Impact Building Calculator

Site Guide — Complete Documentation

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Welcome to the Impact Building Calculator

Welcome to the Schneider Electric Impact Building Calculator. The purpose of this tool is to give sales teams and partners a way to drive customer conversations and help define their retrofit strategy, including the relevant Schneider Electric solutions .

Asset and Portfolio Analysis

The **Asset** tab is used to evaluate and compare retrofit strategies for a single existing asset. By default, each asset consists of multiple scenarios when created. The reference 'baseline' scenario is the scenario which represents the existing building, where no Energy and Carbon Conservation Measures (ECCMs) have been applied . Additional retrofit scenarios can be made by applying ECCMs to the baseline.

The **Portfolio** tab is used to evaluate multiple assets together. For each asset, one of its scenarios is included in the analysis. The portfolio tab is helpful for comparing between assets to identify 'leaders and laggards' within a portfolio, and in aggregating results from multiple assets.

Users should be familiar with the tool assumptions and geographic and segment coverage to know which customers and buildings it is best suited to model.

Read the full documentation for Asset and Portfolio Analysis ↗

SRI/EPC Estimator

In addition to analysis of building assets and portfolios, the Impact Building Calculator currently includes the capability to generate a preliminary ISO 52120, Smart Readiness Indicator (SRI), and Energy Performance Certificate (EPC) Ratings results based on a detailed questionnaire on the level of automation present in a building's systems. This functionality is currently limited to hotels and offices in Europe.

Read the full documentation for the SRI/EPC Estimator Tool ↗

Goal and Scope

The asset and portfolio analysis within the Impact Building Calculator combines results from millions of energy models, carbon data from the C.Scale API, and a cost model developed specifically for each ECCM.

Goal

The goal of this tool is to support strategic retrofit planning and the inclusion of relevant Schneider Electric products in those retrofit plans by providing data on how they can lower energy use, carbon emissions and cost. The tool supports data-driven decision making and provides transparency in the expected performance of its solutions, extending Schneider's competitive advantage while supporting the modernization of the built environment through digital-first retrofits of existing buildings.

Scope

Asset and Portfolio analysis in the Calculator includes data on cost, whole life carbon emissions, and energy use. It uses time series analysis to study the impact of ECCMs over the designated time horizon based on implementation year.

Additional information on the scope of analysis is provided in the **methodology** section below.

Uses and Limitations

This tool is not a replacement for your professional judgement.

The Impact Building Calculator is a robust tool to approximate results from these methodologies. When using results from the tool in client-facing conversations, caution should be taken to confirm the tool's results against common sense, local regulations, the specifics of the building asset in question, and client expectations.

This is a comparative tool for decision making, not an absolute source of truth.

This analysis is meant to support directionally accurate decisions, not provide a verified source of truth. Comparisons between scenarios describe general patterns, but may not be reflect the idiosyncrasies of a particular building. In many cases, a more detailed and customized analysis will be the next step following the tool.

User's Guide

Basic Workflow

1. Generate Assets

In the Impact Building Calculator, you will create one or more building assets using a simple description of the building.

2. Customize Scenarios

For each of those assets, there are multiple scenarios. Each scenario describes how the implementation of a set of Energy and Carbon Conservation Measures (ECCMs) affect the cost, carbon, and energy use of that building over time. A number of default scenarios are generated automatically for each asset. You can edit these scenarios, and also create additional scenarios with custom combinations of ECCMs.

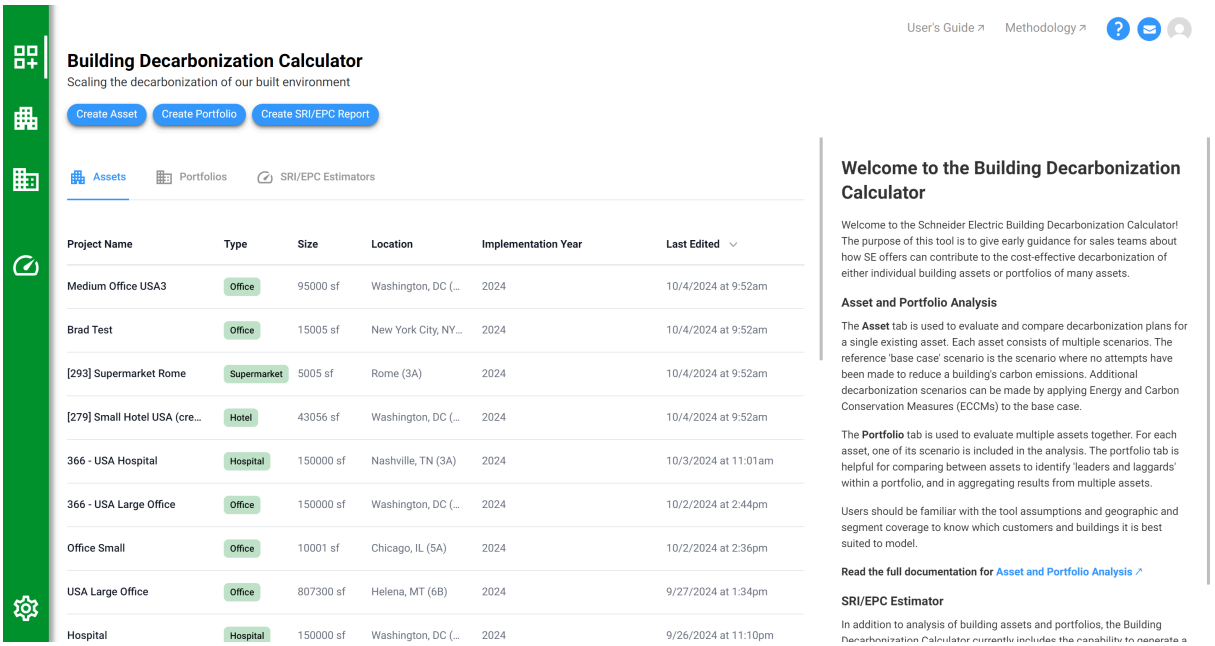
3. Share Asset-Level Results

A PDF describing the asset and all its scenarios can be downloaded or viewed online using a sharable PDF report link. You can also download the Asset-level PDF report to then share. Use this to communicate results to clients, team members, and other project stakeholders.

4. Build a Portfolio of Many Assets

Multiple assets can be analyzed together as a portfolio. The portfolio views helps to identify which assets will have the largest potential for cost, carbon, and energy savings.

Guide to the Interface



Overview of the Impact Building Calculator interface.

Left Navigation Bar

The Left Navigation Bar allows easy access to all parts of the app. The following describe the icons in the left navigation bar, from top to bottom:

- **Dashboard**. This is the landing page of the application, and where you can access all saved assets, portfolios, and SRI/EPC Estimator reports.
- **Asset-Level Analysis**. The analysis page for single assets.
- **Portfolio-Level Analysis**. The analysis page for portfolios of many assets.
- **SRI/EPC Estimator**. An EU-specific tool for evaluating ISO 52120, SRI, and EPC results based on a comprehensive audit of building systems.
    - *The SRI/EPC Estimator is hidden by default; it can be toggled on in the Settings panel.*
- **Settings**. Adjust global settings in the app.

User's Guide

The circled question mark in the upper right-hand corner of the screen will bring you to this site and all documentation related to the tool.

Feedback and Comments

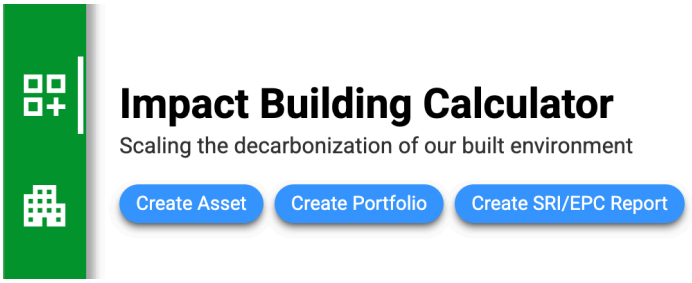
The envelope button in the lower right-hand corner will direct an email to impactbuildingcalculator@se.com. Please share feedback on the application and its use to this address, along with any issues or additional feature requests.

Asset-Level Analysis

Creating and Loading Assets

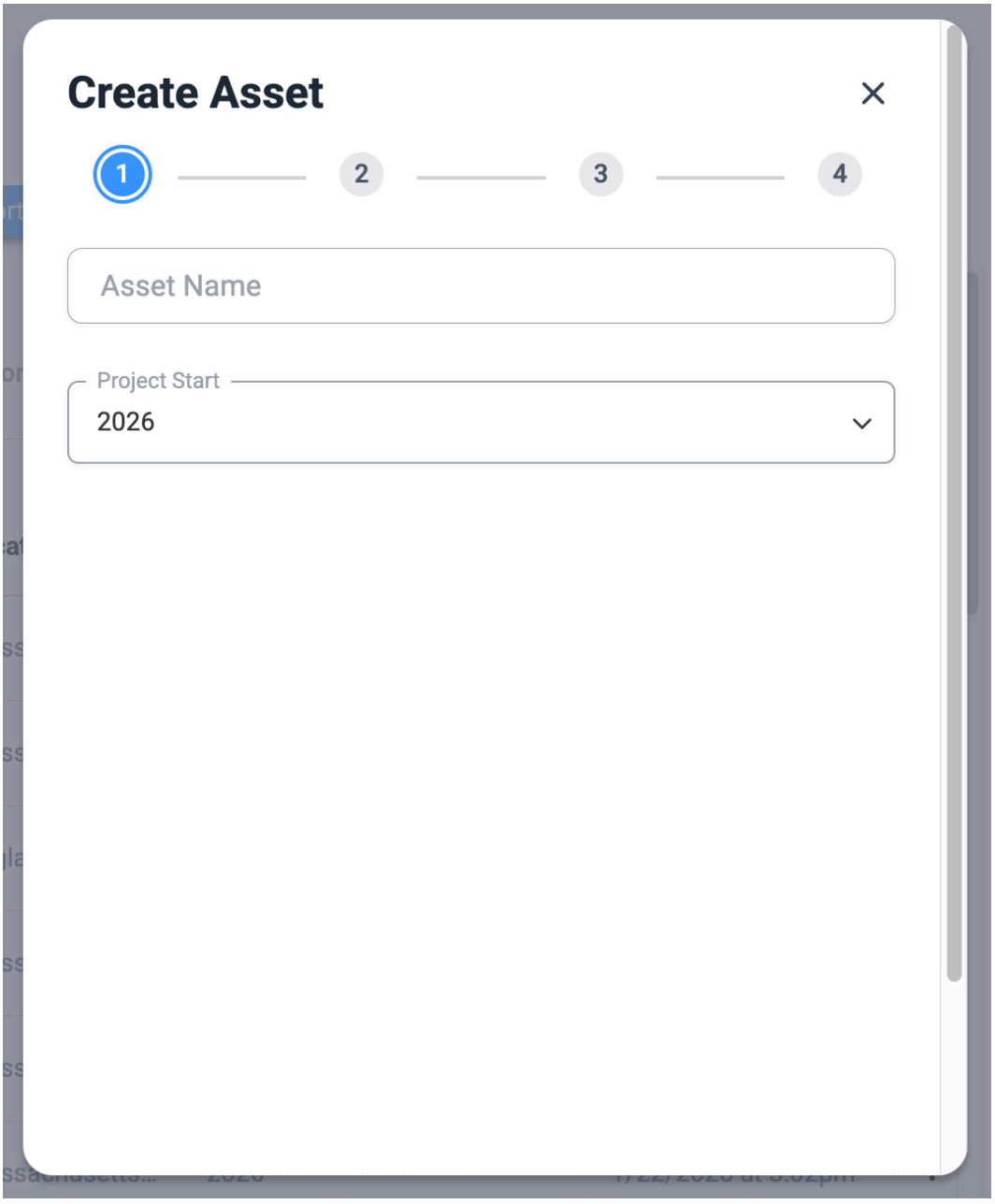
Create a New Asset

Create a new asset by clicking the **Create Asset** button on the top of the Calculator's dashboard page.



