Develop and implement a Cx plan. - Confirm incorporation of Cx requirements into the construction documents. - Develop construction checklists. - Develop a system test procedure. - Verify system test execution. - Maintain an issues and benefits log throughout the Cx process. - Prepare a final Cx process report. - Document all findings and recommendations and report directly to the owner throughout the process. ● Prepare and maintain a current facilities requirements and operations and maintenance plan.	**Mandatory**
	Minimum Energy Performance *Option 1: Whole-building Energy Simulation (AHSRAE 90.1-2010)* Demonstrate an improvement of 5% for new construction, 3% for major renovations, or 2% for core and shell projects in the proposed building performance rating compared with the baseline building performance rating. Calculate the baseline building performance according to ANSI/ASHRAE/IESNA Standard 90.1–2010, Appendix G, with errata. -OR- Option 2: *Prescriptive Path: ASHRAE 50% Advanced Energy Design Guide* Comply with the mandatory and prescriptive provisions of ANSI/ASHRAE/IESNA Standard 90.1–2010, with errata. Comply with the HVAC and service water heating requirements in Chapter 4, Design Strategies and Recommendations by Climate Zone, for the appropriate ASHRAE 50% Advanced Energy Design Guide and climate zone. -OR- *Option 3: Prescriptive Path: Advanced Buildings™ Core Performance™ Guide* Comply with the mandatory and prescriptive provisions of ANSI/ASHRAE/IESNA Standard 90.1-2010, with errata. Comply with Section 1: Design Process Strategies, Section 2: Core Performance Requirements, and the following three strategies from Section 3: Enhanced Performance Strategies, as applicable: 3.5 Supply Air Temperature Reset (VAV), 3.9 Premium Economizer Performance, 3.10 Variable Speed Control *Note:* Option 3 is only applicable for projects less than 100,000 sqft.	**Mandatory**
	Enhanced Commissioning *Option 1. Enhanced systems commissioning* ***Path 1: Enhanced commissioning:*** Complete the enhanced Cx tasks listed by USGBC, including reviewing contractor submittals and reviewing building operations 10 months after substantial completion. ***Path 2: Enhanced and monitoring-based commissioning:*** Achieve Path 1 and Develop monitoring-based procedures to assess performance of energy- and water-consuming systems. -OR- *Option 2: Envelope commissioning* Complete commissioning process activities listed by USGBC for the building's thermal envelope in accordance with ASHRAE Guideline 0–2005 and the National Institute of Building Sciences (NIBS) Guideline 3–2012.	6

Figure 8: Energy Efficiency Practices

	ICC/ASHRAE 700-2015 NGBS		Points Possible
Energy Efficiency	701.1.1 & 702	**Performance Path (IECC 2015)** Demonstrate an improvement of 1% or more in the proposed building performance rating compared with the baseline building performance rating. Calculate the baseline building performance according to ICC IECC 2015.	30+
	701.1.2 & 703	**Prescriptive Path (ICC/ASHRAE 700-2015 & ICC IECC 2015)** Comply with all mandatory requirements, as well as earn more than 30 points, within Section 703 of the ICC/ASHRAE 700-2015.	30+
	701.1.3	**EPA HERS Index Target Path** The building must complete the EPA HERS Index Target Procedure with the final value less than EPA HERS Index Target. Points are awarded per percent less than EnergyStar HERS Index Target.	30+
	701.1.4	**ENERGY STAR Version 3.0 Certified Home** A project that qualifies as an ENERGY STAR Version 3.0 Certified Home or ENERGY STAR Multifamily High Rise Version 1.0 Rev 03 can satisfy the Energy Efficiency category, but **can only achieve Bronze Certification.** A project that qualifies as an ENERGY STAR Version 3.1 Certified Home or ENERGY STAR Multifamily High Rise Version 1.0 Rev 03 (with the baseline as AHSRAE 90.1-2010) can satisfy the Energy Efficiency category, but **can only achieve Silver Certification.**	N/A
	705.7 (2)	**Energy Consumption Control** Install a whole-building energy-monitoring device or system.	1
	706.9	**Automatic Demand Response** An automatic demand response system is installed that curtails energy usage upon a signal from the utility or energy service provider.	1
	706.5	**On-site Renewable Energy System** An on-site renewable energy production system is installed. Two points are awarded based on kW produced, divided by the number of dwelling units.	2+
	706.2	**Renewable Energy Service Plan** A renewable energy service plan is provided: - Builder's local administrative office has renewable energy service and also selects renewable energy service plan for interim electric service for project until occupant occupied (1 pt) - The homeowner selects a renewable energy service provider with minimum two-year commitment for 1-49% (1 pt) or 50%+ (2 pts) of projected energy use.	3

	LEEDv4-NC	Points Possible
Energy Efficiency	**Optimize Energy Performance** *Option 1: Whole-building Energy Simulation (18 pts)* Demonstrate an improvement of 6% or more for new construction, 4% or more for major renovations, or 3% or more for core and shell projects in the proposed building performance rating compared with the baseline building performance rating. Calculate the baseline building performance according to ANSI/ASHRAE/IESNA Standard 90.1–2010, Appendix G, with errata. -OR- *Option 2: Prescriptive Path: ASHRAE Advanced Energy Design Guide (6 pts)* Implement and document compliance with the applicable recommendations and standards in Chapter 4, Design Strategies and Recommendations by Climate Zone, for the appropriate ASHRAE 50% Advanced Energy Design Guide and climate zone. *Note:* To be eligible for Option 2, projects must use Option 2 in "Minimum Energy Performance."	18
	Building-Level Energy Metering Install building-level energy meters, or submeters that can be aggregated to provide building-level data representing total building energy consumption. Commit to sharing with USGBC the resulting energy consumption data and electrical demand data for a 5-year period.	**Mandatory**
	Demand Response *Case 1:* Participate in an existing demand response (DR) program (2 pts) -OR- *Case 2:* Provide infrastructure to take advantage of future demand response programs or dynamic, real-time pricing programs. (1 pt)	2
	Renewable Energy Production Use renewable energy systems to offset building energy costs. Calculate the percentage of renewable energy produced (by cost) compared to total building annual energy cost.	3
	Green Power & Carbon Offsets Engage in a contract for qualified resources that have come online since January 1, 2005, for a minimum of five years, to be delivered at least annually. The contract must specify the provision of at least 50% (1 pt) or 100% (2 pts) of the project's energy from green power, carbon offsets, or renewable energy certificates (RECs).	2

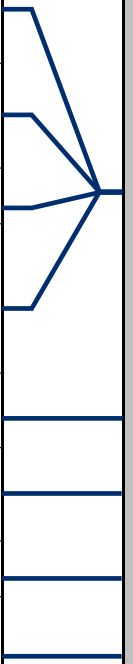


Figure 8: Energy Efficiency Practices

Other NGBS 2015 Energy Efficiency Credits

	ICC/ASHRAE 700-2015 NGBS		Points Possible
Energy Efficiency	701.4.1.1	**HVAC System Sizing** Equipment is sized according to loads calculated using ACCA Manual J (or equal)	**Mandatory**
	701.4.1.2	**Radiant and Hydronic Space Heating** System is designed, installed, and documented using industry-approved guidelines and standards.	**Mandatory**
	701.4.2.1	**Duct Air Sealing** All duct sealing is in conformance with UL 181A or UL 181B	**Mandatory**
	701.4.2.2	**Ducts and Plenums** Building cavities are not used as ducts or plenums.	**Mandatory**
	701.4.2.3	**Duct System Sizing** Duct systems are sized and designed in accordance with ACCA Manual D (or equal).	**Mandatory**
	701.4.3.1	**Building Thermal Envelope Air Sealing** Building thermal envelope is durably sealed to limit infiltration. All openings, penetrations, joints, seams, connections, common walls, and other sources of infiltration are caulked, gasketed, weather-stripped, or otherwise sealed with an air barrier material, suitable film, or solid material.	**Mandatory**
	701.4.3.4	**Fenestration Air Leakage** Fenestrations, such as windows, must not have an infiltration rate of 0.3 cfm per square foot, while swinging doors must not exceed 0.5 cfm per square foot.	**Mandatory**
	701.4.3.5	**Recessed Lighting** Recessed luminaries installed in the thermal envelope must be sealed to limit air leakage, must be IC-rated and labeled as meeting ASTM E283, and sealed with a gasket or caulk.	**Mandatory**
	701.4.4	**High-Efficacy Lighting** Dwelling unit(s) must either have a minimum of 75% of total hard-wired lighting fixtures or bulbs qualify as high efficacy, or the lighting power density be 1.1 watts/square foot or less.	**Mandatory**
	701.4.5	**Boiler Supply Piping** Any boiler supply piping in unconditioned space must be insulated.	**Mandatory**
	705.2.1	**Lighting Controls** Points can be earned for providing dimming controls and/or occupancy or photo sensors for interior and/or exterior lighting fixtures of dwelling units. Multifamily projects can earn pts for having dimmers or occupancy sensors in common areas, and for providing automatic light reduction for unoccupied interior corridors, stairwells, garages, and parking areas.	15
	705.2.2	**TDD's and Skylights** A tubular daylight device or skylight is installed in rooms without windows.	2
	705.2.3	**Lighting Outlets** Occupancy sensors are installed for 80% or more hard-wired lighting outlets in living spaces.	1
	705.2.4	**Recessed Luminaires** Recessed luminaires penetrating the thermal envelope is less than 1 per 400 square feet.	1
	705.3	**Induction Cooktop** An induction cooktop is installed.	1

Other LEEDv4-NC Energy Efficiency Credits

	LEEDv4-NC	Points Possible
Energy Efficiency	**Fundamental Refrigerant Management** Do not use or phase out existing chlorofluorocarbon (CFC)-based refrigerants in new heating, ventilating, air-conditioning, and refrigeration (HVAC&R) systems. Phase-out plans extending beyond the project completion date will be considered on their merits. *Note:* Existing small HVAC&R units containing less than 0.5 pound of refrigerant are exempt.	**Mandatory**
	Advanced Energy Metering Install advanced energy metering for all whole-building energy sources used by the building and any individual energy end uses that represent 10% or more of the total annual consumption of the building.	1
	Enhanced Refrigerant Management *Option 1:* Do not use refrigerants, or use only refrigerants (naturally occurring or synthetic) that have an ozone depletion potential (ODP) of zero and a global warming potential (GWP) of less than 50. *Option 2:* Select refrigerants that are used in heating, ventilating, air-conditioning, and refrigeration (HVAC&R) equipment to minimize or eliminate the emission of compounds that contribute to ozone depletion and climate change.	1

