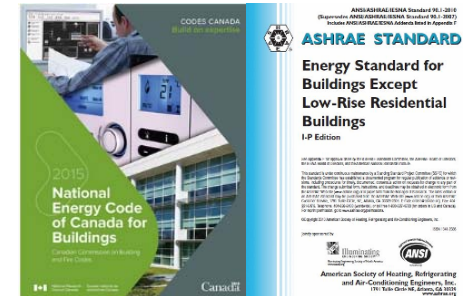


GREEN BUILDING METRICS, CODES, STANDARDS, RATING SYSTEMS



AGENDA

1. Prior Presentations, Sustainability,
2. Green House Gasses, Carbon Neutrality, Adaptation
3. Energy and Green Building Codes and Standards,
4. Energy Codes/Standards/Rating Systems Compared
5. Green Building Rating and Certification Systems
6. Green Building Metrics
7. Green Building Rating and Certification Systems Compared



WHAT WE TALKED ABOUT PREVIOUSLY AND SUSTAINABILITY

- 2007 Fall Conference session covered: Sustainability, LEED NC.
- In 2012, 2015, 2016 (twice) we covered Codes and Standards applicable to telecommunications, in Canada and the US.
- Sustainability - Federal definition: “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”:
 - Waste / Pollution
 - Energy / Water
 - Other Resources
- Why Buildings, not transportation or energy industries? In 2020, about 53% of stationary end-uses of energy will be for residential and commercial buildings. Space heating, cooling, hot water, etc. (excluding small equipment). Low cost solution to greenhouse gas reductions with existing

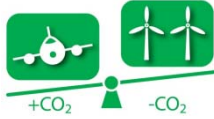


Sustainability



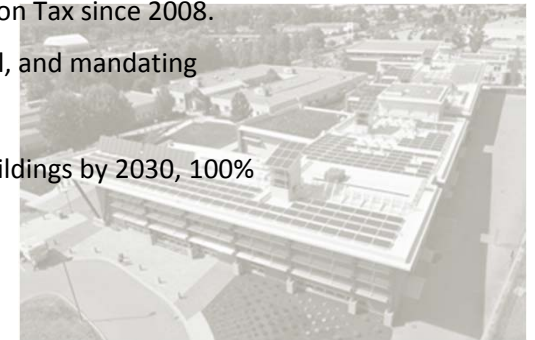
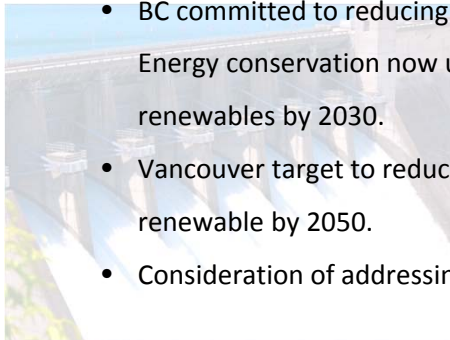
CODES & STANDARDS





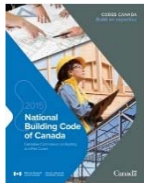
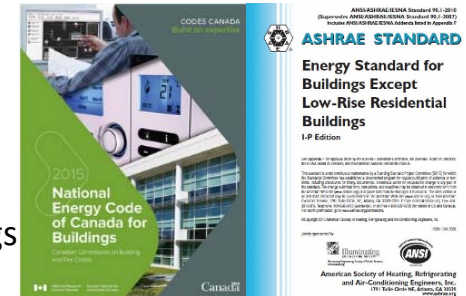
WHAT HAS CHANGED SINCE 2007

- Updates to codes, standards, rating and certification systems, and legislation.
- More widespread acknowledgement that humans contribute to and can therefore mitigate climate change (with a few notable exceptions)
- Shift of focus to Green House Gas emissions, Carbon Neutrality, Renewable Energy.
- Acceptance that we are talking about adaptation vs. avoidance.
- Buildings, Transportation, and Energy Industry all active areas.
- Canadian federal government mandating price on carbon from 2018 to 2022, coal-fired electricity phase-out and 90% renewables government by 2030.
- BC committed to reducing GHG 80% below 2007 by 2050. Net zero energy ready bldgs. by 2032. Carbon Tax since 2008. Energy conservation now unrestricted matter under Building Act General Reg. Alberta phasing out coal, and mandating renewables by 2030.
- Vancouver target to reduce community-based GHG by 33% from 2007 by 2020, zero emissions new buildings by 2030, 100% renewable by 2050.
- Consideration of addressing sick-building syndrome, and other goals.



