

CALCULATOR TOOL USER GUIDE FOR THE
QUANTIFICATION AND REGISTRATION OF
ENVIRONMENTAL IMPACTS OF GREEN
FINANCE FOR

GREEN BUILDING PROJECTS: NEW CONSTRUCTION AND MAJOR RENOVATIONS

VERSION 1.0

November 2021

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ABOUT AMERICAN CARBON REGISTRY® (ACR)

ACR is a scientific standards body for the creation of environmental assets. This includes tradable assets like carbon offset credits issued by ACR Environmental Markets and the quantification of environmental attributes of financial instruments by ACR Capital Markets. We complement decades of expertise in the development of market-making standards and project measurement methodologies with operational expertise in the verification, registration, issuance, retirement, and reporting of environmental claims.

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ACRONYMS

ACR	American Carbon Registry
CO ₂ e	Carbon dioxide equivalent
CUSIP	Committee on Uniform Securities Identification Procedures
DOE	United States Department of Energy
EC3	Embodied Carbon in Construction Calculator
EPD	Environmental Product Declaration
EUI	Energy use intensity
ft ²	Square foot
FTE	Full-time equivalent employee
gal	Gallon
GHG	Greenhouse gas
ISIN	International Securities Identification Number
K-12	Kindergarten through 12 th grade
kBtu	Thousand British thermal units
kgal	Kilogallons (thousand gallons)
KPI	Key performance indicator
MT	Metric ton
RNG	Renewable natural gas

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1 INTRODUCTION

The American Carbon Registry (ACR) developed methods to quantify environmental key performance indicators (KPIs) for bond-funded activities related to the new construction or major renovation of green buildings. The Methodology calculates a project's Carbon Return and applies benchmarks to assess a project's impact relative to investments in the same category. The Methodology quantifies the following environmental benefits:

- Greenhouse gas (GHG) emission reductions;
- On-site renewable energy generation;
- Energy use and savings; and
- Water use and savings.

The Methodology is a technical document that includes project eligibility data requirements, quantification approach, and project data requirements. To make these methods accessible to issuers, ACR created an accompanying Calculator Tool that embeds the methods and equations found in the Methodology. **This User Guide is a supplement to the Methodology and provides instructions on how to use the Calculator Tool.**

The Methodology for the Quantification and Registration of Environmental Impacts of Green Finance for Green Building Projects: New Construction and Major Renovations and the accompanying Calculator Tool are available at www.winrock.org/ms/acr-capital-markets. The online Calculator Tool is password protected. Email ACRcapitalmarkets@winrock.org to request access.

2 CALCULATOR TOOL INPUTS

The Methodology relies on project-specific data to assess the environmental impacts of a new construction or major renovation green building project. Users will input these data into the Calculator Tool. This Chapter defines the inputs used for quantifying the KPIs and guides users on making appropriate selections in the Calculator Tool. Project data fall into twelve categories and are detailed in the sections below.

2.1 GENERAL PROJECT INFORMATION

- **Bond issuer:** Entity issuing the bond (i.e., city, state, county, other government entity, or corporation)
- **CUSIP number:** Nine character alphanumeric code serving as a unique identifier for bonds registered in North America
- **ISIN:** Twelve character alphanumeric code serving as a unique identifier for bonds outside of North America, if applicable
- **Bond name:** Bond name as used in bond official statement
- **Project name:** Project name funded with bond proceeds
- **Contact person (name, title):** Contact person responsible for completing or responding to inquiries related to issuer's use of the Methodology and Calculator Tool
- **Contact email:** Email address for the contact person identified
- **Contact phone:** Phone number for the contact person identified
- **Total bond financing for the new building project (in U.S. dollars):** Amount of money from the bond used for the project
- **Total project cost (in U.S. dollars):** Amount of money from all sources required for the project

2.2 BASIC BUILDING INFORMATION

- **Building zip code:** Enter the five digit zip code where the building will be located.
- **Green building certification, version, and level for which the building qualifies:** Select from the dropdown menu the green building certifying organization, certification, version, and level for which the building qualifies. The list of green building certifications is not exhaustive but compiles certifications that are widely used, available for common commercial and multifamily residential buildings, and includes a minimum prerequisite for energy efficiency improvements. If using a different certification than those listed, select "Other." To be eligible, the building must qualify as green under a certification that has minimum requirements for energy efficiency.