Figure 8: Energy Efficiency Practices

Other NGBS 2015 Energy Efficiency Credits (cont'd)

	ICC/ASHRAE 700-2015 NGBS (Cont'd)		Points Possible
Energy Efficiency	705.4	**Return Ducts/Transfer Grilles** Return ducts or transfer grilles installed in every room with a door (except bathrooms, kitchens, closets, pantries, and laundry rooms)	2
	705.6.3	**Insulating Hot Water Pipes** Piping involved in hot water is insulated with a minimum thermal resistance of R-3	1
	705.6.4	**Potable Hot Water Demand Re-circulation System** A Potable Hot Water Demand Re-circulation System is installed	2
	705.7	**Submetering System** In a multifamily building, an advanced submetering system is installed to monitor energy consumption for each unit. Information is available to occupants monthly.	1
	706.3	**Smart Appliances and Systems** Smart appliances and systems are installed for at least three of the following: refrigerator, freezer, dishwasher, clothes dryer, clothes washer, HAVC System, Service Hot Water Heating System	2
	706.4	**Pumps** • Electronically controlled variable-speed pumps are installed. • Sump pumps with electrically commutated motors or permanent split capacitor motors are installed.	5
	706.6	**Parking Garage Efficiency** Structured Parking Garages are designed to require no mechanical ventilation for fresh air	2
	706.7	**Grid-Interactive Thermal Storage System** A grid-interactive electric thermal storage system is installed for water and/or space heating and cooling	2
	706.8	**Electrical Vehicle Charging Station** A Level 2 or 3 electric vehicle charging station is installed on the building site.	2

Water Efficiency

ICC/ASHRAE 700-2015 NGBS – Water Efficiency

The "Water Efficiency" practice category is focused on conserving and efficiently utilizing one of the world's most important resources, water. From rainwater harvesting to wastewater treatment systems, this category provides a broad selection of water efficiency strategies specifically targeted towards residential design, construction and operation.

Mandatory Practices:

- If a project is seeking Gold or Emerald Certification, all water closets and urinals must have a maximum flow rate of 1.28gpm, regardless of dual-flush capabilities.
- If a landscaping system is installed, an irrigation plan and implementation must be executed by a qualified professional certified by a WaterSense labeled system (or equal).

Minimum Point Requirements:

Table 12: Water Efficiency Minimum Point Requirements

Green Building Categories	Minimum Points Required			
	BRONZE	SILVER	GOLD	EMERALD
Water Efficiency	25	39	69	97

LEED-NC – Water Efficiency

The "Water Efficiency" category is focused on reducing the use of water inside and outside the home through conservation measures. LEED-NC also includes process water within this category, as well as water used in cooling towers. Whole-building water is required and data must be shared with the USGBC for at least five years after occupancy.

Mandatory Practices:

- Either reduce irrigation demand via plant selection and irrigation efficiency by least 30% or do not install permanent irrigation.
- Reduce aggregate water consumption of fixtures and fitting by at least 20% baselines.
- Install only ENERGY STAR or performance equivalent residential clothes washers, dishwashers, and ice machines.
- Install only CEE Tier 3A commercial clothes washers.
- Install pre-rinse spray valves with flow rates less than 1.3 gpm.
- Once-through cooling with potable water for any equipment or appliances that reject heat is not allowed.

- Equip cooling towers and evaporative condensers with makeup water meters, conductivity controllers and overflow alarms, efficient drift eliminators that reduce drift to maximum of 0.002% of recirculated water volume for counterflow towers and 0.005% of recirculated water flow for cross-flow towers.

Minimum Point Requirements:

LEED does not require projects to obtain a minimum number of points per category.

Analysis

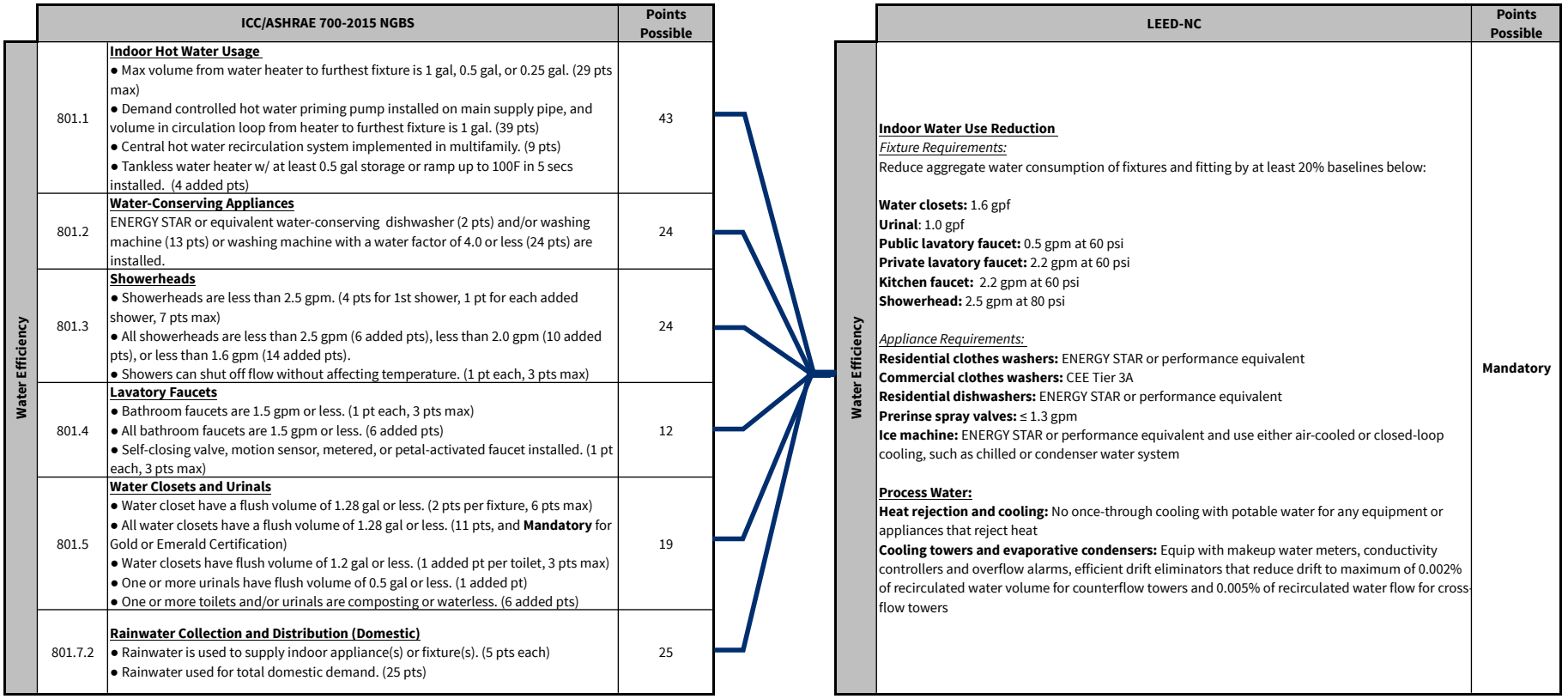
Both LEED and the NGBS tackle indoor and outdoor water conservation. Indoors, LEED sets baseline flush and flow rates for fixtures, and then requires projects to reduce overall indoor consumption by 20% from those baselines by using low-flow fixtures. Points are available for increased reductions or use of alternative water sources such as rainwater, leading to a 25% or more reduction from the baseline. The project cannot earn points for using alternative water sources unless it first reduces the overall consumption through low-flow fixtures by 20%.

NGBS also provides practices that set maximum flush and flow rate limits, and awards projects that further reduce their water consumption through low-flow fixtures. The standard also awards the use of alternative water sources, such as greywater and rainwater, but a project is not dependent reducing indoor water use via low-flow fixtures to be acknowledged for using these sources and earn points.

Outdoors, LEED requires that either no irrigation is installed, or that irrigation demand is reduced by 30% for peak water month via low-water plant selection, calculated using WaterSense Waster Budget Tool. The NGBS awards projects which reduce irrigation water consumption through plant selection and smart irrigation systems, but it is not mandatory. It does, however, require that if an irrigation system is installed, the irrigation plan and implementation must be executed by a qualified professional certified by a WaterSense-labeled program (or equal).

Water conservation strategies are mandatory for cooling towers in LEED-NC, while cooling towers are not addressed in NGBS. LEED also mandates that a water meter for the entire building be installed, and meter data must be compiled into monthly and annual summaries and shared with the USGBC for five years. NGBS does not mandate water-metering, but points can be earned in the Operation, Maintenance, and Building Owner Education category for projects that include verification systems to monitor post-occupancy energy and water use.

