

Sustainable Construction Guide for Single Family Homes:

Key Reference: Green Globes for New Construction Multifamily Protocol

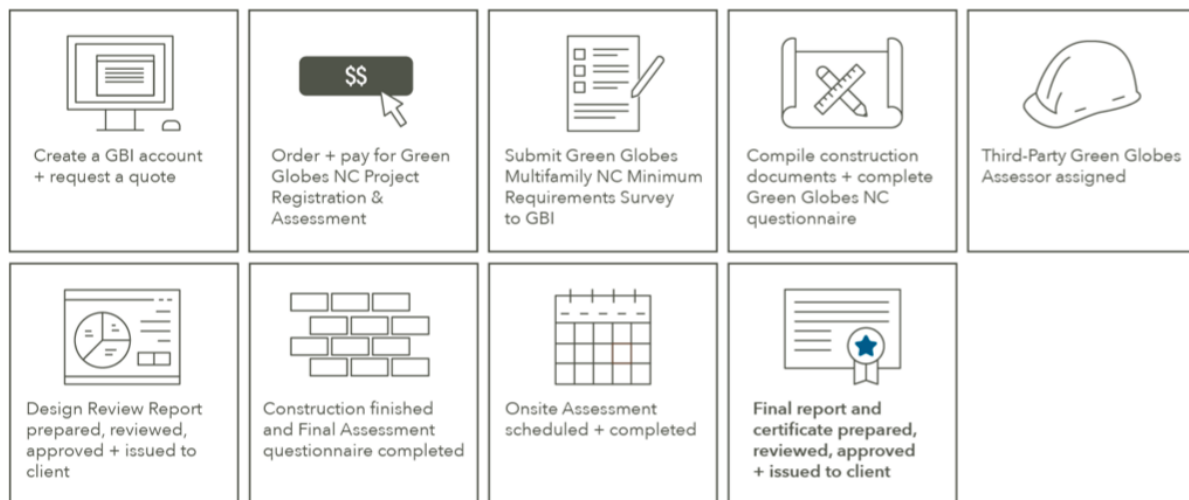
https://thegbi.org/files/training_resources/Green_Globes_NC_2013_MF_Protocol_Guidance_2021-August2021.pdf

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TOTAL		1000

Certification Process:



Minimum Basic Requirements:

15% energy saving in building design over established baseline

Ventilation:

- Acceptable Indoor Air Quality in Low Rise Residential Buildings
- https://ashrae.iwrapper.com/ViewOnline/Standard_62.2-2013
- Air handling equipment with ventilation air
- Operations/maintenance plan

Energy:

- ENERGY STAR performance score of 75 or better in Target Finder Program
- ENERGY STAR certified products and appliances
- Whole project metering and energy consumption data for each energy utility type
- ENERGY STAR portfolio manager
- Required docs for Green Globes:
 - Completed minimum req survey
 - Construction docs with ventilation info
 - ENERGY STAR Portfolio Management Statement of Energy Design Intent (SEDI) survey, screenshot of ENERGY STAR score
 - Energy model outputs

1. Project Management (50 pts)

Integrated Design Process (9)

- At least 5 key design jobs employed for project
 - Architect
 - Contractor
 - Landscape Architect
 - Mechanical Engineer (HVAC/Plumbing)
 - Structural Engineer
 - Interior Designer
- Were there Green Design Goals established at the pre-design phase
 - Site design?
 - Envelope?
 - Materials Efficiency?
 - Indoor Environment?
- Were there performance objectives established in the pre-design phase
 - Energy efficiency?
 - % of energy renewable?
 - GHG emission?
 - Water conservation, efficiency, and reuse?
 - Life cycle cost analysis (a cost of ownership financial analysis is performed on the project's collective bundle of green features that are expected to impact (project first costs, operation costs)
 - Construction waste diversion
- Did the IDP team hold meetings prior to project phases
 - Concept Design Phase?
 - Design Development Phase?
 - Construction Documents Phase?