- **Project operational life (years):** The Methodology assumes (and Calculator Tool defaults to) an operational life of 30 years for a new green building project. Individual project operational lives may vary. If entering a different operational life, project proponents must substantiate the alternative project duration with documentation (e.g., manufacturer specifications for average lifetime, ASHRAE equipment lifetime tables, cost segregation study).
- **Number of building use types:** Select the number of building use types from the dropdown menu (up to three use types for a single building can be calculated). For each building type:
 - ◆ **Building use type:** Select the building use type from the dropdown menu:
 - ◆ Office
 - ◆ Elementary School
 - ◆ Other K-12 School
 - ◆ Multifamily
 - ◆ Other
 - ◆ **Gross floor area of building use type (ft²):** Enter in area of the building dedicated to that use type.
 - ◆ **If “Other” building type, specify:** Type in the building use type. While the calculator tool can be used for other building types than those listed, additional baseline, project, and benchmark inputs will be required for alternative building types.
- **Number of floors:** Enter the number of floors in the building (or the number of floors in the tallest building within a complex with multiple buildings)

2.3 PROJECT ENERGY USE INFORMATION

- **Are building designs available and sufficient for quantifying project building energy use intensities (EUIs)?:** Select “Yes” or “No” from the dropdown menu to indicate whether the user will be entering project-specific EUI information.

Note: This question does not appear when “Other” is selected for the green building certification or any of the building use types because project-specific EUIs are required under those circumstances.

If no, proceed to next page. If yes, proceed to the next field.
- **For each building use type:** Energy use, savings, and associated emission reductions are calculated using EUIs. These EUIs will vary based on the building type and location of the building, among other factors. To ensure consistency, the EUIs used in the baseline and project scenarios must assume the same building type(s), climate zone, and GHG emission factors. See the Methodology for additional instructions for determining EUIs.
 - ◆ **Project electricity EUI (kBtu/ft²/year):** Enter the electricity portion of the overall project energy use intensity.

- ◆ **Project natural gas EUI (kBtu/ft²/year):** Enter the natural gas portion of the overall project energy use intensity. If the project building is all-electric or uses a district energy system for all thermal energy demands, the project natural gas EUI of the building will be 0.
- **Site-specific electricity emission factor from utility:** Users may enter utility-specific emission factors, if available and documented. If left blank, a default emission factor based on e-GRID subregion is applied.

2.4 PROJECT RENEWABLE ENERGY INFORMATION

- **Quantity of annual on-site renewable electricity to be generated by project (kWh/year):** Enter the renewable electricity expected to be generated by the project. Only additional on-site renewable electricity, as defined in the Methodology, should be included. Only renewable energy sources without combustion are included. The direct purchase of off-site renewable electricity is not included. If none, enter “0”.
- **Quantity of annual on-site renewable electricity to be generated in baseline (zero, unless required by state code) (kWh/year):** Enter the baseline on-site renewable electricity generation as required by state code. If none, enter “0”.

2.5 DISTRICT ENERGY INFORMATION

- **Does the building receive energy from a district energy loop?:** Select “Yes” or “No” from the dropdown menu to indicate whether the project obtains district energy.
Note: This question does not appear if the user previously responded that building designs are not available or sufficient for quantifying project building EUIs.

If no, proceed next page. If yes, proceed to the next field.

- **For each building use type:** District energy will not be applicable to most projects and these EUIs will be assumed to be 0. However, for projects connected to a district energy loop, such as those on university campuses or located in municipalities with multi-user district energy systems, there will be emissions associated with production of energy distributed through the district system. Project district energy use intensities for steam, hot water, and chilled water make up the district energy portion of the overall project EUI.
 - ◆ **Project district steam EUI (kBtu/ft²/year):** Enter the district steam portion of the overall project energy use intensity. If the project does not receive district steam, enter “0”.
 - ◆ **Project district hot water EUI (kBtu/ft²/year):** Enter the district hot water portion of the overall project energy use intensity. If the project does not receive district hot water, enter “0”.