ENERGY CODES AND STANDARDS

- Model National Energy Code for Buildings (NECB) 2015
- ASHRAE 90.1-2016 Energy Standard for Buildings Except Low-Rise Residential Buildings
- Model National Building Code of Canada (NBCC) 2015, BCBC 2018, VBBL 2014
 - Thermal Resistance of Assemblies, Air Leakage, Vapour Diffusion/Condensation Control, Windows, Doors, Skylights, Fenestrations, Exterior Insulation Finish Systems, Service Water Heating, CO control storage garage ventilation, HRVs, reference to NECB
- Material, Product and Equipment standards also factor into building sustainability (windows, building materials, HVAC, SWH, motors, transformers, lighting, appliances, consumer electronics, etc.). Most notable equipment standard is Energy Star or EnerGuide, but others such as CSA, UL, AHRI, AHAM, etc. include efficiency.
- Beyond Energy there isn't much in the way of a national, provincial, or local code or standard regarding sustainability (by-laws not codes or standards).



CODES & STANDARDS

GREEN CODES AND STANDARDS

- International Green Construction Code 2018 powered by
- ANSI/ASHRAE/ICC/USGBC/IES Standard 189.1 – 2017 Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings
- Not used in Canada (at least not directly)



LEGISLATION

- Adoption of NECB 2011 (or 2015) or ASHRAE 90.1 2010 (or 2013 or 2016) by BC, AB, MB, ON, NS, VBBL. BC Step Code (Airtightness, Energy Use Intensity (Bldg Equip and Sys), Thermal Energy Demand Intensity, Peak Thermal Load, Resi, some MDU & Comm)
- LEED GOLD
 - BC new and major renovations public sector buildings since 2007
 - Vancouver requires LEED Gold for rezoning, including some specific points.
- Carbon Neutral
 - Federal Gov't 40% reduction in GHG by 2030, 100% renewable electricity by 2025.
 - BC mandated carbon neutral public sector (since 2011). Some municipal governments also. Uses offsets.
 - Vancouver zero emissions new buildings by 2030.
- Federal restriction on manufacture, import, sell or lease restrictions on product such as incandescent bulbs (NRC Energy Efficiency Regulations, 2016 - Amendment 13).



Provinces and territories that have adopted regulations based on the 2015 National Model Construction Codes

P/T	NBC 2015	NFC 2015	NPC 2015	NECB 2015
NT	Adopted 15 November 2016	Adopted 15 November 2016		
NS	Adopted	Adopted		Adopted

CODES AND STANDARDS VS. RATING / CERTIFICATION SYSTEMS

- Legislation, and other legally enforceable requirements, are generally focused on energy efficiency (regardless of type), green house gas emissions (non-renewable energy), or, in the case of LEED, discretionary sustainability.
- Neither ASHRAE 90.1 nor NECB relate specifically to carbon (GHG), rather energy efficiency (NECB Energy Used, ASHRAE Energy Cost). ASHRAE 189.1 covers more topics, as does IgCC. Written to be mandatory.
- Rating and Certification systems measure specific, or a variety of, sustainability measures that they feel most important but don't put a priority on objectives (discretionary). Not intended to be mandatory.
- Some rating/certification systems such as Passive House (voluntary) out-perform mandatory codes and standards – “code is the minimum standard”



GetCertified



SOME CURRENT BUILDING RATING / CERTIFICATION SYSTEMS (Excluding Homes)

- LEED V4 BD+C NC, C+S, SCHOOLS, RETAIL, HOSPITALITY, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS, AND HEALTHCARE; LEED V4 ID+C, COMMERCIAL INTERIORS, RETAIL, HOSPITALITY; LEED V4 O&M, EB, SCHOOLS, RETAIL, HOSPITALITY, DATA CENTERS, WAREHOUSES & DISTRIBUTION CENTERS; LEED V4 HOMES & MULTIFAMILY LOWRISE, AND MULTIFAMILY MIDRISE; LEED V4 NEIGHBORHOODS
- GREENGLOBES (NC or Sustainable Interiors by ECD JLL, and Cont.Imprv.EB aka BOMA BEST in Canada for single building or portfolio)
- PASSIVE HOUSE
- LIVING BUILDING CHALLENGE (by Cascadia Green Building Council / International Living Future Institute) (incl optional Net Zero Energy Building Certification (by ILFI)
- ENERGY STAR (energy and water use)
- BREEAM (Building Research Establishment Environmental Assessment Method)
- SITES (Sustainable SITES Initiative, by Green Building Certification Inc.)
- WELL Building Standard (by International WELL Building Institute)
- Fitwel (Center of Active Design)
- MANY Others



WHY SO MANY?

HOW STANDARDS PROLIFERATE:



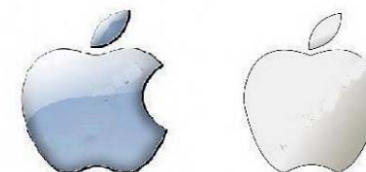
According to Apple.



Apple

Samsung

According to Samsung.

