Last Updated – June 10, 2024

Introduction

The "Net Zero Narrative" is required for projects subject to Green Building Requirements, Section 22.20 of the Cambridge Zoning Ordinance. The requirement is based on the recommendations of the City's Net Zero Action Plan (adopted in 2015), which seeks to neutralize greenhouse gas emissions in Cambridge by 2050. This plan sets a timeframe of 2025 for most new construction to be designed to a "net zero" standard, meaning that on an annual basis, all greenhouse gas emissions resulting from building operations are offset by carbon-free energy production. In the meantime, the goal is to reduce greenhouse gas emissions to the maximum extent possible, and to design and develop buildings to adapt to net zero emissions in the future.

This Net Zero Narrative is provided for advisory review only. It is intended to inform City staff and officials on how the Net Zero Action Plan has influenced the design of the project, and to begin a dialogue so that all parties can better understand what building improvements are possible and what the major barriers are to achieving net zero emissions. As research, design, and development of the project continues to unfold, this narrative must be updated and included in the submission for the Building Permit and Certificate of Occupancy.

Example Narrative Template

This document provides an example format for the Net Zero Narrative as a guide for developers and designers. Variations are appropriate to account for the unique conditions of a case. However, any Net Zero Narrative must include the components set forth in Paragraph (c), Section 22.25.1 of the Zoning Ordinance:

(1) anticipated building envelope performance, including roof, foundation, walls and window assemblies, and window-to-wall ratio;

(2) anticipated energy loads, baseline energy simulation tool assumptions, and proposed energy targets, expressed in terms of site energy use intensity ("EUI"), source EUI (expressed as British Thermal Unit (BTU) per square foot per year), and annual greenhouse gas emissions projected until 2050, expressed as Metric Tons of Carbon Dioxide Equivalents (MTCO2e), and calculated in accordance with the standards and requirements established in Chapter 8.67 of the Municipal Code ("Building Energy Use") and associated regulations. If anticipated tenant plug loads (EUI and emissions) are provided, they shall be separately broken out and clearly identified as such;

(3) description of ways in which building energy performance has been integrated into aspects of the Green Building Project 's planning, design, and engineering, including building use(s), orientation, massing, envelope systems, building mechanical systems, on-site and off-site renewable energy systems, and district- wide energy systems;

(4) description of the technical framework by which the Green Building Project can be transitioned to net zero emissions prior to 2050 (acknowledging that such a transition might not be economically feasible at first), including future net zero emissions options for building envelope, HVAC systems, domestic hot water, interior lighting, and on- and off-site renewable energy sources;

(5) description of programs provided by local utility companies, government agencies, and other organizations that provide technical assistance, rebates, grants, and incentives that can assist in achieving higher levels of building performance, summarizing which entities have been contacted and which programs could be utilized in the Green Building Project;

Net Zero Narrative – EXAMPLE TEMPLATE

Project Name/Address:

Submitted By:

Date of Submission:

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(6) assessment of the technical and financial feasibility to meet the projected HVAC and domestic hot water demands of the building as noted above in (2) using energy systems that do not consume carbon-based fuels on-site compared to code-compliant energy systems that consume carbon-based fuels on-site, which shall include the cost of installation, maintenance and upkeep of the energy system and its components (incorporating programs and incentives as noted above in (5); and

*(7) embodied carbon w*hole building lifecycle analysis of the estimated emissions generated by the construction of the Green Building Project. As further detailed in the below template, such reporting shall include at minimum the estimated lifecycle emissions generated by the use of major building materials, including but not limited to wood, concrete, steel, aluminum and glass, using embodied emissions modeling software and industry standards acceptable to CDD staff. This section shall not impose a requirement on any building project that does not meet the standard threshold for project review special permit of 50,000 square feet or includes housing units.