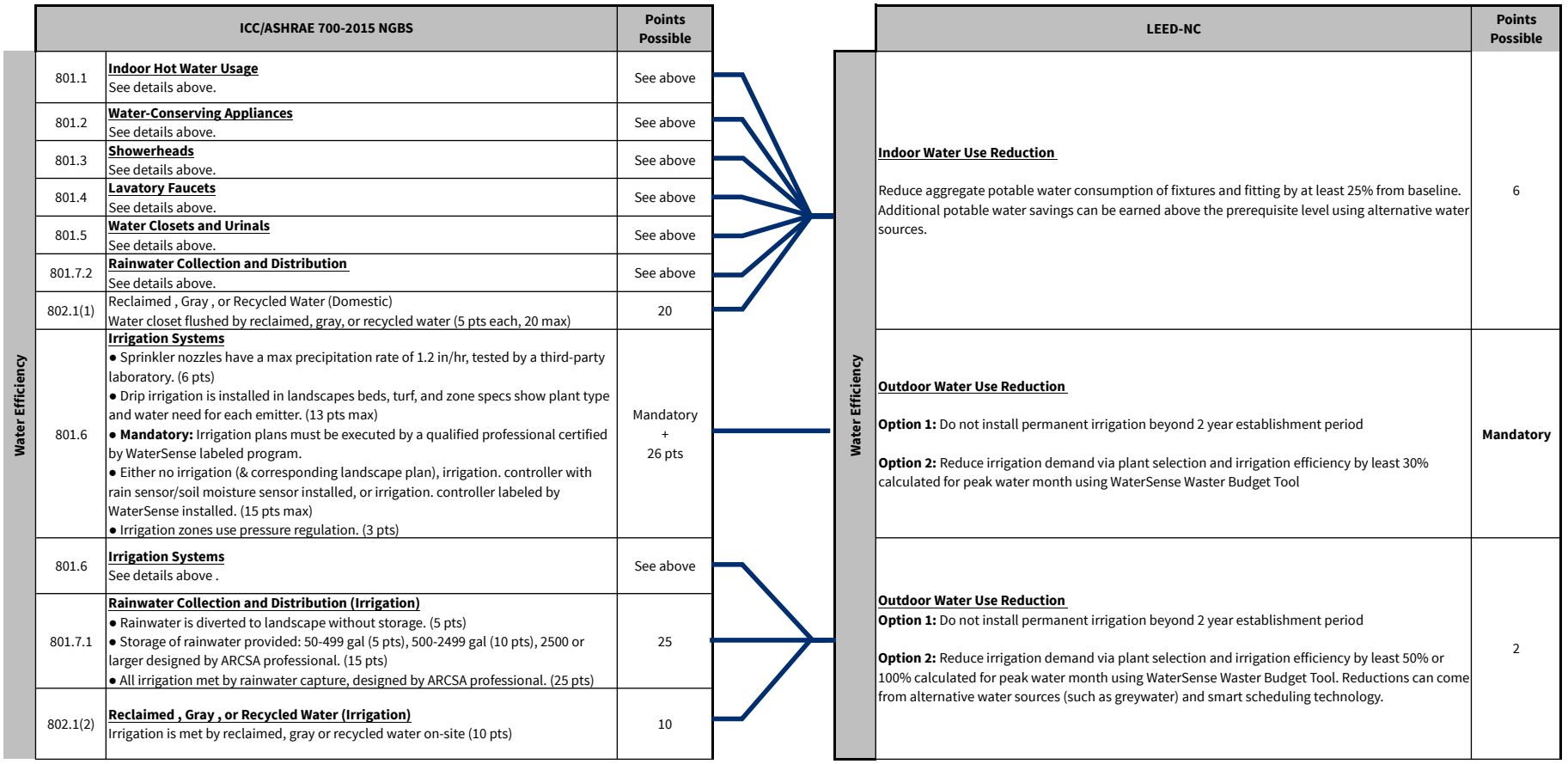
Figure 9: Water Efficiency Practices



	ICC/ASHRAE 700-2015 NGBS		Points Possible
Water Efficiency	801.1	**Indoor Hot Water Usage** • Max volume from water heater to furthest fixture is 1 gal, 0.5 gal, or 0.25 gal. (29 pts max) • Demand controlled hot water priming pump installed on main supply pipe, and volume in circulation loop from heater to furthest fixture is 1 gal. (39 pts) • Central hot water recirculation system implemented in multifamily. (9 pts) • Tankless water heater w/ at least 0.5 gal storage or ramp up to 100F in 5 secs installed. (4 added pts)	43
	801.2	**Water-Conserving Appliances** ENERGY STAR or equivalent water-conserving dishwasher (2 pts) and/or washing machine (13 pts) or washing machine with a water factor of 4.0 or less (24 pts) are installed.	24
	801.3	**Showerheads** • Showerheads are less than 2.5 gpm. (4 pts for 1st shower, 1 pt for each added shower, 7 pts max) • All showerheads are less than 2.5 gpm (6 added pts), less than 2.0 gpm (10 added pts), or less than 1.6 gpm (14 added pts). • Showers can shut off flow without affecting temperature. (1 pt each, 3 pts max)	24
	801.4	**Lavatory Faucets** • Bathroom faucets are 1.5 gpm or less. (1 pt each, 3 pts max) • All bathroom faucets are 1.5 gpm or less. (6 added pts) • Self-closing valve, motion sensor, metered, or petal-activated faucet installed. (1 pt each, 3 pts max)	12
	801.5	**Water Closets and Urinals** • Water closet have a flush volume of 1.28 gal or less. (2 pts per fixture, 6 pts max) • All water closets have a flush volume of 1.28 gal or less. (11 pts, and **Mandatory** for Gold or Emerald Certification) • Water closets have flush volume of 1.2 gal or less. (1 added pt per toilet, 3 pts max) • One or more urinals have flush volume of 0.5 gal or less. (1 added pt) • One or more toilets and/or urinals are composting or waterless. (6 added pts)	19
	801.7.2	**Rainwater Collection and Distribution (Domestic)** • Rainwater is used to supply indoor appliance(s) or fixture(s). (5 pts each) • Rainwater used for total domestic demand. (25 pts)	25

	LEED-NC	Points Possible
Water Efficiency	**Indoor Water Use Reduction** *Fixture Requirements:* Reduce aggregate water consumption of fixtures and fitting by at least 20% baselines below: **Water closets:** 1.6 gpf **Urinal**: 1.0 gpf **Public lavatory faucet:** 0.5 gpm at 60 psi **Private lavatory faucet:** 2.2 gpm at 60 psi **Kitchen faucet:** 2.2 gpm at 60 psi **Showerhead:** 2.5 gpm at 80 psi *Appliance Requirements:* **Residential clothes washers:** ENERGY STAR or performance equivalent **Commercial clothes washers:** CEE Tier 3A **Residential dishwashers:** ENERGY STAR or performance equivalent **Prerinse spray valves:** ≤ 1.3 gpm **Ice machine:** ENERGY STAR or performance equivalent and use either air-cooled or closed-loop cooling, such as chilled or condenser water system **Process Water:** **Heat rejection and cooling:** No once-through cooling with potable water for any equipment or appliances that reject heat **Cooling towers and evaporative condensers:** Equip with makeup water meters, conductivity controllers and overflow alarms, efficient drift eliminators that reduce drift to maximum of 0.002% of recirculated water volume for counterflow towers and 0.005% of recirculated water flow for cross-flow towers	**Mandatory**

Figure 9: Water Efficiency Practices



	ICC/ASHRAE 700-2015 NGBS		Points Possible
Water Efficiency	801.1	**Indoor Hot Water Usage** See details above.	See above
	801.2	**Water-Conserving Appliances** See details above.	See above
	801.3	**Showerheads** See details above.	See above
	801.4	**Lavatory Faucets** See details above.	See above
	801.5	**Water Closets and Urinals** See details above.	See above
	801.7.2	**Rainwater Collection and Distribution** See details above.	See above
	802.1(1)	Reclaimed , Gray , or Recycled Water (Domestic) Water closet flushed by reclaimed, gray, or recycled water (5 pts each, 20 max)	20
	801.6	**Irrigation Systems** • Sprinkler nozzles have a max precipitation rate of 1.2 in/hr, tested by a third-party laboratory. (6 pts) • Drip irrigation is installed in landscapes beds, turf, and zone specs show plant type and water need for each emitter. (13 pts max) • **Mandatory:** Irrigation plans must be executed by a qualified professional certified by WaterSense labeled program. • Either no irrigation (& corresponding landscape plan), irrigation. controller with rain sensor/soil moisture sensor installed, or irrigation. controller labeled by WaterSense installed. (15 pts max) • Irrigation zones use pressure regulation. (3 pts)	Mandatory + 26 pts
	801.6	**Irrigation Systems** See details above .	See above
	801.7.1	**Rainwater Collection and Distribution (Irrigation)** • Rainwater is diverted to landscape without storage. (5 pts) • Storage of rainwater provided: 50-499 gal (5 pts), 500-2499 gal (10 pts), 2500 or larger designed by ARCSA professional. (15 pts) • All irrigation met by rainwater capture, designed by ARCSA professional. (25 pts)	25
	802.1(2)	**Reclaimed , Gray , or Recycled Water (Irrigation)** Irrigation is met by reclaimed, gray or recycled water on-site (10 pts)	10

	LEED-NC	Points Possible
Water Efficiency	**Indoor Water Use Reduction** Reduce aggregate potable water consumption of fixtures and fitting by at least 25% from baseline. Additional potable water savings can be earned above the prerequisite level using alternative water sources.	6
	Outdoor Water Use Reduction **Option 1:** Do not install permanent irrigation beyond 2 year establishment period **Option 2:** Reduce irrigation demand via plant selection and irrigation efficiency by least 30% calculated for peak water month using WaterSense Waster Budget Tool	**Mandatory**
	Outdoor Water Use Reduction **Option 1:** Do not install permanent irrigation beyond 2 year establishment period **Option 2:** Reduce irrigation demand via plant selection and irrigation efficiency by least 50% or 100% calculated for peak water month using WaterSense Waster Budget Tool. Reductions can come from alternative water sources (such as greywater) and smart scheduling technology.	2

Figure 9: Water Efficiency Practices

Other NGBS 2015 Water Efficiency Credits

	ICC/ASHRAE 700-2015 NGBS		Points Possible
Water Efficiency	801.8	**Sediment Filters** Water filter installed to reduce sediment and protecting plumbing for entire building or dwelling unit(s) (1 pt)	1
	802.2	**Reclaimed Water, Graywater, or Rainwater Pre-Piping** These systems are rough-plumbed into building for future use (3 pts per system)	9
	802.3	**Automatic Shutoff Water Device** One of the following installed: excess water flow automatic shutoff or leak detection system with automatic shutoff (2 pts)	2
	802.4	**Engineered Biological System or Intensive Bioremediation System** One of these systems are installed and treated water is used on-site. (20 pts)	20
	802.5	**Recirculating Humidifier** Where humidifier required, a recirculating humidifier is used in lieu of flow through type. (1 pt)	1
	802.6	**Advanced Wastewater Treatment System** Advanced wastewater (aerobic) treatment system installed and treated water used on-site. (20 pts)	20

Other LEED Water Efficiency Credits

	LEED-NC	Points Possible
Water Efficiency	**Cooling Tower Water Use** Conduct a one-time potable water analysis of cooling towers and evaporative condensers, in order to optimize cooling tower cycles. Limit cooling tower cycles to avoid exceeding maximum values for any of following parameters. Ca (as CaCO3): 1000 ppm Total alkalinity: 1000 ppm SiO2: 100 ppm Cl-: 250 ppm Conductivity: 2000 µS/cm	2
	Building-Level Water Metering Install permanent water meters that measure the total potable water use for the building and associated grounds. Meter data must be compiled into monthly and annual summaries; meter readings can be manual or automated; share data with USGBC for 5 years.	**Mandatory**
	Water Metering (Submetering) Install permanent water meters for two or more of the following water subsystems, as applicable to the project: - Irrigation - Indoor plumbing fixtures and fittings - Domestic Hot Water - Boiler (100,000 gay/yr use or 500,00BtUH) - Reclaimed Water - Other Process Water	1

Indoor Environmental Quality

ICC/ASHRAE 700-2015 NGBS – Indoor Environmental Quality

The "Indoor Environmental Quality" practice category is focused on providing clean air and a higher quality environment inside the home. This encompasses a multitude of interior components from floor to ceiling, including how fireplaces are installed and which types of paint are used. Ventilation is primary focus, with a number of mandatory ventilation requirement and points being available for strategies such as cross-ventilation and MERV 14 filters.