Environmental Management During Construction (12)

- Emergency Management System (EMS) elements documented by GC
 - GC's environmental policies
 - Regulatory compliance and training

- Environmental risk assessment showing sensitive ecological areas for construction
- Environmental Risk Management Strategies
- Environmental Management Roles, Responsibilities, and Reporting Structure for construction phase
- Site and work instructions for site personnel
- Environmental Inspection checklists
- Records of compliance
- GC clean diesel strategies (idling-reduction, clean fuels (low sulfur diesel), engine upgrades/maintenance records)
- Best practices for sustainable building materials/control mold
 - Organic materials that could absorb moisture protected
 - Building envelope is weather tight and permitted to dry before installation of interior walls, wood floors, ceilings, and HVAC systems
- One of the following done to maintain good indoor air quality
 - Area under construction to be flushed with 100% outdoor air 14 consecutive days and filters changed after flush out prior to occupancy
 - Baseline Indoor Air Quality Testing results as per EPA Testing for Indoor Air Quality

Commissioning (29)

- Commissioning agent to lead team and to document Owner Project Requirements/Basis of Design which includes:
 - Mechanical/HVAC systems, plumbing, temp, daylight/shading, etc.
- Property Commissioning which includes
 - HVAC&R systems, building envelope, structural systems, fire protection systems, plumbing systems, electrical system, lighting system/controls
- Operations and Maintenance Manual
 - For all systems/replacements in units (HVAC/filters, energy metering reporting, water efficiency plan (water filter replacements))
 - Waste minimization plan, general housekeeping, pest management plan, chemical management, low-impact site, site maintenance contract
 - Operating schedule for EPA Water sense tech auto-rain shutoff/moisture sensors for irrigation

2. Site (115 pts)

Development Area (30)

- Is the project located within 0.5 miles from a commercial zone
- Is building being constructed on a previously developed site that had a utility structure for at least a full year
- Is the building being constructed on a brownfield
- Is the project avoided of being located on a site that was used for farmland, public recreation/park, natural/wildlife area
- Does the project avoid construction or site disturbance in the 100 year flood plain

Ecological Impacts (32)

- Erosion and Sedimentation Control Plan signed and stamped by a professional engineer
 - Construction Site Planning and Management Measures (preserving natural vegetation)
 - Erosion/Sediment Control Plans (area of disturbance, amount of precipitation, stormwater runoff/runon/volume, soil info, stormwater engineering plans)
 - Natural buffers for surface water within 50 ft, install perimeter controls, minimize sediment trackoff, control discharge, minimize dust, preserve topsoil, minimize soil compaction, protect storm inlets
- Are the following in the landscape plan:
 - Large trees, tree clusters, undergrowth
 - Tree protection barriers enclosing a minimum Tree Protection Zone (TPZ) around the trees and shrubs on the site
 - Root protection installed to protect tree roots
 - Sediment control barriers to fill/excavate near TPZ
- Do buildings have a vegetated roof/roof with high solar reflective index SRI (over 70% of the roof is vegetated/shaded; has a high SRI)
- Hardscape surfaces: (all other constructed materials apart from the building (walkways, sidewalks, driveways, etc.)
 - solar reflectance (SR value of at least 0.28)

- shading (shaded by things other than the building)
- permeable surfaces (at least 50% is permeable); clay, concrete paver, gravel, mulch, pervious concrete
- 75% of opaque wall surfaces (by area) on the east, west, and south have an SRI of 29 or greater

Stormwater Management (18)

- Is there a stormwater management report by a civil engineer
 - shows local watershed flood and erosion control targets
 - A minimum of 80% Total Suspended Solids (TSS) removal or complies with municipal AND/OR local watershed water quality control targets
 - The site will retain at least 50% of total average annual rainfall volume Site Water Balance Assessment
 - Are hardshape structures 100ft or more from a natural body of water/waterway

Landscaping (28)

- Was a landscape design planned/installed
 - By a professional landscape architect
 - Plan includes types of plantings/soils used and maintenance schedules for plant care, pruning, fertilizers, mulch and turf
 - Pest management, irrigation schedules, eco roofs and rain gardens
 - Shows the natural light conditions of the site; AND structural limitations (shading, utilities, overhangs, and lights) that would impact the location and growth of plants
- Identifies existing soil types; uses appropriate soil drainage for vegetation and root development planned on site
- 75% or more of vegetated area uses non-invasive and drought tolerant plants
- 75% or more of vegetated area covered by native plants
- Minimal turf grass limited to within 20 ft of buildings and doesn't extend beyond 5 ft from driveways, sidewalks, rain gardens, bioswales, and retention
- Broken up soil (6 in)/organic mulch