- ◆ **Project district chilled water EUI (kBtu/ft²/year):** Enter the district chilled water portion of the overall project energy use intensity. If the project does not receive district chilled water, enter “0”.
- **Site-specific district energy emission factors:** If the issuer has access to emissions data for the district energy system, the issuer may provide site-specific GHG emission factors for the energy produced from that system in order to capture the full compounded energy savings achieved by combining an efficient building with an efficient district system. These site-specific values would come from district energy system operating records for the fuel and/or electricity consumed at the plant, and the efficiency ratio between the input fuel at the plant and the energy distributed to the district system.
- ◆ **Project district steam EUI (kBtu/ft²/year):** Enter the district steam portion of the overall project energy use intensity. This field is optional; if left blank, a default emission factor from Energy Star will be applied.
- ◆ **Project district hot water EUI (kBtu/ft²/year):** Enter the district hot water portion of the overall project energy use intensity. This field is optional; if left blank, a default emission factor from Energy Star will be applied.
- ◆ **Project district chilled water EUI (kBtu/ft²/year):** Enter the district chilled water portion of the overall project energy use intensity. This field is optional; if left blank, a default emission factor from Energy Star based on technology type will be applied.

-- OR --

Technology type for district chilled water: Select the district chilled water technology from the dropdown menu:

- ◆ Electric chiller
- ◆ Absorption chiller using natural gas
- ◆ Engine driven chiller using natural gas

This field is optional; if left blank, a default emission factor from Energy Star based on the average technology type will be applied.

2.6 ADDITIONAL ONSITE FUEL INFORMATION

- **Are there additional fuels used onsite?:** Select “Yes” or “No” from the dropdown menu to indicate whether the project uses energy other than electricity, natural gas, or district energy.

Note: This question does not appear if the user previously responded that building designs are not available or sufficient for quantifying project building EUIs.

If no, proceed next page. If yes, proceed to the next field.

- **For each building use type:** Enter the project EUI (kBtu/ft²/year) for each of the following fuels. If the fuel is not used, enter “0”.
- ◆ **Fuel oil (No. 1)**
- ◆ **Fuel oil (No. 2)**

- ◆ **Fuel oil (No. 4)**
- ◆ **Fuel oil (No. 5, No. 6)**
- ◆ **Diesel**
- ◆ **Propane**
- ◆ **Kerosene**
- ◆ **Solid biomass (agricultural byproducts, peat, solid byproducts)**
- ◆ **Solid biomass (wood and wood residue)**
- ◆ **Liquid biomass**
- ◆ **Biogas, if delivered directly to site:** Biogas delivered to site refers to biogas that is piped directly from a generation site, such as a landfill or farm, to the project site. Renewable Natural Gas (RNG) is biogas that is delivered through the regulated utility's natural gas distribution system; in this sense, it is analogous to off-site renewable electricity and is thus assigned the same emission factor as natural gas.

2.7 BASELINE ENERGY USE INFORMATION

Note: These questions only appear if “Other” is selected for the building use types because default EUIs are used under all other circumstances.

- **For each building use type:** Enter the custom baseline or benchmark EUI.
 - ◆ **Baseline building electricity EUI (kBtu/ft²/year):** Enter the electricity EUI for the same building type and location as if built to the energy code currently enforced by the state government. The custom baseline must be derived from an energy model of the project building, calibrated for the requirements of the energy code currently enforced by the state government. A list of state energy codes can be found in the Methodology Appendix A, Table A-1.
 - ◆ **Baseline building natural gas EUI (kBtu/ft²/year):** Enter the natural gas EUI for the same building type and location as if built to the energy code currently enforced by the state government. The custom baseline must be derived from an energy model of the project building, calibrated for the requirements of the energy code currently enforced by the state government. A list of state energy codes can be found in the Methodology Appendix A, Table A-1.
 - ◆ **Benchmark building electricity EUI (kBtu/ft²/year):** Enter the electricity gas EUI for the same building type and location as if built to the ASHRAE 90.1-2016 energy code. For consistency with the provided benchmarks derived from the U.S. Department of Energy (DOE) Prototype Building Models, custom benchmarks must assume the use of natural gas or electricity as the source of heating energy, not district energy.
 - ◆ **Benchmark building natural gas EUI (kBtu/ft²/year):** Enter the natural gas EUI for the same building type and location as if built to the ASHRAE 90.1-2016 energy code. For consistency with the provided benchmarks derived from the U.S. DOE

Prototype Building Models, custom benchmarks must assume the use of natural gas or electricity as the source of heating energy, not district energy.

