

Comparison of USGBC LEED for Homes Versus the NAHB National Green Building Program

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This paper reviews the green certification of residential construction under LEED for Homes and the NAHB National Green Building Program. The NAHB National Green Building Program consisted of Model Green Building Guidelines and the proposed National Green Building Standard. LEED for Homes, the NAHB Guidelines and the proposed Standard, are applicable for single family homes. Six of major divisions in both LEED and the NAHB Guidelines and Standard are very similar: LEED for Homes requires prerequisites with a minimum of points in some major divisions and minimum total points required for each designation. The NAHB Guidelines and the Standard have some general requirements and requires a minimum number of points for each major division for each designation level. LEED for Homes, the NAHB Guidelines and the Standard require a minimum of two field inspections by either a Green Rater or a Verifier. LEED for Homes, the NAHB Guidelines and the proposed National Green Building Standard has an Adjustment for House Size. Third party inspections and testing of the Energy Efficiency of the building appears critical to insure a successful project. The minimum additional cost for certification for a green home with a base price of approximately \$150,000 appears to be approximately \$7,450 for LEED for Homes, \$2,550 for the Guidelines and \$2,650 for the Standard.

Key Words: LEED, NAHB Standard, NAHB Guidelines, Green Programs, Residential Construction

Introduction

There are over thirty state and regional green programs throughout the United States that promote some level of energy efficiency and environmental responsibility for the residential construction industry. The homeowner can find it confusing to determine how green or energy efficient their home really is. This paper looks at certifying residential construction under the two main national certifying agencies: the United States Green Building Council (USGBC) and the National Association Home Builders (NAHB).

The USGBC has developed Leadership in Energy and Environmental Design (LEED), which is applicable for most construction and major remodeling projects. For residential construction LEED for New Construction & Major Renovations (U.S. Green Building Council, 2005) and LEED for homes (U.S. Green Building Council, 2008) are applicable. Jensen (2007) in his paper, "Post-Design LEED certification for Commercial and Residential Structures", gives a good overview of LEED for New Construction.

The NAHB National Green Building Program has developed the Model Green Building Guidelines (National Association of Home Builders, 2006). They are currently developing the National Green Building Standard (National Association of Home Builders, 2008) which will be an American National Standards Institute (ANSI) Standard. Draft #2 of the Standard is currently waiting final adoption as of December, 2008.

This paper compares the *applicability, requirements, verification* and *fees* required for the LEED for Homes program and the two NAHB programs that address residential green construction. After giving an overview of the programs, the major divisions of each program will be reviewed as well as thresholds for efficient floor plan use.

LEED for New Construction & Major Renovations is only applicable to high-rise residential buildings (four or more stories and will not be covered in this paper).

LEED-Homes

Applicability for LEED Homes

1. Single-family homes, 2. Low-rise multifamily, 3. Production homes, 4. Affordable homes, 5. Manufactured and modular housing and 6. Existing homes. LEED-ND for Neighborhood Development is in its pilot program phase.

Requirements for LEED Homes

There are eighteen-plus prerequisites: 1. Preliminary Rating, 2. Durability Planning, 3. Durability Management, 4. Erosion, 5. No Invasive Plants, 6. Performance of Energy Star Homes, 7. Refrigerant Charge Test, 8. Framing Order Waste Factor Limit, 9. FSC Certified Tropical Wood, 10. Construction Waste Management Planning, 11. Basic Combustion Venting Measures, 12. Basic Outdoor Air Ventilation, 13. Basic Local Exhaust, 14. Room-by-Room Load Calculation, 15. Good Filters, 16. Radon-Resistant Construction in High-risk Areas, 17. No HAVC in Garage, and 18. Basic Operation Training. Forty-five points are required for certification, sixty points are required for silver designation, seventy-five points for gold designation, and ninety points for platinum designation out of a possible one-hundred and thirty-nine total points. There are also a minimum required number of points in four of the eight major divisions as shown in Table 1 (LEED-Homes Prerequisites and Points Required by Division).