- Do plans show groups of plants with similar water requirements are grouped together on site; plants spaced to allow for 5 yr growth
- 15% of impervious walkways/pathways/driveways have pervious materials
- On site agriculture accessible for tenants through rooftop gardens, edible landscapes, at least 25% pollinator friendly plants, aquaponics farm

Exterior Light Pollution (7)

- Electrical engineer created lighting design meeting all requirements IDA-IES Model Lighting Ordinance
- Moderate ambient lighting (LZ2)

3. Energy (390 pts)

Energy Performance (100)

- ENERGY STAR Portfolio Manager to compare actual performance data in first year of operation with energy design target.
- Building design must achieve greater than 15% projected energy consumption savings and meet all 3 Energy Minimum Requirements:
 - Energy STAR Score: score greater than 75 in the Target Finder program
 - Try to receive a 94 or better for full points
 - Install Energy STAR appliances/products
 - Energy consumption metering for each utility type
 - Was an energy simulation performed to determine strategies for HVAC and lighting (based on windows, walls, envelope)
 - Was a simulation of systems for envelope lighting, and HVAC done
- Docs for basis of utility rates per building
- CO2 emission reduction (from solar panels)

Energy Demand (35)

- Load shedding
 - Lighting systems can reduce 30% or more from peak power
 - HVAC systems have it
- Does a minimum of 20% of the building envelope gross wall area have a heat capacity of at least 5 Btu/ft²°F
- Does a minimum of 20% of interior partition mass walls within building envelope have 7 Btu/ft²°F
- Thermal Mass: the ability of a building component to absorb and store heat (effective in reducing temp variations which reduces peak electrical demand for cooling/increases conductivity)
- Are 50% of return air plenums located directly in contact with a floor or wall having 7 Btu/ft²°F
- Modeled monthly power demand factor (lowest monthly kW demand versus peak monthly kW demand) is >85%
 - For example: July = 3500 kW and Jan. = 2000 kW ----> Ineligible (57%)

Metering, Measurement, and Verification (12)

- 100% of heating, cooling, and electricity is metered
- Submetering for: HVAC systems, onsite renewable energy power generation, heating water
- Energy Metering Reporting Plan
 - Seasonal peak demand and month consumption (HVAC, chilled/heated water, renewable energy)

Building Opaque Envelope (31)

- Do the thermal resistance (R/RSI values) or thermal transmittance values (U,C,F-factor) values for all opaque elements meet requirements
- R Values (inch per pound): insulation in framing cavities

- U,C,F-factors (inch per pound): heat transmission in a unit of time through a unit of area induced by unit temperature difference on both sides
- Requirements for Climate Zone 1 (South Florida)

CLIMATE ZONE	1
Opaque Elements	
Roofs	
Insulation above Deck	U-0.063
Metal Building	U-0.065
Attic and Other	U-0.034
Walls Above Grade	
Mass	U-0.580
Metal Building	U-0.093
Steel Framed	U-0.124
Wood Frame & Other	U-0.089
Walls Below Grade	
Below Grade Wall	C-1.140
Floors	
Mass	U- 0.332
Steel Joist	U-0.052
Wood Frame & Other	U-0.051
Slab-On-Grade Floors	
Unheated	F-0.730
Heated	F-1.020
Opaque Doors	
Swinging	U-0.700
Non-Swinging	U-1.450

CLIMATE ZONE	1
Opaque Elements	
Roofs	
Insulation above Deck	R-15.0 ci
Metal Building	R-19.0
Attic and Other	R-30.0
Walls Above Grade	
Mass	NR
Metal Building	R-16.0
Steel Framed	R-13.0
Wood Frame & Other	R-13.0
Walls Below Grade	
Below Grade Wall	NR
Floors	
Mass	NR
Steel Joist	R-19.0
Wood Frame & Other	R-19.0
Slab-On-Grade Floors	
Unheated	NR
Heated	R-7.5 for 12 in.
NR – No Requirement CI – Continuous Insulation	

