

Urban Green Building Rating Systems Cost Comparison

Prepared for Home
Builders Association
of Greater Chicago

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Executive Summary

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EXECUTIVE SUMMARY

This report evaluates the additional costs of elevating three sample code-compliant, urban, residential building types in the City of Chicago into compliance with three different green building rating systems at one point in time (March 2010).

The three residential building types are:

- Single Family Home (**SF**) 2,483 square feet with detached 2-car garage.
- Townhouse (**TH**) 1,753 square feet including an attached 1-car unconditioned garage.
- Six Flat (**6F**) 8,532 square feet with surface parking.

These three typical urban housing types were utilized for the cost evaluation of the three green building rating systems. The anecdotal results presented in this report are intended to represent the relative cost differences between the green rating systems and the varying levels of achievement — not as final statistically significant conclusions, but rather as estimates for informational purposes only.

The three green building rating systems referenced in this study are:

- Chicago Green Homes Program (**CGH**), Green Homes Guide, Version 2, April 2009;
- ANSI-Approved ICC-NAHB National Green Building Standard (**NGBS**), Version 2, December 2008;
- LEED for Homes (**LEED-H**), Version 1, January 2008.

Costs vary between all rating systems and achievement levels, with the NGBS the least costly rating system overall. The CGH program is very similar to the LEED-H program by the U.S. Green Building Council, without the cost, registration and commissioning fees. When only comparing the direct compliance costs — that is, those costs associated only with changes or additions in construction and exclusive of program costs — the CGH rating system cost is greater than the NGBS costs by more than one thousand dollars at the base compliance level (e.g., “1 Star”), and increases in cost significantly over the NGBS at the “3 Star” compliance level.

Results indicate that the LEED-H “Certified” direct costs are roughly 2.5 times the cost of the CGH or NGBS equivalent levels “1 Star” or “Bronze”, respectively. The LEED-H costs at higher levels of certification are similarly more expensive than the other two rating systems, although the differences diminish as higher levels are reached. At the highest certification level (NGBS’s “Emerald” or LEED-H’s “Platinum”) the direct compliance costs are similar. The direct costs are summarized below.

Rating System					
	CGH NGBS LEED-H	1 Star Bronze Certified	2 Stars Silver Silver	3 Stars Gold Gold	Emerald Platinum
SF Home					
	CGH	0.53%	1.65%	3.07%	NA
	NGBSv2	0.21%	2.20%	3.70%	7.40%
	LEED-H	0.72%	2.40%	6.10%	7.80%
Townhouse					
	CGH	0.71%	2.52%	4.15%	NA
	NGBSv2	0.31%	3.10%	4.80%	10.10%
	LEED-H	0.74%	2.80%	7.90%	10.60%
Six Flat					
	CGH	0.22%	0.36%	1.08%	NA
	NGBSv2	0.17%	0.77%	1.40%	2.80%
	LEED-H	0.32%	1.10%	2.80%	3.30%

Table 1 – Certification Cost Percentage over Code Minimum. Percentage increase over a baseline (code compliant) house/townhouse/six flat cost shown.

In all cases, registration, verification and certification costs for LEED-H were greater than the estimated costs for the CGH and the NGBS. LEED-H registration, verification and certification costs are approximately \$2,776 compared to approximately \$500 for verification and certification in the CGH or NGBS rating systems.

These costs have changed during our research period and can be expected increase in the future due to ongoing changes in each of the three rating systems.

Comparisons between each of the systems' mandatory points and openness to alternatives are included in this study. LEED-H includes more mandatory requirements than either the NGBS or CGH, yet it rewards those actions with fewer proportional points. The CGH and the NGBS have minimum thresholds for each category of green building practice at each level of certification that LEED-H does not require. Each green rating system program is open to alternative energy saving measures.

Regardless of which green building rating system is chosen, the differences between programs and the additional compliance requirements' can be challenging for the design team because of required changes in design, construction, marketing, sales and operations to the residential building.

Background

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BACKGROUND

The purpose of this report is to better understand the costs associated with achieving certification in the various levels of the three green rating systems on three urban house types in the City of Chicago, as compared against a similar basic code compliant building.

The three green home building rating systems referenced in this study are:

- Chicago Green Homes Program (**CGH**), Green Homes Guide, Version 2, April 2009;
- ANSI approved ICC-NAHB National Green Building Standard (**NGBS**), Version 2, December 2008;
- LEED for Homes (**LEED-H**), Version 1, January 2008.

The three residential building types referenced in this study are:

- Single Family Home (**SF**) Two-story, 2,483 square feet with detached 2-car garage.
- Townhouse (**TH**) Three-story, 1,753 square feet including an attached 1-car unconditioned garage.
- Six Flat (**6F**) Three-story, 8,532 square feet with surface parking.



Single Family Home



Townhome



Six Flat

This report measures the cost of compliance at all levels of three green building standards over similar basic code-compliant buildings. The report also weighs the mandatory requirements and choices allowed within each system. The City of Chicago currently recognizes two of the three national green building rating systems. It is important to understand the green rating systems, their requirements, their objectives and relative costs for certification.

The City of Chicago has made some types of land usage and/or development approval contingent on construction that exceeds energy code minimums or meets other environmental standards. For example, the use of City land, developments that require Planned Development approval, and the use of TIF or Home Flex Loan funds require compliance with either the Chicago Green Homes program or LEED Certification. Such mandates effectively create a de facto green building code from voluntary programs increasing housing costs and leading to questions regarding the cost of compliance.

The LEED program was created by the United States Green Building Council in 1993. The USGBC is a non-profit organization that was started to address the sustainable future of our nation through cost-efficient and energy-saving green buildings. The LEED® green building certification program is a voluntary, consensus-based national rating system for buildings designed, constructed and operated for improved environmental and human health performance. LEED addresses all building types and emphasizes state-of-the-art strategies in five areas: sustainable site development, water savings, energy efficiency, materials and resources selection, and indoor environmental quality.

The Chicago Green Homes program was created by the City of Chicago Department of Environment in 2007 in response to Mayor Daley's directive to make the City of Chicago more environmentally friendly. The CGH program provided a low-rise residential standard for Chicago before LEED-H was established. In fact, the NGBS was the reference standard early in the development of the CGH program, although it was later changed to align more with LEED-H. The CGH is intended to be a program for builders and developers that is a less cumbersome alternative to the LEED program.

The National Green Building Standard began in 2005 as the National Association of Home Builders Model Green Home Building Guidelines, the continuation of green building efforts the association initiated in 1998. In 2006, NAHB announced its intent to develop a national green building standard in accordance with the consensus-based requirements of the American National Standards Institute (ANSI) and in 2007 partnered with the International Code Council (ICC) to convene the consensus committee that would spearhead the effort. The ICC 700-2008 National Green Building Standard was approved by ANSI in January, 2009. It is the only green residential rating system to carry this distinction. The standard is applicable to all single and multifamily residential projects including new construction as well as renovations, additions and remodeling projects. It can also be used to rate and certify the development of subdivisions. Certification of a building based on the NGBS is called Green Certified by the NAHB Research Center since the NGBS is only a rating system.

In summary, each green building rating system:

- Has three or four certification levels;
- Includes a point system for employing various green building products and processes; and,
- Has a methodology for accruing points and determining compliance with the criteria that defines each rating level.

The levels of certification are outlined in Table 2.