Table 1
LEED-Homes Prerequisites and Points Required by Division

Division	Prerequisites	Maximum Points	% of Total	Certified	Silver	Gold	Platinum
ID – Innovation in Design	3	11	8	-	-	-	-
LL- Location & Linkages	-	10	7	-	-	-	-
SS - Sustainable Sites	2	22	16	5	5	5	5
WE - Water Efficiency	-	15	11	3	3	3	3
EA - Energy & Atmosphere	2 (7)	38	28	-	-	-	-
MR - Materials & Resources	3	16	12	2	2	2	2
EQ - Indoor Environmental Quality	7	21	15	6	6	6	6
AE – Awareness & Education	1	3	2	-	-	-	-
Other Points	-	-	-	29	44	59	74
Total	18 (23)	136	100	45	60	75	90

Verification for LEED Homes

The contractor is required to hire one of the thirty LEED-for-Homes Providers who manages a team of Green Raters and works under contract with USGBC. The Green Rater conducts field inspections and performance testing with a minimum of two site visits. Performance testing required includes: Energy Star Homes, Envelope Air Leakage, Duct Leakage and Refrigerant Charge. Optional testing includes Outdoor Air Flow Test, Exhaust Air Flow Test, and Supply Air flow Test. The Provider or Green Rater verifies all credits earned.

Fees for LEED Homes

The range of fees are between \$50 to \$100 for enrollment, \$250 to \$400 for certification, \$300 to \$1,000 for the provider, \$100 to \$150 for the dry wall inspection (1st inspection by green rater) and \$350 to \$700 for testing (2nd inspection and document review by green rater). The total cost is between \$1,050 and \$2,350. If you have subcontractors that are not familiar with LEED for Homes, they will need training at the job site which cost approximately \$150 per hour.

NAHB Model Green Building Guidelines

Applicability for Guidelines

For single family homes. Note: The second edition was going to include multiple residential buildings and land development. The NAHB is currently planning not to publish a second edition, and at some time, stop supporting the Model Green Building Guidelines in favor of supporting just the National Green Building Standard.

Requirements for Guidelines

There are three prerequisites related to energy efficiency and 237 points required for bronze designation which is the lowest certification level; 311 points are required for silver designation; and 395 points for gold designation, which is the highest designation out of an approximate 920 total points. There are also a minimum required number of points in all the major divisions for each designation (i.e. bronze, silver and gold) as shown in Table 2 (NAHB Guidelines Prerequisites and Points Required by Division).

Table 2
NAHB Guidelines Prerequisites and Points Required by Division

Division	Prerequisites	Maximum Points	% of Total	Bronze	Silver	Gold
Lot design, Preparation & Development	-	82	9	8	10	12
Resource Efficiency	-	217	24	44	60	77
Energy Efficiency	3	338	37	37	62	100
Water Efficiency	-	115	12	6	13	19
Indoor Environmental Quality	-	132	14	31	54	72
Operation, Maintenance & Homeowners Education	-	19	2	7	7	9
Global Impact	-	18	2	3	5	6
Other Points	-	-	-	100	100	100
Total	3	921	100	237	311	395

Verification for Guidelines. The NAHB Research Center is the sole certifier. The builder submits an online check list and hires an Accredited Verifier who conducts field inspections and performance testing with a minimum of two site visits. The Verifier also verifies all credits earned.

Fees for Guidelines. The ranges of fees are between \$200 (member) to \$500 (non-member) for certification, \$100 to \$150 for the dry wall inspection (1st inspection by verifier) and \$350 to \$700 for testing (2nd inspection and document review by verifier). The total cost would be between \$650 and \$1,250. If you have subcontractors that are not familiar with the NAHB Guidelines, they will need training at the site which cost approximately \$150 per hour.

National Green Building Standard (Draft #2)

Applicability for Standard

The residential portion(s) of any building not classified as an institution and subdivisions, building sites, alterations, additions, renovations, and remodels, mixed use residential buildings, and historic buildings where applicable.

Requirements for Standard

There are several proposed prerequisites and a proposed 222 points required for bronze designation which is the lowest certification level; 406 points are proposed for silver designation; 558 points for gold; and 697 points for the emerald designation which is the highest designation out of a proposed 1445 total points. There are also a proposed minimum required number of points in all the major divisions for each designation (i.e. bronze, silver, gold, and emerald) as shown in Table 3 (ANSI Standard, Prerequisites and Points Required by Division).

Table 3

ANSI Standard, Prerequisites and Points Required by Division (Draft #2)

Division	Prerequisites	Maximum Points	% of Total	Bronze	Silver	Gold	Emerald
Lot design, Preparation & Development	-	263	18	39	66	93	119
Resource Efficiency	?	290	20	45	79	113	146
Energy Efficiency	?	325	22	30	60	100	120
Water Efficiency	?	170	12	14	26	41	60
Indoor Environmental Quality	?	367	25	36	65	100	140
Operation, Maintenance & Homeowners Education	?	30	2	8	10	11	12
Other Points	-	-	-	50	100	100	100
Total	2	1445	100	222	406	558	697

Verification for Standard. NAHB Research Center is the sole certifier. The builder submits an online check list and hires an Accredited Verifier who conducts field inspections and performance testing with a minimum of two site visits. The Verifier also verifies all credits earned.