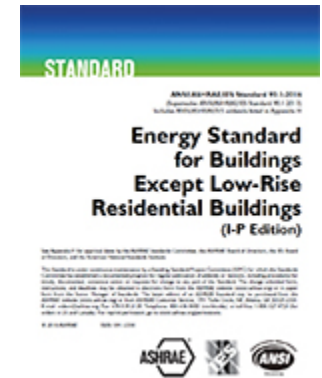


Apple

Samsung

ASHRAE 90.1-2010 (2013 & 2016)

- Energy Efficiency Standard
- Building Envelope, Power, Lighting, Mechanical (HVAC, SWH)
- New bldgs., new portion of bldgs., new systems and equip. in exist. bldgs., specific new equip of industrial or manufacturing processes.
- Excludes single-family, and three stories or fewer.
- Mandatory Provisions, Prescriptive or Trade-Off (Envelope only), Energy Cost Budget Method
- References other standards for non-energy performance such as lighting levels and ventilation requirements



NECB 2015

Energy Code

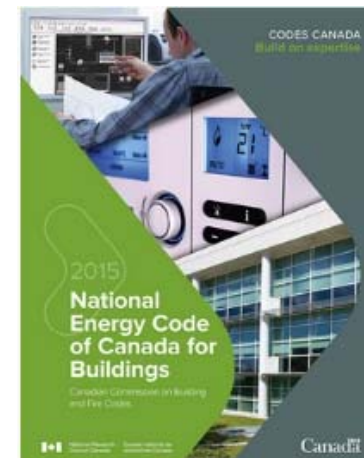
Building Envelope, Lighting, Mechanical (HVAC, SWH)

Prescriptive, Trade-off (envelope, Itg, HVAC, SWH), or Performance compliance paths

Building Energy Performance target (not cost)

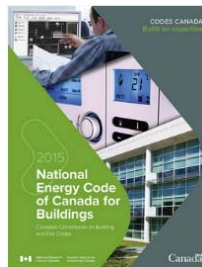
Written in conjunction with NBCC, NPC, NFC, CEC, etc.

Intended to be applied to new buildings and construction.

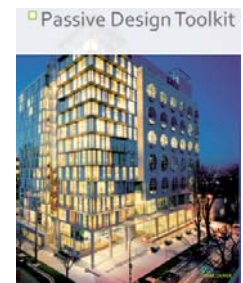


ASHRAE 90.1 vs. NECB, PH & LBC-NZEB

- ASHRAE balances heating and cooling efficiency; NECB is biased toward heating. In Canada the bias is toward heating (3/4 of the time) so NECB typically results in an operational saving over ASHRAE.
- ASHRAE looks at energy cost, NECB looks at energy consumed. At the building level in a low-carbon world the building uses more electricity since fossil fuels are excluded, but neighborhood energy, biomass, and other low-carbon sources are options. Low-carbon typically increases energy cost whereas heat pumps decrease energy consumed at expense of capital cost.
- Passive House typically exceed energy cost and energy use performance of either. Similarly a NZEB would be the best.



**PASSIVEHOUSE
CANADA** Build better.
Feel better.



ASHRAE/ICC/USGBC/IES 189.1 - 2017

- Standard for the Design of High-Performance Green Buildings Exc. Low-Rise Resi. Bldgs.
- Areas: Site Sustainability, Water Use Efficiency, Energy Efficiency, IEQ, Materials & Resources, Building's Impact on the Atmosphere (Construction and Operations Plans).
- Goes beyond energy requirements of ASHRAE 90.1
- Not just an energy standard, but not a rating or certification system.
- Not used in Canada directly



Passive House

- Certification system: Outcome-based (not prerequisites and optional credits) design standard, low-energy consumption through passive solar design, superinsulation, high-tech windows, airtightness, premium efficiency HVAC, & appliances.
- Some jurisdictions are looking to Passive House as an alternative to NECB/ASHRAE 90.1 because building energy performance is so good (dramatically less heat, significantly less cooling). Well suited to Canadian climate.



Canadian Passive House Institute



**PASSIVEHOUSE
CANADA** Build better.
Feel better.

naphn
North American
Passive House
Network

iPHA
Affiliate

2019
ICT/CANADA
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USGBC LEED V4

- Certification system: multiple construction types, multiple aspects of sustainability. Mature system. Quoting City of Vancouver such systems are “widely proven, have broad credibility, and are third party verified”.
- LEED started by USGBC in 1998
- NC has multiple market segments & categories (performance areas): Sustainable sites, water efficiency, energy & atmosphere, materials & resources, indoor environmental quality, Integrative Strategies, Regional Priority, and Location & Transportation. Pre-requisites and credits. Certification levels.

EDGE	EQAC	WELEED	LEED	ND	HCWES
<ul style="list-style-type: none"> New Construction Core & Shell Schools Retail Hospitality Class Centers Warehouses & Distribution Centers Healthcare 	<ul style="list-style-type: none"> Commercial Interiors Retail Hospitality 	<ul style="list-style-type: none"> Existing Buildings: Classrooms & Laboratories Schools Retail Hospitality Class Centers Warehouses & Distribution Centers 	<ul style="list-style-type: none"> Neighborhood Development: New Neighborhood Development: Existing 	<ul style="list-style-type: none"> Homes Multi-Res 	



Living Building (Challenge)

- Performance-based standard (certification options) with flexibility for building type and region. Seven performance areas or “petals”: Place (site), Water, Energy, Health (& Happiness), Materials, Equity, Beauty. Twenty Imperatives.
- Four scales: building, neighborhood, village/campus, and city.
- Four typologies: buildings, renovations, landscape or infrastructure, neighborhood.
- Targets Net Zero (Energy, water, waste) and on-site renewable energy. Net Zero Energy Building is a certification option. Others are Full Living, Petal, & LB Challenge.
- Third-party Auditor for document review and onsite verification.