Achievement Level	CGH	NGBS	LEED-H
Highest	n/a	Emerald	Platinum
 Lowest	3 Stars	Gold	Gold
	2 Stars	Silver	Silver
	1 Star	Bronze	Certified

Table 2. Rating Level Comparison Chart

Each green rating system requires that a building garner a minimum number of points across several categories, and each allows three to four levels of certification. The categories covered by the rating systems are very similar, as are many of the available points within each system. The CGH & NGBS have minimum thresholds to achieve in their respective categories in order to reach each successive achievement level. LEED-H does not require a minimum threshold for its various chapters, only a minimum point total for each successive achievement level. Tables 3, 4 and 5 summarize the minimum points required for compliance at each level of certification under each system and the relative weight of points allocated to each subject area.

CGH CATEGORY	CGH ONE STAR		CGH TWO STAR		CGH THREE STAR	
	Points	% Total	Points	% Total	Points	% Total
Sustainable Sites	41	20.5%	64	21.3%	64	18.3%
Energy Efficiency	59	29.5%	89	29.7%	110	31.4%
Materials	31	15.5%	42	14.0%	52	14.9%
Health & Safety	37	18.5%	57	19.0%	73	20.9%
Resource Conservation	25	12.5%	41	13.7%	44	12.6%
Homeowner Education	7	3.5%	7	2.3%	7	2.0%
Innovation	0	0.0%	0	0.0%	0	0.0%
	200	100.0%	300	100.0%	350	100.0%

Table 3. Minimum Point Requirements to Achieve Chicago Green Homes Certification Levels. Each green building rating system has different point thresholds to achieve each certification level.

NGBS CATEGORY	NGBS BRONZE		NGBS SILVER		NGBS GOLD		NGBS EMERALD	
	Points	% Total	Points	% Total	Points	% Total	Points	% Total
Lot Resource	39	17.6%	66	16.3%	93	16.7%	119	17.1%
Efficiency	45	20.3%	79	19.5%	113	20.3%	146	20.9%
Energy Efficiency	30	13.5%	60	14.8%	100	17.9%	120	17.2%
Water Efficiency	14	6.3%	26	6.4%	41	7.3%	60	8.6%
IEQ & Global Impact	36	16.2%	65	16.0%	100	17.9%	140	20.1%
Operations, Maint. & Ed.	8	3.6%	10	2.5%	11	2.0%	12	1.7%
Additional from any Category	50	22.5%	100	24.6%	100	17.9%	100	14.3%
	222	100.0%	406	100.0%	558	100.0%	697	100.0%

Table 4. Minimum Point Requirements to Achieve National Green Building Standard Certification Levels. Each green building rating system has different point thresholds to achieve each certification level.

LEED-H CHAPTER	LEED-H CERTIFIED		LEED-H SILVER		LEED-H GOLD		LEED-H PLATINUM	
	Points	% Total	Points	% Total	Points	% Total	Points	% Total
Location & Linkages (LL)	5	11.1%	5	8.3%	6	8.0%	6	6.7%
Sustainable Sites (SS)	15	33.3%	15	25.0%	15	20.0%	16	17.8%
Materials & Resources (MR)	5	11.1%	7	11.7%	7	9.3%	10	11.1%
Energy & Atmosphere (EA)	3	6.7%	6	10.0%	20	26.7%	23	25.6%
Water Efficiency (WE)	3	6.7%	12	20.0%	12	16.0%	12	13.3%
Environmental Quality (EQ)	6	13.3%	7	11.7%	7	9.3%	15	16.7%
Awareness & Education (AE)	2	4.4%	2	3.3%	2	2.7%	2	2.2%
Innovation & Design (ID)	6	13.3%	6	10.0%	6	8.0%	6	6.7%
Minimum Allowable Points	45	100.0%	60	100.0%	75	100.0%	90	100.0%

Table 5. Minimum Point Requirements to Achieve LEED-H Certification Levels. Each green building rating system has different point thresholds to achieve each certification level.

COMPARISON METHODOLOGY

The team members assembled to establish the scope and objectives of the study included large- and small-volume contractors and a LEED Accredited Professional Architect. The team provided expertise to define the base housing types and select products and practices to achieve successive certification ratings under each of the green building rating systems for each of the three urban housing types. Products and practices were selected based on the need for obtaining points in a certain category, the cost of the measure, its feasibility and its regional appropriateness, and repeatability in their home building environment.

Baseline Specifications

The baseline specifications for each of the three housing types meet the 2009 City of Chicago Building and Energy Conservation Codes. The Chicago energy conservation code is similar to and slightly exceeds the 2006 IECC. The baseline specifications were verified using the total UA alternative compliance path and the Department of Energy's RESCheck software, or performance based solution. The total UA alternative path for code compliance provides more latitude and flexibility over the prescriptive path requirements, by allowing an average value for compliance instead of a per-item prescriptive requirement. All landscaping materials are assumed to be native plant species that meet the requirements of Chicago's Zoning Ordinance. In all cases, access to parking was assumed to be from a public alley. Private walks were considered to be poured in-place-concrete.

Tables 6, 7, and 8 describe the three home types' baseline specifications as used in the study. The urban single family detached house, townhouse and six flat plans were selected based on the size, style, and foundation type considered most representative of new construction in Chicago.

In addition to the specifications covered in Tables 6, 7, and 8, it was assumed that the house, townhouse and six flat were built on fully prepared infill lots in an inner city neighborhood. Therefore, the homes were able to earn those points available under each rating system for land development or proximity to public transportation and were therefore qualified for lot-related points.

SINGLE FAMILY HOME	Baseline Spec
1 Located in County and State	Cook County, IL
2 Climate Zone - IRC 2006	5
3 Climate Zone - CBC	6
4 Winter, Design Dry-Bulb (°F)	-10°F
5 Summer, Design Dry-Bulb (°F)	92°F
6 Summer, Design Wet-Bulb (°F)	74°F
7 Lot size; Square feet	2851 SF
8 Housing type	single family detached
9 Foundation	partial basement
10 Stories	2
11 Total Conditioned Square Feet	2026 SF
12 Total Finished Square Feet	2483 SF
13 Unfinished Sq. Ft. (Basement)	457 SF
14 Number of Baths	3.5
15 Number of Bedrooms	3
16 Optional Bedroom/Gameroom	family room
17 Integral Garage	no; detached
18 House Cost	\$372,450
19 Foundation	formed concrete
20 Walls - structural	2x4" studs @ 16" o.c.
21 walls - nonstructural	2x4 furring @ 16" o.c.
22 Floors	16" truss @ 19.2" o.c.
23 Roofs	gable truss @ 24" o.c.
24 Roof style	gable with 18" overhang
25 Wall sheathing	5/8" Dens-Glass
26 Insulated Windows U-value	0.35
27 Insulated Windows SHGC	0.55 ¹
28 Door U-value (Insulated steel)	U=0.20/R-5 or more ²
29 Basement Insulation	R-15 / 2" polystyrene ³
30 Wall Insulation	R-13 batt insulation ⁴
31 Ceiling Insulation	R-49 blown-batt insulation
32 Siding	Vinyl
33 Roofing	asphalt shingle
34 Roofing Underlayment	30# building felt
35 Roofing drip edge	Yes
36 Roofing ice dam protection	Yes
37 Other architectural features	covered front porch
38 Other architectural features	fireplace
39 Other architectural features	
40 Trim	Wood
41 Primary Heat	furnace/gas
42 Primary Cooling	AC/electric
43 Number HVAC Zones	1
44 Location of Furnace	basement closet
45 Water Heating	.62 EF/40 gal/gas
46 WH Location	basement closet
47 Plumbing Supply Pipe Type	copper
48 Range	basic model/gas
49 Range Hood	outside vent
50 Dishwasher	Energy Star
51 Refrigerator	Energy Star

¹ The Chicago ECC does require a minimum SHGC for residential buildings.

² All fenestration has a minimum 0.35 U-value requirement which the door exceeds.