Net Zero Narrative – EXAMPLE TEMPLATE

Project Name/Address:

Submitted By:

Date of Submission:

Project Profile

Development Characteristics

Lot Area (sq.ft.):	
Existing Land Use(s) and Gross Floor Area (sq.ft.), by Use:	
Proposed Land Use(s) and Gross Floor Area (sq.ft.), by Use:	
Proposed Building Height(s) (ft. and stories):	
Proposed Dwelling Units:	
Proposed Open Space (sq.ft.):	
Proposed Parking Spaces:	
Proposed Bicycle Parking Spaces (Long-Term and Short-Term):	

Green Building Rating System

Choose the Rating System selected for this project:

LEED-Leadership in Energy & Environmental Design (U.S. Green Building Council)					
Rating System & Version:		***Seeking Certification?****	Yes	No	TBD
Rating Level:		***# of Points:***			

Enterprise Green Communities					
Rating System & Version:		***Seeking Certification?****	Yes	No	TBD
Rating Level:		***# of Points:***			

Passive House Institute US (PHIUS) or Passivhaus Institut (PHI)					
Rating System & Version:		***Seeking Certification?****	Yes	No	TBD

**NOTE: Certification is not required through the Green Building Requirements. However, you may choose to indicate if the Project Team intends to pursue formal certification through these Green Building Rating Programs (or their affiliates).*

Net Zero Narrative – EXAMPLE TEMPLATE

Project Name/Address:

Submitted By:

Date of Submission:

Proposed Project Design Characteristics

Building Envelope

Assembly Descriptions:

Roof:	*[Describe assembly/assemblies …]*
Foundation:	*[Describe assembly/assemblies …]*
Exterior Walls:	*[Describe assembly/assemblies …]*
Windows:	*[Describe assembly/assemblies …]*
Window-to-Wall Ratio:	*[Calculate approximate % of window glazing to total façade area]*
Other Components:	*[Describe any additional envelope components …]*

Envelope Performance:

Provide estimates of the thermal transmittance (U-value) for the building envelope compared to "Baseline" standards required by the Massachusetts Stretch Energy Code, latest adopted edition.

	Proposed		***Baseline***	
	Area (sf)	*U-value*	*Area (sf)*	*U-Value*
Window				
Wall				
Roof				

Envelope Commissioning Process:

[Describe anticipated commissioning process for building envelope components …]

Net Zero Narrative – EXAMPLE TEMPLATE

Project Name/Address:

Submitted By:

Date of Submission:

Building Mechanical Systems

Systems Descriptions:

Space Heating:	*[Describe systems …]*
Space Cooling:	*[Describe systems …]*
Heat Rejection:	*[Describe systems …]*
Pumps & Auxiliary:	*[Describe systems …]*
Ventilation:	*[Describe systems …]*
Domestic Hot Water:	*[Describe systems …]*
Interior Lighting:	*[Describe systems …]*
Exterior Lighting:	*[Describe systems …]*
Other Equipment:	*[Describe any other building mechanicals/utilities]*

Systems Commissioning Process:

[Describe anticipated commissioning process for building systems …]

Net Zero Narrative – EXAMPLE TEMPLATE

Project Name/Address:

Submitted By:

Date of Submission:

Building Energy Performance Measures

Overview

Broadly describe the ways in which building energy performance has been integrated into the following aspects of the project's planning, design, engineering, and commissioning. More detail on specific measures can be provided in appendices.

Land Uses:	*[Examples: Mixed-use development promoting walking and bicycling, efficient arrangement of uses within a site …]*
Building Orientation and Massing:	*[Examples: Solar orientation (for daylighting, reduced heat gain, solar energy capacity, &c.), passive ventilation …]*
Envelope Systems:	*[Examples: Continuous insulation, high performance glazing, sun screening, green roofs …]*
Mechanical Systems:	*[Examples: Heat pumps, energy/heat recovery equipment, high-efficiency equipment …]*
Renewable Energy Systems:	*[Examples: Solar energy, geothermal energy, wind energy …]*
District-Wide Energy Systems:	*[Examples: District cogeneration, waste steam from power plants, microgrids …]*
Other Systems:	*[Examples: Electric vehicle charging …]*

Net Zero Narrative – EXAMPLE TEMPLATE

Project Name/Address:

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Date of Submission:

Integrative Design Process

Describe how different parties in the development process (owners, developers, architects, engineers, contractors, commissioning agents) have collaborated in the design. Include the Basis of Design and Owner's Project Requirements and describe how they have been informed by planning activities such as meetings or design charettes. Describe how continuing collaborative processes will inform Schematic/Design and Construction Documents.