Mandatory Practices:

- Bathrooms are vented to the outdoors.
- Clothes dryers (except listed and labeled condensing ductless dryers) are vented to the outdoors.
- Carbon Monoxide alarms are provided in accordance with the IRC Section R315.
- Gas-fired fireplaces and direct heating equipment within dwelling units are installed in accordance with applicable code and vented to the outdoors.
- Solid Fuel-burning appliances must be code compliant and are in accordance with the requirements listed in Figure 10.
- Doors installed in common walls between garage and conditioned space are sealed and gasketed.
- Continuous air barrier is provided in common wall between garage and conditioned space.
- Radon control measures are mandatory for Zone 1 areas.
- The living space is sealed in accordance with Section 701.4.3.1 (Building Thermal Envelope Air Sealing) to prevent unwanted contaminants.
- Structural plywood is compliant DOC PS and/or DOC PS 2. OSB meets DOC PS 2.
- Wall-to-wall carpeting is not installed near water closets and bathing fixtures.

Minimum Point Requirements:

Table 13: Indoor Environmental Quality Minimum Point Requirements

Green Building Categories	Minimum Points Required			
	BRONZE	SILVER	GOLD	EMERALD
Indoor Environmental Quality	25	42	69	97

LEED-NC – Indoor Environmental Quality

The "Indoor Environmental Quality" practice category is focused on providing a high-quality indoor environment and reducing the occupants' exposure to possible indoor pollutants, including meeting the ventilation requirements of ASGRAE 62.1-2010, using low-emitting materials, and designing for occupant comfort. This category has detailed mandatory prerequisites, some of which are specific to residential buildings. Other practices are specific to commercial buildings and are less applicable to this report.

Mandatory Practices:

- Mechanically ventilated spaces: Meet the minimum requirements of ASHRAE Standard 62.1–2010, Sections 4–7, Ventilation for Acceptable Indoor Air Quality (with errata), or a local equivalent.
- Naturally ventilated spaces: Determine the minimum outdoor air opening and space configuration requirements (ASHRAE Standard 62.1–2010 or local equal). Meet the requirements of ASHRAE Standard 62.1–2010, Section 4, or a local equivalent.
- Comply with all additional requirements for mechanically and naturally ventilated spaces listed within Minimum Indoor Air Quality Performance in Figure 10.
- For Residential Buildings:
    - Unvented combustion appliances (e.g., decorative logs) are not allowed.
    - Carbon monoxide monitors must be installed on each floor of each unit.
    - Indoor fireplaces and woodstoves must have solid glass enclosures or doors that seal when closed.
    - Any indoor fireplaces and woodstoves that are not closed combustion or power-vented must pass a backdraft potential test to ensure that depressurization of the combustion appliance zone is less than 5 Pa.
    - Space- and water-heating equipment that involves combustion must be designed and installed with closed combustion or with power-vented exhaust, or located in a detached utility building or open-air facility.
    - For projects in high-risk areas for radon, EPA Radon Zone 1, design and construct any dwelling unit on levels one through four above grade with radon-resistant construction techniques. For indoor fireplaces and woodstoves, provide closing doors or a solid glass enclosure.

Minimum Point Requirements:

LEED does not require projects to obtain a minimum number of points per category.

Analysis

Both systems have multiple mandatory and optional practices related to whole-building, spot and combustion ventilation. LEED requires compliance with AHSRAE 62.1-2010, and sets several mandates for mechanically and naturally ventilated spaces, such as providing airflow measurement devices. Specifically for residential projects, LEED sets out the indoor air quality requirements listed above and in Figure 10. Similar, if not identical, practices are also provided in NGBS, most of which are also mandatory. NGBS also includes some residential-specific spot ventilation requirements for bathrooms and clothes dryers.

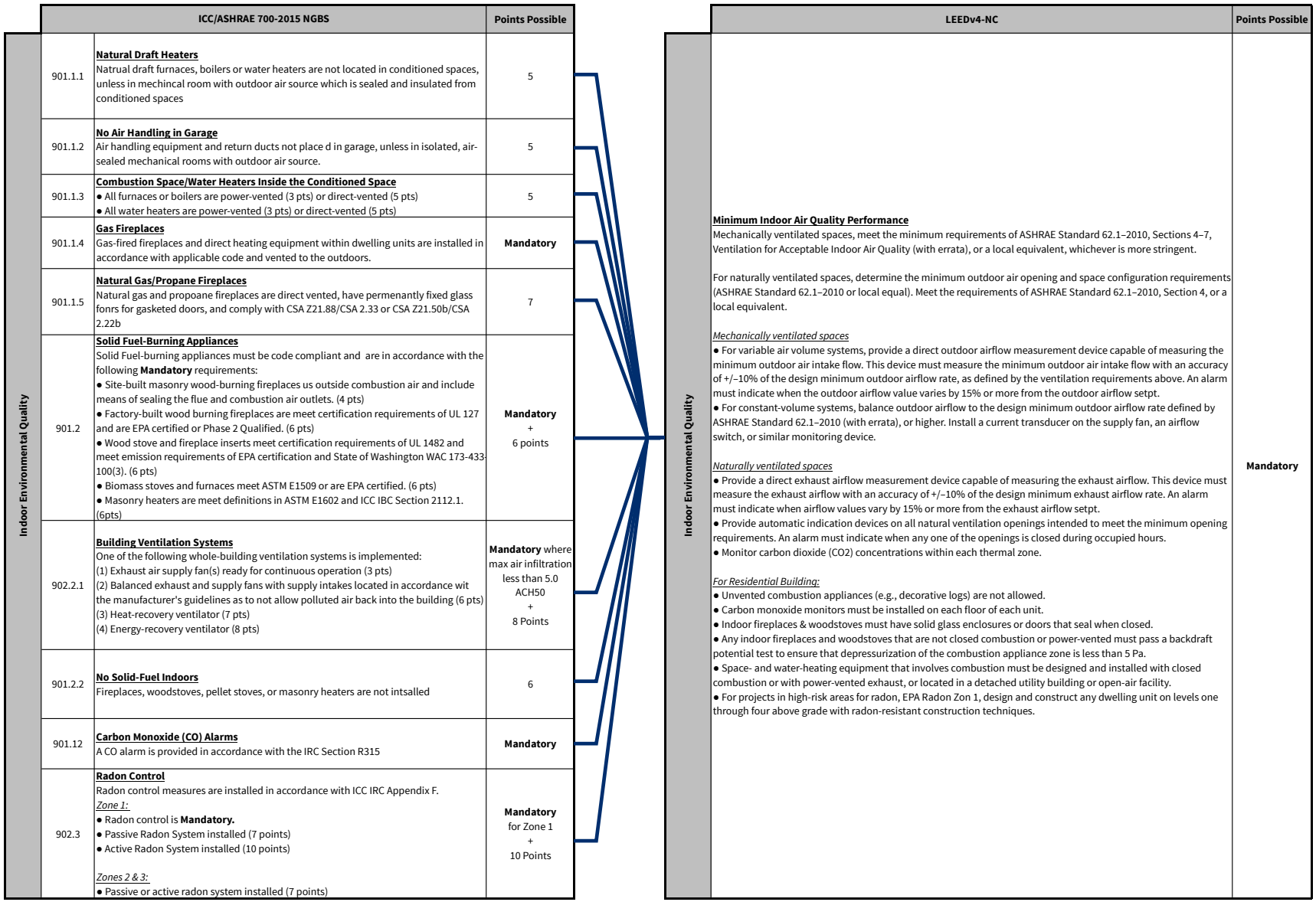
For residential buildings, LEED-NC requires that projects either prohibit smoking inside or compartmentalize units to prevent smoke from entering it from common areas. NGBS does not mandate this, but projects can earn point for prohibiting smoking in common areas and providing smoking areas outside at least 25 feet away from air intakes, doors and windows.

Both rating systems encourage additional pollution control measures, such as building entrance walk-off mats and high MERV filters for HVAC equipment. Both rating systems also encourage low-emitting products from floor to ceiling by recognizing the value in products that are Zero-VOC or have been tested and found compliant with the California Department of Public Health Standard Method V1.1.

While NGBS encourages occupancy sensors and dimmers for lighting controls and programmable thermostats for the whole dwelling unit, LEED-NC takes it further by awarding points for providing 90% of individual occupant spaces with multilevel lighting controls and 50% of these spaces with thermal comfort controls.

Both LEED-NC and NGBS have additional practices which do not correlate with each other. For instance, points can be earned in LEED-NC for providing quality views to occupants and meeting acoustic performance standards. NGBS has no such practices, but it does have requirements for garages attached to the building and for bathroom floorings which are not included in LEED-NC.