Create asset.

This will bring up the **Create Asset** panel.



Create Asset.

Here, add detail about the asset in question:

- **Asset Name**: provide the asset name.
- **Project Start:** enter the year that ECCMs will be applied by default
- **Country**: select the country where the asset is located.
    - Note: if your asset is in a country not in the available Country dropdown list, **request a new country**. Consider selecting another country and entering a city with similar climate zone to your project as a proxy.

- **Location**: **a**fter selecting a country, enter the address or city of your project.
- **Use Type**: select the asset's use type. You can select up to two use types.
- **Total Gross Floor Area**: input the size of the asset. If selecting multiple use types, enter the breakout of space type for each as a percentage.
- **Number of Floors**: input the asset's number of above grade floors.
- **Original Construction or Last Major Renovation**: select when the asset underwent its last major renovation. If the asset has not undergone a major renovation, select when it was originally constructed.
    - Note: the methodology used to determine baseline buildings for Asset and Portfolio analysis references a specific building vintage and prototype model. For more details, see **here**.
- **System of Measurement**: select either SI (metric) or IP (imperial)
- **Currency**: select the currency units used in the analysis.
- **Additional Analyses**: select additional optional analyses to add to the asset.
- **Energy Use Intensity (EUI):** enter the baseline EUI if known, this will override the default baseline EUI and be used to calibrate all scenario results. You can also override the default breakout of energy use by fuel type here by entering the Percent age of EUI from Electricity. These are optional inputs and not required to proceed with the analysis.
- **EV Charging:** Enter the number of EV chargers currently present, and override default assumptions on the type of chargers and usage profile if desired.

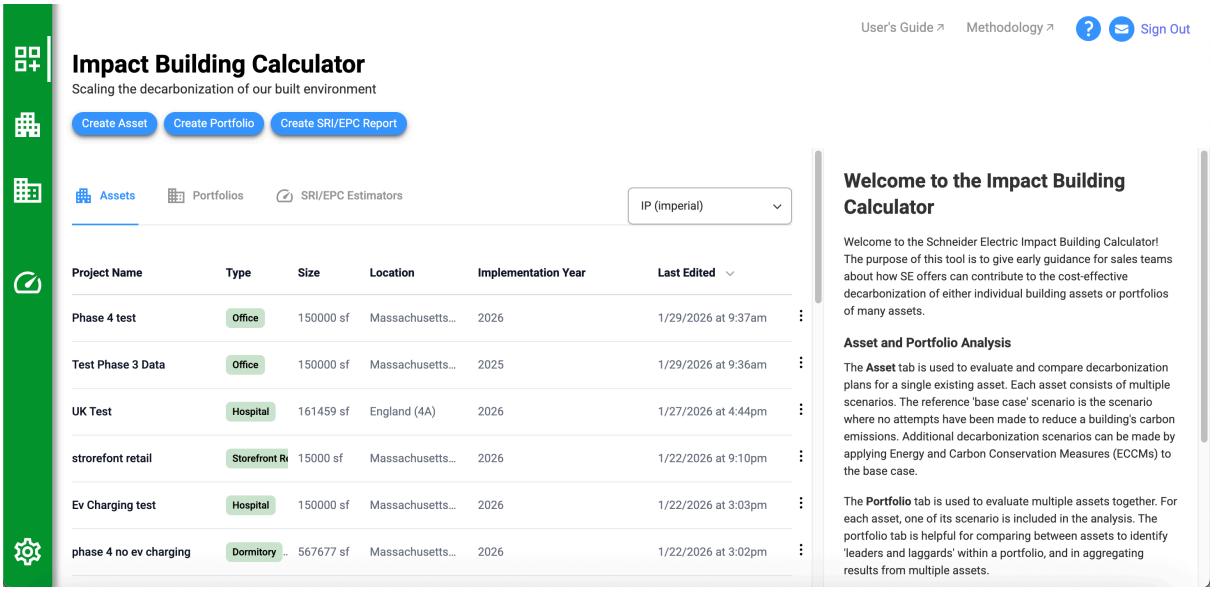
When you've filled out all the necessary data, click **Create** and proceed to the Asset-level analysis screen.

Upon creating the asset, you will be redirected to the asset-level analysis page with an automatically created set of scenarios specific to your asset.

After its initial creation, all changes to the asset and its scenarios are automatically saved.

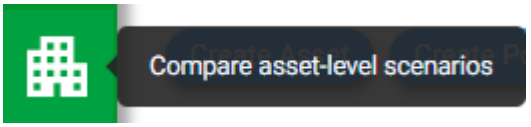
Loading a Saved Asset

On the Dashboard page, a previously created asset can be loaded by clicking that Asset's row on the dashboard. The row contains some information describing the Asset for cases when the Project Name alone is not descriptive enough.



Load asset from the dashboard.

The most recently edited asset can always be reloaded by navigating directly to the asset-level analysis page in the left navigation bar.



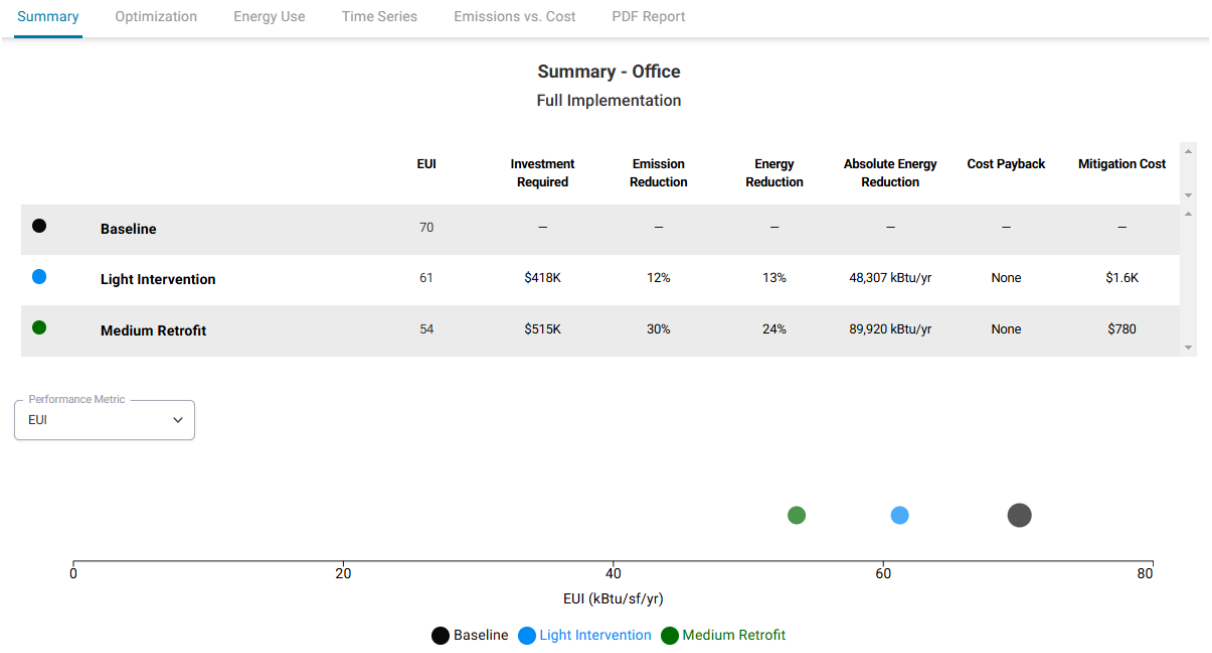
Asset analysis is always available via the left navigation bar.

Visualizing Asset Scenarios

In the asset-level analysis page, you will see a list of all current scenarios in a list on the left and a set of figures which visualize the results in a panel on the right. You can switch between figures using the titles above the figures to the right.

Summary

The Summary tab provides a tabular overview of all the scenarios, as well as dot plots comparing key metrics between them. Hovering your cursor over the column headers will give an explanation of that metric.

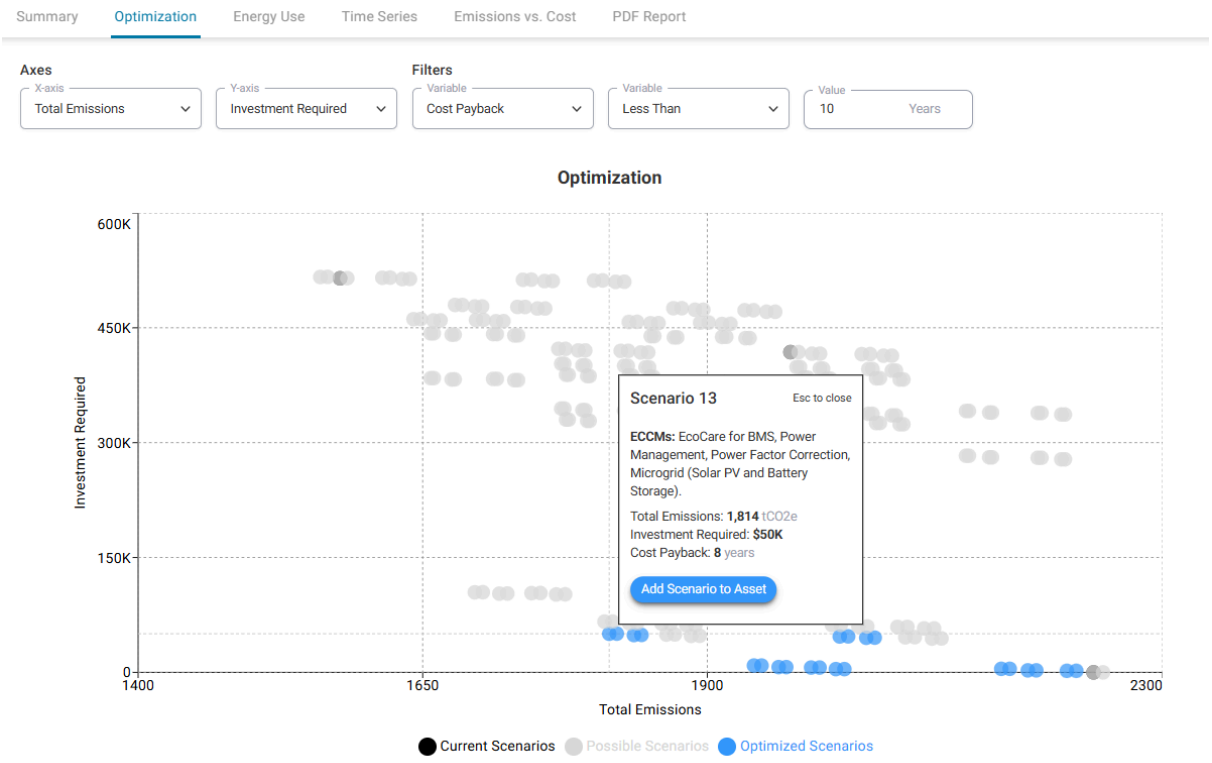


Summary tab.

Optimization

The Optimization tab enables you to plot possible scenarios on a chart with user-defined axes (ex: investment required vs total emissions). You can filter the scenarios to identify those that meet your criteria (ex: cost payback is less than 10 years), and add select scenarios to the asset by clicking on the dot within the chart, and clicking "Add Scenario to Asset".