CLIMATE ZONE	1
Framing materials other than metal wit	
<i>U-factor</i>	1.20
Metal framing with or without thermal	
Curtain / Storefront <i>U-factor</i>	1.20
Entrance Door U	1.20
All Other <i>U-Factor</i> ^a	1.20
Skylights (3% maximum)	
<i>U-factor</i>	0.75
SHGC-All Frame Types	
SHGC: North ^b	0.45
SHGC: E, S & W PF < 0.25	0.25
SHGC: E, S & W 0.25 ≤ PF < 0.5	0.30
SHGC: E, S & W PF ≥ 0.5	0.40
Skylights (3% maximum)	
SHGC	0.20
NR = No requirement. PF = <i>Projection factor</i>	

- Ratio of North/South fenestration area to east/west fenestration area between 1.25 and 2 (2 for all 5 points credited)
- Fenestration: All areas including frames in the building envelope that transmit lighting
- Fenestration area is less than or equal to table U-values

- Is the Solar Heat Gain Coefficient (SHGC) of the building fenestration system less than or equal to table values
- List of SHGC values should be included
- Calculate weighted average for all these values

Lighting (36)

- Total lighting power density (LPD); energy use (watts) per square foot
- Multifamily = 0.60 W/ft² ; Office = 0.90 W/ft²
- Interior automatic lighting shutoff (over 50% of lighting is time scheduled)
- Reduce lighting load by 50% using dual switching/individual lamps and occupancy sensors
- Is the vertical fenestration (windows, etc.) and the skylights equal to at least 10% of sqft
- What percentage of the roof has skylights (at least 5% of roof)
- Use a light bulb/lamp that has at least 60 lumens per watt
- Mercury free/LED

HVAC Systems and Controls (59)

- Automation system that encompasses all systems affecting energy performance, lighting, and thermal comfort

Other HVAC Systems and Controls (32)

- HVAC system efficiency and capabilities
 - Efficient cooling systems (A/C) (2 speed fans)
 - Water heater (tankless)
 - HVAC design uses ventilation compartmentalization (eliminates reheat and recool by using zoning systems)
- Minimize/eliminate reheat and re-cool (resets cooling supply air temperature in shoulder and cooler weather)
- Fans and ductwork systems (registers and diffusers with full flow pressure drop no greater than 0.1 in)
- Is there a Variable Refrigerant Flow (VRF) system technology

Other Energy Efficient Equipment and Measures (11)

- Energy efficient lighting fixtures/lamps, etc..

Renewable Energy (50)

- On-site Renewable Energy (Study on technical feasibility and lifecycle cost; what percentage of site energy is produced by systems)
- Purchase renewable energy certificates (tradable energy commodities representing proof that 1 megawatt-hour of electricity was generated from a renewable source)
- <http://apps1.eere.energy.gov/states/>
- <http://energy.gov/eere/femp/building-life-cycle-cost-programs>

Energy Efficient Transportation (24)

- Is the site within 0.25 miles of public trans/bikepath/lane
- Is there bike parking for at least 50% of units
- Is there alternative refueling or EV chargers
- Walkability index greater than 75% (walkscore.com)

4. Water Efficiency (190 pts)

Water Consumption (42)

- Using the Green Globes Water Consumption Calculator, is the projected water consumption > 40% less than the given baseline based on the following variables:
 - Square footage, occupancy, water factor for dishwashers and washers
 - Daily flush fixture usage, daily use of showers/sinks
- Plumbing fixtures and fittings must comply with EPA's Watersense Program (fixtures use 20% less water than average products without sacrificing performance)
- http://www.epa.gov/watersense/product_search.html
 - Toilets (Maximum flush volume 1.28 gal. (4.8 L) per flush)
 - Showerheads (Maximum flow rate 2.0 gal. (7.6 L) per minute)