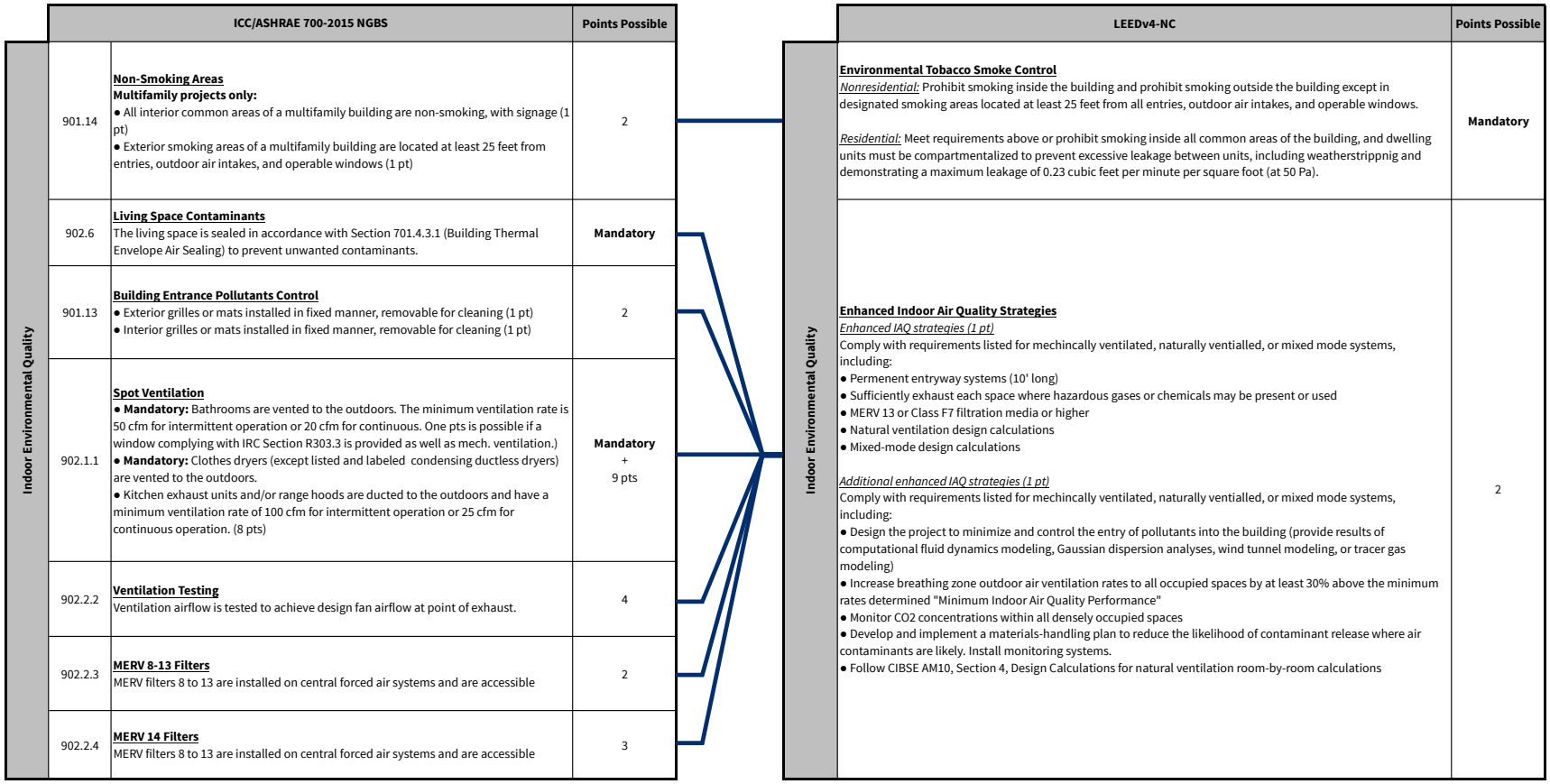
Figure 10: Indoor Environmental Quality Practices



	ICC/ASHRAE 700-2015 NGBS		Points Possible
Indoor Environmental Quality	901.1.1	**Natural Draft Heaters** Natrual draft furnaces, boilers or water heaters are not located in conditioned spaces, unless in mechincal room with outdoor air source which is sealed and insulated from conditioned spaces	5
	901.1.2	**No Air Handling in Garage** Air handling equipment and return ducts not place d in garage, unless in isolated, air-sealed mechanical rooms with outdoor air source.	5
	901.1.3	**Combustion Space/Water Heaters Inside the Conditioned Space** ● All furnaces or boilers are power-vented (3 pts) or direct-vented (5 pts) ● All water heaters are power-vented (3 pts) or direct-vented (5 pts)	5
	901.1.4	**Gas Fireplaces** Gas-fired fireplaces and direct heating equipment within dwelling units are installed in accordance with applicable code and vented to the outdoors.	**Mandatory**
	901.1.5	**Natural Gas/Propane Fireplaces** Natural gas and propoane fireplaces are direct vented, have permenantly fixed glass fonrs for gasketed doors, and comply with CSA Z21.88/CSA 2.33 or CSA Z21.50b/CSA 2.22b	7
	901.2	**Solid Fuel-Burning Appliances** Solid Fuel-burning appliances must be code compliant and are in accordance with the following **Mandatory** requirements: ● Site-built masonry wood-burning fireplaces us outside combustion air and include means of sealing the flue and combustion air outlets. (4 pts) ● Factory-built wood burning fireplaces are meet certification requirements of UL 127 and are EPA certified or Phase 2 Qualified. (6 pts) ● Wood stove and fireplace inserts meet certification requirements of UL 1482 and meet emission requirements of EPA certification and State of Washington WAC 173-433-100(3). (6 pts) ● Biomass stoves and furnaces meet ASTM E1509 or are EPA certified. (6 pts) ● Masonry heaters are meet definitions in ASTM E1602 and ICC IBC Section 2112.1. (6pts)	**Mandatory** + 6 points
	902.2.1	**Building Ventilation Systems** One of the following whole-building ventilation systems is implemented: (1) Exhaust air supply fan(s) ready for continuous operation (3 pts) (2) Balanced exhaust and supply fans with supply intakes located in accordance wit the manufacturer's guidelines as to not allow polluted air back into the building (6 pts) (3) Heat-recovery ventilator (7 pts) (4) Energy-recovery ventilator (8 pts)	**Mandatory** where max air infiltration less than 5.0 ACH50 + 8 Points
	901.2.2	**No Solid-Fuel Indoors** Fireplaces, woodstoves, pellet stoves, or masonry heaters are not intsalled	6
	901.12	**Carbon Monoxide (CO) Alarms** A CO alarm is provided in accordance with the IRC Section R315	**Mandatory**
	902.3	**Radon Control** Radon control measures are installed in accordance with ICC IRC Appendix F. *Zone 1:* ● Radon control is **Mandatory.** ● Passive Radon System installed (7 points) ● Active Radon System installed (10 points) *Zones 2 & 3:* ● Passive or active radon system installed (7 points)	**Mandatory** for Zone 1 + 10 Points

	LEEDv4-NC	Points Possible
Indoor Environmental Quality	**Minimum Indoor Air Quality Performance** Mechanically ventilated spaces, meet the minimum requirements of ASHRAE Standard 62.1–2010, Sections 4–7, Ventilation for Acceptable Indoor Air Quality (with errata), or a local equivalent, whichever is more stringent. For naturally ventilated spaces, determine the minimum outdoor air opening and space configuration requirements (ASHRAE Standard 62.1–2010 or local equal). Meet the requirements of ASHRAE Standard 62.1–2010, Section 4, or a local equivalent. *Mechanically ventilated spaces* ● For variable air volume systems, provide a direct outdoor airflow measurement device capable of measuring the minimum outdoor air intake flow. This device must measure the minimum outdoor air intake flow with an accuracy of +/–10% of the design minimum outdoor airflow rate, as defined by the ventilation requirements above. An alarm must indicate when the outdoor airflow value varies by 15% or more from the outdoor airflow setpt. ● For constant-volume systems, balance outdoor airflow to the design minimum outdoor airflow rate defined by ASHRAE Standard 62.1–2010 (with errata), or higher. Install a current transducer on the supply fan, an airflow switch, or similar monitoring device. *Naturally ventilated spaces* ● Provide a direct exhaust airflow measurement device capable of measuring the exhaust airflow. This device must measure the exhaust airflow with an accuracy of +/–10% of the design minimum exhaust airflow rate. An alarm must indicate when airflow values vary by 15% or more from the exhaust airflow setpt. ● Provide automatic indication devices on all natural ventilation openings intended to meet the minimum opening requirements. An alarm must indicate when any one of the openings is closed during occupied hours. ● Monitor carbon dioxide (CO2) concentrations within each thermal zone. *For Residential Building:* ● Unvented combustion appliances (e.g., decorative logs) are not allowed. ● Carbon monoxide monitors must be installed on each floor of each unit. ● Indoor fireplaces & woodstoves must have solid glass enclosures or doors that seal when closed. ● Any indoor fireplaces and woodstoves that are not closed combustion or power-vented must pass a backdraft potential test to ensure that depressurization of the combustion appliance zone is less than 5 Pa. ● Space- and water-heating equipment that involves combustion must be designed and installed with closed combustion or with power-vented exhaust, or located in a detached utility building or open-air facility. ● For projects in high-risk areas for radon, EPA Radon Zon 1, design and construct any dwelling unit on levels one through four above grade with radon-resistant construction techniques.	**Mandatory**