³ The Chicago ECC prescriptive compliance path requires R-10 for basement walls.

⁴ The Chicago ECC prescriptive compliance path requires R-13 in the stud cavity plus a continuous R-5 insulation.

Table 6. Baseline Specifications Single Family Home with 2-car detached garage.

TOWNHOUSE	Baseline Spec	
1	Located in County and State	Cook County, IL
2	Climate Zone - IRC 2006	5
3	Climate Zone - CBC	6
4	Winter, Design Dry-Bulb (°F)	-10°F
5	Summer, Design Dry-Bulb (°F)	92°F
6	Summer, Design Wet-Bulb (°F)	74°F
7	Lot size; Square feet	2250 SF
8	Housing type	townhouse
9	Foundation	slab on grade
10	Stories	3
11	Total Conditioned Square Feet	1487 SF
12	Total Finished Square Feet	1753 SF
13	Unfinished Sq. Ft. (Basement)	266 SF
14	Number of Baths	1.5
15	Number of Bedrooms	2
16	Optional Bedroom/Gameroom	den
17	Integral Garage	single
18	House Cost	\$262,950
19	Foundation	slab on grade
20	Walls - structural	8" CMU
21	walls - nonstructural	metal studs @ 16" o.c.
22	Floors	16" truss @ 19.2" o.c.
23	Roofs	16" truss @ 19.2" o.c.
24	Roof style	flat
25	Wall sheathing	5/8" Dens-Glass
26	Insulated Windows U-value	0.35
27	Insulated Windows SHGC	0.55 ¹
28	Door U-value (Insulated steel)	U=0.20/R-5 or more ²
29	Basement Insulation	N/A ³
30	Wall Insulation	R-13 batt insulation ⁴
31	Ceiling Insulation	8" rigid board/R-40 ⁵
32	Siding	Brick Masonry
33	Roofing	Energy Star Modified Bitumen Cap
34	Roofing Underlayment	single-ply bitumen roof
35	Roofing drip edge	Yes
36	Roofing ice dam protection	Yes
37	Other architectural features	no fireplace
38	Other architectural features	masonry construction
39	Other architectural features	
40	Trim	Wood
41	Primary Heat	furnace/gas
42	Primary Cooling	AC/electric
43	Number HVAC Zones	1
44	Location of Furnace	first floor closet
45	Water Heating	.62 EF/40 gal/gas
46	WH Location	first floor closet
47	Plumbing Supply Pipe Type	copper
48	Range	basic model/gas
49	Range Hood	outside vent
50	Dishwasher	Energy Star
51	Refrigerator	Energy Star

¹ The Chicago ECC does require a minimum SHGC for residential buildings.

² All fenestration has a minimum 0.35 U-value requirement which the door exceeds.

³ Basement insulation is not required because the Townhome is built on a slab on grade.

⁴ The Chicago ECC prescriptive compliance path requires R-13 in the stud cavity plus a continuous R-5 insulation.

⁵ The Chicago ECC prescriptive compliance path requires R-49 at the roof.

Table 7. Baseline Specifications Townhouse with attached 1-car garage

SIX FLAT	Baseline Spec	
1	Located in County and State	Cook County, IL
2	Climate Zone - IRC 2006	5
3	Climate Zone - CBC	6
4	Winter, Design Dry-Bulb (°F)	-10°F
5	Summer, Design Dry-Bulb (°F)	92°F
6	Summer, Design Wet-Bulb (°F)	74°F
7	Lot size; Square feet	7500 SF
8	Housing type	six flat
9	Foundation	slab on grade
10	Stories	3
11	Total Conditioned Square Feet	8532 SF
12	Total Finished Square Feet	8532 SF
13	Unfinished Sq. Ft. (Basement)	N/A
14	Number of Baths	12
15	Number of Bedrooms	12
16	Optional Bedroom/Gameroom	
17	Integral Garage	no; surface parking
18	House Cost	\$1,279,800
19	Foundation	slab on grade
20	Walls - structural	CMU
21	walls - nonstructural	2x4 furring 16" o.c.
22	Floors	16" Truss 19.2" o.c.
23	Roofs	16" Truss 19.2" o.c.
24	Roof style	flat
25	Wall sheathing	5/8" Dens-Glass
26	Insulated Windows U-value	0.35
27	Insulated Windows SHGC	0.55 ¹
28	Door U-value (Insulated steel)	U=0.20/R-5 or more ²
29	Basement Insulation	N/A ³
30	Wall Insulation	R-13 batt insulation ⁴
31	Ceiling Insulation	8" rigid board/R-40 ⁵
32	Siding	Brick Masonry
33	Roofing	Energy Star Modified Bitumen Cap
34	Roofing Underlayment	single-ply bitumen roof
35	Roofing drip edge	Yes
36	Roofing ice dam protection	Yes
37	Other architectural features	steel entry canopy
38	Other architectural features	no fireplace
39	Other architectural features	masonry construction
40	Trim	cast stone
41	Primary Heat	furnace/gas
42	Primary Cooling	AC/electric
43	Number HVAC Zones	6
44	Location of Furnace	hall closet
45	Water Heating	.62 EF/ 75 gal/gas
46	WH Location	hall closet
47	Plumbing Supply Pipe Type	copper
48	Range	basic model/gas
49	Range Hood	outside vent
50	Dishwasher	Energy Star
51	Refrigerator	Energy Star

¹ The Chicago ECC does require a minimum SHGC for residential buildings.

² All fenestration has a minimum 0.35 U-value requirement which the door exceeds.

³ Basement insulation is not required because the Six-Flat is built on a slab on grade.

⁴ The Chicago ECC prescriptive compliance path requires R-13 in the stud cavity plus a continuous R-5 insulation.

⁵ The Chicago ECC prescriptive compliance path requires R-49 at the roof.

Table 8. Baseline Specifications Six Flat with surface parking.

Code Minimum Definition

In order to produce realistic and quantifiable results, actual urban residential building plans were used that are representative of those built in Chicago neighborhoods. The builders' original specifications were slightly modified to form baseline houses that would meet the minimum requirements of the 2009 Chicago Building and Energy Conservation Codes. Performance provisions required by the Chicago Building Code were used to illuminate these specifications. Chicago's Energy Conservation Code requirements provide points to a variety of mandatory and optional credits for all three programs. Therefore, the baseline specification was set to make each of the three buildings studied as nearly compliant with the minimum certification level of all three green building rating systems as possible. Tables 9, 10, and 11 indicate which of these baseline specifications are actual code requirements and will contribute to points under each of the green building rating systems: CGH, NGBS and LEED-H.