The 20 Imperatives of the Living Building Challenge: Follow down the column associated with each typology to see which Imperative apply

	LIVING BUILDING CHALLENGE 3.0			
	BUILDINGS	RENOVATIONS	LANDSCAPE / INFRASTRUCTURE	
PLACE	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	01. LIMIT TO RESIDENT
	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	02. PROVIDE AMENITY CLUBS
WATER	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	03. MAXIMIZE EXCHANGE
	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	04. HUMAN-POWERED LIVING
HEALTH & HAPPINESS	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	05. USE POSITIVE WATER
	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	06. USE FOOD TO THRIVE
MATERIALS	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	07. QUALIFIED PROCUREMENT
	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	08. HEALTHY INTERIOR ENVIRONMENT
EQUITY	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	09. BIOPHILIC ENVIRONMENT
	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	10. GOOD LIGHT
BEAUTY	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	11. EMPLOYED LABOUR PROTECT
	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	12. RESPONSIBLE PRODUCTION
	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	13. CONTRIBUTE TO COMMUNITY
	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	14. MET POSITIVE WASTE
	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	15. HUMAN SCALE + HUMANE PLACES
	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	16. UNIVERSAL ACCESS TO AMENITY PLACES
	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	17. CIRCULAR ECONOMY
	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	18. JUST ORGANIZATIONS
	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	19. SECURITY + SAFETY
	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	SCALE 1/2/3/4/5	20. TOP QUALITY EDUCATION

Green Globes

Online Rating/Certification System (1-5 Green Globes in Canada). Based on 1996 CSA BREEAM Canada, 2000 (EB), NC 2013 based on ANSI/GBI 01-2010, next expected GBI 01-2017. GBI an ANSI SDO. Used by DND, PWGSC and US GSA.

Green Building Initiative (BOMA – EB, NC now ECD JLL in CA).

Seven key areas (NC): energy, indoor environment, site, water, materials & resources, emissions, and project/environmental management (emissions). No prerequisites, just credits.

Assessment Tools: New buildings and significant renovations (NC), Office fit-up (CI - Comm.Int.), existing buildings (EB, aka BOMA BEST in Canada).

Assessor provide 3rd party certification services.



BREEAM

- Rating System – one of the very first for buildings, basis of many others.
- Building Research Establishment's Environmental Assessment Method (developed for UK in 1990s, but now also used in EU and elsewhere).
- Multi-attribute scores for Management, Health & well-being, Energy, Transport, Water, Land use & ecology, Materials, Waste and pollution are weighted for a rating.
- Multiple schemes including Communities, Courts, Education, Health care, Offices, Prisons, Retail, etc.



BREEAM®

GREEN CONSTRUCTION RATING /CERTIFICATION METRICS



- How many key areas could the different rating/certification systems cover?
- 27 to 28 requirements from Energy Independence Security Act (US EISA) Study in 2012:
- New Buildings: Integrated Design, Commissioning, Indoor Water, Process Water, Outdoor Water, Storm Water, Water-Efficient Products, Energy Efficiency, On-Site Renewable Energy, Measurement and Verification, Benchmarking, Recycled Content, Biobased Content, Environmentally Preferable Products, Waste and Materials Management, Ozone Depleting Compounds, Low-Emitting Materials, Ventilation, Thermal Comfort, Daylighting, Environmental Tobacco Smoke Control, Protect Indoor Air Quality during Construction, Moisture Control, Acoustic, Building System Controls, Siting, Greenhouse Gas
- Existing Buildings: as above except Integrated Assessment, Operation, and Management vs. Design, adds Integrated Pest Management
- Includes energy efficiency, greenhouse gas, & renewables covered by legislation, codes & standards.

SUSTAINABLE DEVELOPMENT GOALS

- UN SDG



CRITERIA FOR EVALUATING RATING / CERTIFICATION SYSTEMS

- So, how do you compare so many different rating systems?
- US EISA Green Building Certification System Study 2012 (ASHRAE 189.1 supplemented 2012, LEED v4 supplemented 2014) by US Gen.Svcs.Admin.
 - Robustness of the technical components of the certification system to address Federal high-performance design and operational requirements for Federal facilities: whole building evaluation, addressing key sustainable design and operations metrics
 - Independence and availability of technically qualified auditors or assessors.
 - Documented verification method
 - Transparency of certification systems' approach to collecting and addressing public comments
 - Consensus-based standard for documenting a development and revision process
 - System maturity
 - Usability of the system, especially in a particular jurisdiction
 - National recognition within the building industry



CRITERIA FOR EVALUATING RATING / CERTIFICATION SYSTEMS – cont'd



US EISA 2012

Criteria included 3rd party verification, whole-building analysis, availability in US

ASHRAE 189.1, and LEED v4 added later by supplement.