2.8 ENERGY COST INFORMATION

- **Are location-specific energy costs available for quantifying energy cost savings from project building?:** Select “Yes” or “No” from the dropdown menu to indicate whether the user will be entering project-specific energy cost information.

If no, proceed next page. If yes, proceed to the next field.

- **For each fuel type:** Enter the cost. If the fuel is not used, enter “0”.
 - ◆ **Electricity (\$/kWh)**
 - ◆ **Natural gas (\$/kBtu)**
 - ◆ **Fuel oil (\$/kBtu)**
 - ◆ **Diesel (\$/kBtu)**
 - ◆ **Propane (\$/kBtu)**
 - ◆ **Kerosene (\$/kBtu)**
 - ◆ **Solid biomass (agricultural byproducts, peat, solid byproducts)**
 - ◆ **Solid biomass (wood and wood residue)**
 - ◆ **Liquid biomass**
 - ◆ **Biogas, if delivered directly to site:** Biogas delivered to site refers to biogas that is piped directly from a generation site, such as a landfill or farm, to the project site. Renewable Natural Gas (RNG) is biogas that is delivered through the regulated utility’s natural gas distribution system; in this sense, it is analogous to off-site renewable electricity and is thus assigned the same emission factor as natural gas.

2.9 REFRIGERANT INFORMATION

- **Are building designs available and sufficient for quantifying avoided fugitive refrigerant emissions?:** Select “Yes” or “No” from the dropdown menu to indicate whether the user will be entering project-specific fugitive refrigerant information.

If no, proceed next page. If yes, proceed to the next field.

- **Refrigerant type:** Select the type of refrigerant to be used from the dropdown menu. This field is required for calculating refrigerant emission reductions while other fields in this category may be left blank.
- **Cooling load (Btu/ft²):** Optional field; if left blank, a default cooling load based on climate zone will be applied.

- **Refrigerant charge volume rate (lbs/ton of capacity):** Optional field; if left blank, a default refrigerant charge volume based on building type and system type will be applied.

-- OR --

Cooling system type: Select from the type of system used in the building from the dropdown menu. Optional; if left blank, a default refrigerant charge volume will be applied.

- ◆ **Electric Mini-Split Heat Pump**
- ◆ **Variable Refrigerant Flow**
- ◆ **Air Source Heat Pump with Hydronic Distribution**
- ◆ **Natural Refrigerant System**
- ◆ **Other**

2.10 CONSTRUCTION MATERIAL INFORMATION

- **Are building designs available and sufficient for quantifying embodied carbon from project building materials?:** Select “Yes” or “No” from the dropdown menu to indicate whether the user will be entering project-specific construction material information.

If no, proceed next page. If yes, proceed to the next field.

Project Building Materials

- **How many lower-emission primary framing and facing building material types displace conventional materials?:** Select from the dropdown menu the number of primary framing and facing materials used for the building, including the following, as applicable: concrete, steel, aluminum, wood, glass, and insulation (12 is the maximum number of materials for which emissions can be calculated).
- For each lower-emission, project construction material:
 - ◆ **Embodied carbon target of primary framing and facing project building material, by material type (MTCO₂e/unit of material):** Enter the embodied carbon target from project building material, as sourced from the Embodied Carbon in Construction Calculator (EC3) tool or Environmental Product Declaration (EPD) documentation.
 - ◆ **Quantity of project building material (unit of material):** Enter the quantity of the material. Units will vary by material type.

Conventional Building Materials

- **How many conventional framing and facing building material types are substituted with lower-emission materials?:** Select from the dropdown menu the number of primary framing and facing materials that would have been used in the baseline building but are substituted in the project building with lower-emitting materials (12 is the maximum number of materials for which emissions can be calculated).