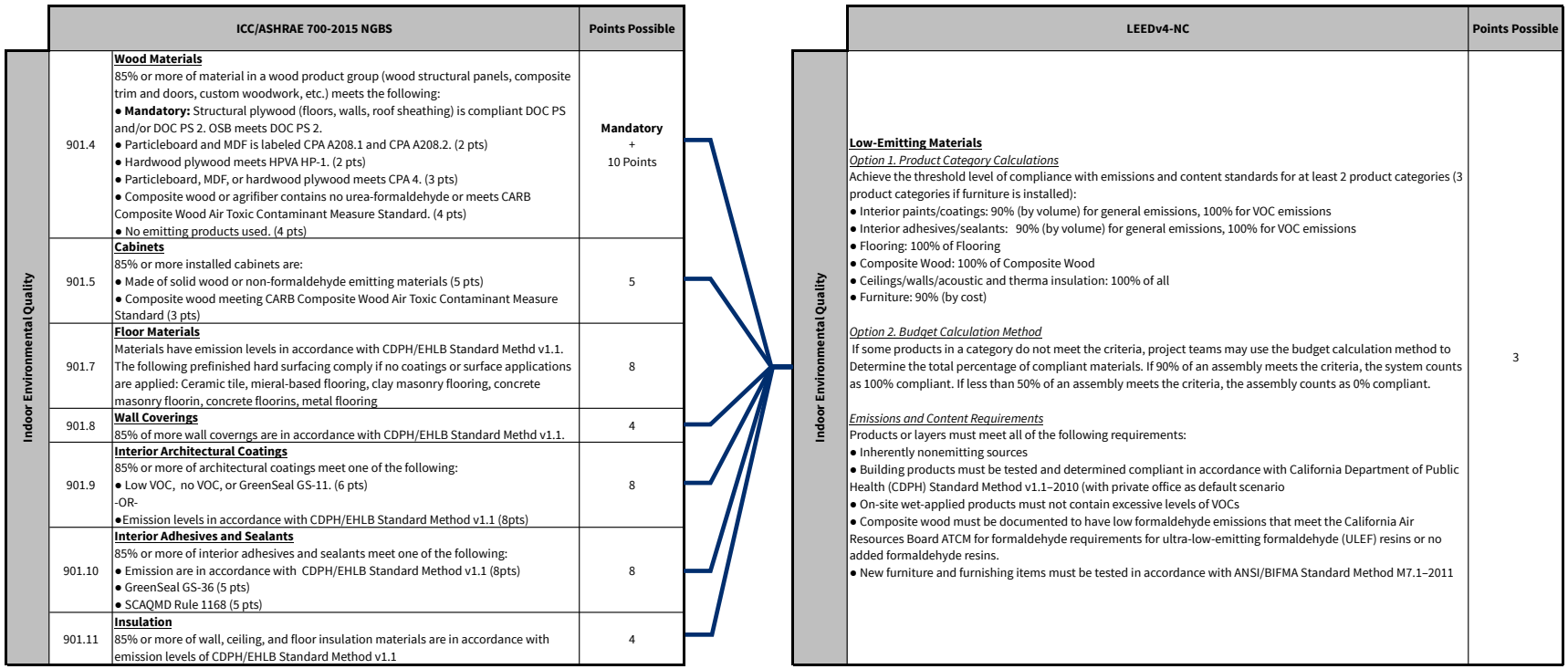
Figure 10: Indoor Environmental Quality Practices



	ICC/ASHRAE 700-2015 NGBS		Points Possible
Indoor Environmental Quality	901.14	**Non-Smoking Areas** **Multifamily projects only:** ● All interior common areas of a multifamily building are non-smoking, with signage (1 pt) ● Exterior smoking areas of a multifamily building are located at least 25 feet from entries, outdoor air intakes, and operable windows (1 pt)	2
	902.6	**Living Space Contaminants** The living space is sealed in accordance with Section 701.4.3.1 (Building Thermal Envelope Air Sealing) to prevent unwanted contaminants.	**Mandatory**
	901.13	**Building Entrance Pollutants Control** ● Exterior grilles or mats installed in fixed manner, removable for cleaning (1 pt) ● Interior grilles or mats installed in fixed manner, removable for cleaning (1 pt)	2
	902.1.1	**Spot Ventilation** ● **Mandatory:** Bathrooms are vented to the outdoors. The minimum ventilation rate is 50 cfm for intermittent operation or 20 cfm for continuous. One pts is possible if a window complying with IRC Section R303.3 is provided as well as mech. ventilation.) ● **Mandatory:** Clothes dryers (except listed and labeled condensing ductless dryers) are vented to the outdoors. ● Kitchen exhaust units and/or range hoods are ducted to the outdoors and have a minimum ventilation rate of 100 cfm for intermittent operation or 25 cfm for continuous operation. (8 pts)	**Mandatory** + 9 pts
	902.2.2	**Ventilation Testing** Ventilation airflow is tested to achieve design fan airflow at point of exhaust.	4
	902.2.3	**MERV 8-13 Filters** MERV filters 8 to 13 are installed on central forced air systems and are accessible	2
	902.2.4	**MERV 14 Filters** MERV filters 8 to 13 are installed on central forced air systems and are accessible	3

	LEEDv4-NC	Points Possible
Indoor Environmental Quality	**Environmental Tobacco Smoke Control** *Nonresidential:* Prohibit smoking inside the building and prohibit smoking outside the building except in designated smoking areas located at least 25 feet from all entries, outdoor air intakes, and operable windows. *Residential:* Meet requirements above or prohibit smoking inside all common areas of the building, and dwelling units must be compartmentalized to prevent excessive leakage between units, including weatherstrippnig and demonstrating a maximum leakage of 0.23 cubic feet per minute per square foot (at 50 Pa).	**Mandatory**
	Enhanced Indoor Air Quality Strategies *Enhanced IAQ strategies (1 pt)* Comply with requirements listed for mechincally ventilated, naturally ventialled, or mixed mode systems, including: ● Permenent entryway systems (10' long) ● Sufficiently exhaust each space where hazardous gases or chemicals may be present or used ● MERV 13 or Class F7 filtration media or higher ● Natural ventilation design calculations ● Mixed-mode design calculations *Additional enhanced IAQ strategies (1 pt)* Comply with requirements listed for mechincally ventilated, naturally ventialled, or mixed mode systems, including: ● Design the project to minimize and control the entry of pollutants into the building (provide results of computational fluid dynamics modeling, Gaussian dispersion analyses, wind tunnel modeling, or tracer gas modeling) ● Increase breathing zone outdoor air ventilation rates to all occupied spaces by at least 30% above the minimum rates determined "Minimum Indoor Air Quality Performance" ● Monitor CO2 concentrations within all densely occupied spaces ● Develop and implement a materials-handling plan to reduce the likelihood of contaminant release where air contaminants are likely. Install monitoring systems. ● Follow CIBSE AM10, Section 4, Design Calculations for natural ventilation room-by-room calculations	2

Figure 10: Indoor Environmental Quality Practices



	ICC/ASHRAE 700-2015 NGBS		Points Possible
Indoor Environmental Quality	901.4	**Wood Materials** 85% or more of material in a wood product group (wood structural panels, composite trim and doors, custom woodwork, etc.) meets the following: ● **Mandatory:** Structural plywood (floors, walls, roof sheathing) is compliant DOC PS and/or DOC PS 2. OSB meets DOC PS 2. ● Particleboard and MDF is labeled CPA A208.1 and CPA A208.2. (2 pts) ● Hardwood plywood meets HPVA HP-1. (2 pts) ● Particleboard, MDF, or hardwood plywood meets CPA 4. (3 pts) ● Composite wood or agrifiber contains no urea-formaldehyde or meets CARB Composite Wood Air Toxic Contaminant Measure Standard. (4 pts) ● No emitting products used. (4 pts)	**Mandatory** + 10 Points
	901.5	**Cabinets** 85% or more installed cabinets are: ● Made of solid wood or non-formaldehyde emitting materials (5 pts) ● Composite wood meeting CARB Composite Wood Air Toxic Contaminant Measure Standard (3 pts)	5
	901.7	**Floor Materials** Materials have emission levels in accordance with CDPH/EHLB Standard Methd v1.1. The following prefinished hard surfacing comply if no coatings or surface applications are applied: Ceramic tile, mieral-based flooring, clay masonry flooring, concrete masonry floorin, concrete floorins, metal flooring	8
	901.8	**Wall Coverings** 85% of more wall coverngs are in accordance with CDPH/EHLB Standard Methd v1.1.	4
	901.9	**Interior Architectural Coatings** 85% or more of architectural coatings meet one of the following: ● Low VOC, no VOC, or GreenSeal GS-11. (6 pts) -OR- ●Emission levels in accordance with CDPH/EHLB Standard Method v1.1 (8pts)	8
	901.10	**Interior Adhesives and Sealants** 85% or more of interior adhesives and sealants meet one of the following: ● Emission are in accordance with CDPH/EHLB Standard Method v1.1 (8pts) ● GreenSeal GS-36 (5 pts) ● SCAQMD Rule 1168 (5 pts)	8
	901.11	**Insulation** 85% or more of wall, ceiling, and floor insulation materials are in accordance with emission levels of CDPH/EHLB Standard Method v1.1	4

	LEEDv4-NC	Points Possible
Indoor Environmental Quality	**Low-Emitting Materials** *Option 1. Product Category Calculations* Achieve the threshold level of compliance with emissions and content standards for at least 2 product categories (3 product categories if furniture is installed): ● Interior paints/coatings: 90% (by volume) for general emissions, 100% for VOC emissions ● Interior adhesives/sealants: 90% (by volume) for general emissions, 100% for VOC emissions ● Flooring: 100% of Flooring ● Composite Wood: 100% of Composite Wood ● Ceilings/walls/acoustic and therma insulation: 100% of all ● Furniture: 90% (by cost) *Option 2. Budget Calculation Method* If some products in a category do not meet the criteria, project teams may use the budget calculation method to Determine the total percentage of compliant materials. If 90% of an assembly meets the criteria, the system counts as 100% compliant. If less than 50% of an assembly meets the criteria, the assembly counts as 0% compliant. *Emissions and Content Requirements* Products or layers must meet all of the following requirements: ● Inherently nonemitting sources ● Building products must be tested and determined compliant in accordance with California Department of Public Health (CDPH) Standard Method v1.1–2010 (with private office as default scenario ● On-site wet-applied products must not contain excessive levels of VOCs ● Composite wood must be documented to have low formaldehyde emissions that meet the California Air Resources Board ATCM for formaldehyde requirements for ultra-low-emitting formaldehyde (ULEF) resins or no added formaldehyde resins. ● New furniture and furnishing items must be tested in accordance with ANSI/BIFMA Standard Method M7.1–2011	3