- Residential lavatory faucets (Maximum flow rate 1.5 gal. (5.7 L) per minute)
- Residential kitchen faucets (Maximum flow rate 2.2 gal. (8.3 L) per minute)
- Residential Indoor Appliances
 - Are residential clothes washers ENERGY STAR labeled and possess a maximum water factor (WF) of 6.0 gal/ft³ per full cycle?
 - Are residential dishwashers ENERGY STAR labeled and possess a maximum water factor (WF) of 5.8 gal/ft³ per full cycle

Hot Water Heaters (4)

- Efficient hot water delivery piping systems
- Hot water recirculating systems using occupant sensors

Water Intensive Applications (18)

- Water leak detection and recirculation
- Non-potable water used (storm water)
- Rain tanks to take over 50%

Water Treatment (3)

- Reverse osmosis

Alternate Sources of Water (5)

- What percentage of indoor water sources are met with non-potable water (toilets)
- Pre-plumbed systems (rain water, recycled water, reclaimed water) → use grey water for raintanks
- Replacing potable water for rain/recycled water for outdoor sources (irrigation) and water features

Water Metering (11)

- Sub-metering installed (irrigation too)
- Water supply pipes have meters
- 90% of units have tenants view their consumption of water and billed accordingly

Irrigation (18)

- Over 75% of exterior vegetated spaces don't require irrigation
- Does the irrigation system have gutters, reclaiming water systems (raintanks), capability to regulate precipitation rate
- Over 45% reduction in water demand; EPA Watersense Water Budget Tool
- Smart sense tech for irrigation SWAT (smart water application technology); pressure regulation/flow sensing

5. Material Resources (150 pts)

Building Assembly/Core and Shell Envelope (33)

- 2 building designs with one of them having a total of 30 percent lower global warming, acidification, eutrophication, ozone, and smog potential
- The LCA must minimally be cradle-to-grave, addressing resource extraction, manufacturing, building construction, product replacement, demolition, landfill processes, and transportation in all stages. If the assessments include operating energy, all relevant processes from energy extraction to delivery and consumption must be included.
- Documentation provided **during the design review prior to showing construction docs:**
 - The Athena Impact Estimator for Buildings (Version 4.2 or later): <http://calculatelca.com/software/impact-estimator/>
 - GaBi Software Building LCA: <http://www.gabi-software.com/america/solutions/building-lca/>
 - SimaPro Sustainability Life Cycle Assessment Carbon Footprinting: <http://www.simapro.co.uk/>
 - CMLCA Scientific Software for LCA: <http://www.cmlca.eu/>

Impacts	Units	Reference Design	Final Design	% Change Final Design
GWP	Kg CO ₂ eq	384,786	338,612	-12%
Acidification	Kg SO ₂ eq	3,231	3,199	-1%
Eutrophication	Kg N eq	44.1	45.9	+4%
Ozone	Kg CFC-11 eq	0.00034	0.00034	0%
Smog	Kg O ₃ eq	10,820	9,738	-10%
Fossil Fuel	MJ	6,560,563	5,576,479	-15%

Interior Fitouts/Finishings and Furnishings (16)

- Third party certifications showing cradle-to-gate product lifecycle (third party verified type III Environmental Product Declarations)
- Docs shown during **Design Review**
- LCA for minimum of 2 alternative interior fitouts
- How many products have a 1st, 2nd, or 3rd party risk assessment; screening level product risk assessment (constituent chemicals, hazardous ingredients, human health, safety, and ecological impacts)

Reuse of Existing Structures (26)

- What percentage of the facade/structural systems/nonstructural elements/furnishings from an existing building on the site is retained and incorporated in new design
- Atleast of reused, refurbished and/or offsite salvaged materials are incorporated in place of new materials

Waste (9)

- Was a pre-construction waste management plan created/was a summary report done after construction
- What is the amount of construction waste per unit area of the building floor (less than 1.2lbs/ft²)
- What percentage of construction waste is diverted from the landfill (at least 75%)
- Recycling collection, annual recycling data, landfill diversion through recycling, returning, reusing, selling to 3rd party, commercial composting, less than 10% combustion, waste-to-energy (taking out all of recycled parts)
- US Zero Waste Business Council verification

Building Service Life Plan (7)

- Is there a preliminary Building Service Life Plan (BSLP) that includes the expected service life estimates for the building,

structural systems, building envelope, and hardscape materials that will need to be replaced