To be updated in 2017 (but . . .)

Certification System	Owner	Whole-building sustainability	Building Types	Third-party Certification
Green Globes®	Green Building Initiative (GBI)	Green Globes is comprised of seven key areas: energy, indoor environment, site, water, resources, emissions, and project/ environmental management.	Green Globes certifies new buildings and significant renovation, existing buildings, building emergency management, building intelligence, and fit-up.	Green Globes Assessors provide third-party certification services.
LEED®	U.S. Green Building Council (USGBC)	LEED is comprised of five key areas: sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality.	LEED certifies new construction and major renovations, existing buildings, commercial building interiors, core and shell construction, schools, retail, healthcare, and homes.	The Green Building Certification Institute (GBCI) provides third-party certification services.
Living Building Challenge™	International Living Building Institute (ILBI)	Living Building Challenge is comprised of seven performance areas: site, water, energy, health, materials, equity and beauty.	Living Building Challenge certifies development at four scales: building, neighborhood, village/campus, and city.	A third-party auditor is responsible for performing document review and onsite verification.

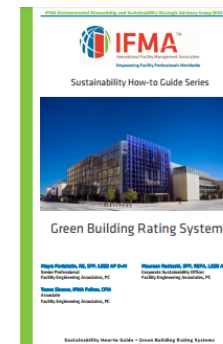
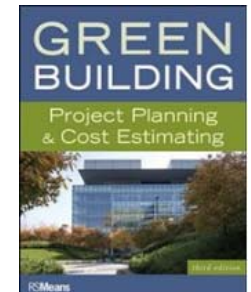
CRITERIA FOR EVALUATING RATING / CERTIFICATION SYSTEMS – cont'd

- Whole Building Design Guide (US National Institute of Building Sciences)
 - Who is assessing? First-party, second-party, or third-party?
 - Multi-attribute program?
 - Overall environmental performance: Water, energy, emissions, toxicity
- RSMears
 - Science-based – reproducible results and decisions by others
 - Transparent – standard and process for recognition open and transparent
 - Objective – certification body free of conflict of interest
 - Progressive – should advance industry practices
- International Facility Management Association (IFMA) (2015)
 - Formal certification program?
 - Multi-attribute program?
 - Original program (vs. derivative of other system)?
 - Mature system (not in development or pilot)



WBDG Whole Building Design Guide®

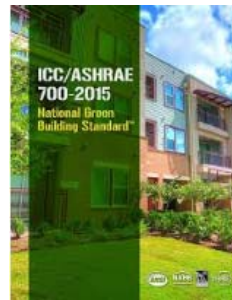
RSMears data
from **GORDIAN**





US EPA Green Building Standards

- Reviewed IgCC 2012, ASHRAE/USGBC/IES 189.1-2011, 2012 National Green Building Standard, Green Globes, USGBC LEED, ILFI LBC ver. 2.1 (2012)
- Code or Rating/Certification System, Intended Application (Mandatory/Voluntary), Building Types (eg. Comm., Resi., . . .), Project Types (eg. NC, Alterations, . . .), Subject Areas (eg. Site, Energy, IEQ, . . .), Certification/Compliance Process (by AHJ, 3rd party, . . .), Relationship to Standards (ASHRAE 90.1, 189.1, etc.).





EPA Green Bldg. Std. - List

Green Building Standards

American communities have more options than ever for encouraging greener building and development. Many organizations have developed model codes or rating systems that communities can use to develop green building programs or revise building ordinances. Learn about some of the major options, which are listed below. You can view a side-by-side comparison by selecting the checkboxes of options that interest you, then clicking the Compare button below the table.