Fees for Standard. The ranges of fees are between \$200 (member) to \$500 (non-member) for certification, \$100 to \$150 for the dry wall inspection (1st inspection by verifier) and \$350 to \$700 for testing (2nd inspection and document review by verifier). The total cost would be between \$650 and \$1,250. If you have subcontractors that are not familiar with the NAHB Guidelines, they will need training at the job site which cost approximately \$150 per hour.

Major Divisions

Listed below in Table 4 (Major Divisions) are the major divisions of the programs which all have similar divisions. LEED for Homes has these identical six divisions plus an additional two divisions: Location and Linkage and Awareness and Education. The Guidelines and the Standard have the same six major divisions, but the Guidelines also have a seventh division for Global Impact.

Table 4

Major Divisions

#	LEED-Homes	NAHB Model Green Building Guidelines	National Green Building Standard
I	ID - Innovation in Design Process	Lot Design, Preparation, & Development	Lot Design, Preparation, & Development
II	LL - Location & Linkages	Resource Efficiency	Resource Efficiency
III	SS - Sustainable Sites	Energy Efficiency	Energy Efficiency
IV	WE - Water Efficiency	Water Efficiency	Water Efficiency
V	EA - Energy & Atmosphere	Indoor Environmental Quality	Indoor Environmental Quality
VI	MR - Materials & Resources	Operation, Maintenance & Homeowners Education	Operation, Maintenance & Building Owner Education

VII	EQ - Indoor Environmental Quality	Global Impact	
VIII	AE - Awareness & Education		

There is a fundamental difference in defining the major divisions under LEED and the NAHB Guidelines and Standard. LEED uses definitions for each major division, whereas the Guidelines and Standard use guiding principles as shown in Table 5 (Major Divisions, LEED Definition and NAHB Guiding Principles). Six major divisions in both LEED and the NAHB Guidelines and Standard are very similar: 1. Sustainable Site versus Lot Preparation and Design; 2. Water Efficiency versus Water Efficiency & Conservation; 3. Energy & Atmosphere versus Energy Efficiency; 4. Materials & Resources versus Resource Efficiency; 5. Indoor Environmental Quality versus Indoor Environmental Quality; and 6. Awareness & Education versus Homeowner Education.

Table 5
Major Divisions, LEED Definitions and NAHB Guiding Principles

LEED Definitions	NAHB Guiding Principles
<u>Sustainable Sites (SS)</u> . The use of the entire property so as to minimize the project's impact on the site.	<u>Lot Preparation and Design</u> – Reduce the home's impact on vegetation, soil, water, plus a home's long-term performance can be enhanced.
<u>Water Efficiency (WE)</u> . Water conservation practices, both indoor and outdoor	<u>Water Efficiency/Conservation</u> – Decrease a homeowner's need for indoor and outdoor water and thus reduce utility bills, regardless of location.
<u>Energy & Atmosphere (EA)</u> . Energy efficiency, particularly in the building envelope and heating and cooling design	<u>Energy Efficiency</u> – Create a building envelope and incorporate energy efficient mechanical systems, appliances, and lighting into a home.
<u>Materials & Resources (MR)</u> . Efficient utilization of materials, selection of environmentally preferable materials, and minimization of waste during construction	<u>Resource Efficiency</u> – Use framing techniques and home designs that effectively optimize the use of building materials. Also the use of construction waste management concepts.
<u>Indoor Environmental Quality (EQ)</u> . Improvement of indoor air quality by reducing the creation of and exposure to pollutants	<u>Indoor Environmental Quality</u> – Effectively manage moisture, ventilation, and other issues in order to create a comfortable indoor living environment.
<u>Awareness & Education (AE)</u> . The education of homeowner, tenant, or multifamily building manager about the operations and maintenance of the green features of a LEED Home.	<u>Homeowner Education</u> - Give the homeowner guidance on how to optimally operate and maintain the house.
<u>Location & Linkages (LL)</u> . The placement of homes in socially and environmentally responsible ways in relation to the larger community.	<u>Global Impact</u> – Use materials that have impact on the environment prior to occupying the home.
<u>Innovation & Design (ID) Process</u> . Special design methods, unique regional credits, measures not currently addressed in the Rating System, and exemplary performance levels	

Adjustment for House Size

LEED for Homes and the NAHB Guidelines adjusts for the square footage of the home versus the number of bedrooms as shown in Table 6 (LEED-Homes, Threshold Adjustment & NAHB Guidelines for Efficient Floor Plan). LEED for Homes has a neutral floor size for a given number of bedrooms. If you had a three-bedroom house, the neutral size of the house would be 1900 square feet. If you had fewer (i.e. 1500 square feet for a three bedroom house) you would require six fewer points for each category, (i.e. thirty-nine points for certification, fifty-four points for silver, sixty-nine points for gold, and eighty-four points for platinum). If you had more square feet (i.e. 2390 square feet for a three bedroom house) you would need six points more for each category (i.e. fifty-one points for certification, sixty-six points for silver, eighty-one points for gold, and ninety-six points for platinum).