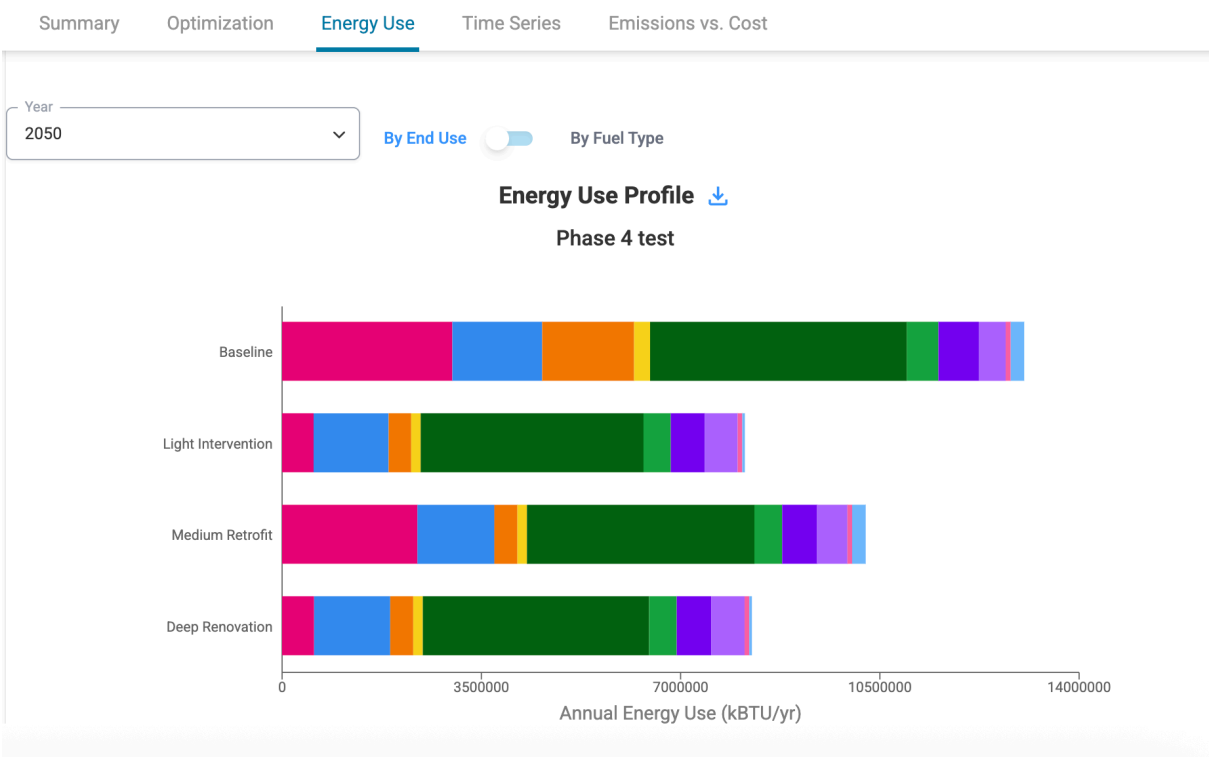
Note: each time the "Edit Asset" or "Edit Costs" modals are modified, the optimization tab will be regenerated.



Optimization tab.

Energy Use

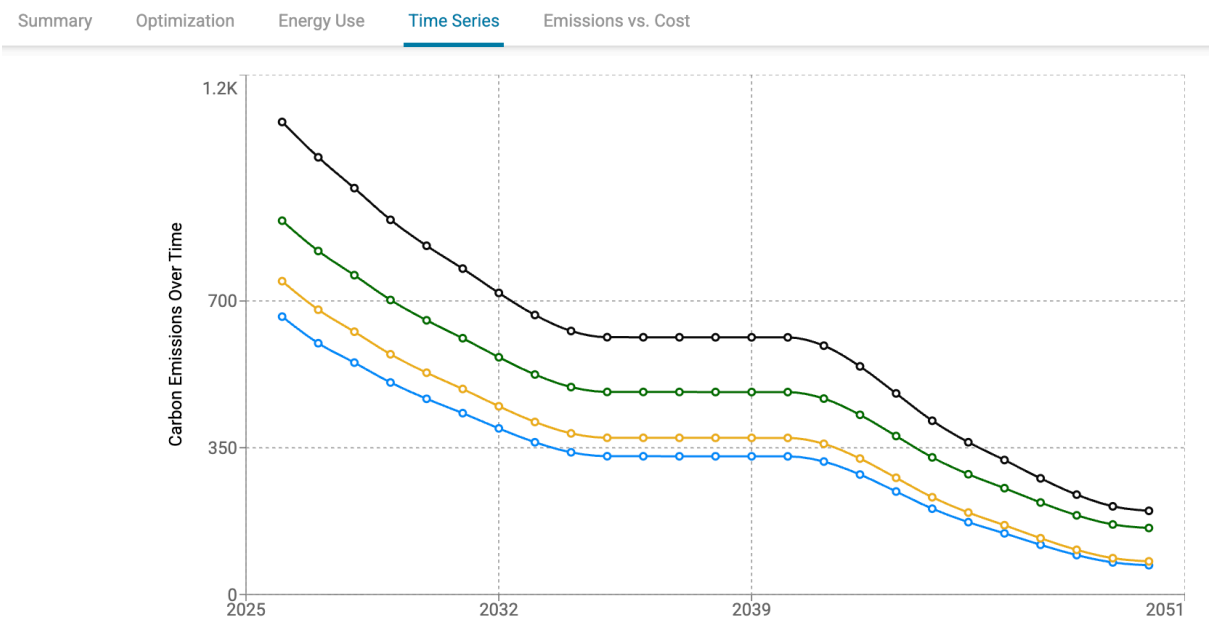
The Energy Use tab shows the annual energy use for each scenario by **end use**. Hovering over any of the bars will give you energy consumption by end use category for that scenario. You can also toggle this chart to view energy use by fuel type.



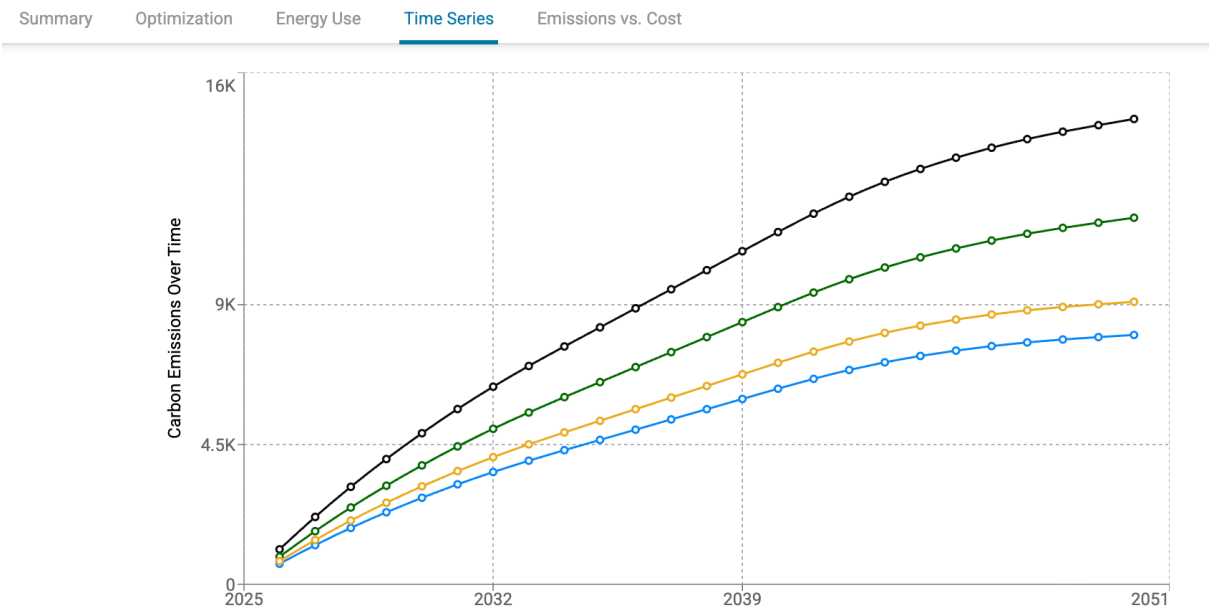
Energy use tab.

Time Series

The Time Series tab shows cumulative cost or carbon emissions over time, as well as annual cost or carbon emissions. Hovering your cursor over any year will give you information for each scenario in that year.



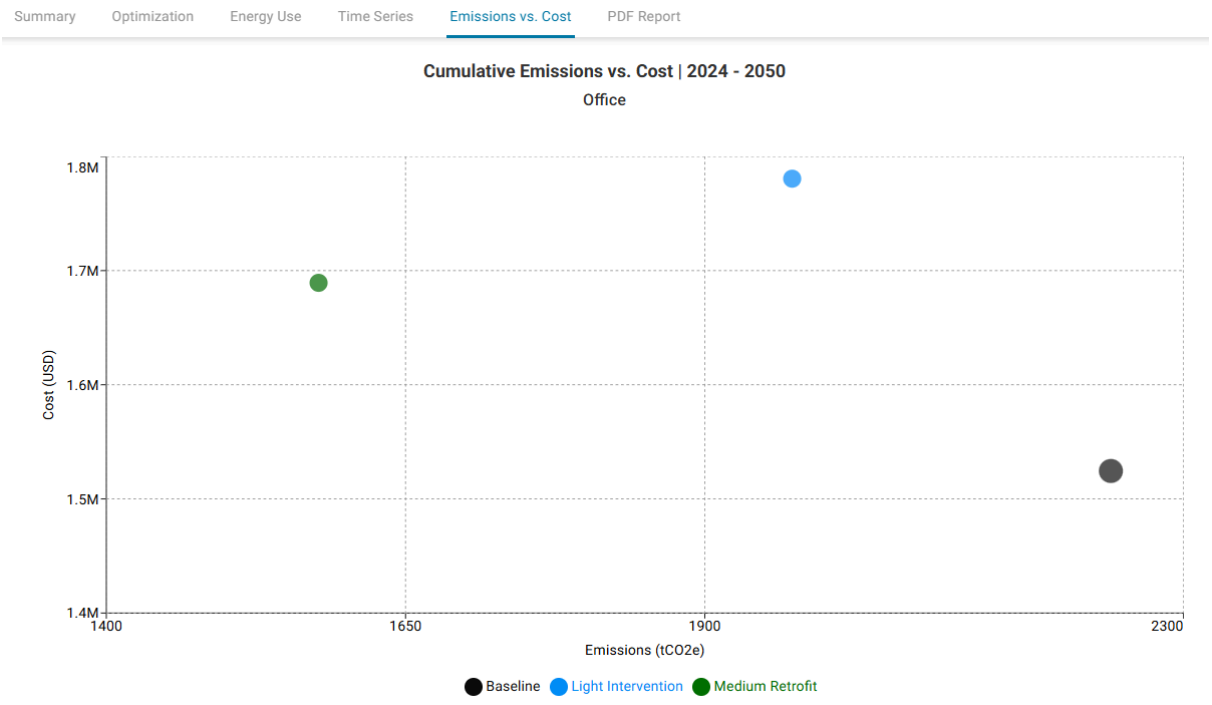
Time series of annual emissions.



Time series of cumulative emissions.

Cumulative Emissions vs. Cost

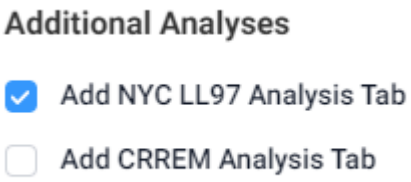
The Emissions vs. Cost tab shows total cost plotted against total emissions, evaluated over the entire time horizon. Hovering your cursor over any point will give you total cost and total emissions data for that scenario.



Emissions vs. cost tab.