SINGLE FAMILY HOME		Baseline Spec	LEED				NGBS				CGH		
			Certified	Silver	Gold	Platinum	Bronze	Silver	Gold	Emerald	1 Star	2 Stars	3 Stars
1	Located in County and State	Cook County, IL											
2	Climate Zone - IRC 2006	5											
3	Climate Zone - CBC	6											
4	Winter, Design Dry-Bulb (°F)	-10°F											
5	Summer, Design Dry-Bulb (°F)	92°F											
6	Summer, Design Wet-Bulb (°F)	74°F											
7	Lot size: Square feet	2851 sf											
8	Housing type	single family detached											
9	Foundation	partial basement											
10	Stories	2											
11	Total Conditioned Square Feet	2026 SF											
12	Total Finished Square Feet	2483 SF											
13	Unfinished Sq. Ft. (Basement)	457 SF											
14	Number of Baths	3.5											
15	Number of Bedrooms	3											
16	Optional Bedroom/Gameroom	family room											
17	Integral Garage	no; detached											
18	House Cost	\$372,450											
19	Foundation	formed concrete											
20	Walls - structural	2x4 studs @ 16" o.c.											
21	Walls - nonstructural	2x4 furring @ 16" o.c.											
22	Floors	16" truss @ 19.2" o.c.											
23	Roofs	gable truss @ 24" o.c.											
24	Roof style	gable with 18" overhang											
25	Wall sheathing	5/8" Dens-Glass											
26	Insulated Windows U-value	0.35											
27	Insulated Windows SHGC	0.55											
28	Door U-value (Insulated steel)	U=0.20/R-5 or more											
29	Basement Insulation	R-15 / 2" polystyrene											
30	Wall Insulation	R-13 batt insulation											
31	Ceiling Insulation	R-49 blown-batt insulation											
32	Siding	Vinyl											
33	Roofing	asphalt shingle											
34	Roofing Underlayment	30# building felt											
35	Roofing drip edge	Yes											
36	Roofing ice dam protection	Yes											
37	Other architectural features	covered front porch											
38	Other architectural features	fireplace											
39	Other architectural features												
40	Trim	Wood											
41	Primary Heat	furnace/gas											
42	Primary Cooling	AC/electric											
43	Number HVAC Zones	1											
44	Location of Furnace	basement closet											
45	Water Heating	.62 EF/40 gal/gas											
46	WH Location	basement closet											
47	Plumbing Supply Pipe Type	copper											
48	Range	basic model/gas											
49	Range Hood	outside vent											
50	Dishwasher	Energy Star											
51	Refrigerator	Energy Star											

Table 9. Points from Baseline Specifications for Single Family Home. The colors represent the certification level that the baseline specification achieves under each rating system.

TOWNHOUSE		Baseline Spec	LEED				NGBS				CGH		
			Certified	Silver	Gold	Platinum	Bronze	Silver	Gold	Emerald	1 Star	2 Stars	3 Stars
1	Located in County and State	Cook County, IL											
2	Climate Zone - IRC 2006	5											
3	Climate Zone - CBC	6											
4	Winter, Design Dry-Bulb (°F)	-10°F											
5	Summer, Design Dry-Bulb (°F)	92°F											
6	Summer, Design Wet-Bulb (°F)	74°F											
7	Lot size; Square feet	2250 sf											
8	Housing type	townhouse											
9	Foundation	slab on grade											
10	Stories	3											
11	Total Conditioned Square Feet	1487 SF											
12	Total Finished Square Feet	1753 SF											
13	Unfinished Sq. Ft. (Basement)	266 SF											
14	Number of Baths	1.5											
15	Number of Bedrooms	2											
16	Optional Bedroom/Gameroom	den											
17	Integral Garage	single											
18	House Cost	\$262,950											
19	Foundation	slab on grade											
20	Walls - structural	8" CMU											
21	walls - nonstructural	metal studs @ 16" o.c.											
22	Floors	16" truss @ 19.2" o.c.											
23	Roofs	16" truss @ 19.2" o.c.											
24	Roof style	flat											
25	Wall sheathing	5/8" Dens-Glass											
26	Insulated Windows U-value	0.35											
27	Insulated Windows SHGC	0.55											
28	Door U-value (Insulated steel)	U=0.20/R-5 or more											
29	Basement Insulation	N/A											
30	Wall Insulation	R-13 batt insulation											
31	Ceiling Insulation	8" rigid board											
32	Siding	Brick Masonry											
33	Roofing	Energy Star Modified Bitumen Cap											
34	Roofing Underlayment	single-ply bitumen roof											
35	Roofing drip edge	Yes											
36	Roofing ice dam protection	Yes											
37	Other architectural features	no fireplace											
38	Other architectural features	masonry construction											
39	Other architectural features												
40	Trim	Wood											
41	Primary Heat	furnace/gas											
42	Primary Cooling	AC/electric											
43	Number HVAC Zones	1											
44	Location of Furnace	first floor closet											
45	Water Heating	.62 EF/40 gal/gas											
46	WH Location	first floor closet											
47	Plumbing Supply Pipe Type	copper											
48	Range	basic model/gas											
49	Range Hood	outside vent											
50	Dishwasher	Energy Star											
51	Refrigerator	Energy Star											

Table 10. Points from Baseline Specifications for Townhome.

SIX FLAT		Baseline Spec	LEED				NGBS				CGH		
			Certified	Silver	Gold	Platinum	Bronze	Silver	Gold	Emerald	1 Star	2 Stars	3 Stars
1	Located in County and State	Cook County, IL											
2	Climate Zone - IRC 2006	5											
3	Climate Zone - CBC	6											
4	Winter, Design Dry-Bulb (°F)	-10°F											
5	Summer, Design Dry-Bulb (°F)	92°F											
6	Summer, Design Wet-Bulb (°F)	74°F											
7	Lot size; Square feet	7500 sf											
8	Housing type	six flat											
9	Foundation	slab on grade											
10	Stories	3											
11	Total Conditioned Square Feet	8532 sf											
12	Total Finished Square Feet	8532 sf											
13	Unfinished Sq. Ft. (Basement)	N/A											
14	Number of Baths	12											
15	Number of Bedrooms	12											
16	Optional Bedroom/Gameroom												
17	Integral Garage	no; surface parking											
18	House Cost	\$1,279,800											
19	Foundation	slab on grade											
20	Walls - structural	CMU											
21	walls - nonstructural	2x4 furring 16" o.c.											
22	Floors	16" Truss 19.2" o.c.											
23	Roofs	16" Truss 19.2" o.c.											
24	Roof style	flat											
25	Wall sheathing	5/8" Dens-Glass											
26	Insulated Windows U-value	0.35											
27	Insulated Windows SHGC	0.55											
28	Door U-value (Insulated steel)	U=0.20/R-5 or more											
29	Basement Insulation	N/A											
30	Wall Insulation	R-13 batt insulation											
31	Ceiling Insulation	8" rigid board											
32	Siding	Brick Masonry											
33	Roofing	Energy Star Modified Bitumen Cap											
34	Roofing Underlayment	single-ply bitumen roof											
35	Roofing drip edge	Yes											
36	Roofing ice dam protection	Yes											
37	Other architectural features	steel entry canopy											
38	Other architectural features	no fireplace											
39	Other architectural features	masonry construction											
40	Trim	cast stone											
41	Primary Heat	furnace/gas											
42	Primary Cooling	AC/electric											
43	Number HVAC Zones	6											
44	Location of Furnace	hall closet											
45	Water Heating	.62 EF/ 75 gal/gas											
46	WH Location	hall closet											
47	Plumbing Supply Pipe Type	copper											
48	Range	basic model/gas											
49	Range Hood	outside vent											
50	Dishwasher	Energy Star											
51	Refrigerator	Energy Star											

Table 11. Points from Baseline Specifications for Six-Flat.

Green Rating

A baseline rating was created for each housing type using the three green building rating systems. The architectural plans and specifications outlined in Tables 5, 6 and 7 were used in this assessment. For each green building system, a line-by-line cost comparison was conducted to determine the most practical and cost-effective products or practices that could be incorporated into the building design to meet each level of certification. Products and practices were ultimately selected based on their ease of implementation, cost-effectiveness, and points contributed toward achieving each certification level of all three green building ratings available under the CGH, NGBS and LEED-H programs. This process was performed successively until the highest level of certification in each green building rating system was reached. By design, the process involved co-development of the both scores and the costs. Initial results were then shared with a group of contractors and builders who reviewed the costs. Revisions were made based on the comments and recommendations obtained from this group. To the extent possible, revisions were made to incorporate the experience of those who have actually built within these green building rating systems. This feedback was invaluable and underscores the value of an interdisciplinary approach in assessing the countless options that must be weighed in order to choose the best means of achieving a sustainable solution.