Green Building Incentive Program Assistance

Describe any programs applicable to this project that would support improved energy performance or reduced greenhouse gas emissions, and which of those programs have been contacted and may be pursued. Programs may be offered by utility companies, government agencies, and other organizations, and might include rebates, grants, financing, technical assistance, and other incentives.

[Example programs: MassSave (Eversource), Massachusetts Clean Energy Center, MA Department of Energy Resources.]

Net Zero Narrative – EXAMPLE TEMPLATE

Project Name/Address:

Submitted By:

Date of Submission:

Net Zero Scenario Transition

Describe the technical framework by which the project can be transitioned to net zero greenhouse gas emissions prior to 2050, acknowledging that such a transition might not be economically feasible at first. This description should explain the future condition and the process of transitioning from the proposed design to the future condition.

	Net Zero Condition:	***Transition Process:***
Building Envelope:	*[Describe measures that could be implemented to meet "net zero" performance prior to 2050.]*	*[Describe process for adapting from the current proposal to a "Net Zero Condition" prior to 2050.]*
HVAC Systems:	*[Describe measures that could be implemented to meet "net zero" performance prior to 2050.]*	*[Describe process for adapting from the current proposal to a "Net Zero Condition" prior to 2050.]*
Domestic Hot Water:	*[Describe measures that could be implemented to meet "net zero" performance prior to 2050.]*	*[Describe process for adapting from the current proposal to a "Net Zero Condition" prior to 2050.]*
Lighting:	*[Describe measures that could be implemented to meet "net zero" performance prior to 2050.]*	*[Describe process for adapting from the current proposal to a "Net Zero Condition" prior to 2050.]*
Renewable Energy Systems:	*[Describe measures that could be implemented to meet "net zero" performance prior to 2050.]*	*[Describe process for adapting from the current proposal to a "Net Zero Condition" prior to 2050.]*
Other Strategies:	*[Describe measures that could be implemented to meet "net zero" performance prior to 2050.]*	*[Describe process for adapting from the current proposal to a "Net Zero Condition" prior to 2050.]*

Net Zero Narrative – EXAMPLE TEMPLATE

Project Name/Address:

Submitted By:

Date of Submission:

Energy Systems Comparison

Overview

This section should describe the results of an analysis comparing the technical and financial feasibility to meet the projected HVAC and domestic hot water demands of the building using energy systems that do not consume carbon-based fuels on-site compared to code-compliant energy systems that consume carbon-based fuels on-site.

Assumptions

Describe what building energy systems were included and excluded in your analysis and why.

	Included in analysis?		***Describe the systems for which this was analyzed or explain why it was not included in the analysis:***
	Yes	***No***	
Solar Photovoltaics:			
Solar Hot Water:			
Ground-Source Heat Pumps (Geothermal):			

Water-Source Heat Pumps:			
Air-Source Heat Pumps:			
Non-Carbon-Fuel District Energy:			
Other Non-Carbon-Fuel Systems:			

Non-Carbon-Fuel Scenario

Describe the final scenario used in this analysis.

Net Zero Narrative – EXAMPLE TEMPLATE

Project Name/Address:

Submitted By:

Date of Submission:

Solar-Ready Roof Assessment

The purpose of this assessment is to determine the technical feasibility of solar energy system installation, either as part of the proposed project or in the future. It is helpful to supplement this narrative with a plan depicting the information provided.