Figure 10: Indoor Environmental Quality Practices

	ICC/ASHRAE 700-2015 NGBS		Points Possible
Indoor Environmental Quality	902.4	**HVAC System Protection** Perform one the following: ● HVAC supply registers, return grilles, and rough-ins are covered during construction. ● Prior to occupancy, HVAC supply registers, return grilles, and duct terminations are inspected and vacuumed. Coils are inspected and cleaned.	3
	904.1	**Indoor Air Quality During Construction** Wood is kept dry, sources of water infiltration of condensation is eliinated, accessible interior surfaces are dry a free of water damage	2
	903.3	**Relative Humidity** In climate zones 1A, 2A, 3A, 4A, and 5A defined by the 2015 IECC, install equipment to maintian relative humidityat or below 60% using either additional dehumidifcation systems or a central HVAC system equipped with controls to operate in dehumidification mode	7
	905.1	**Humidity Monitoring System** A humidity monitoring system is installed that meaures temperature and relative humidity. The system shall have two remote sensor units, minimum, with one inside the conditioned space and the other outside.	2
	706.1(1) & (4)	**Programmable Thermostats** ● Install a whole-dwelling unit programmable communicating thermostat with capability to be remotley controlled. (1 pt) ● Install a whole-dwelling unit programmabale thermostat with control cabaility based on occupant presence or usage pattern. (1 pt)	2
	705.2.1.1	**Interior Lighting** Permentantly installed lightin fixtures are controlled by occupancy sensors or diimmers for 50-74% of lgihting fixtures (1 pt) or 75+% of lighting fixtures (2 pts)	2
	705.2.1.3	**Multifamily Common Areas** Occupancy Snesors or dimmers are installed in common areas for 50-74% of lgihting fixtures (1 pt) or 75+% of lighting fixtures. (2 pts)	2

	LEEDv4-NC	Points Possible
Indoor Environmental Quality	**Construction Indoor Air Quality Management Plan** Develop and implement an indoor air quality (IAQ) management plan for the construction and preoccupancy phases of the building, including the following: ● During construction, meet or exceed all applicable recommended control measures of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 2nd edition, 2007, ANSI/SMACNA 008–2008, Chapter 3. ● Protect absorptive materials stored on-site and installed from moisture damage. ● Do not operate permanently installed air-handling equipment during construction unless with MERV 8 filtration media. Replace before occupancy. ● Prohibit the use of tobacco products inside the building and within 25 feet of entrance during construction.	1
	Thermal Comfort *Option 1. ASHRAE Standard 55-2010* Design heating, ventilating, and air-conditioning (HVAC) systems and the building envelope to meet the requirements of ASHRAE Standard 55–2010 *Option 2. ISO and CEN Standards* Design HVAC systems and the building envelope to meet the requirements of ISO 7730:2005 and CEN Standard EN 15251:2007 Provide individual thermal comfort controls for at least 50% of individual occupant spaces. Provide group controls for 100% of all shared space and for any individual occupant space without individual controls.	1
	Interior Lighting *Option 1. Lighting control (1 pt)* For at least 90% of individual occupant spaces, provide individual lighting controls with at least three lighting levels For all shared multioccupant spaces, install multizone control systems that adjust the lighting to meet group needs, with at least three lighting levels. All controls must have direct line of sight to luminaires. *Option 2. Lighting quality (1 pt)* Choose four of the eight strategies listed in LEED, including but not limited to, use light sources with a CRI of 80 or higher for the entire project, use light sources that have a rated life of at least 24,000 hours for 75% of the total connected lighting load, or use direct-only overhead lighting for 25% or less of the total connected lighting load for all regularly occupied spaces.	2

Figure 10: Indoor Environmental Quality Practices

Other NGBS 2015 IEQ Credits

		ICC/ASHRAE 700-2015 NGBS	Points Possible
Indoor Environmental Quality	901.1.6	**Electric heat pump air handler** Option 1: Install the heat pump in an unconditioned space (2 pts) Option 2: Install the heat pump in a conditioned space (5 pts)	5
	901.3	**Garages** *Option (1) - Attached garages:* ● **Mandatory:** Doors installed in common walls with conditioned space are sealed and gasketed (2 pts) ● **Mandatory:** Continuous air barrier is provided in common wall with conditioned space (2 pts) ● For 1-2 family welling units, ducted exhaust fan installed and vented to outdoors (8 pts) -OR- *Option (2) - Detached or no garage:* A carport is installed in lieu of garage, garage is detached, or no garage installed (10 pts)	**Mandatory** + 10 Points
	901.6	**Bathroom Carpets** Wall-to-wall carpeting is not installed near water closets and bathing fixtures	**Mandatory**
	902.5	***Central Vacuum Systems*** Central vacuum system is installed and vented outside	3
	903.1	**Plumbing** *Path 1:* Cold water pipes in unconditioned spaces are insulated, R-4 or higher (2 pts) *Path 2:* Plumbing is not installed in unconditioned spaces. (5 pts)	5
	903.2	**Duct Installation** ● All HVAC ducts, plenums, & trunks located in conditioned space (1 pt) ● Option 1, as well as all HVAC ducts insulated to R4 or higher (3 pts)	3
	904.2	**Indoor Air Quality Post Completion** Verification is perforemd that no mold, mopitsure, or dust issues per ASTM D7338 Sections 6.3 and 7.4.3	3
	905.2	**Kitchen Exhaust** The kitchen exhast unit equals or exceeds 400 cfm, with make-up air provided	2

Other LEEDv4-NC IEQ Credits

	LEEDv4-NC	Points Possible
Indoor Environmental Quality	**Quality Views** Achieve a direct line of sight to the outdoors via vision glazing for 75% of all regularly occupied floor area. Views must be have 2 of the following: ● Multiple lines of sight to vision glazing in different directions at least 90 degrees apart ● Views that include at least two of the following: (1) flora, fauna, or sky; (2) movement; and (3) objects at least 25 feet from the exterior of the glazing ● Unobstructed views located within the distance of three times the head height of the vision glazing ● Views with a view factor of 3 or greater, as defined in "Windows and Offices; A Study of Office Worker Performance and the Indoor Environment."	1
	Acoustic Performance For all occupied spaces, meet the requirements set in LEEDv4-NC for HVAC background noise, sound isolation, reverberation time, and sound reinforcement and mask, such as achieving maximum background noise levels from HVAC systems per 2011 ASHRAE Handbook, HVAC Applications, Chapter 48, Table 1; AHRI Standard 885-2008, Table 15; or a local equivalent.	1
	Indoor Air Quality Assessment *Option 1. Flush-out (1 pt)* ***Path 1.*** Before Occupancy - Perform flush-out by supplying a total air volume of 14,000 cubic feet of outdoor air per square foot (60°F-80°F, relative humidity no higher than 60%) ***Path 2.*** During occupancy - Space may be occupied only after delivery of a minimum of 3,500 cubic feet of outdoor air per square foot (60°F-80°F, relative humidity no higher than 60%). Once occupied, ventilate at a minimum rate of 0.30 cubic foot per minute (cfm) per square foot of outdoor air, begining 3 hours before occupancy daily and continuing during occupancy. Mintain conditions until a total of 14,000 cubic feet per square foot of outdoor air has been delivered to the space. *Option 2. Air testing (2 pts)* Conduct baseline IAQ testing - Use Use current versions of ASTM standard methods, EPA compendium methods, or ISO methods. Demonstrate that contaminants do not exceed the concentration levels listed iwhtin LEED Program. Conduct all measurements before occupancy but during normal occupied hours.	2
	Daylight *Option 1. Simulation: Spatial Daylight Autonomy (2–3 pts)* Demonstrate through annual computer simulations that spatial daylight autonomy300/50% (sDA300/50%) of at least 55%, 75%, or 90% is achieved. Also, demonstrate through annual computer simulations that annual sunlight exposure1000,250 (ASE1000,250) of no more than 10% is achieved. *Option 2. Simulation: Illuminance Calculations (1–2 pts)* Demonstrate through computer modeling that illuminance levels will be between 300 lux and 3,000 lux for 9 a.m. and 3 p.m., both on a clear-sky day at the equinox, for 75% more of occupied floor area. *Option 3. Measurement (2–3 pts)* Achieve illuminance levels between 300 lux and 3,000 lux for for 75% more of occupied floor area.	3

Operation, Maintenance, and Building Owner Education

ICC/ASHRAE 700-2015 NGBS – Operation, Maintenance, and Building Owner Education

The "Operation, Maintenance, and Building Owner Education" practice category is focused on providing information on the building's use, maintenance, and green components to all necessary parties. This includes mandatory operation and maintenance manual(s) and first-hand training of building owners or operators. Additional points can be earn for providing public education of the buildings green aspects as well as performing a posy occupancy performance assessment.

Mandatory Practices:

- Single-family: Provide a homeowner's manual to responsible parties that complies with Figure 11.
- Multifamily: Provide a building construction manual to responsible parties that complies with Figure 11.
- Multifamily: Provide an operations manual to responsible parties that complies with Figure 11.
- Multifamily: Provide a maintenance manual to responsible parties that complies with Figure 11.
- Provide on-site training to responsible parties regarding O&M, control systems, and actions that will improve the environmental performance of the building.

Minimum Point Requirements:

Table 14: Operation, Maintenance, and Building Owner Education Minimum Point Requirements

Green Building Categories	Minimum Points Required			
	BRONZE	SILVER	GOLD	EMERALD
Operation, Maintenance, and Building Owner Education	8	10	11	12

LEED-NC – Not Applicable

LEED-NC does not have a designated Operation, Maintenance, and Building Owner Education category. However, under the Energy Efficiency category, the project team is required to prepare a current Facilities Requirements and Operations and Maintenance Plan.

Mandatory Practices (in "Energy Efficiency" Category):

The project team must prepare and maintain a current Facilities Requirements and Operations and Maintenance Plan.

Minimum Point Requirements:

Not applicable to this section.

Analysis

As stated above, LEED-NC does not have a designated Operation, Maintenance, and Building Owner Education category. However, under the Energy Efficiency category, the commissioning agent is required to prepare a current facilities requirements and operations and maintenance plan.

NGBS requires a home owner manual for single-family homes, or a series of operation and maintenance manuals for multifamily homes, to be provided to responsible parties. These manuals include mandatory information, such as appliance data sheets and lists of green features, but are also required to include a few additional practices from a provided list. Examples include information on opportunities to purchase renewable energy from local utilities, information on local and on-site recycling and hazardous waste disposal programs and waste handling and disposal procedures, organic pest control, fertilizers, de-icers, and cleaning products.