Mandatory Measures

In addition to specifying the minimum point requirements for each section in the CGH and NGBS programs, all rating systems also include prerequisites or mandatory measures necessary to obtain any level of certification. The prerequisites of each rating system may or may not correspond directly with code required items and may, in some cases, even exceed code requirements. Code required items have been included in the baseline specification and baseline cost. Even though they may contribute to certification under the green building rating systems, they are not included in the additional costs associated with obtaining certification in any program. The prerequisites required to qualify in each of the green building rating system are outlined in Table 12.

Another prerequisite of LEED-H that can increase or decrease the minimum number of points needed for certification is the number of bedrooms relative to the total size, in square feet, of the home. The sample home in this study, a three bedroom with 2,026 square feet which exceeds the “neutral” size of 1,900 square feet that LEED-H permits for a three bedroom home. Consequently, two additional credits are required to achieve each level of certification for this three bedroom home. The alternative of designing a four-bedroom home of this size was not considered as it does not correspond to the Chicago market demand in this size range but doing so would reduce the credits needed while likely increasing the costs for the base house.

Section Prerequisite Action		X Indicates Rating System Action Required		
		CGH	NGBSv2	LEED-H
Innovation & Design	Obtain a preliminary program rating at project planning			X
	Pre-construction plan for durability including std. wet room measures			X
	Single family home size threshold adjustment		X	X
	Third Party program verification		X	X
Sustainable Sites	Erosion controls during construction	X		X
	Capture and reuse storm water on site	X		
	No invasive plants on site			X
	Protect trees and natural features during construction	X		
Materials & Resources	Waste factor or framing material is 10% or less			X
	Tropical woods used must be FSC			X
	Limit single family house size per number of bedrooms	X		
	Diversion rate of waste from landfill must be documented			X
Energy & Atmosphere	Third party insulation inspection is HERS grade II			X
	**HVAC equipment sized and calculated using ACCA Manual J		X	X
	**Building cavities are not used as ducts		X	
	**Perform duct design calculations			X
	**Air sealing required		X	X
	**Windows meet U-value and SHGC of Energy Star		X	X
	Third party whole house air leakage test			X
	Third party duct leakage tested to 4 cfm per 100 sf to outside			X
	Third party refrigerant charge test			X
	No unvented combustion appliances	X		
House includes 3 Energy Star fixtures	X		X	
Environmental Quality	Gas appliances with closed or power exhaust			X
	Merv 8 filters with adequate air flow	X		X
	Fireplaces sealed and provided with outside air gas models direct vent		X	
	**Garage/house tightly sealed		X	
	**Attached garage is air sealed at house walls/floors		X	
	All bathrooms are vented to outside at 50 cfm intermittent or 20 cfm continuous		X	
	Carpet is not installed in bathrooms		X	
Site applied architectural coatings are low VOC		X		
Energy & Atmosphere	**Achieves min. required points for Energy Efficiency for Chicago Green Homes	X		
	**Meets ASHRAE 62.2		X	X
	Performance of Energy Star for homes			X
	No HVAC equipment/systems in garage			X
Awareness/Ed u./Operation	Green program certificate and narrative		X	X
	List of green building features in house/Green Rating		X	
	Product manufacturer's information supplied to homeowner	X	X	
	Program promotion			X
**Mandatory requirements by Chicago Energy Conservation Code				

Table 12 Prerequisites or Mandatory Measures for Minimum Certification in Green Building Rating System.

Cost Estimates

Contractors provided cost data for the baseline spec and also for the green improvements for each residential building type. To obtain a baseline cost for each type of building, construction cost was estimated from actual budgets and adjusted for any changes that were necessary to arrive at the code minimum specifications outlined in Tables 6, 7 and 8.

Team members developed cost estimates for each line item change selected to bring the baseline home into compliance with the green building rating systems. Cost estimates were uniformly applied, where pertinent, in assigning costs to the model under each of the three green building systems. All costs are subjective choices made by the project team and are therefore subject to change, depending on the specific approach, to achieving any level of certification. Although this was obviously a subjective process, every effort was made to incorporate the insights and suggestions of the experienced professionals involved in the interest of achieving each level of certification at the minimum additional costs.

No-Cost Tasks Actions

Many of the measures that make a project green are merely preferential practices that can be adopted with little or no cost. Therefore there are a number of activities or products not explicitly stated as features of the baseline houses which garner points for compliance but are assigned zero cost. Examples of these measures would include developing a bill of materials and a cut list in order to minimize framing material waste (e.g., ordering pre-cut lengths, exact piece counts, reusing bracing materials for blocking, etc.). These practices help demonstrate that green building isn't merely a purchased commodity; it is a way of thinking and of doing business with an awareness of the environmental consequences of construction practices and processes.

The cost of administering these checklists and the subcontractor verification forms that are required for LEED-H certification was assumed to be performed by persons already on the jobsite as tasks attendant to performance in their positions. Therefore no costs were assigned to the administrative area of rating system compliance.

While this is probably a safe assumption for projects of limited scale, such as those contemplated in this study, it should be noted that, a development consisting of more numerous, or larger buildings could generate significantly more administrative work that the normal jobsite crew could reasonably assume in addition to their other duties. In this event, additional administrative assistance would be required which would add overhead cost to the project. In the interest of avoiding unnecessary complexity it was assumed that each building was a stand alone project.

Results

Urban Green Building Rating Systems Cost Comparison



RESULTS

The following results are provided based on the above analytical methodologies for each of the three sample residential types studied. The actual costs associated with complying with all three rating systems will obviously vary due to the volatility of material costs, changing availability of some products, design and construction considerations and decisions, overall economic conditions and residential market demand. Additional data collection and trend analysis will be critical to understanding the cost of green design in the future and refining the standards to achieve the maximum cost-benefit ratio.

Cost Comparisons

The costs incurred to achieve the various certification levels for the residential building types of each different rating system can be arranged by

- direct costs added to the baseline residential building types;
- administrative and consultant costs incurred by providing the documentation of the direct costs, and
- registration, certification and verification fees.

Direct Costs

The estimated direct construction cost for achieving a rating level can be found in Table 13.

Rating System	CGH NGBS LEED-H	1 Star Bronze Certified	2 Stars Silver Silver	3 Stars Gold Gold	Platinum Emerald
SF Home					
CGH		\$1,995	\$6,145	\$11,445	NA
NGBS		\$756	\$8,006	\$13,806	\$27,606
LEED-H		\$2,928	\$8,950	\$22,700	\$29,370
Townhouse					
CGH		\$1,875	\$6,625	\$10,925	NA
NGBS		\$824	\$8,174	\$12,574	\$26,574
LEED-H		\$1,950	\$7,303	\$20,803	\$27,950
Six Flat					
CGH		\$2,850	\$4,668	\$13,878	NA
NGBS		\$2,118	\$9,868	\$17,218	\$35,218
LEED-H		\$4,218	\$13,418	\$36,118	\$41,768

Table 13. Estimated Additional Direct Cost over Baseline.

Registration, Verification and Certification Fees

In addition to the direct costs associated with obtaining points in the rating systems, each organization assesses fees to administer their program. The CGH does not have any registration, verification or certification fees. The NGBS fees are currently \$200 for each house for Program Certification plus an additional \$400 for Plan Review and another \$600 for verification of the built home. The CGH and NGBS certification includes registry and a certificate. Additional cost for the collection and submission of supporting documentation by consultants was also considered to fall under normal jobsite administration duties and is also not included.