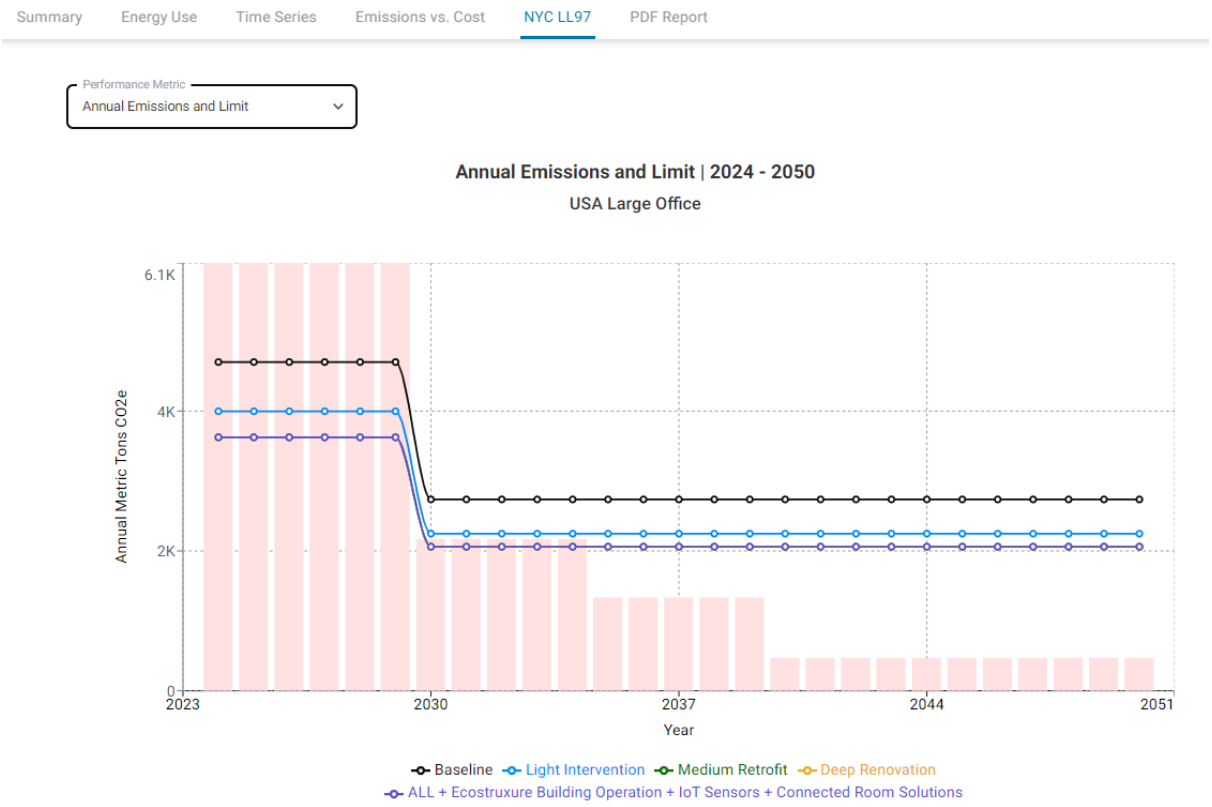
NYC LL97 Analysis

For Assets located in the USA, an additional NYC LL97 Analysis Tab can be added by clicking **Edit Asset**, and then selecting **Add NYC LL97 Analysis Tab**.



Add NYC LL97 analysis tab.

The NYC LL97 tab shows annual penalties (cost) or annual carbon emissions in comparison to the LL97 limit. Hovering your cursor over any year will give you information for each scenario in that year.

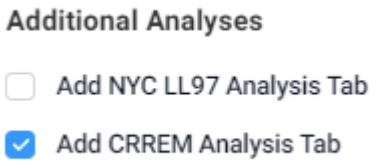


NYC LL97 tab.

For more information on LL97 and how it was integrated within the Impact Building Calculator, click **here**.

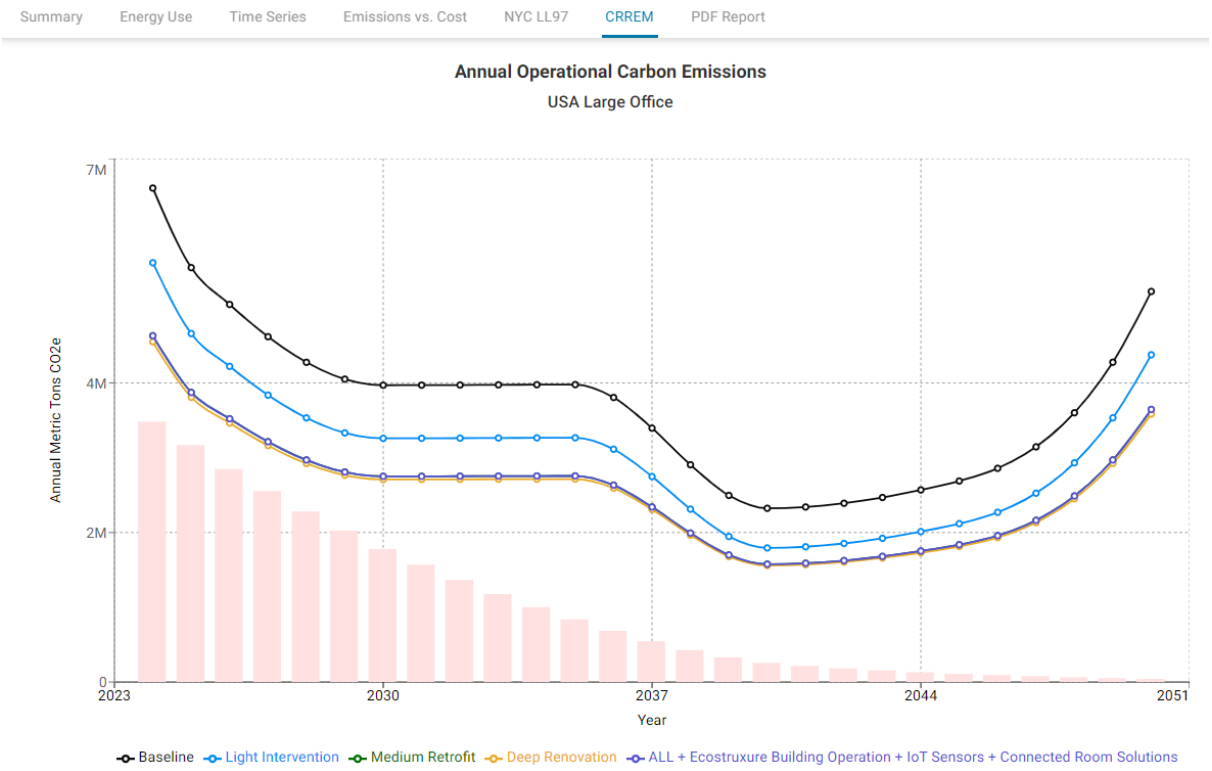
CRREM Analysis

An additional CRREM Analysis Tab can be added by clicking Edit Asset, and then selecting Add CRREM Analysis Tab.



Add CRREM analysis tab.

The CRREM tab shows annual operational carbon emissions in comparison to the CRREM limit. Hovering your cursor over any year will give you information for each scenario in that year.



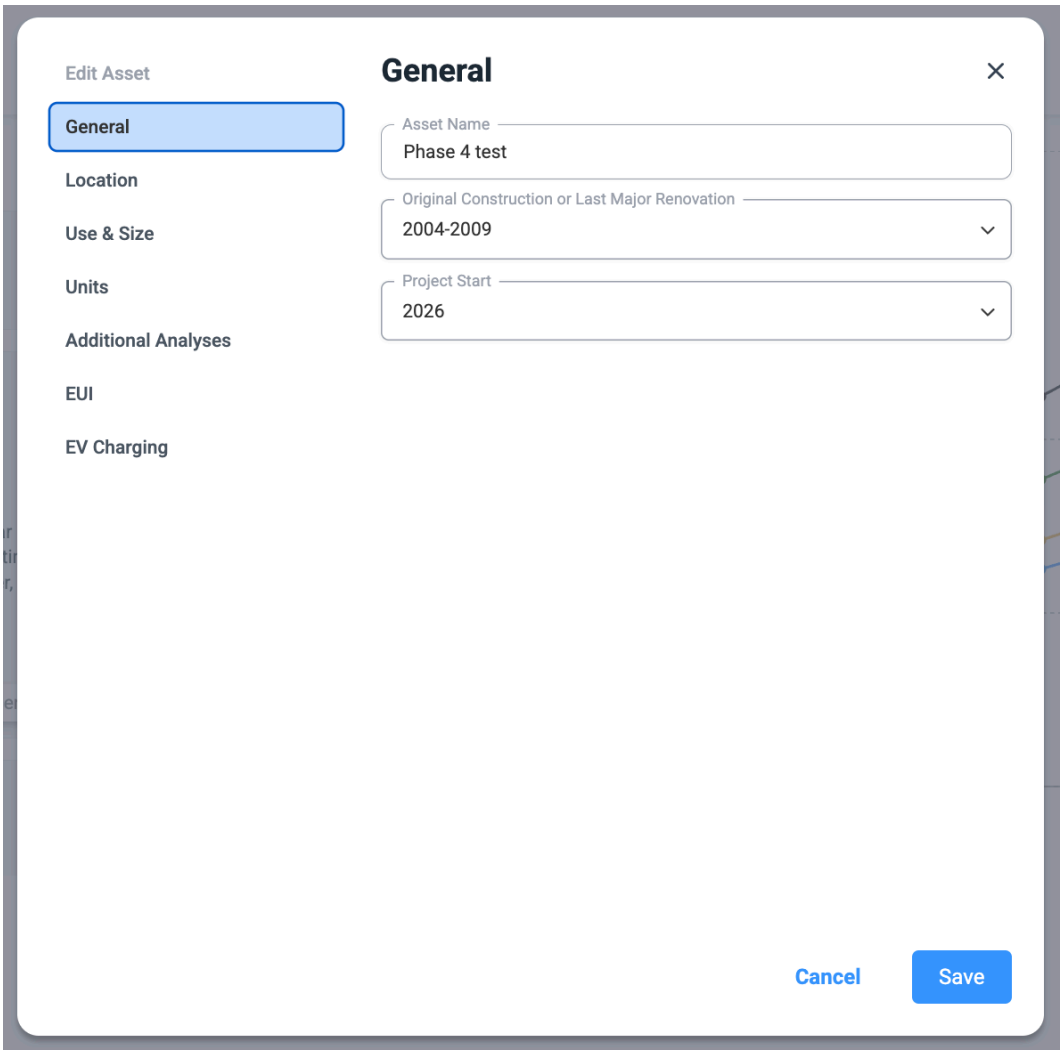
CRREM tab.

For more information on CRREM, its methodology, and how it was integrated within the Impact Building Calculator, click **here**.

Asset Information

To modify the asset's information, click the **Edit Asset** button on the top of the Calculator's asset page.

This will bring up the **Edit Asset** panel.



Edit Asset.

Here, you will be able to edit some of the asset's details. Note, some asset details cannot be modified after creating an asset, such as asset type.