- For each baseline building construction material:
 - ◆ **Conservative benchmark embodied carbon of substituted baseline building material, by material type (MTCO₂e/unit of material):** Enter the conservative benchmark embodied carbon from substituted baseline building material, as sourced from the EC3 Tool.
 - ◆ **Quantity of project building material (unit of material):** Enter the quantity of the material. Units will vary by material type.

2.11 INDOOR WATER INFORMATION

- **Are building designs available and sufficient for quantifying indoor water use?:** Select “Yes” or “No” from the dropdown menu to indicate whether the user will be entering project-specific indoor water information.

If no, proceed next page. If yes, proceed to the next field.

- **Are all fixtures in the project building WaterSense fixtures?:** Select “Yes” or “No” from the dropdown menu. If all fixture types in the building will be WaterSense fixtures, project water fixture use is assumed to be 20% less than the baseline and have less information to enter.

If yes, proceed to the Quantity of Users field. If no, first answer the data inputs for Project Building Flush and Flow Rates fields that appear.

- **Project Building Flush Rates:** Enter the project building flush rate (gal/flush) for each of the following fixtures. If the fixture type is not used, enter “0”.
 - ◆ **Toilet (male)**
 - ◆ **Toilet (female)**
 - ◆ **Urinal**
- **Project Building Flow Rates:** Enter the project building flow rate (gal/minute) for each of the following fixtures. If the fixture type is not used, enter “0”.
 - ◆ **Public restroom faucet**
 - ◆ **Private (residential) restroom faucet**
 - ◆ **Kitchen faucet**
 - ◆ **Residential kitchen faucet**
 - ◆ **Showerhead**
 - ◆ **Residential showerhead**
- **Quantity of Users:** Enter the number of people of each user class that occupy the building. Enter the average quantity per day that the building is accessible to most users. If there are no users of a given type, enter “0”.
 - ◆ **Employees:** Use the full-time equivalent (FTE) unit
 - ◆ **Visitors**
 - ◆ **Retail Customers**

- ◆ **Students**
- ◆ **Residents**
- **Gender Split of Users:** Enter the percentage of the user class that are male (% male). If “0” was entered as the quantity of users, there will be no field for the gender split.
- ◆ **Employees**
- ◆ **Visitors**
- ◆ **Retail Customers**
- ◆ **Students**
- ◆ **Residents**
- **Number of days per year the building is accessible to most users (days/year):** Enter the number of days per year that the building is occupied by most users. This field is optional for residential, offices, and K-12 schools where default values are applied (365 for multifamily residential, 260 for offices, and 180 for schools).
- **Annual rainwater to be captured and used in place of potable indoor water (kgal/year):** Enter the rainwater that displaces potable indoor water each year. This field is optional; if left blank, rainwater capture is assumed to be 0.
- **Annual greywater to be recycled and used in place of potable indoor water (kgal/year):** Enter the greywater that displaces potable indoor water each year. This field is optional; if left blank, greywater capture is assumed to be 0.

2.12 LANDSCAPE WATER INFORMATION

- **Are building designs available and sufficient for quantifying landscaping water use?:** Select “Yes” or “No” from the dropdown menu to indicate whether the user will be entering project-specific landscaping water information.

If no, proceed next page. If yes, proceed to the next field.

- **Local reference evapotranspiration from WaterSense Budget Data Finder (inches/month):** Baseline and project landscape water use in the peak irrigation month is calculated using local evapotranspiration based on project zip code from the WaterSense Water Budget Data Finder, available at <https://www.epa.gov/watersense/water-budget-tool>.
- **Average rainfall during peak irrigation month from WaterSense Budget Data Finder (inches/month):** If a project has plans to have irrigated landscaping, project landscape water use in the peak irrigation month is calculated using local rainfall based on project zip code from the WaterSense Water Budget Data Finder, available at <https://www.epa.gov/watersense/water-budget-tool>.
- **Rainwater to be captured and used for landscaping in place of potable water during peak irrigation month (gal/month):** Enter the rainwater that displaces potable outdoor water use during the peak irrigation month. This field is optional; if left blank, rainwater capture is assumed to be 0.