The LEED-H certification fee has recently been increased to \$225 plus a separate \$150 registration fee that applies to each house. These fees are paid to the USGBC and Green Building Certification Institute (GBCI) solely for registration and certification administration. A third-party LEED Provider is then retained at an additional cost to work with the design and construction team to establish the credits that will be sought. An optional Charette is highly recommended by the LEED Provider. This is conducted by the LEED Provider with the entire design and construction team along with the Owner in order to discuss all of the potential options to achieve LEED credits. The final LEED plan review and verification of the built home is the most costly, an additional \$2,100. The total cost of LEED-H registration, verification and certification is over three times the cost of compliance with the NGBS. The cost of achieving certification under the CGH rating system is effectively zero...

The process and methods for verification of green features under CHG, NGBS and LEED-H are different but the objective is to confirm that the intended green features are constructed in accordance with the program requirements and the project documents that define how they are met. Verification of compliance differs under each rating system and ranges from review of architectural plans, product data and specifications, contractors scope of work and energy modeling, to actual post construction blower door testing for air leakage, HERS rating testing, functional commissioning, and HVAC system air flow testing and balancing. Each green building rating system program guide must be consulted for the full range of verification requirements.

	CGH	NGBS	LEED-H
Activity			
Registration	\$0	\$0	\$150
Program Certification	\$0	\$200	\$225
LEED Provider	\$0	\$0	\$650
LEED Charette	\$0	\$0	\$800
Plan Review/Builder Collaboration	\$0	\$400	\$2,100
Verification	\$0	\$600	
Total	\$0	\$1,200	\$3,925

Table 14. Registration, Verification and Certification Costs

As can be seen from the data, the cost of registration, certification and verification ranges from as little as 3% to as much as 158% of the direct project cost for green buildings under the NGBS program.. LEED-H's cost for registration, certification and verification cost ranges from 9% to 201% of direct costs. The CGH zero cost of registration, certification and verification is, understandably, more attractive to builders in Chicago, particularly those attempting to meet affordable mandates.

The NGBS online tool provides instant feedback, is easy to use and offers some comfort and predictability about the level of certification that can be achieved. The NGBS online tool also saves time which translates into lower design and certification costs. The USGBC fees for registration and program certification are administrative fees only; the LEED Provider is the one who does the actual verification. He provides a recommendation of certification which is then reviewed by the USGBC. The LEED Charette which is highly recommended is also conducted by the LEED Provider with the participation of the design and construction team. If this Charette is omitted, it could result in higher LEED Provider costs due to expending more of their time in answering questions that might have been resolved during the Charette. The complexity of a LEED review is lengthier and the results are uncertain until the testing process has been completed.

The NGBS system of registration, certification and verification provides the most certainty of a desired level of certification due to its easy-to-use online tool and confidence that the results achieved are accurate due to its third-party verification.

The CGH system puts the burden of proof on the design team and the CGH may, at their discretion, conduct two audits during construction. This does not provide the same level of confidence in the results that NGBS or LEED do since it lacks third-party verification.

Rating System Costs

The following figures show a comparison of the costs of compliance at each certification level by the green building point system used by the CGH, NGBS and LEED-H. Figure 1 shows the cost distribution for the model single family home. Figure 2 shows the cost distribution for the townhome and Figure 3 the six flat. The three green building sections of NGBS and LEED-H mirror one another. While CGH sections do not align as closely. This leads to some variance in the distribution of costs between the three programs..

Single Family Home Direct Cost by Green Building Section

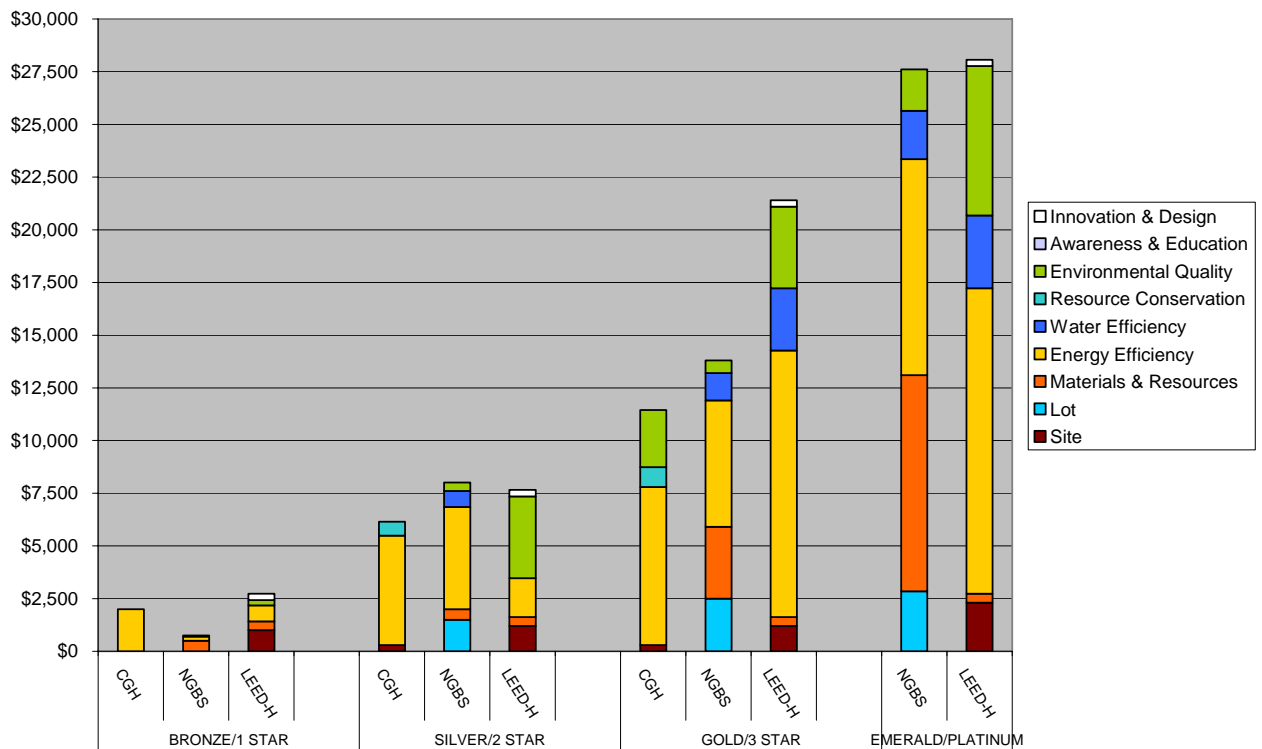


Figure 1 – Single Family Home Direct Cost by Green Building Category. Shown at each certification level.

In all building types, the cost to comply with the Energy Efficiency category of each of the green building programs resulted in the largest percentage increase in costs. For the single family and townhome projects, the second most costly green building category to comply with, is indoor Environmental Quality. For the six-flat building the second most costly category is Materials & Resources; which can be accounted for by the increased area of finished flooring materials present in this building type. A close third for single family home and townhomes is the additional cost in Materials and Resources. The Six-flats third most costly green building category is Water Efficiency; which again can be accounted for by the increased number of kitchens and bathrooms.