Standard	Standard Type ¹	Mandatory/ Voluntary ²	Building Type(s)	Project Type	Subject Areas	Compare
<p>International Code Council's 2012 International Green Construction Code (IgCC)</p> <p>A model code that contains minimum requirements for increasing the environmental and health performance of buildings sites and structures. Generally, it applies to the design and construction of all types of buildings except single- and two-family residential structures, multi-family structures with three or fewer stories, and temporary structures.</p> <p>View information about 2012 IgCC</p>	Model code	Mandatory	<ul style="list-style-type: none"> Commercial: all Industrial: all but manufacturing systems and equipment Mixed use: all Residential: multi-family with more than 3 stories 	<ul style="list-style-type: none"> New construction Additions Retrofits 	<ul style="list-style-type: none"> Sustainable sites Energy efficiency Water efficiency Materials and resource use Indoor environmental quality Emissions Operations and maintenance 	<input checked="" type="checkbox"/> Compare IgCC with other standards
<p>ANSI/KHFAE/USGBC/IES Standard 189.2-2011: Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings (ASHRAE 189.2)</p> <p>A model code that contains minimum requirements for increasing the environmental and health performance of buildings sites and structures. Generally, it applies to the design and construction of all types of buildings except single-family homes, multi-family homes with 1 or fewer stories, and modular and mobile homes.</p> <p>View information about ANSI 189.2</p>	Model code	Mandatory	<ul style="list-style-type: none"> Commercial: all Industrial: all Mixed use: all Residential: multi-family with more than 3 stories 	<ul style="list-style-type: none"> New construction Additions 	<ul style="list-style-type: none"> Sustainable sites Energy efficiency Water efficiency Materials and resource use Indoor environmental quality Construction and operations plans 	<input checked="" type="checkbox"/> Compare ASHRAE 189.2 with other standards
<p>ICC 700-2012: 2012 National Green Building Standard (ICC 700)</p> <p>A rating and certification system that aims to encourage increased environmental and health performance in residences and residential portions of buildings. Its criteria apply to the design and construction of homes and subdivisions.</p> <p>View information about ICC 700</p>	Rating and certification system	Voluntary	<ul style="list-style-type: none"> Mixed use: residential space Residential: all except institutional uses 	<ul style="list-style-type: none"> New construction Additions Retrofits 	<ul style="list-style-type: none"> Sustainable sites Energy efficiency Water efficiency Materials and resource use Indoor environmental quality Operations and maintenance Building owner education 	<input checked="" type="checkbox"/> Compare ICC 700 with other standards
<p>Green Globes™</p> <p>A series of rating and certification systems that encourage improved environmental and health performance for all types of buildings except residential structures. Green Globes™ is administered in the U.S. by the Green Building Initiative.</p> <p>View information about Green Globes</p>	Rating and certification system	Voluntary	<ul style="list-style-type: none"> Commercial: all Mixed use: all Residential: multi-family 	<ul style="list-style-type: none"> New construction Additions Alterations Existing buildings 	<ul style="list-style-type: none"> Sustainable sites Energy efficiency Water efficiency Materials and resource use Indoor environmental quality Emissions Project environmental management 	<input checked="" type="checkbox"/> Compare GBG with other standards
<p>US Green Building Council's Leadership in Energy and Environmental Design (LEED)</p> <p>A series of rating systems aimed at increasing the environmental and health performance of buildings sites and structures and of neighborhoods. LEED covers the design, construction, and operation of all types of buildings.</p> <p>View information about LEED</p>	Rating and certification system	Voluntary	<ul style="list-style-type: none"> Commercial: all Industrial: all Mixed use: all Residential: all 	<ul style="list-style-type: none"> New construction Existing buildings Additions 	<ul style="list-style-type: none"> Sustainable sites Energy efficiency Water efficiency Materials and resource use Indoor environmental quality Emissions Operations and maintenance 	<input checked="" type="checkbox"/> Compare LEED with other standards
<p>The International Living Future Institute's Living Building Challenge™, version 2.1 (May 2012)</p> <p>A certification system that advocates for transformation in the design, construction, and operation of buildings. In addition to encouraging improved environmental and health performance, it supports building structures that are restorative, regenerative, and an integral component of the local ecology and culture.</p> <p>View information about the Living Building Challenge</p>	Certification system	Voluntary	<ul style="list-style-type: none"> Commercial: all Industrial: all Mixed use: all Residential: all 	All	<ul style="list-style-type: none"> Sustainable sites Energy efficiency Water efficiency Materials and resource use Indoor environmental quality Equity Aesthetics 	<input checked="" type="checkbox"/> Compare LBC with other standards