Table 6

LEED-Homes, Threshold Adjustment & NAHB Guidelines for Efficient Floor Plan

Maximum home size (ft) by number of bedrooms						LEED-H Adjustment to thresholds / Guidelines Additional Points
	1 bedroom	2 bedroom	3 bedroom	4 bedroom	5 bedroom	
LEED-H <i>Guidelines</i>	610 -	950 -	1290 -	1770 -	1940 -	-10 -
LEED-H <i>Guidelines</i>	640 -	990 932	1340 1277	1840 1788	2010 2306	-9 9
LEED-H <i>Guidelines</i>	660 -	1030 982	1400 1345	1910 1883	2090 2430	-8 8
LEED-H <i>Guidelines</i>	680 -	1070 1032	1450 1414	1990 1979	2180 2553	-7 7
LEED-H <i>Guidelines</i>	710 -	1110 1082	1500 1482	2060 2075	2260 2667	-6 6
LEED-H <i>Guidelines</i>	740 -	1160 1132	1570 1551	2140 2171	2350 2801	-5 5
LEED-H <i>Guidelines</i>	770 -	1200 1182	1630 1619	2230 2267	2440 2995	-4 4
LEED-H <i>Guidelines</i>	800 -	1250 1232	1690 1688	2320 2363	2540 3048	-3 3
LEED-H <i>Guidelines</i>	830 -	1300 1282	1760 1756	2400 2459	2640 3172	-2 2
LEED-H <i>Guidelines</i>	860 -	1350 1332	1830 1825	2500 2555	2740 3296	-1 1
LEED-H <i>Guidelines</i>	900 -	1400 1382	1900 1890	2600 2684	2850 3442	0 ('neutral') 0
LEED-H	940	1450	1970	2700	2960	+1
LEED-H	970	1510	2050	2810	3080	+2
LEED-H	1010	1570	2130	2920	3200	+3
LEED-H	1050	1630	2220	3030	3320	+4
LEED-H	1090	1700	2300	3150	3460	+5
LEED-H	1130	1760	2390	3280	3590	+6
LEED-H	1180	1830	2490	3400	3730	+7
LEED-H	1220	1910	2590	3540	3880	+8
LEED-H	1270	1980	2690	3682	4030	+9
LEED-H	11320	2060	2790	3820	4190	+10

Under the Guidelines, you get to add points as shown in Table 6 to Resource Efficiency. The Guidelines has a neutral floor size for a given number of bedrooms. If you had a three bedroom house, the neutral size of the house would be 1890 square feet. Therefore, if you had 1890 square feet or more, you would receive zero points. If you had fewer (i.e. 1482 square feet for a three bedroom house), you would receive six points under Resource Efficiency.

Under the National Green Building Standard, it is proposed that floor plans with fewer than 2,500 square feet, regardless of the number of bedrooms, receive points under Resource Efficiency as shown in Figure 1 (NAHB National Green Building Standard (ANSI Guidelines Floor Space Adjustment)). For floor plans greater than 4,000 square feet, additional points would be required for Bronze, Silver, Gold or Emerald as shown in Figure 1.

- (1) Less than or equal to 1,000 square feet 15
- (2) Less than or equal to 1,500 square feet 12
- (3) Less than or equal to 2,000 square feet 9
- (4) Less than or equal to 2,500 square feet 6

(5) Greater than 4,000 square feet. An additional one point shall be required in Table 4 to achieve any given rating level for every 100 square feet over 4,000.

Figure 1 NAHB National Green Building Standard (ANSI Guidelines Floor Space Adjustment)

Cost Comparison

The NAHB National Green Program has done a preliminary comparison of additional construction costs for green rating compliance as shown in Table 7 (Taggart 2008). The data is based on a sample of two model homes in different geographic regions for three green rating systems. The data includes only additional construction compliance cost from a based house of \$151,063-\$172,745, not programmatic cost like registration, certification, and verification.