Total Roof Area (sq. ft.):	*[Calculate roof area of all buildings in the project.]*
Unshaded Roof Area (sq. ft.):	*[Determine amount of roof area with adequate solar access for solar photovoltaic (PV) or hot water panels.]*
Structural Support:	*[Identify roof sections that will be designed to physically support solar PV or hot water panels, including a manual roof access point from the uppermost floor and a roof hoist mounting point/plate. Identify the solar panels' sun exposure angle.]*
Electrical Infrastructure:	*[Describe capacity of electrical panel to accommodate potential solar array capacity, pathway from solar-ready roof area to electrical panel, and location reserved for future inverters and other electrical equipment.]*
Other Roof Appurtenances:	*[Describe any other objects that will occupy roof area, such as mechanical equipment or headhouses, the extent to which those objects would preclude the installation of solar PV or hot water panels, and measures taken to minimize such interference.]*
Solar-Ready Roof Area (sq. ft.):	*[Based on information above, estimate the total roof area on which the installation of solar PV or hot water panels would be technically feasible either immediately or in the future.]*
Capacity of Solar Array:	*[Based on the solar-ready area, estimate the total energy capacity of a solar PV or hot water system, if installed.]*
Financial Incentives:	*[Describe programs that are available to mitigate the up-front costs of solar PV or hot water system installation, including the potential for third-party ownership.]*
Cost Feasibility:	*[Determine whether it is cost-feasible to install a solar PV or hot water system as a component of the project. This may be supplemented with a detailed third-party analysis.]*

Net Zero Narrative – EXAMPLE TEMPLATE

Project Name/Address:

Submitted By:

Date of Submission:

Results

Briefly summarize the results of the analysis and how it has informed the design of the project. Also include figures for the "Non-Carbon-Fuel Scenario" in the concluding Summary Table at the end of the Net Zero Narrative. Attachments can be provided with more specific figures and metrics regarding installation, maintenance, and upkeep costs (exclusive *of operating fuel expenses), but a full report is not necessary.*

	Proposed Design		***Non-Carbon-Fuel Scenario***	
	Installation Cost	*Maintenance Cost*	*Installation Cost*	*Maintenance Cost*
Space Heating				
Space Cooling				
Heat Rejection				
Pumps & Aux.				
Ventilation				
Domestic Hot Water				
(Financial Incentives)				
Total Building Energy System Cost				

Describe results and conclusions from the analysis.

Net Zero Narrative – EXAMPLE TEMPLATE

Project Name/Address:

Submitted By:

Date of Submission:

Anticipated Energy Loads and Greenhouse Gas Emissions

Assumptions

Describe the assumptions and methodology used to conduct preliminary energy modeling and set energy targets for the project. Specifically describe what components of the building were included and excluded.

Annual Projected Energy Consumption and Greenhouse Gas (GHG) Emissions

The preliminary energy modeling results should be shown in a concluding table format similar to what is shown on the next page. It should compare the "baseline building" (Massachusetts Stretch Energy Code) to the proposed design, as well as the "net zero" scenario projected by 2050 and described later in this narrative.

	Baseline Building		***Proposed Design***		***Future Net Zero Scenario***		***Non-Carbon-Fuel Scenario***	
	kWh or Therms	*% of Total*	*kWh or Therms*	*% of Total*	*kWh or Therms*	*% of Total*	*kWh or Therms*	*% of Total*
Space Heating								
Space Cooling								
Heat Rejection								
Pumps & Aux.								
Ventilation								
Domestic Hot Water								
Interior Lighting								
Exterior Lighting								
Misc. Equipment								
	$US, kBTU, kBTU/SF		*$US, kBTU, kBTU/SF*	*% Reduction from Baseline*	*$US, kBTU, kBTU/SF*	*% Reduction from Baseline*	*$US, kBTU, kBTU/SF*	*% Reduction from Baseline*
Site EUI								
Source EUI								
Total Energy Use								
Total Energy Cost								
	kWh or Therms	*% Total Energy*	*kWh or Therms*	*% Total Energy*	*kWh or Therms*	*% Total Energy*	*kWh or Therms*	*% Total Energy*
On-Site Renewable Energy Generation								
Off-Site Renewable Energy Generation								
	Tons CO_2 [/SF]		*Tons CO_2 [/SF]*	*% Reduction from Baseline*				
GHG Emissions								
GHG Emissions per SF								

It may be helpful to present this information in a chart or graph. The following page provides examples.