- **Greywater to be recycled and used for landscaping in place of potable water during peak irrigation month (gal/month):** Enter the greywater that displaces potable outdoor water use during the peak irrigation month. This field is optional; if left blank, greywater capture is assumed to be 0.
- **How many hydrozones?:** Select from the dropdown menu the number of hydrozones in the landscaping for the project building (6 is the maximum number of hydrozones for which water use/savings can be calculated). A hydrozone is a grouping of plants with similar water and environmental requirements for irrigation with one of more common station/zone valves. For each hydrozone:
 - ◆ **Landscape area (ft²):** Enter the landscaped area of the hydrozone.
 - ◆ **Irrigation type:** Select the irrigation type from the dropdown menu:
 - ◆ Drip – Standard
 - ◆ Drip – Press Comp
 - ◆ Fixed Spray
 - ◆ Microspray
 - ◆ Rotor or Rotating Nozzles
 - ◆ No Irrigation
 - ◆ **Landscape feature type:** Select the plant type or landscape feature from the dropdown menu:
 - ◆ Trees
 - ◆ Shrubs
 - ◆ Groundcover
 - ◆ Turfgrass
 - ◆ Pool, Spa, or Water Feature
 - ◆ Permeable Hardscape
 - ◆ Non-vegetated Softscape
 - ◆ Xeriscape
 - ◆ **Water requirement:** Select the water requirement from the dropdown menu:
 - ◆ Low
 - ◆ Medium
 - ◆ High

3 CALCULATOR TOOL OUTPUTS



After entering the project data inputs into the Calculator Tool, the resulting KPIs are displayed as outputs, pictured below.

Figure 1: Image of Calculator Tool Outputs

KEY PERFORMANCE INDICATOR	TOTAL	PRO-RATED (IF APPLICABLE)	REPRESENTATIVE YEAR	UNIT	SUSTAINABLE DEVELOPMENT GOAL
Net GHG Emission Reductions from Project				Metric tons carbon dioxide equivalent (MTCO ₂ e)	
Avoided Embodied Carbon Emission			N/A	MTCO ₂ e avoided emission	
Avoided Fugitive Refrigerant Emission				MTCO ₂ e avoided emission	
GHG Emission Reductions from Project Energy Use				MTCO ₂ e emission reductions	
Percent Reduction in GHG Emission from Project Energy Use		N/A		%	
Project Energy GHG Intensity		N/A		kg CO ₂ e/ft ² /year	
Carbon Return			N/A	MTCO ₂ e emission reductions/\$1,000 bond financing/years of project operation	
GHG Cost Effectiveness			N/A	MTCO ₂ e emission reductions/\$1,000 bond financing	
Social Cost of Carbon Benefit				\$ (thousands)	
Project Energy GHG Emission Reductions Compared to Benchmark Baseline of ASHRAE 90.1-2016				MTCO ₂ e emission reductions	
Project Energy GHG Emission Reductions Compared to Benchmark		N/A		MTCO ₂ e emission reductions compared to benchmark	
Project Energy GHG Emission Reductions Compared to Benchmark		N/A		% relative to benchmark	
Project Energy GHG Intensity Compared to Energy GHGI Benchmark		N/A		% relative to benchmark	

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On-site Renewable Energy Generated				Kilowatt hour (kWh)	
Site Energy Use		N/A		kBtu/ft ² /year	
Source Energy Use		N/A		kBtu/ft ² /year	
Source Energy Savings				kBtu	
Project Energy Use Reductions Compared to Baseline		N/A		%	
Nominal Energy Cost Savings				\$	
Annual Potable Indoor Water Use		N/A		kgal/year	
Annual Potable Indoor Water Use Intensity		N/A		gal/ft ² /year	
Potable Indoor Water Use Savings				kgal	
Potable Indoor Water Use Savings		N/A		%	
Potable Landscape Water Use During Peak Irrigation Month		N/A	N/A	gal/month	
Potable Landscape Water Use Savings During Peak Irrigation Month			N/A	gal/month	
Potable Landscape Water Use Savings During Peak Irrigation Month		N/A	N/A	%	