- The mechanical, electrical, plumbing, and energy generation systems that will require inspection and/or replacement during service life of the building
- Schedule for maintenance, repair and replacement
- <http://www.wbdg.org/tools>

Resource Conservation (6)

- Material efficiency and minimizes use of raw materials
- Over 20% building elements are prefabricated/modular construction
- Design for deconstruction/end of life removal plan
- Assemblies that perform multiple functions, easy to deconstruct/reconfigure

Envelope Roofing/Openings (10)

- Constructed according to manufacturer with tech personnel
- Flashings and sheet metal: prescribed/inspected (gutters)
- Moisture management design that is prescribed/inspected per industry standard and tested
- Windows/skylights/doors all meet standards

Envelope Foundation/Waterproofing (6)

- Requirements to be constructed with slab on ground vapor retarders
- Slab on grade positioned directly over vapor retarders and capillary-break base courses
- 5% slope grade away indicated from building for at least 10 ft
- Roof drainage to be directed at least 3 ft beyond the building overhang; foundation drainage system

Envelope Cladding (5)

- Install cladding systems that are either EIFS cladding system, aluminum framed glazing systems, or masonry veneer cladding
- Exterior rain screen wall cladding system

Envelope Barriers (7)

- Air barrier material for each assembly detail shows air tight and flexible joints
- Withstands positive and negative wind; does not displace materials under full load
- Building, assembly, and materials tested

6. Emissions (50 pts)

Heating (18)

- Is district heating used?
- A district heating system consists of a heating production plant and a transport network. The district heating system will provide thermal energy to more than one building at the same time. This district heating system can produce steam, heating hot water, or domestic hot water. District heating plants can provide higher efficiencies and improved pollution control than localized boilers.
- Low/ultra-low NOx/CO emission boilers and furnaces

Cooling (29)

- Have near zero or zero ozone depletion potential/global warming potential (no refrigerants)

7. Indoor Environment (160 pts)

Ventilation (37)

- Quantity of air ventilation meets requirements
- Air change effectiveness: zone air distribution effectiveness (Ez value) is greater than or equal to 0.9 (cool, warm, ceiling, and floor air)
- Naturally ventilated spaces are close to door/window/roof opening that is as large as 5% of area being ventilated
- CO2 sensing

Source Control and Measure of Indoor Pollutants (46)

- Volatile Organic Compounds (VOC) are tested with manufacturer declarations or 3rd party verification
- Provide documentation indicating compliance with VOC emission requirements for adhesives/sealants, paintings/coatings, floors, acoustic/thermal insulation, ceiling/wall systems, furniture and furnishings
- Compliance with predetermined
 - EcoLogo (Paints & Adhesives) – Environmental Choice
 - Green Seal (Paints & Adhesives)
 - FloorScore (Resilient Flooring)
 - UL 2818 GREENGUARD Certification Program for Chemical Emissions for Building Materials, Finishes, and Furnishings
 - Indoor Advantage Gold
- HVAC can control moisture and dew point, materials resistant to mold growth
- Pest and contamination control systems
- Non-smoking policy
- Pre-occupancy Indoor Air Quality Test/Total VOC count
 - U.S. EPA's Compendium of Methods for the Determination of Toxic Organic Pollutants in Ambient Air

Lighting Design and Systems (30)

- Over 75% of the floor area achieves a DF (daylight factor) of at least 2
 - $DF = 0.1 \times PG$, where:
 - DF = daylight factor
 - PG = percentage of glass to floor area (area of the windows/floor area)
- Majority of living area has views of outside
- Active, automated shading devices
- Over 75% of daylit areas use photo-sensors to maintain consistent lighting levels
- Meets Recommended Illuminance
 - Based on the Illuminating Engineering Society (IES): The Lighting Handbook

Thermal Comfort (18)

- HVAC systems and building design provides a thermal environment

Acoustic Comfort (29)

- Acoustic sealing of wall panels/penetrations that are fire-stopping/rated
- Entry doors a
- Are HVAC fans/equipment acoustically separated using vibration isolators
- No piping noise/electrical system noise