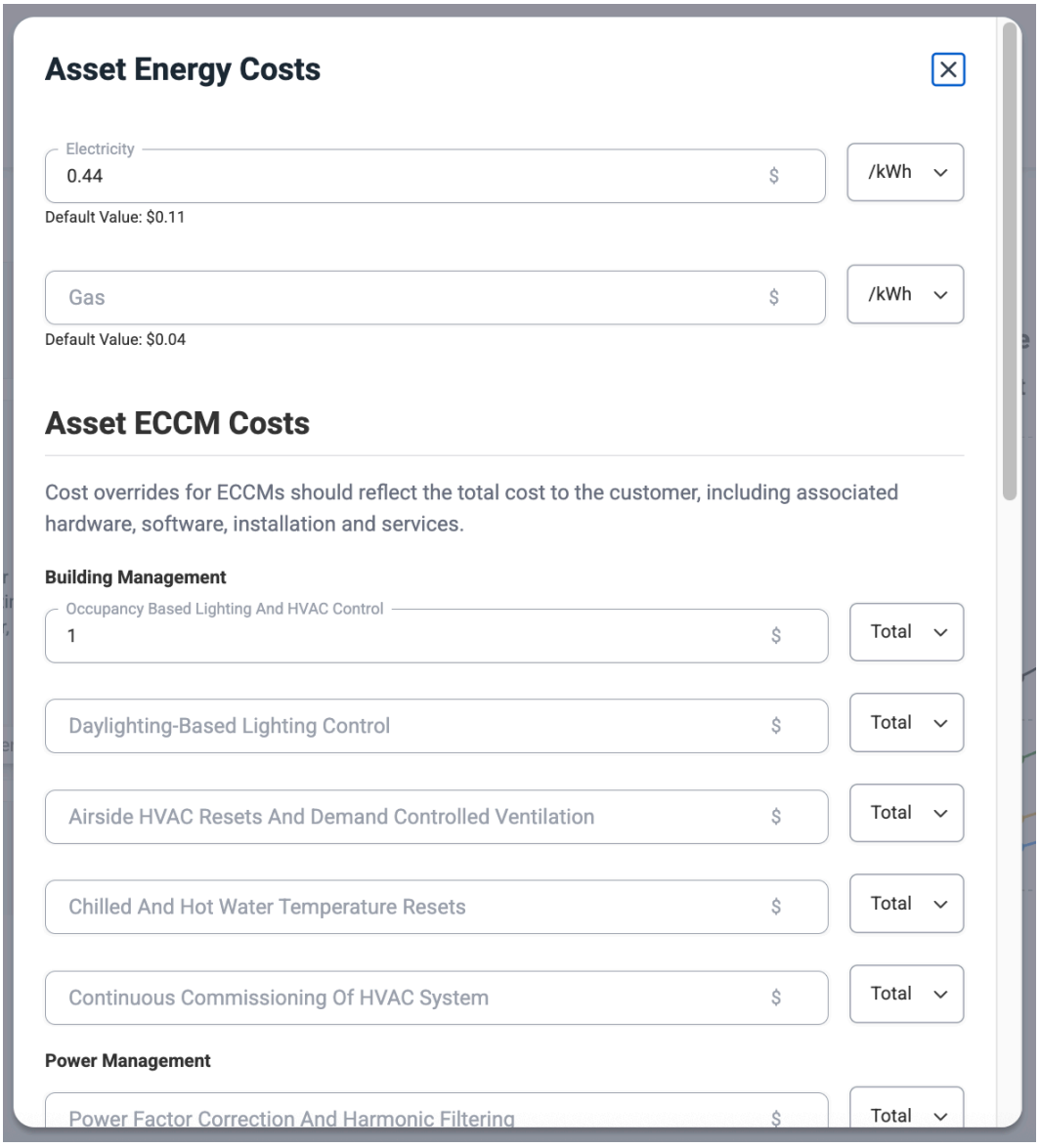
After modifying the details, click **Save** to proceed to the Scenario analysis screen.

Editing Cost Data

Asset Energy Costs

Edit the asset's cost data by clicking the **Edit Costs** button on the top of the Calculator's asset page.

This will bring up the **Asset Costs** panel.



Asset energy costs and ECCM costs.

Here, enter custom Electricity and Gas costs. If the fields are left blank, default values will be used. If necessary, **modify the currency units in the Settings menu**.

Additionally, custom ECCM costs can be entered for each ECCM in use. Note, an ECCM must first be added to at least one of the asset's scenarios before custom cost data can be input.

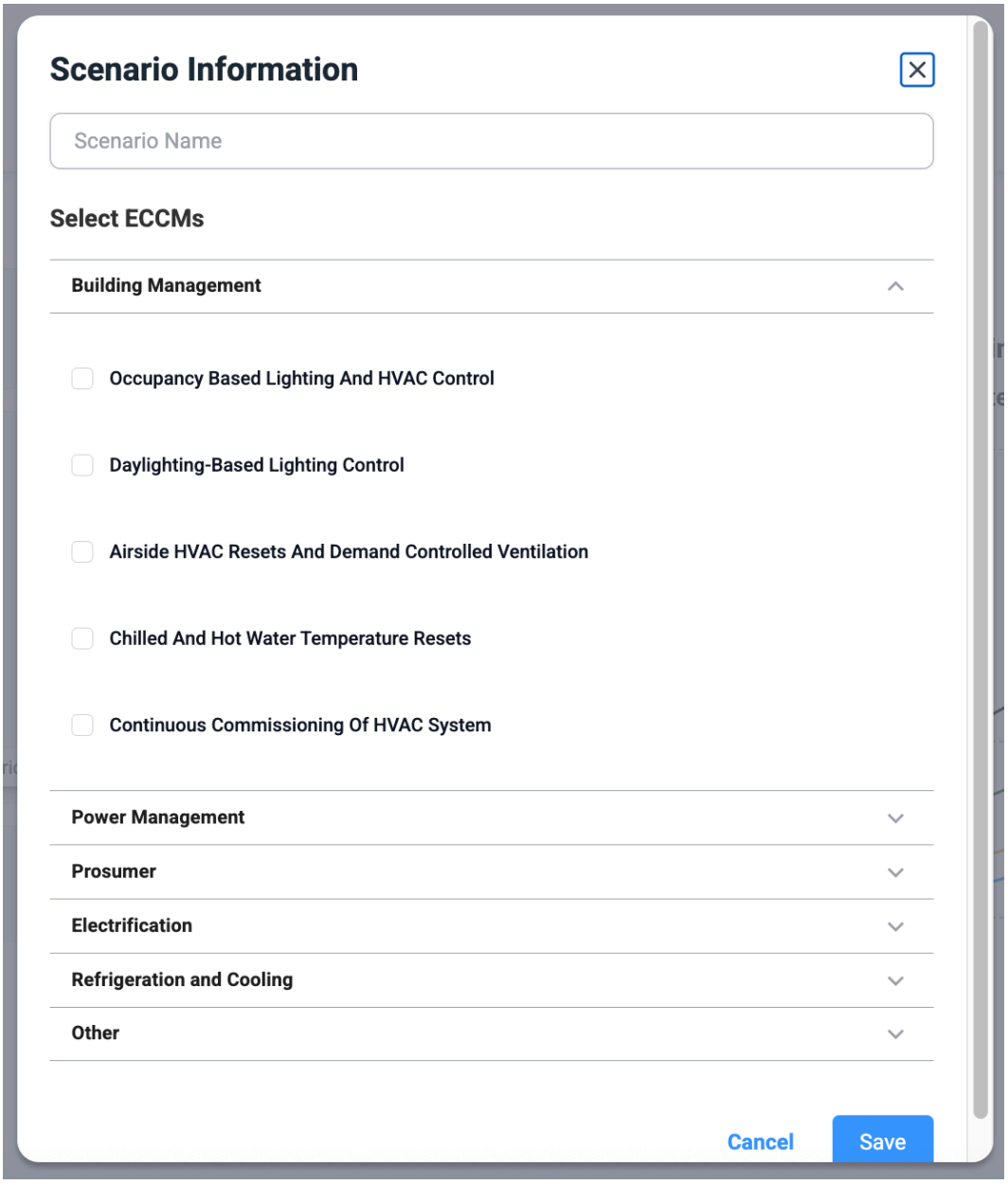
After inputting custom Asset Costs, click **Save** to proceed to the Scenario analysis screen.

Creating a Scenario

Create a New Scenario

Create a new scenario by clicking the **Create Scenario** button on the top of the Calculator's asset page.

This will bring up the **Scenario Information** panel.



Scenario information.

Here, name the new scenario and select the ECCMs to include in the new scenario. Remember, not all ECCMs are available for all building use types. **Read more information on ECCMs**.

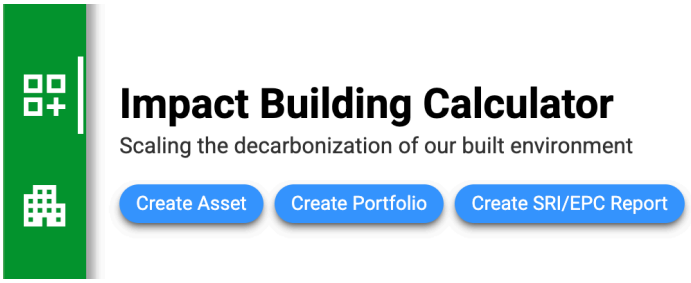
After selecting the ECCMs, click **Save** to proceed to the Scenario analysis screen.

Portfolio-Level Analysis

Creating and Loading Portfolios

Creating a Portfolio

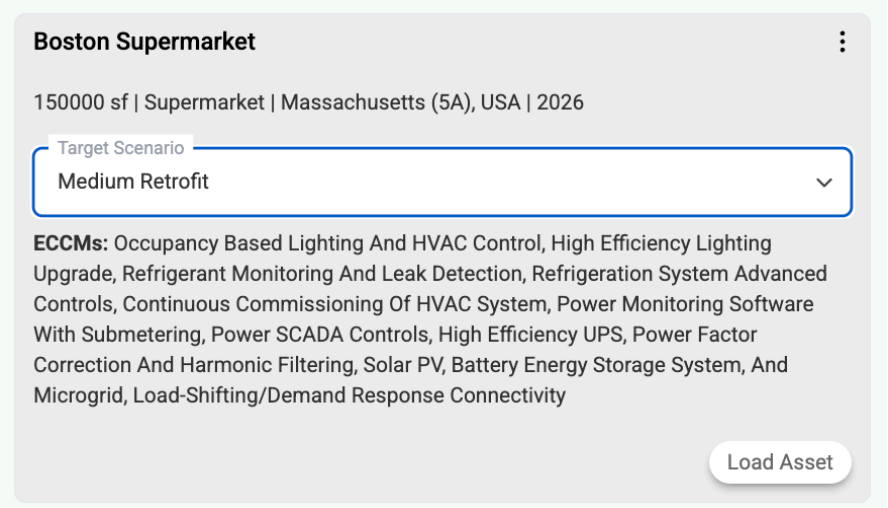
After creating asset(s), you can create a portfolio by clicking the **Create Portfolio** button at the top of the list of saved projects.



Create portfolio.

This will bring up the Portfolio data panel. Choose the assets to include in the portfolio. Click **Save** and proceed to the Portfolio-level analysis screen.

After creating the portfolio, a specific scenario for each asset must be selected for analysis within the portfolio.

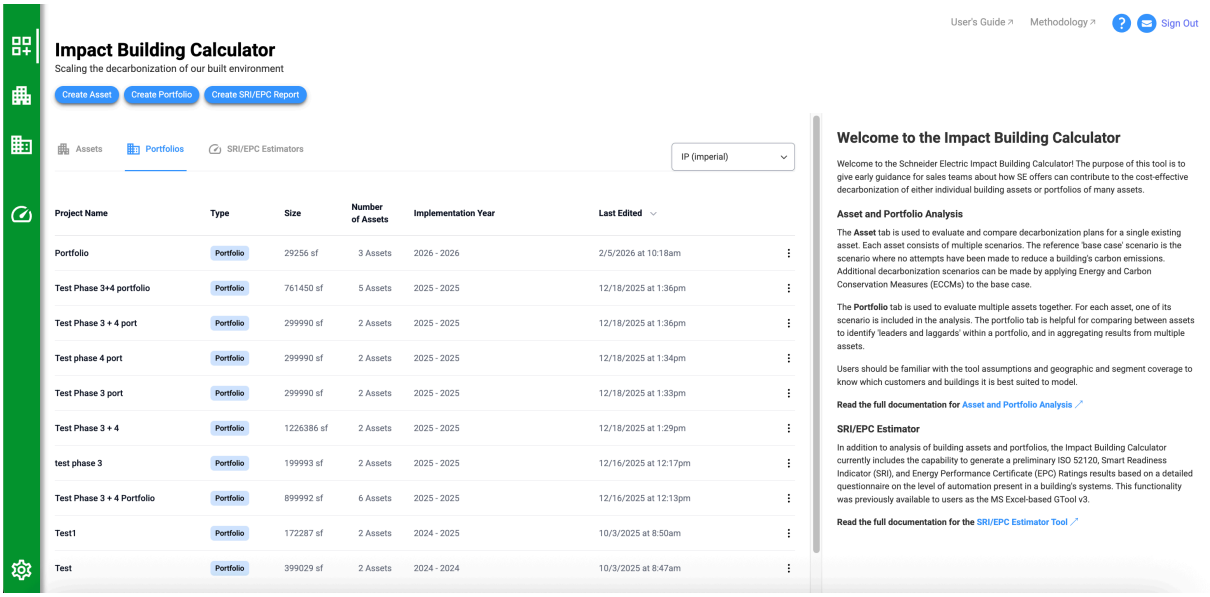


Select which scenario to include in the portfolio.