Townhome Direct Cost by Green Building Section

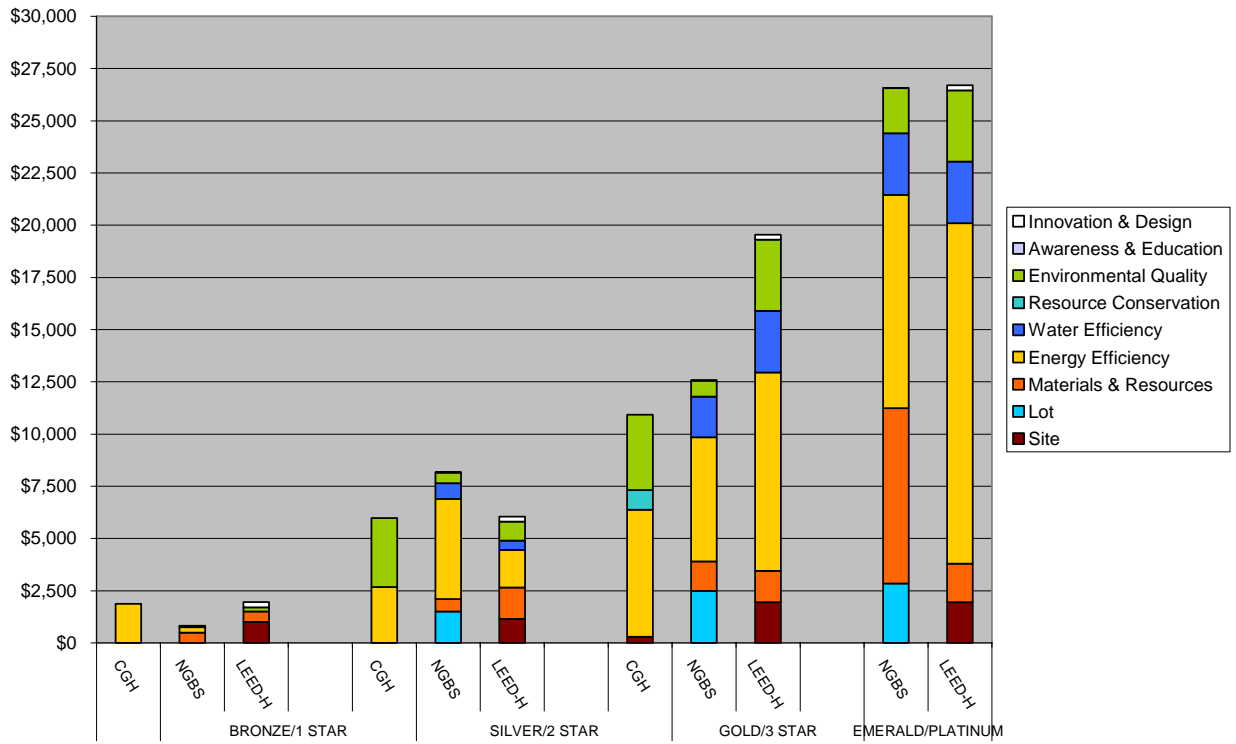


Figure 2 – Townhome Direct Cost by Green Building Category. Shown at each certification level.

Six Flat Direct Cost by Green Building Section

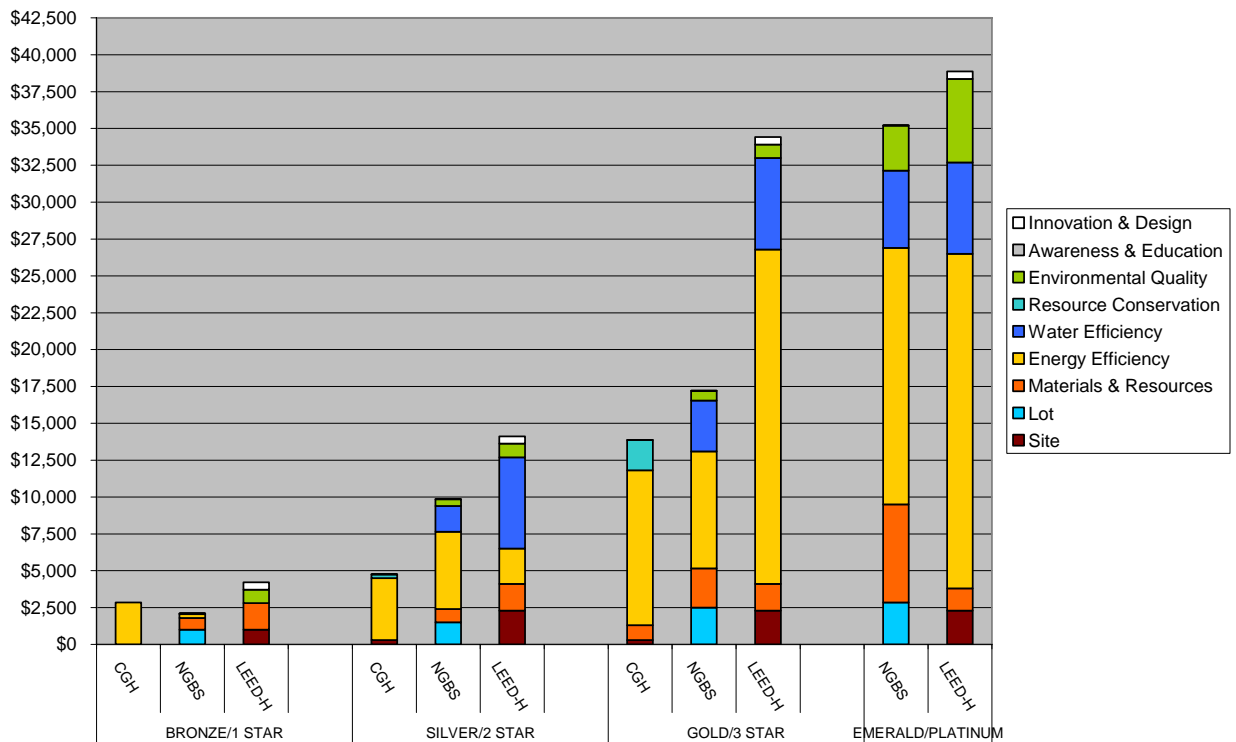


Figure 3 – Six Flat Direct Cost by Green Building Category. Shown at each certification level.

Figures 1, 2 and 3, demonstrate that the cost of Energy Efficiency compliance is higher under CGH and NGBS than it is with LEED-H at the first two levels of certification. However, under LEED-H the combined cost of Energy Efficiency and Environmental Quality at Silver certification exceeds that of both CGH and NGBS. At the two highest levels of certification, LEED-H compliance is nearly double the cost of CGH and NGBS. The increased costs of all green building rating systems are of sufficient magnitude to warrant a closer look at the “payback offered over time to justify the additional up-front investment. This is particularly true given its effect on affordability.

Choice versus Mandatory

Each green building rating system includes some mandatory requirements as well as a variety of optional requirements, to be considered in determining how to achieve certification. The approach of selecting credits for each certification level will ultimately be made based on the knowledge and ability of the project team to select those products or systems that best meet the criteria for achieving the necessary point requirements. The way in which a project team chooses compliance will vary depending on individual preference, cost, market demand, project availability and site.

Each green building rating system describes their desired outcome differently. The CGH and NGBS are, by design, prescriptive in their approach; meaning they describe the exact result that a particular credit should achieve in order to be to be verified. As an example: to prescribe a sill sealer and caulk between the foundation and sill plate awards a credit and presumably achieves the desired outcome. These types of credits are particularly appealing to government agencies and building officials because the language is readily understood and they give clear direction to builders. The result can be readily understood and checked by building inspectors.

LEED-H differs in that it is performance-based in its approach. It describes desired and intended measurable outcomes without prescribing a specific method of achieving them. For example, Credit EA 3: Air Infiltration’s intended purpose is to reduce air leakage in the building envelope. One way to reduce air leakage is to install a sill sealer but this is not explicitly described in the credit requirement. Rather, the credit lists an air change goal for each IECC climate zone and leaves the specific solutions for achieving it to the design and construction team. This performance based approach affords the design and construction team more flexibility than the prescriptive approach but can also be more challenging to code officials and building inspectors when checking for code compliance.