Table 7
Preliminary Comparison of Additional Construction Cost for Green Rating Compliance

Rating System	Bronze / Certified	Silver	Gold	Emerald / Platinum	Programmatic Cost
Green Building Guidelines	\$1,900-\$2,700 (1-2%)	\$4,000-\$6,000 (+,-3%)	\$8,200- \$11,000 (5-6%)	N/A	\$1,050-\$2,350 (0.7 -1 .3%)
National Green Building Standard	\$2,000-\$3,000 (1-2%)	\$4,000-\$6,000 (+,-3%)	\$11,500-\$13,600 (+,-8%)	\$25,600-\$31,200 (17-18%)	\$650-\$1250 (0.4 - 0.7 %)
LEED for Homes	\$6,400-\$11,000 (4-6%)	\$8,800-\$13,800 (3-8%)	\$19,300-\$22,500 (+,-13%)	\$629,800-\$38,00 (20-22%)	\$650-\$1250 (0.4 - 0.7 %)

Note: Table 7 is based on a sample of two model homes in different geographic regions for three green rating systems.

Summary

LEED for Homes, the NAHB Guidelines and the proposed National Green Building Standard are applicable for single family homes. LEED for Homes and the proposed National Green Building Standard are also applicable to multifamily units.

LEED for Homes requires eighteen prerequisites with a minimum of number of points in four of the major divisions and minimum total points required for each designation. The NAHB Guidelines has two requirements and requires a minimum number of points for each major division for each designation level. The proposed National Green Building Standard has several requirements and requires a minimum number of points for each major division for each designation level.

LEED for Homes, the NAHB Guidelines and the proposed National Green Building Standard require field inspections with a minimum of two field inspections by either a Green Rater or a Verifier. Performance testing is required by LEED for Homes and the Standard, but is optional in the Guidelines. LEED for Homes also requires that a Provider is hired for the project, and the Green Rater reports to the Provider. All credits earned are verified by the Rater or Provider for LEED for Homes and the Verifier for the Guidelines and Standard.

The total fees for a single family home are between \$1,050 to \$2,350 for LEED for Homes and \$650 to \$1,250 for both the Guidelines and the Standard. In addition, training costs about \$150 per hour for subcontractors not familiar with the requirements.

The major divisions in both LEED and the NAHB Guidelines and Standard are very similar: 1. Sustainable Site versus Lot Preparation and Design; 2. Water Efficiency versus Water Efficiency & Conservation; 3. Energy & Atmosphere versus Energy Efficiency; 4. Materials & Resources versus Resource Efficiency; 5. Indoor Environmental Quality versus Indoor Environmental Quality; and 6. Awareness & Education versus Homeowner Education.

LEED for Homes, the NAHB Guidelines and the proposed National Green Building Standard have an Adjustment for House Size. LEED for Homes adjusts the number of total points up or down as required for each designation (certification, silver, gold or platinum) in relation to the number of bedrooms to the square footage of the dwelling. The NAHB Guidelines give points under Resource Efficiency for the relationship of the number of bedrooms to the square footage of the dwelling. The Standard gives points under Resource Efficiency for the total square footage of the dwelling and requires additional points for each designation for dwellings larger than 4,000 square feet.

Conclusions

In LEED for Commercial and Institutional Projects, the expertise and professionalism of the green project to meet the requirements for certification or higher designation is left up to professionals hired for the project by the owner. The USGBC does not appear to think that on smaller projects that are common for LEED for Homes, the contractor or owner provide enough expertise and professionalism to the project for planning and verification of green projects. Therefore they require the contractor or owner to hire a Provider to provide this expertise and professionalism for the planning and a Green Rater supervised by the Provider for verification of the points earned with field inspections and testing.

The NAHB Guidelines and proposed National Green Standard assume that the Homebuilder can provide the expertise and professionalism to run the green project and does not required hiring a third party such as the LEED for Homes Providers. The Guidelines and Standard do require the Homebuilder to hire a third party Accredited Verifier for verification of the points earns with field inspections and testing.

Third party inspections and testing of the Energy Efficiency of the build appears critical to insure a successful project. Testing is required for LEED for Homes and the Standard but was not the Guidelines.

In comparing both additional construction cost and programmatic costs like registration, certification, and verification, the total cost of building a green home seems to be significantly higher for being certified by LEED for Homes than for the NAHB Guidelines or Standard. The minimum additional cost for certification for a green home with a base price of around a \$150,000 appears to be around \$7,450 for LEED for Homes, \$2,550 for the Guidelines and \$2,650 for the Standard.

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