After its initial creation, all changes to the portfolio and its scenarios are automatically saved. You can create more portfolios based on the same procedure.

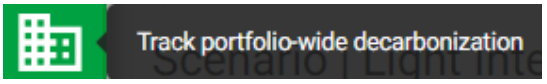
Loading a Saved Portfolio

On the Dashboard page, a previously saved portfolio can be loaded by clicking that portfolio **row** on the dashboard. The row contains some information describing the portfolio for cases when the Project Name alone is not descriptive enough.



Load portfolio from the dashboard.

The most recently edited portfolio can be reloaded by navigating directly to the portfolio-level analysis page in the left navigation bar.



Portfolio analysis is always available via the left navigation bar.

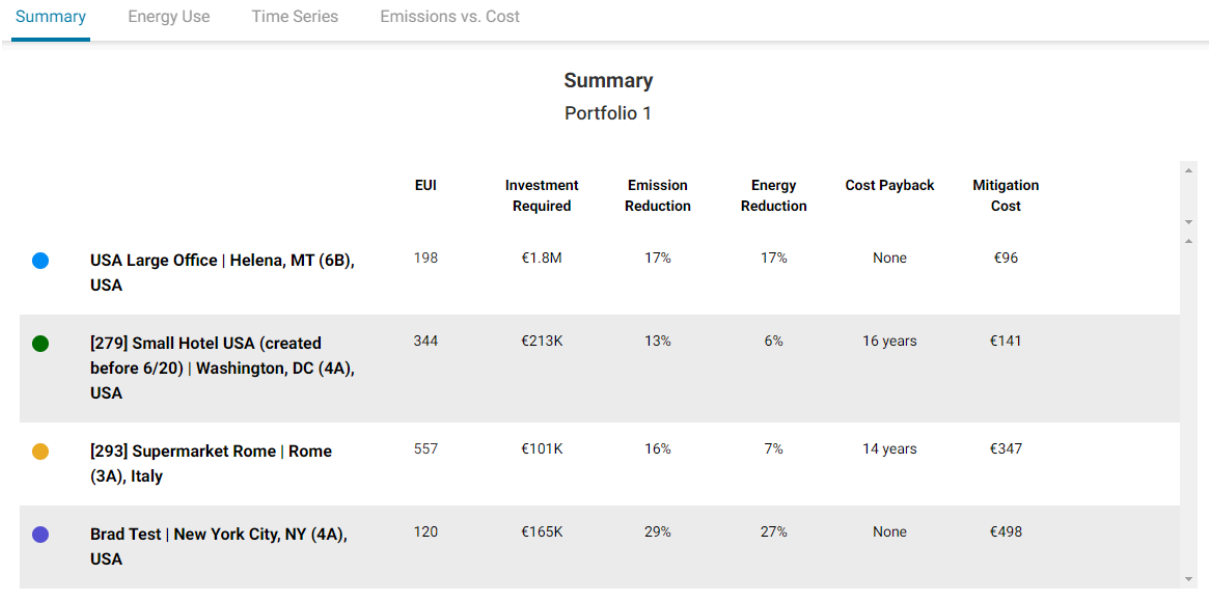
Visualizing Portfolio Data

The portfolio-level analysis page contains a list of all selected assets and their associated target scenarios on the left and a set of figures that visualize the results on the right. You can switch between figures using the titles above the figures. Target scenarios for each asset can be selected with the dropdown list in the summary card for each asset.

You can add or remove projects from your portfolio in bulk by clicking the **Edit Portfolio** button above the list of assets. Individual assets can be removed by clicking three dots in the upper righthand corner of that asset's summary card and selecting **Remove from portfolio**.

Summary

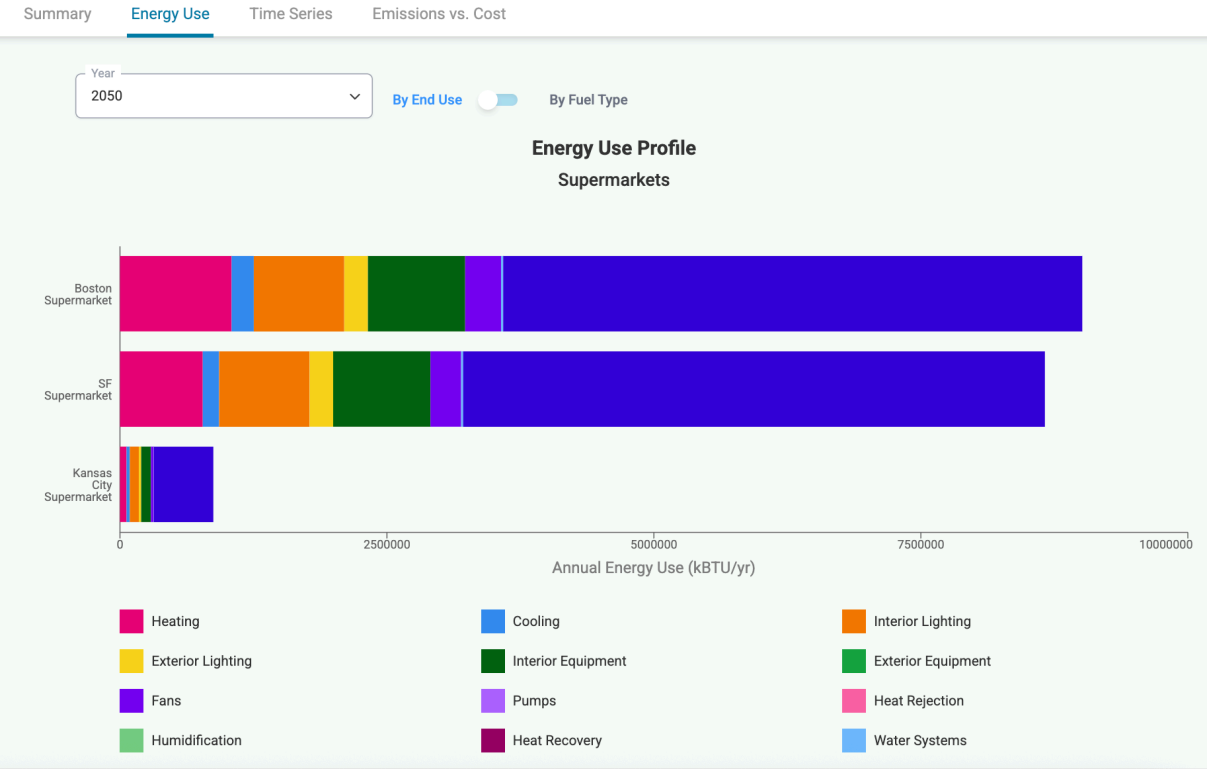
The Summary tab provides a tabular overview of each asset in your portfolio, as well as dot plots comparing key metrics between them. Hovering your cursor over the column headers will explain that metric.



Summary Tab.

Energy Use

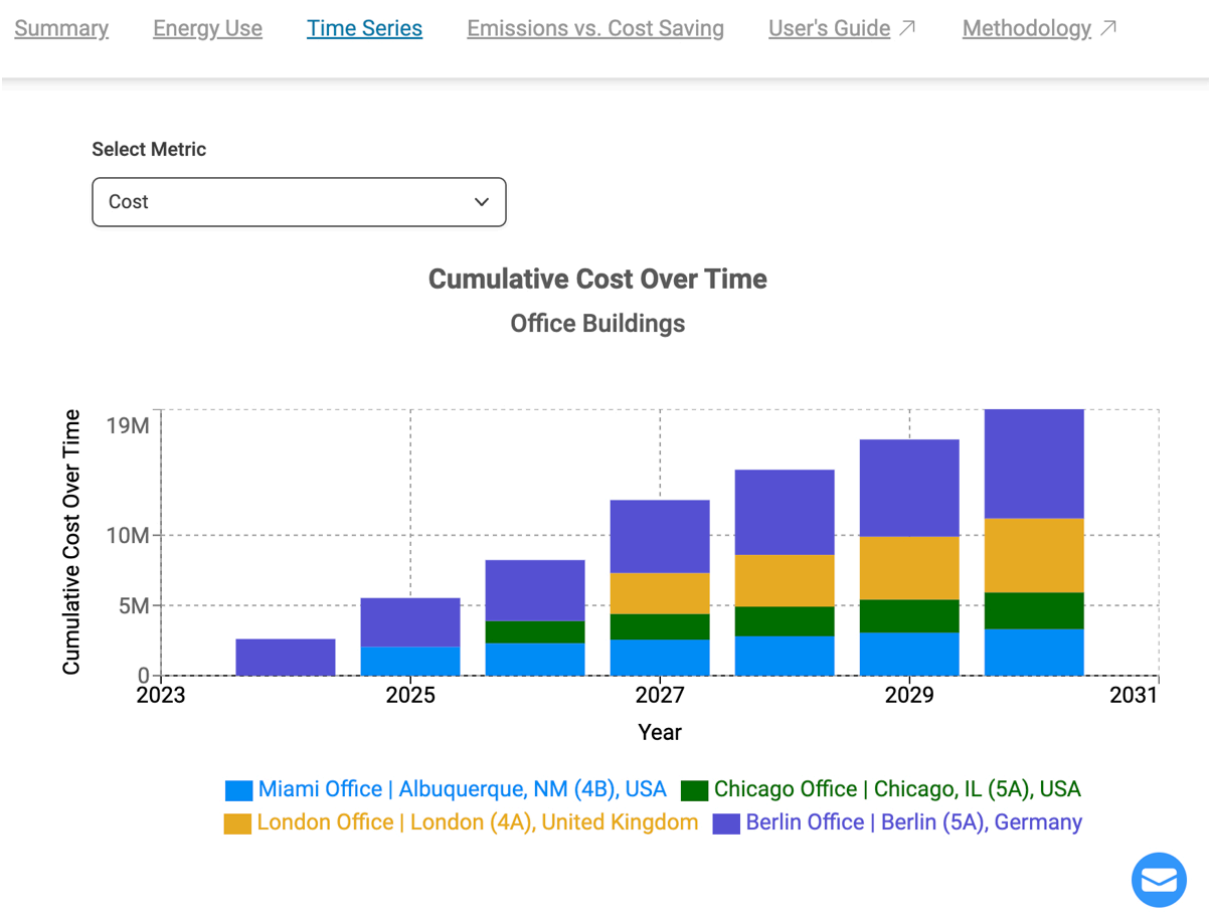
The Energy Use tab shows the annual energy use for each asset by end-use or by fuel type. Hovering over any of the bars will give you energy consumption by end-use category for that asset, or by fuel type.



Energy use tab.

Time Series

The Time Series tab displays the cumulative cost or carbon emissions over time for these assets. By hovering your cursor over any specific year, detailed information for each asset during that year is provided.