EPA Green Bldg. Std. - Comparison



Comparison of Green Building Standards

Standard	International Code Council's 2012 International Green Construction Code (IGCC), 2012 edition	American Society of Heating, Refrigeration, and Air-Conditioning Engineers' ASHRAE/USGBC/IES Standard 90.1-2010, Standard for High-Performance Green Buildings Except Low-Rise Residential Buildings (ASHRAE 90.1-2010 edition)	National Association of Home Builders' ICC 700 National Green Building Standard (NGBS), 2012 edition	Green Building Initiative's ANSI/GBI 03-2009 Green Building Assessment Protocol for Commercial Buildings (Green Globes, 2009 edition)	US Green Building Council's Leadership in Energy and Environmental Design (LEED)	The International Living Future Institute's Living Building Challenge, Version 2.1 (May 2012)
Description	A model code that contains minimum requirements for increasing the environmental and health performance of building sites and structures. Generally, it applies to the design and construction of all types of buildings excepting and to publicly residential structures. Multi-family structures that have three stories, semi-detached structures.	A model code that contains minimum requirements for increasing the environmental and health performance of building sites and structures. Generally, it applies to the design and construction of all types of buildings except single-family homes, multi-family homes with three or fewer stories, and modular and mobile homes.	A rating and certification system that aims to encourage increased environmental and health performance in residential and non-residential commercial buildings. Its criteria apply to the design and construction of homes and buildings.	A series of rating and certification systems that encourage improved environmental and health performance for all types of buildings except non-residential structures. Green Globes is administered in the United States by the Green Building Initiative.	A series of rating programs aimed at increasing the environmental and health performance of building sites and structures and of high-performance LEED® across the design, construction, and operation of all types of buildings.	A certification system that is based on transformation in the design, construction, and operation of buildings. In addition to encouraging more use of environmental and health performance, it supports the building of structures that are resilient, regenerative, and an integral component of the local ecology and culture.
Standard Type ¹	Model code	Model code	Rating and certification system	Rating and certification system	Rating and certification system	Certification system
Mandatory/ voluntary ²	Voluntary	Voluntary	Voluntary	Voluntary	Voluntary	Voluntary
Building Types ³	Commercial all Industrial all but manufacturing systems and equipment Retail all Residential: Multi-family with more than three stories	Commercial all Industrial all Retail all Residential: Multi-family with more than three stories	Fixed use residential space Residential: at least institutional uses	Commercial all Retail all Residential: Multi-family	Commercial all Industrial all Retail all Residential all	Commercial all Industrial all Retail all Residential all
Project Type	New construction Additions Renovations	New construction Additions Renovations	New construction Additions Renovations	New construction Additions Renovations Existing buildings	New construction Additions Existing buildings Renovations	All
Subject Areas	Customer satisfaction Energy efficiency Water efficiency Materials and resource use Indoor environmental quality Emissions Operations and maintenance	Customer satisfaction Energy efficiency Water efficiency Materials and resource use Indoor environmental quality Construction and operations plans	Customer satisfaction Energy efficiency Water efficiency Materials and resource use Indoor environmental quality Emissions Operations and maintenance Building performance	Customer satisfaction Energy efficiency Water efficiency Materials and resource use Indoor environmental quality Emissions Project environmental management	Customer satisfaction Energy efficiency Water efficiency Materials and resource use Indoor environmental quality Emissions Operations and maintenance	Customer satisfaction Energy efficiency Water efficiency Materials and resource use Indoor environmental quality Emissions Resilience
Community Application	Designed to be incorporated into a jurisdiction's code and ordinance and enforced by building officials and inspectors. Requires adoption by a governing jurisdiction before a local market. Jurisdictions that do not use other International Code Council codes in place might want to make a detailed review of their building ordinance to ensure that the code is compatible with this code. In addition to the mandatory requirements, IGCC offers jurisdictions a range of options for increasing the stringency of the code or encouraging more use of performance-based practices in their jurisdiction.	Designed to be incorporated into a jurisdiction's code and ordinance and enforced by building officials and inspectors. Requires adoption by a governing jurisdiction before a local market. Jurisdictions that do not use other International Code Council codes in place might want to make a detailed review of their building ordinance to ensure that the code is compatible with this code. In addition to the mandatory requirements, IGCC offers jurisdictions a range of options for increasing the stringency of the code or encouraging more use of performance-based practices in their jurisdiction.	Community could use this content as the basis for a voluntary program to encourage construction of green homes.	Community could use this content as the basis for a voluntary program that encourages construction of green commercial buildings.	Community could use the rating systems to encourage green construction of commercial buildings, homes, or neighborhoods.	Community could use this system as the basis for a green building program.
Certification/Compliance Process	Designed to be incorporated into a jurisdiction's code and ordinance and enforced by building officials and inspectors. As a part of the code, it is designed to be mandatory, except that the jurisdiction includes an opt-out clause for those jurisdictions that do not wish to enforce it. There are no requirements for the jurisdiction to encourage construction and implementation of specific practices, other than those that are part of the code.	Designed to be incorporated into a jurisdiction's code and ordinance and enforced by building officials and inspectors. Based on mandatory requirements with no compliance path options. Personnel not considered to be a compliance option with minimal credits and no deductions and Performance Point considered to be the more complicated optional path for flexibility and more options to make building green efforts.	There are four green certification levels for homes: Basic, Silver, Gold, and Emerald. Land development is certified under the Three or Four Stars. LEED certification is available for commercial and development facilities in existing green building facilities. Project Home partner path includes new for meeting certain performance or construction goals. Certification requires verification by third-party inspectors accredited by the National Association of Home Builders (NAHB) at the design stage and on completion. Inspections verify that every criterion listed by the builder in the LEED Green Building Checklist has been met.	Certification for one or two stars (i.e., 1 or 2 green) requires achieving minimum number of LEED points. Has to include more than 100 points but does not specify a goal, but it does have building green building practices that the builder has to achieve to receive Green Globes certification. It also includes a range of options to make building green building practices. Requires third-party review of building documentation and onsite walk-throughs.	LEED® points are awarded on a 100-point scale, and credits are assigned to reflect the potential environmental benefits. The total score and an available floor of credit address regional specific environmental issues. A project must satisfy all prerequisites and earn a minimum number of points to be certified. The primary certification is required. Includes four levels of certification: Certified, Silver, Gold, or Platinum.	Projects that meet all IGCC requirements to achieve full certification, however, partial recognition is available, including the Green Star Building Certification. The certification process involves a review of building documents and a site visit by an independent auditor.
Relationship to Other Standards	ASHRAE/USGBC/IES Standard 90.1-2010, Standard for High-Performance Green Buildings Except Low-Rise Residential Buildings (ASHRAE 90.1-2010) is an alternate compliance path to IGCC. In jurisdictions that adopt IGCC, a builder has the option to design and construct a building in compliance with the provisions of ASHRAE 90.1-2010 rather than IGCC. IGCC are also jurisdictions with options for meeting their residential structures comply with the National Association of Home Builders' National Green Building Standard (NGBS). IGCC is designed to coordinate and integrate with the family of International Code Council codes and complementary voluntary green building systems. Some provisions reference standards published by other organizations, e.g., ASTM International, National Science Foundation, and South Coast Air Quality Management District.	It is an alternate compliance path for the International Green Construction Code (IGCC). In jurisdictions that adopt IGCC, a builder has the option to design and construct a building in compliance with the provisions of ASHRAE 90.1-2010 rather than IGCC. ASHRAE 90.1-2010 is designed to coordinate and integrate with the family of International Code Council codes and complementary voluntary green building systems. Some provisions reference standards published by other organizations, e.g., ASTM International, National Science Foundation, and South Coast Air Quality Management District.	Includes a voluntary green building system for entire subdivisions, similar to the LEED for Neighborhood Development system. Many of the mandatory requirements from the ICC 700 National Green Building Standard are consistent with the family of International Code Council's codes.	Intended after Building Research Establishment Environmental Assessment Scheme (BREEAM).	Meeting or achieving ASHRAE standards is necessary for achieving some of the LEED® levels, including ASHRAE 90.1-2007 and 90.1-2010.	