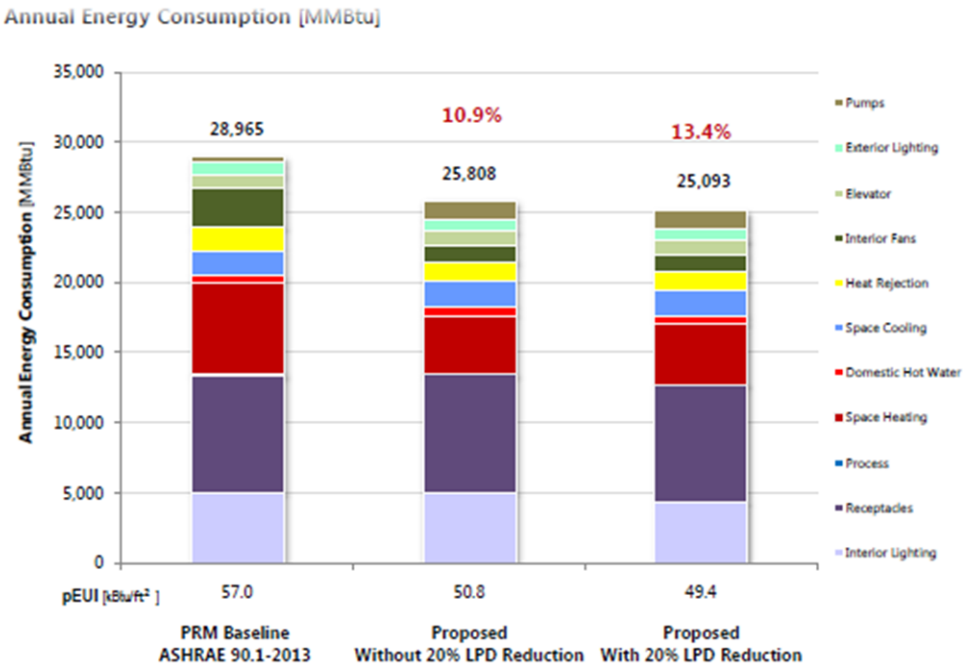
Net Zero Narrative – EXAMPLE TEMPLATE

Project Name/Address:

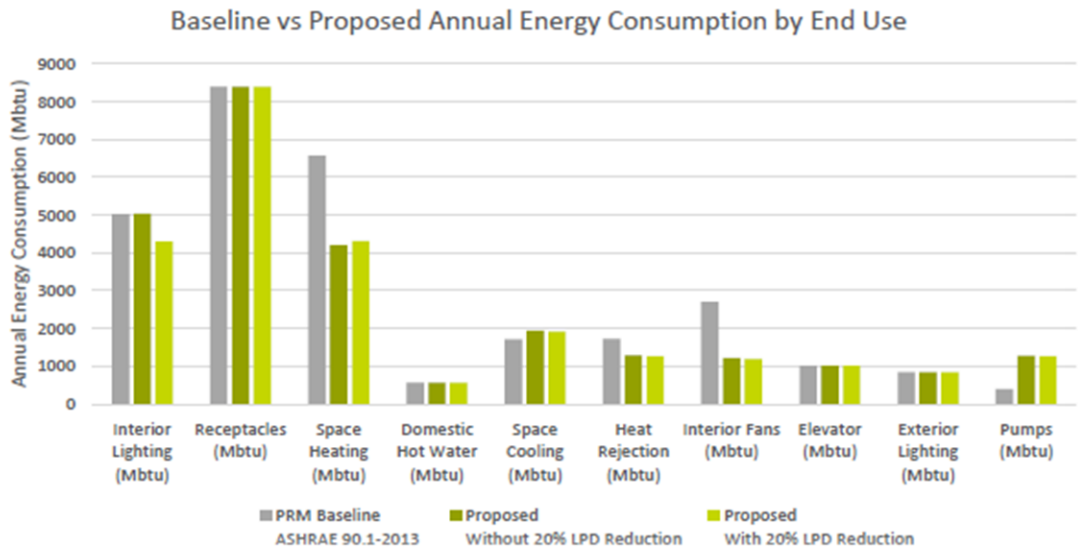
Submitted By:

Date of Submission:

Example Chart 1:



Example Chart 2:



CITY OF CAMBRIDGE EMBODIED CARBON REPORTING TEMPLATE

City of Cambridge Zoning Ordinance Amendment to Section 22.25.1(c) of Article 22, entitled Sustainable Design and Development (Ordinance No. 2022-20), Section 7. Embodied Emissions:

"A whole building lifecycle analysis of the estimated emissions generated by the construction of the Green Building Project. The Assistant City Manager for Community Development shall promulgate regulations for how these estimated emissions are to be reported.