The performance-based system arguably provides more opportunity for the project team to find creative and cost effective solutions. LEED-H allows the project team broad flexibility to choose from a combination of credits, those that will yield the best solutions to achieve the desired certification level for a specific project. For large, unique, or complex buildings this may offer some advantage over the more prescriptive approach of CGH and NGBS whose attraction is ease of use and predictable compliance.

In smaller project, or those consisting of multiple small structures; the less complex and expensive rating systems may have more appeal for builders and building code officials alike.

	LEED	NGBSv2	CGH
Lot Design & Development	12%	18%	0%
Resource Efficiency	4%	20%	0%
Energy Efficiency	0%	13%	50%
Water Efficiency	7%	6%	0%
Indoor Environ. Quality	13%	16%	0%
Operation, Maint. & Educ.	0%	4%	0%
Add'l Points any Section	64%	23%	50%
Total Points	100%	100%	100%

Table 15 – Relative Weight of Minimum Point Requirements by Green Building Section

Another way to evaluate the three green building rating systems is to compare their respective minimum point requirements for each Green Building category. Figure 4 indicates that CGH requires 50% of its points to be obtained from Energy Efficiency and 50% from any other category. The NGBS requires a balance of points across all categories' with up to 23% of the points from any single section. LEED-H stipulates minimum point requirements in four sections and allows a maximum 64% of the points from any one section. Based on a comparison of information in Figure 4, the NGBS appears to provide the most balanced approach to green design and construction certification.

Overall Strategy

The certification emphasis and requirements for each green building rating system (CGH, NGBS and LEED-H) are quite different and vary for each level of certification..

- CGH requires minimum points in Energy Efficiency and any combination of points from its other sections.
- NGBS requires increasing minimum points in each section at each successive certification level.
- LEED-H requires achieving specific performance prerequisites in each section and a selection of points from any of its other sections.

Each green building rating system strives to achieve sustainable design that reduces environmental impact, energy and water consumption, improves indoor air quality, uses recycled and local materials and reduces the energy consumption. But their, suggested means of accomplishing these goals are varied.

CGH and NGBS tend to be more prescriptive green building rating systems that employ a longer list of possible points that can be readily achieved using broadly recognized materials and methods. The prescriptive approach results in a measure of inflexibility which leaves little room for interpretation. The requirements are either in compliance or they are not achieved. This approach may be best for some project teams because it is a clear blueprint to achieve conformance that is both recognizable and actionable.

The U.S. Green Building Council states that LEED-H is aimed at market leadership, targeting the top 25% of home building practices in terms of environmental responsibility. The performance nature of LEED-H is evidence of this goal. This affirms that LEED-H is not suitable for all projects. The program's requirements set a goal to achieve the each level of certification but leave the materials and methods to the project team to decide how to best achieve it. This is clearly a more time intensive and, therefore, more costly approach as it involves more analysis and requires more expertise the other rating systems.

The NGBS is directed to a broad range of builders including production home builders, custom home builders and remodelers and has been designed to be more easily understood and implemented by smaller firms with less expertise in green building practices. The NGBS is also the only green rating system that is ANSI approved.

In either CGH or NGBS, the desired credit is written in a clearly defined method that can be understood, constructed and observed by the person(s) responsible for such activities as a normal

part of their daily work responsibilities. In contrast, LEED-H requires both the design and the construction team to consider each credit objective and determine the most cost effective way to achieve the credit's intent for, what is, arguably the same project result. The predictability of CGH and NGBS is established in the writing of both systems, while LEED-H requires projects to be completed in order to determine whether or not they have achieved the predicted result. Each credit is written to accomplish a certain performance level that must be field verified to achieve LEED certification.

Regardless of which rating system is applied, the project team must evaluate the risks and rewards of obtaining green certification in CGH, NGBS and LEED-H for each individual project. No single solution applies to each building type, just as no single building design is appropriate for each market. The intent to achieve a certain level of certification under any of these green building rating systems must be carefully evaluated by the design and construction team with regard to the anticipated benefits and costs to be certain that they are making choices that will best serve the projects goals and the end-user's needs..

Conclusion

Urban Green Building
Rating Systems Cost
Comparison



CONCLUSION

The green building rating systems CGH, NGBS and LEED-H all provide a verifiable method of building energy efficient and environmentally sustainable housing. The basis of each program is to improve the environmental impact across six green building sections:

- lot design and development,
- resource efficiency,
- energy efficiency,
- water efficiency,
- indoor environmental impact and operations,
- maintenance, and
- sustainable education.

Each certification program achieves all of these objectives to some degree and each provides a valid method of encouraging green building compliance and sustainable practices.

The City of Chicago Building and Energy Conservation Code prescribe building performance that is closely compliant with the minimum certification level of all three of the green building rating systems. The 2009 Chicago Energy Conservation Code revisions raised the minimum code requirements closer to the requirements of the CGH and, actually increased certain requirements to exceed the ECC code minimums. The economic impact of these changes has been to increase the cost of achieving the minimum certification level by less than 1% over the code-minimum baseline cost for 1 Star, Bronze or Certified achievement rating. These changes to the City of Chicago Code have, in effect, raised the cost of homebuilding albeit by a relatively small amount. However, it should be noted that this increase, like any increase, in building cost, has the greatest impact on the least costly housing thereby conflicting with the City's expressed desire to increase affordability.

At the 2 Stars or "Silver" certification levels, the additional cost impact is still quite low; at 3% or less above the baseline code-minimum cost for all of the green building rating systems. Only at 3 Stars or Gold certification level is there a clearer cost distinction between CGH or NGBS and LEED-H. At this, the third highest achievement rating, LEED-H becomes nearly two times more costly. This cost differential diminishes at the highest achievement rating, Emerald or Platinum, where direct costs vary by less than 1% different (the CGH program does not have a 4 Stars rating).

The City of Chicago currently recognizes both the CGH and LEED-H green building rating systems but not the NGBS. This is somewhat perplexing considering that the CGH began its development based on the NGBS. As a result, a project requiring compliance with a green building rating system for land use entitlement or financial incentives, only has two compliance paths available, the CGH or LEED-H. It seems obvious that the prescriptive nature and performance obtained under the CGH and NGBS are quite similar which suggests that the NGBS should be recognized by the City of Chicago as an equal alternative to the CGH for projects that require green building certification.

Under both CGH and NGBS the increased cost of achieving a specific level of certification is directly attributable to improving the standard of conventional residential construction by improving practices and detailing not by resorting to exotic finish materials or innovative but more expensive energy production systems. For example, improving conventional wall construction to be more air tight and more highly insulated can significantly reduce the size of heating and air-conditioning equipment without the need for unfamiliar or costly new materials or methods.

The CGH and NGBS green rating systems are both based on prescriptive requirements that rely on widely available common materials and recognized methods of construction. As such, they may be more directly applicable to the type of scattered site, small scale infill construction and remodeling that comprises a large part of construction activity in Chicago. LEED-H, being a more performance-based system that relies on verification to determine program certification is, in some ways, a more flexible rating system that encourages in-depth analysis of the unique attributes of each building and permits considerable latitude when designing a project. It is less “user friendly” in that it requires considerable skill and expertise to navigate but it also provides more opportunities for creative and innovative solutions. It is also more costly and challenging to administer and is, therefore,, perhaps best suited to larger scale or complex projects where its performance based nature may offer flexibility. Each system has its own stated purpose that appears to satisfy their target audience but understanding their differences is important. Permitting builders and designers the latitude to select the rating system that they find most appropriate for a particular project would seem to be the best way to encourage more widespread adoption of green building principals and the benefits that they produce.