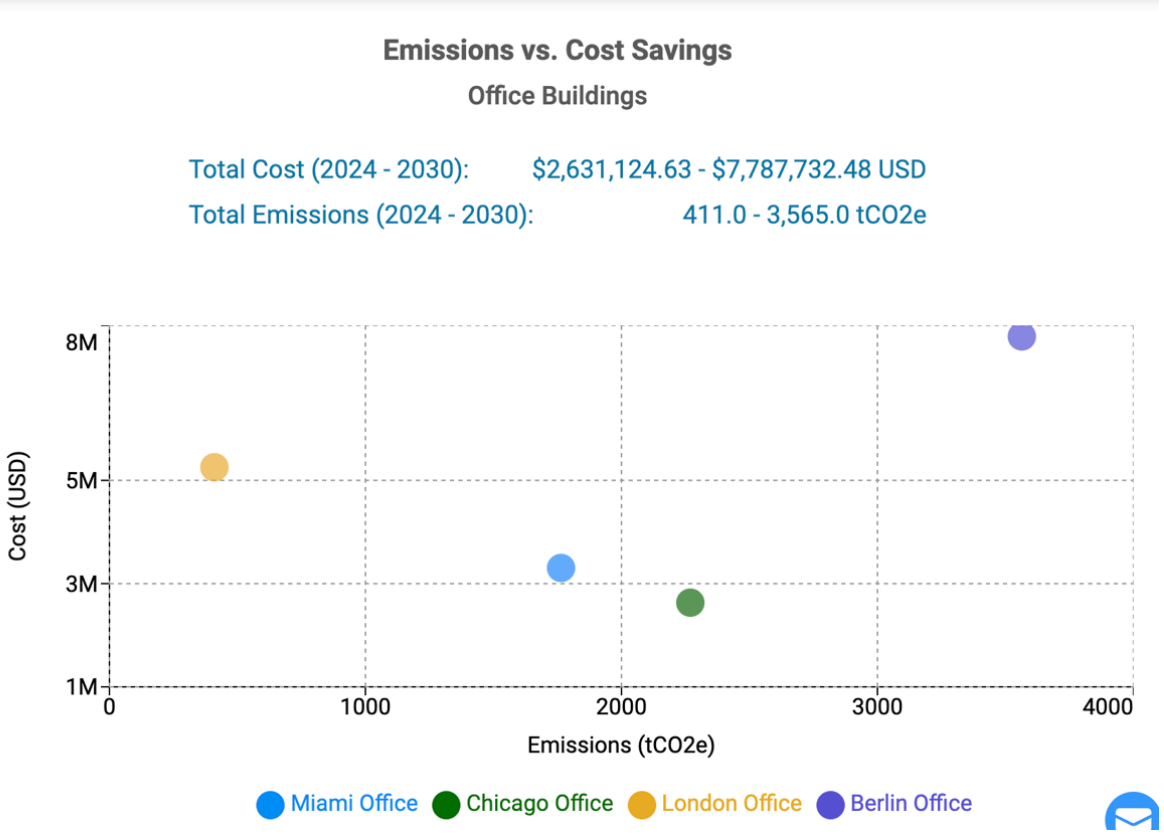


Time series tab.

Cumulative Emissions vs. Cost

The Emissions vs. Cost tab shows the total cost plotted against total emissions, evaluated over the entire time horizon. Hovering your cursor over any point will give you the total cost and emissions data for that asset.

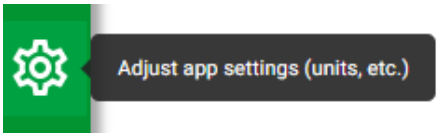
Summary Energy Use Time Series Emissions vs. Cost Saving User's Guide ↗ Methodology ↗



Emissions vs. cost tab.

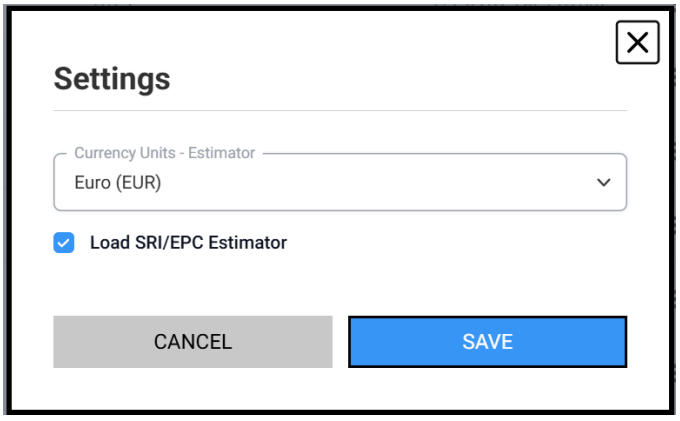
Settings

Global settings can be viewed and changed in the Settings panel. Open the Settings panel by clicking the Settings icon at the bottom of the left navigation bar.



Settings.

This will bring up the **Settings** panel.



Settings panel.

Here, you can configure the following global settings:

- **Currency Units - Estimator**: By default all currencies for the Estimator tool are set to EUR, € (Euro)
- **Load SRI/EPC Estimator**: include or exclude SRI/EPC Estimator analyses within the tool

Methodology

Analysis within the Impact Building Calculator is comprised of three interconnected calculations for cost, whole life carbon emissions, and energy use. Methodologies for each of these is detailed in the sections which follow.

Time Series Analysis

The Impact Building Calculator analyzes cost, carbon, and energy use over time. In the current version of the tool, this analysis is done on the basis of an annual average (future versions of the tool will calculate on an hourly basis).

Using time series analysis for buildings is the appropriate choice because 1) buildings are long-lived assets, 2) the value of retrofits is realized over time, and 3) the carbon emissions reductions from retrofits changes over time as electrical utilities decarbonize their generation portfolios in line with their declared targets.

Uncertainty in Time Series Analysis

Time series analysis is essential for understanding how ECCMs deliver cost and carbon reductions to particular buildings, and the future into which we make these projections is inherently uncertain. Energy prices, for instance, are inherently volatile —a reality which can be exacerbated by unexpected geopolitical events.

While we can state confidently that this uncertainty exists, quantifying this uncertainty is outside the scope of this tool. In your interpretation of the tool's results, it is recommended that you consider how much the results of the tool could be affected by future uncertainty and use your professional judgement in qualifying the results of the tool in light of this.

Energy Use Modeling

EnergyPlus

The energy use data embedded in the Impact Building Calculator is modeled with the physics-based EnergyPlus whole building energy simulation engine supplemented by a machine learning algorithm. Simulations were performed using the **Existing Commercial Reference Buildings Constructed In or After 1980** (v1.4) provided by the United States Department of Energy. Simulations were performed for every possible combination of ECCMs available in the Impact Building Calculator within each Building Segment, across all representative climate zones.

Results of these simulations were normalized by unit gross floor area. When asset data is entered in the Calculator, the area-normalized data is scaled to the user input.

End Use

In the context of energy consumption, "end use" refers to the specific category or application where energy is utilized within a building or system. End use breaks down total energy use into individual functions, such as heating, cooling, lighting, or equipment operation. Understanding end uses helps identify where energy is consumed most and informs targeted energy efficiency measures for each category.

Characteristics of Prototype Models

The following is a summary of the characteristics of the prototype models used in the analysis. Where available prototype models were used rather than custom created, the full model documentation and the models themselves are available from **the US Department of Energy Office of Energy Efficiency and Renewable Energy**.

Use Category	Conditioned GFA	Window-to-Wall Ratio
Hospital (built before 2000)	564,400 sf	16%
Hospital (built after 2000)	241,410 sf	16%

Hotel (small)	43,200 sf	11%
Hotel (large)	122,132 sf	30%
Office (small)	5,500 sf	21%
Office (medium)	53,600 sf	33%
Office (large)	498,600 sf	40%
Supermarket	45,006 sf	7%
Urban Grocery*	5,000 sf	15%
Storefront Retail	3,200 sf	15%
Warehouse	52,000 sf	1%
Refrigerated Warehouse*	215,200 sf	1%
Quick Service Restaurant	2,500 sf	14%
Mixed Use Super Tall Building*	821,791 sf	58%
Dormitory*	40,000 sf	30%

** The urban grocery, refrigerated warehouse, mixed-use super tall building, and dormitory prototype models were created for this tool only and are not DoE-supplied models.*

Typical Baseline Systems

USA & AUS & CAN

Use Category	Baseline HVAC Systems
Hospital	Hot water system with gas boilers; Chilled water system with water-cooled chillers and open cooling tower; Floor-by-floor VAV AHUs with hot water reheat and steam humidifiers; Central service water heaters - gas-fired
Hotel (small)	Packages terminal air conditioner with electric heating; Packaged rooftop air conditioner or Packaged rooftop air conditioner with two fan speed (Size dependent); Warm air furnace, electric
Hotel (large)	Hot water system with gas boilers; Chilled water system with air-cooled chillers; Guest rooms: four-pipe fan coils; Public spaces: VAV with hot water reheat; Central service water heaters - gas-fired
Office (small)	Packaged rooftop heat pump with gas auxiliary heat

Office (medium)	Packaged air conditioning unit with gas-fired heating; Distribution via Variable Air Volume (VAV) terminals with electric reheat; Service water heaters - gas-fired
Office (large)	Hot water system with a gas boiler; Chilled water system with water-cooled chillers and open cooling tower; Fluid coolers for data centers; Distribution via VAV terminals with hot water reheat; Service water heaters - gas-fired
Supermarket	Packaged single-zone rooftop units with DX cooling and gas-fired furnaces; Service water heaters - gas-fired
Urban Grocery	Packaged central unit, pPackaged rooftop units (RTUs), Centralized water heater - gas-fired
Storefront Retail	Packaged RTUs equipped with an electric DX coil for cooling and gas furnace for heating, Gas water heaters
Warehouse	Packaged single-zone RTUs, Instantaneous electric water heater
Refrigerated Warehouse	Packaged RTUs for office and loading, Instantaneous electric water heater, Central cooling system with screw compressors and evaporator units for cooler/freezer storage areas
Quick Service Restaurant	Packaged single-zone RTUs, Natural gas water heater
Mixed Use Super Tall Building	Centralized hydronic plant with natural gas boilers and water-cooled chillers, Floor-by-floor VAV AHUs for office, retail, and hotel common spaces. DOAS supplying OA to each AHU, Fan coil + DOAS for hotel guest rooms, Natural gas water heaters (multi-zone distribution)
Dormitory	Fan coil units with a makeup air unit and district cooling and heating, Centralized natural gas-fired boiler system

EU & UK

Use Category	**Baseline HVAC Systems**
Hospital	Fan coil units with gas boilers and water-cooled chillers; Dedicated Outside Air System (DOAS) with hydronic heating and cooling coils
Hotel (small)	Packages terminal air conditioner with electric heating; Packaged rooftop air conditioner or Packaged rooftop air conditioner with two fan speed (Size dependent); Warm air furnace, electric

Hotel (large)	Hot water system with gas boilers; Chilled water system with air-cooled chillers; Guest rooms: four-pipe fan coils; Public spaces: VAV with hot water reheat; Central service water heaters - gas-fired
Office (small)	Packaged rooftop heat pump with gas auxiliary heat
Office (medium	Packaged air conditioning unit with gas-fired heating; Distribution via Variable Air Volume (VAV) terminals with electric reheat; Service water heaters - gas-fired
Office (large)	Hot water system with a gas boiler; Chilled water system with water-cooled chillers and open cooling tower; Fluid coolers for data centers; Distribution via VAV terminals with hot water reheat; Service water heaters - gas-fired
Supermarket	Packaged single-zone rooftop units with DX cooling and gas-fired furnaces; Service water heaters - gas-fired; Air-to-air heat recovery in all Northern European locations
Urban Grocery	Packaged central unit, pPackaged rooftop units (RTUs), Centralized water heater - gas-fired
Storefront Retail	Packaged RTUs equipped with an electric DX coil for cooling and gas furnace for heating, Gas water heaters
Warehouse	Packaged single-zone RTUs, Instantaneous electric water heater
Refrigerated Warehouse	Packaged RTUs for office and loading, Instantaneous electric water heater, Central cooling system with screw compressors and evaporator units for cooler/freezer storage areas
Quick Service Restaurant	Packaged single-zone RTUs, Natural gas water heater
Mixed Use Super Tall Building	Centralized hydronic plant with natural gas boilers and water-cooled chillers, Floor-by-floor VAV AHUs for office, retail, and hotel common spaces. DOAS supplying OA to each AHU, Fan coil + DOAS for hotel guest rooms, Natural gas water heaters (multi-zone distribution)
Dormitory	Fan coil units with a makeup air unit and district cooling and heating, Centralized natural gas-fired boiler system