BUILDING RATING OR CERTIFICATION SYSTEM	SINGLE- OR MULTI-ATTRIBUTE	TYPE OF STANDARD OR CERTIFICATION	MANAGING ORGANIZATION	ISSUES / AREAS OF FOCUS
Energy Star	Single-Attribute	Government certification using a benchmarking method	U.S. EPA and U.S. DOE	Building energy and water use
Leadership in Energy and Environmental Design (LEED)	Multi-Attribute	Green building rating and certification system through independent third-party verification for: <ul style="list-style-type: none"> New Construction (NC) Existing Buildings, Operations & Maintenance (EB-OM) Commercial Interiors (CI) Core & Shell (CS) Schools (SCH) Retail Healthcare (HC) Homes Neighborhood Development (ND) 	U.S. Green Building Council	Performance in: <ul style="list-style-type: none"> Sustainable Sites Water Efficiency Energy & Atmosphere Materials & Resources Indoor Environmental Quality Locations & Linkages Avant-garde & Education Innovation in Design Regional Priority through a set of prerequisites and credits
Green Globes	Multi-Attribute	Green building guidance and assessment program for: <ul style="list-style-type: none"> Existing buildings New construction 	Green Building Initiative in the U.S. BCMA Canada	Environmental assessment areas to earn credits in: <ul style="list-style-type: none"> Energy Indoor Environment Site Water Resources Emissions Projects Environmental Management <p>No prerequisites</p>
Living Building Challenge	Multi-Attribute	Performance-based standard, and certification program for: <ul style="list-style-type: none"> Landscape and infrastructure projects Partial renovations and complete building renewals New building construction Neighborhood, campus and community design 	International Living Future Institute	Performance areas include: <ul style="list-style-type: none"> Site Water Energy Materials Health Equity Beauty <p>All areas are requirements.</p>
NZEB	Multi-Attribute	Certification program using the structure of the Living Building Challenge which can be applied to any building type.	International Living Future Institute	One hundred percent of the project's energy needs must be supplied by on-site renewable energy on a net annual basis, without the use of on-site combustion. NZEB certified buildings must also meet the following requirements of the Living Building Challenge: <ul style="list-style-type: none"> the first half of Imperative One, Limits to Growth, dealing with appropriate siting of buildings Imperative 19, Beauty and Spirit Imperative 20, Inspiration and Education
SITES	Multi-Attribute	Third party verified rating system for development projects located on sites with or without buildings.	Administered by GBCI	Performance criteria in the areas of: <ul style="list-style-type: none"> Water Wildlife Habitat Energy Air Quality Human Health Outdoor recreation opportunities
WELL Building Standard	Multi-Attribute	Performance based standard and certification program for: <ul style="list-style-type: none"> New and Existing Buildings New and Existing Interiors Core and Shell Retail Education Facilities Restaurant Commercial Kitchen Multifamily Residential 	Administered by the International WELL Building Institute™ (IWBI)	Measures attributes of buildings that impact occupant health by looking at seven factors: Air, Water, Nutrition, Light, Fitness, Comfort, Mind

WBDG SUMMARY

Whole Building Design Guide, Resources Pages
Criteria included single and multi-attribute systems
This summary excludes International Programs including BREEAM



WBDG Whole Building Design Guide®

How Does This All Relate To BICSI

- Lighting Control, Receptacle Control, Measurement & Verification, Energy Management Systems, Mechanical Control Systems, etc., all depend on communication systems. IoT now being applied to occupancy, CCTV analytics, temperature, humidity, CO2, power consumption, etc. Understand where we have an opportunity to participate.

5. QUESTIONS