Such regulations shall include at minimum the required reporting of estimated lifecycle emissions generated by the use of major building materials, including but not limited to wood, concrete, steel, aluminum and glass, using embodied emissions modeling software and industry standards acceptable to CDD staff. This paragraph will become effective on the date of final promulgation of the regulations for Green Building Projects that have not yet completed the initial stage of administrative review by such date, and shall not impose a requirement on any building project that does not meet the standard threshold for project review special permit of 50,000 square feet or includes housing units."

Applicability: For Projects after date of final promulgation of regulations (01/01/2024)

Is this project subject to Green Building Requirements (Section 22.20)?	□ Yes □ No
Does this project meet the threshold for Project Review special permit (Section 19.23)?	□ Yes □ No
Is the gross floor area of this project 50,000 square feet or more?	□ Yes □ No
Does this project exclude dwelling units?	□ Yes □ No

Complete this reporting template if the answer is "Yes" to ALL of the above.

EMBODIED CARBON REPORTING SUBMISSION PROCESS

Submission 1 – Special Permit Stage:

1. Submit all of the Required Narratives noted below and any of the applicable Optional Narratives.
2. A life cycle analysis (LCA) is not required at this submission stage.

Submission 2 - Building Permit Stage:

1. Submit revised Required Narratives and any applicable Optional Narratives to reflect the updated building design.
2. Complete a life cycle analysis (LCA) and complete all LCA-related fields included in this reporting template including:
    - Life Cycle Analysis Inputs
    - Life Cycle Analysis Results

Submission 3 – Certificate of Occupancy Stage:

1. No additional submission is required at this stage.

PROJECT INFORMATION INPUTS -

Current Project Design Phase (% Complete SD/DD/CD/CA)	
# Stories Above Grade	
# Stories Below Grade	

Definitions:

- Story. 'That portion of a building included between the upper surface of a floor and the upper surface of the floor or roof next above.'
- Story Above Grade. 'A Story whose highest point is more than 4 feet above the Grade.'
- Story Below Grade. 'Any Story that is lower than the Ground Story of a building.'

NARRATIVES -

Required Narratives:

☐ Narrative description of the project structural system chosen, and any alternative systems studied related to embodied carbon:

☐ Narrative description of the project enclosure system and materials chosen and any alternative systems/materials studied related to embodied carbon:

☐ Does the project include the adaptive reuse of an existing building (either all or a portion of a building)? Did the project include any reused or reclaimed materials? If yes to either, please describe:

☐ Please describe your intended approach to performing an LCA for the second submission stage including the LCA tool to be used, materials and systems to be included, specific EPD's to be requested, etc.:

Optional Narratives if Applicable:

Include any graphics that illustrate the LCA results.

☐ Did the project set an embodied carbon reduction target? If so, please describe the benchmark data used and the reduction target set:

☐ Did the project perform a whole building life cycle assessment (WBLCA) early in the design process to identify the largest opportunities ("hot spots") for embodied emissions reductions? If yes, please describe the results and decision-making process for materials choices:

☐ Did the project include in its specifications requests for Environmental Product Declarations (EPD's) and for what materials? Did the specifications include specific product or materials embodied carbon (GWP) targets? If yes, please describe:

LIFE CYCLE ANALYSIS (LCA) INPUTS -

Phase of project design during which LCA was performed:	Choose from Options:	Answer = X
	Conceptual Design	
	Schematic Design	
	Design Development	
	Construction Documents	
	During Construction	
	Post-occupancy	

LCA tool/software used:	Choose from Options:	Answer = X
	Athena Impact Estimator	
	BEAM Tool	
	CARE Tool	
	Cove Tool	
	EC3	
	EPiC	
	Kaleidoscope	
	OneClick LCA	
	PH Ribbon	
	Tally	
	TallyCat beta	
	Other:	

Source of material quantities used in the LCA:	Choose from Options:	Answer = X
	BIM (ie: Revit)	
	Material take-offs or quantities from drawings	
	Rules of thumb estimates	
	Other:	

Based on the LCA tool chosen, please select the stages included in the analysis. Refer to the Cambridge Embodied Carbon Educational Toolkit for additional information on LCA stages.