Onsite training of responsible parties is mandatory in NGBS, and must include at minimum the operation and maintenance and occupant actions for all of the following: HVAC filters, thermostat operation and programming, lighting controls, appliance operation, water heater settings and hot water use, fan controls, recycling and composting practices. This level of first-hand training of building owners or managers is not required by LEED-NC.

NGBS also awards points for providing public education about the green features of the project, such as construction signs demonstrating how the project is designed and built in accordance with the National Green Building Standard.

Providing a verification system plan also earns points within the NGBS. The verification system provides methods for demonstrating continued energy and water savings that are determined from the building's initial year of occupancy of water and energy consumption, and comparing it to annualized consumption at least every four years.

Figure 11: Operation, Maintenance, and Building Owner Education Practices

		ICC/ASHRAE 700-2015 NGBS	Points Possible
Energy Efficiency	1002.1	**Building Construction Manual** Provide a building construction manual to responsible parties, including 5 or more of the following: *Mandatory:* ● A narrative detailing the importance of constructing a green building. ● A local green building program certificate and the individual measures achieved by the building. ● Warranty, operation, and maintenance instructions for all equipment, fixtures, appliances, & finishes. *Optional (One Point awarded per two items):* ● Record drawings of the building. ● A record drawing of the site including stormwater management plans, utility lines, landscaping with common name and genus/species of plantings. ● A diagram showing the location of safety valves and controls for major building systems. ● A list of the type and wattage of light bulbs installed in light fixtures. ● A photo record prior to insulation of framing with utilities labeled and installed	**Mandatory** (Points earned for optional items)
	1002.2	**Operations Manual** Provide an operations manual to responsible parties, including 5 or more of the following: *Mandatory:* ● Narrative detailing the importance of operating and living in a green building. ● A list of practices to conserve water and energy *Optional (One point awarded per two items):* ● Information on methods of maintaining the building's relative humidity in the range of 30 to 60 percent. ● Information on opportunities to purchase renewable energy from local utilities or national green power providers and information on utility and tax incentives for the installing onsite renewable energy systems. ● Information on local and on-site recycling and hazardous waste disposal programs and waste handling and disposal procedures. ● Local public transportation options. ● Explanation of the benefits of using compact fluorescent light bulbs, LEDs, or other high efficiency lighting. ● Information on native landscape materials and/or low water requirements. ● Information on the radon mitigation system, where applicable. ● A procedure for educating tenants in rental properties on the proper use, benefits, and maintenance of green building systems including a maintenance staff notification process for improperly functioning equipment. ● Information on the importance and operation of the building's fresh air ventilation system.	**Mandatory** (Points earned for optional items)
	1002.3	**Maintenance Manual.** Provide an operations manual to responsible parties, including 5 or more of the following: *Mandatory:* ● Narrative detailing the importance of maintaining a green building. *Optional (One point awarded per two items):* ● A list of local service providers that offer regularly scheduled service and maintenance contracts to ensure proper performance of equipment and the structure. ● User-friendly maintenance checklist that includes: HVAC filters. thermostat, operation and programming, lighting controls, appliances and settings, water heater settings, fan controls ● List of common hazardous materials often used around the building and instructions for proper handling and disposal of these materials. ● Information on organic pest control, fertilizers, deicers, and cleaning products. ● Instructions for maintaining gutters and downspouts and the importance of diverting water a minimum of 5 feet away from foundation. ● Instructions for inspecting the building for termite infestation. ● A procedure for rental tenant occupancy turnover that preserves the green features. ● An outline of a formal green building training program for maintenance staff. ● A green cleaning plan which includes guidance on sustainable cleaning products.	**Mandatory** (Points earned for optional items)
	1002.4	**Training of Building Owners** On-site training of responsible parties of operation and maintenance and occupant actions for all of the following: (1) HVAC filters (2) Thermostat operation and programming (3) Lighting controls (4) Appliances operation (5) Water heater settings and hot water use (6) Fan controls (7) Recycling and composting practices	**Mandatory**

Figure 11: Operation, Maintenance, and Building Owner Education Practices

		ICC/ASHRAE 700-2015 NGBS	Points Possible
Operation, Maintenance, and Building Owner Education	1001.1	**Single-Family Homeowner's Manual** Provide a homeowner's manual to responsible parties, including the following: *Mandatory:* ● A National Green Building Standard certificate with a web link and completion document. ● List of green building features (can include the national green building checklist). ● Product manufacturer's manuals or product data sheet for installed major equipment, fixtures, and appliances. If product data sheet is in the building owners' manual, manufacturer's manual may be attached to the appliance in lieu of inclusion in the building owners' manual. *Optional (One Point awarded per two items):* ● Maintenance checklist ● Information on local recycling and composting programs. ● Information on available local utility programs that purchase a portion of energy from renewable energy providers. ● Explanation of the benefits of using energy-efficient lighting systems in high-usage areas. ● A list of practices to conserve water and energy. ● Information on the importance and operation of the home's fresh air ventilation system. ● Local public transportation options. ● A diagram showing the location of safety valves and controls for major building systems. ● Where frost-protected shallow foundations are used, owner is informed of precautions including: - Instructions to not remove or damage insulation when modifying landscaping. - Providing heat to the building as required by the ICC IRC or IBC. - Keeping base materials beneath and around the building free from moisture caused by broken water pipes or other water sources. ● A list of local service providers that offer regularly scheduled service and maintenance contracts to ensure proper performance of equipment and the structure. ● A photo record of framing with utilities installed. Photos are taken prior to installing insulation, clearly labeled, and included as part of the building owners' manual. ● List of common hazardous materials often used around the building and instructions for proper handling and disposal of these materials. ● Information on organic pest control, fertilizers, deicers, and cleaning products. ● Information on native landscape materials and/or those that have low water requirements. ● Information on maintaining the building's relative humidity in the range of 30-60%. ● Instructions for inspecting the building for termite infestation. ● Instructions for maintaining gutters and downspouts and importance of diverting water a minimum of 5 feet away from foundation. ● A narrative detailing the importance of maintenance and operation in retaining the attributes of a green-built building. ● Where stormwater management measures are installed on the lot, information on the location, purpose, and upkeep of these measures. ● Explanation of and benefits from green cleaning in the home. ● Retrofit energy calculator that provides baseline for future energy retrofits.	**Mandatory** (Earn 1 point for every two optional items)
	1001.2	**Training of Single-Family Homeowners** On-site training of initial homeowners of operation and maintenance and occupant actions for all of the following: (1) HVAC filters (2) Thermostat operation and programming (3) Lighting controls (4) Appliances operation (5) Water heater settings and hot water use (6) Fan controls (7) Recycling and composting practices	**Mandatory**

Figure 11: Operation, Maintenance, and Building Owner Education Practices

		ICC/ASHRAE 700-2015 NGBS	Points Possible
Energy Efficiency	1003.1	**Public Education** One or more of the following is implemented. (2 pts max): ● Signs showing the project is designed and built in accordance with the National Green Building Standard are posted on the construction site. (1 pt) ● National Green Building Standard certification plaques with rating level attained are placed in a conspicuous location near the utility area of the home or, in a conspicuous location near the main entrance of a multifamily building. (1 pt) ● A URL for the National Green Building Standard is included on site signage, builder website (or property website for multifamily buildings), and marketing materials for homes certified under the National Green Building Standard. (1 pt)	**2**
	1004.1	**Verification System** A verification system plan is provided in the building owner's manual. The verification system provides methods for demonstrating continued energy and water savings that are determined from the building's initial year of occupancy of water and energy consumption as compared to annualized consumption at least every four years. ● Verification plan is developed top monitor post-occupancy energy and water use and is provided in the building owner's manual. (1 pt) ● Verification system is installed in the building to monitor post-occupancy energy and water use. (3 pt)	**4**

Conclusion

In review, both LEED-NC and the National Green Building Standard are effective systems for the integration green building strategies buildings. LEED-NC is primary focused on office, commercial, and high-rise residential buildings, while the NGBS is solely focused on residential buildings spanning from single-family to high-rise and includes remodeling. The NGBS is not applicable to commercial and office buildings.

Both LEED-NC and the NGBS require mandatory practices to be completed, and then offer a catalog of optional practices for a project to earn points. Both systems require a project to meet a minimum number of total points to earn tiered levels of certification. The NGBS is unique in that it also requires projects to earn a minimum number of points within each green building practice category as well. While it does not require a project to earn minimum points in each category, LEED-NC has a greater percentage of mandatory prerequisites when compared to total available practices.

Both LEED and the NGBS focus on five main subject areas of sustainability within the residential industry: Water Efficiency, Energy Efficiency, Location and Site Development, Material and Resource Efficiency, and Indoor Environmental Quality. The NGBS added an additional category for Operation, Maintenance, and Building Owner Education, recognizing the importance of building owner and manager education to the long-term sustainability of the project. Both systems encourage innovative strategies as well as understand impacts to design and construction based on region.

Within each green practice category, both rating systems contain a number of similar or identical design and construction practices, as well as several unique practices. In total, the NGBS has a greater number of individual practices which a project team can select from in order to earn points. While LEED-NC has fewer options, the requirements for earning points are generally more multifaceted and stringent. This means a project completing an option with LEED-NC could be equivalent to a project completing multiple NGBS options. Alternatively, with the NGBS, the team has more flexibility to choose applicable practices given their situation in lieu of the more all-or-nothing approach to LEED, finding multiple paths to earn the required number of points.

While LEED-NC requires commissioning of building systems, the NGBS is unique that it requires third-party on-site verification of proper installation of all green building features at both pre-drywall and post-construction phases. This ensures items have not been value engineered out of the project during the construction phase, and construction practices, such as Grade 1 insulation installation, are completed. In both rating systems, projects then are certified by an overseeing entity – For the NGBS, this is Home Innovation Research Labs; For LEED-NC, this is the Green Business Certification Institute.

LEED-NC and the NGBS are both included as a means of demonstrating energy efficiency and sustainability compliance in a number of regulations and incentive programs across the country, including state Low-Income Housing Tax Credits Qualified Allocation Plans and numerous federal agencies.

As of the time of this report, there are over 100,000 residential units certified to the NGBS, comprised of over 11,000 single-family homes and over 2,000 multifamily

homes.

Per the Project Directory on the USGBC website, there are over 12,000 projects certified under the LEED-NC program. There is no public data available about how many are specifically multifamily high-rise projects.