Life cycle stages that are included in LCA tool used:		**Answer = X**
Product Stage (A1-A3) -	Product Stage (A1-A3) = Cradle to Gate	
• A1 Raw Materials Supply/Extraction		
• A2 Transport (to factory)		
• A3 Manufacturing		
Construction Stage (A4-A5) -	A1-A5	
• A4 Transport (to site)		
• A5 Construction and Installation Process		
Use Stage (B1-B5) -	A1-B5	
• B1 Use		
• B2 Maintenance		
• B3 Repair		
• B4 Replacement		
• B5 Refurbishment		
End of Life Stage (C1-C4) -	A1-C4 Cradle to Grave	
• C1 Demolition/Deconstruction	*LCA stages A1-A5, B2-B5, and C1-C4 = from Cradle to Grave – Recommended *Cradle to Grave Tools include Athena, OneClick LCA, Tally	
• C2 Transport (to disposal)		
• C3 Waste Processing		
• C4 Disposal		
Beyond the Life Cycle (D)- Reuse, Recycling, Energy Recovery	A1-D	
	* Module D is used for any applicable biogenic carbon storage	

Physical scope of materials and systems included in LCA:		**Yes or No**
*At a minimum, embodied carbon calculations should be performed for building structure and building envelope. *Envelope components should include all materials from the exterior material to the interior finish surface.	**Structure (above grade)**	**Required**
	Structure (below grade)	**Required**
	Enclosure (outside surface to interior drywall)	**Required**
	Fireproofing	
	Interiors (partitions, ceilings, doors)	
	Finish materials (floors, walls, ceilings)	
	Mechanical, electrical and plumbing systems	
	Furniture	
	Parking structure included or excluded?	
	Other	

Reference study period, ie: Expected life of the building:		Answer = X
	*Building service life (or expected life of the building) should be a **minimum** of 60 years for this analysis. If your LCA uses a period other than 60 years, please specify that below.	
	LEED LCA Credit period = 60 years	
	Other =	

Refer to the Cambridge Embodied Carbon Educational Toolkit for additional information on types of EPD's-

Source of material carbon data:		Answer = X
	Product-specific EPD's	
	Industry-average EPD's	
	Combination of Product-specific and industry-average EPD's	
	Manufacturers data other than EPD's	

Carbon Sequestration/Biogenic Carbon data (for wood):		Answer = X
	Included in LCA	
	Not included in LCA	

LIFE CYCLE ANALYSIS (LCA) RESULTS-

EMBODIED CARBON FOR TOTAL BUILDING	in kg CO2eq.
Global Warming Potential (GWP) of **Total Project:**	
Global Warming Potential (GWP) of **Structural Components Only:**	
Global Warming Potential (GWP) of **Enclosure Components Only:**	
Global Warming Potential (GWP) of **Division 03: Concrete Only:**	
Global Warming Potential (GWP) of **Division 05: Metals (Steel, Aluminum) Only:**	
Global Warming Potential (GWP) of **Division 06: Wood, Plastics & Composites Only:**	
Global Warming Potential (GWP) of **Division 07: Thermal & Moisture Protection Only:**	
Global Warming Potential (GWP) of **Division 08: Openings & Glazing Only:**	

EMBODIED CARBON (EMISSIONS) PER UNIT OF FLOOR AREA	Emissions Intensity
	in kg CO2eq/SF
Global Warming Potential (GWP) per Square Foot of Total Project: *GWP per square foot is used by LEED	
	in kg CO2eq/m2
Global Warming Potential (GWP) per Square Meter of Total Project: *GWP per square meter, rather than square foot, is used by AIA 2030 and ILFI	