Singapore and Hong Kong

Use Category	**Baseline HVAC Systems**

Hospital	Fan coil units with hydronic coils served by water-cooled chillers; Dedicated Outside Air System (DOAS) with hydronic heating and cooling coils; Demand Control Ventilation was assumed when built after 2000; No airside heat/energy recovery
Hotel (small)	Packages terminal air conditioner with electric heating; Packaged rooftop air conditioner or Packaged rooftop air conditioner with two fan speed (Size dependent); Warm air furnace, electric; No airside heat/energy recovery
Hotel (large)	Hot water system with gas boilers; Chilled water system with air-cooled chillers; Guest rooms: four-pipe fan coils; Public spaces: VAV with hot water reheat; Central service water heaters - gas-fired; No airside heat/energy recovery
Office (small)	Packaged rooftop heat pump with gas auxiliary heat
Office (medium)	Packaged air conditioning unit with gas-fired heating; Distribution via Variable Air Volume (VAV) terminals with electric reheat; Service water heaters - gas-fired; No Demand Control Ventilation when built after 2000
Office (large)	Hot water system with a gas boiler; Chilled water system with water-cooled chillers and open cooling tower; Fluid coolers for data centers; Distribution via VAV terminals with hot water reheat; Service water heaters - gas-fired; No Demand Control Ventilation when built after 2000; Energy recovery wheels on all air handling units
Supermarket	Packaged single-zone rooftop units with DX cooling and gas-fired furnaces; Service water heaters - gas-fired
Urban Grocery	Packaged central unit, pPackaged rooftop units (RTUs), Centralized water heater - gas-fired
Storefront Retail	Packaged RTUs equipped with an electric DX coil for cooling and gas furnace for heating, Gas water heaters
Warehouse	Packaged single-zone RTUs, Instantaneous electric water heater
Refrigerated Warehouse	Packaged RTUs for office and loading, Instantaneous electric water heater, Central cooling system with screw compressors and evaporator units for cooler/freezer storage areas
Quick Service Restaurant	Packaged single-zone RTUs, Natural gas water heater

Mixed Use Super Tall Building	Centralized hydronic plant with natural gas boilers and water-cooled chillers, Floor-by-floor VAV AHUs for office, retail, and hotel common spaces. DOAS supplying OA to each AHU, Fan coil + DOAS for hotel guest rooms, Natural gas water heaters (multi-zone distribution)
Dormitory	Fan coil units with a makeup air unit and district cooling and heating, Centralized natural gas-fired boiler system

UAE

Use Category	**Baseline HVAC Systems**
Hospital	Hot water system with gas boilers; Air-cooled chillers when built before 2000, and district cooling system when built after 2000; Floor-by-floor VAV AHUs with hot water reheat and steam humidifiers; Central service water heaters - gas-fired; No energy recovery
Hotel (small)	Packages terminal air conditioner with electric heating; Packaged rooftop air conditioner or Packaged rooftop air conditioner with two fan speed (Size dependent); Warm air furnace, electric; No energy recovery
Hotel (large)	Hot water system with gas boilers; Chilled water system with air-cooled chillers; Guest rooms: four-pipe fan coils; Public spaces: VAV with hot water reheat; Central service water heaters - gas-fired; No energy recovery
Office (small)	Packaged rooftop heat pump with gas auxiliary heat; No energy recovery
Office (medium)	Packaged air conditioning unit with gas-fired heating; Distribution via Variable Air Volume (VAV) terminals with electric reheat; Service water heaters - gas-fired
Office (large)	Hot water system with a gas boiler; water-cooled chillers when built before 2000, and air-cooled chillers when built after 2000; Fluid coolers for data centers; Single-zone packaged split air conditioners when built before 2000, and distribution via Variable Air Volume (VAV) terminals with electric reheat when built after 2000; Service water heaters - gas-fired; No energy recovery
Supermarket	Packaged single-zone rooftop units with DX cooling and gas-fired furnaces; Service water heaters - gas-fired; No energy recovery

Urban Grocery	Packaged central unit, pPackaged rooftop units (RTUs), Centralized water heater - gas-fired
Storefront Retail	Packaged RTUs equipped with an electric DX coil for cooling and gas furnace for heating, Gas water heaters
Warehouse	Packaged single-zone RTUs, Instantaneous electric water heater
Refrigerated Warehouse	Packaged RTUs for office and loading, Instantaneous electric water heater, Central cooling system with screw compressors and evaporator units for cooler/freezer storage areas
Quick Service Restaurant	Packaged single-zone RTUs, Natural gas water heater
Mixed Use Super Tall Building	Centralized hydronic plant with natural gas boilers and water-cooled chillers, Floor-by-floor VAV AHUs for office, retail, and hotel common spaces. DOAS supplying OA to each AHU, Fan coil + DOAS for hotel guest rooms, Natural gas water heaters (multi-zone distribution)
Dormitory	Fan coil units with a makeup air unit and district cooling and heating, Centralized natural gas-fired boiler system

Saudi Arabia

Use Category	**Baseline HVAC Systems**
Hospital	Hot water system with gas boilers; Chilled water system with air-cooled chillers and open cooling tower; Floor-by-floor VAV AHUs with hot water reheat and steam humidifiers; Central service water heaters - gas-fired; No energy recovery
Hotel (small)	Packages terminal air conditioner with electric heating; Packaged rooftop air conditioner or Packaged rooftop air conditioner with two fan speed (Size dependent); Warm air furnace, electric; No energy recovery
Hotel (large)	Hot water system with gas boilers; Chilled water system with air-cooled chillers; Guest rooms: four-pipe fan coils; Public spaces: VAV with hot water reheat; Central service water heaters - gas-fired; No energy recovery
Office (small)	Packaged rooftop heat pump with gas auxiliary heat; No energy recovery
Office (medium)	Packaged air conditioning unit with gas-fired heating; Distribution via Variable Air Volume (VAV) terminals with electric reheat; Service water heaters - gas-fired; No energy recovery

Office (large)	Hot water system with a gas boiler; water-cooled chillers when built before 2000, and air-cooled chillers when built after 2000; Fluid coolers for data centers; Single-zone packaged split air conditioners when built before 2000, and distribution via Variable Air Volume (VAV) terminals with electric reheat when built after 2000; Service water heaters - gas-fired; No energy recovery
Supermarket	Packaged single-zone rooftop units with DX cooling and gas-fired furnaces; Service water heaters - gas-fired; No energy recovery
Urban Grocery	Packaged central unit, pPackaged rooftop units (RTUs), Centralized water heater - gas-fired
Storefront Retail	Packaged RTUs equipped with an electric DX coil for cooling and gas furnace for heating, Gas water heaters
Warehouse	Packaged single-zone RTUs, Instantaneous electric water heater
Refrigerated Warehouse	Packaged RTUs for office and loading, Instantaneous electric water heater, Central cooling system with screw compressors and evaporator units for cooler/freezer storage areas
Quick Service Restaurant	Packaged single-zone RTUs, Natural gas water heater
Mixed Use Super Tall Building	Centralized hydronic plant with natural gas boilers and water-cooled chillers, Floor-by-floor VAV AHUs for office, retail, and hotel common spaces. DOAS supplying OA to each AHU, Fan coil + DOAS for hotel guest rooms, Natural gas water heaters (multi-zone distribution)
Dormitory	Fan coil units with a makeup air unit and district cooling and heating, Centralized natural gas-fired boiler system

Argentina & Chile

Use Category	**Baseline HVAC Systems**
Hospital	Hot water system with gas boilers; Chilled water system with water-cooled chillers and open cooling tower; Floor-by-floor VAV AHUs with hot water reheat and steam humidifiers; Central service water heaters - gas-fired
Hotel (small)	Packages terminal air conditioner with electric heating; Packaged rooftop air conditioner or packaged rooftop air conditioner with two fan speed; Warm air furnace, electric

Hotel (large)	Hot water system with gas boilers; Chilled water system with air-cooled chillers; Guest rooms: four-pipe fan coils; Public spaces: VAV with hot water reheat; Central service water heaters - gas-fired
Office (small)	Packaged rooftop heat pump with gas auxiliary heat
Office (medium)	Packaged air conditioning unit with gas-fired heating; Distribution via VAV terminals with electric reheat; Service water heaters - gas-fired
Office (large)	Hot water system with gas boiler; Chilled water system with water-cooled chillers and open cooling tower; Fluid coolers for data centers; Distribution via VAV terminals with hot water reheat; Service water heaters - gas-fired
Supermarket	Packaged single-zone rooftop units with DX cooling and gas-fired furnaces; Service water heaters - gas-fired
Urban Grocery	Packaged central unit; Packaged rooftop units (RTUs); Centralized water heater
Storefront Retail	Packaged rooftop units (RTUs), equipped with electric DX coil for cooling and fossil fuel furnace for heating
Warehouse	Packaged single-zone rooftop units (RTUs); Instantaneous electric water heater
Refrigerated Warehouse	Packaged rooftop units (RTUs) serving office spaces and loading areas; Instantaneous electric water heater; Central cooling system with screw compressors and evaporator units for cooler/freezer storage
Quick Service Restaurant	Packaged single-zone rooftop units (RTUs); Natural gas water heater
Mixed Use Super Tall Building	Centralized hydronic plant with natural gas boilers and water-cooled chillers; Floor-by-floor VAV AHUs for office, retail, and hotel common spaces; DOAS supplying OA to each AHU; Fan coil + DOAS for hotel guest rooms; Natural gas water heaters (electric per modifications)
Dormitory	Fan coil units with makeup air unit and district cooling and heating; Centralized natural gas-fired boiler system

Brazil

Use Category	**Baseline HVAC Systems**

Hospital	Hot water system with gas boilers; Chilled water system with water-cooled chillers and open cooling tower; Floor-by-floor VAV AHUs with hot water reheat and steam humidifiers; Central service water heaters - gas-fired
Hotel (small)	Packages terminal air conditioner with electric heating; Packaged rooftop air conditioner or packaged rooftop air conditioner with two fan speed; Warm air furnace, electric; No wall insulation in zones 0-1
Hotel (large)	Hot water system with gas boilers; Chilled water system with air-cooled chillers; Guest rooms: four-pipe fan coils; Public spaces: VAV with hot water reheat; Central service water heaters - gas-fired; No wall insulation in zones 0-1
Office (small)	Packaged rooftop heat pump with gas auxiliary heat; Electric water heaters; Heating coils always off in zones 0-1; No wall insulation in zones 0-1
Office (medium)	Packaged air conditioning unit with gas-fired heating; Distribution via VAV terminals with electric reheat; Electric water heaters; Heating coils always off in zones 0-1; No wall insulation in zones 0-1
Office (large)	Hot water system with gas boiler; Chilled water system with water-cooled chillers and open cooling tower; Fluid coolers for data centers; Distribution via VAV terminals with hot water reheat; Electric water heaters; Heating coils always off in zones 0-1; No wall insulation in zones 0-1
Supermarket	Packaged single-zone rooftop units with DX cooling and gas-fired furnaces; Service water heaters - gas-fired
Urban Grocery	Packaged central unit; Packaged rooftop units (RTUs); Electric water heaters; No wall insulation in zones 0-1
Storefront Retail	Packaged rooftop units (RTUs), equipped with electric DX coil for cooling and fossil fuel furnace for heating; Electric water heaters; Heating coils always off in zones 0-1
Warehouse	Packaged single-zone rooftop units (RTUs); Electric water heaters; Heating coils always off in zones 0-1; No wall insulation in zones 0-1
Refrigerated Warehouse	Packaged rooftop units (RTUs) serving office spaces and loading areas; Electric water heaters; Central cooling system with screw compressors and evaporator units for cooler/freezer storage; Heating coils always off in zones 0-1; No wall insulation in zones 0-1

Quick Service Restaurant	Packaged single-zone rooftop units (RTUs); Electric water heaters; Heating coils always off in zones 0-1
Mixed Use Super Tall Building	Centralized hydronic plant with natural gas boilers and water-cooled chillers; Floor-by-floor VAV AHUs for office, retail, and hotel common spaces; DOAS supplying OA to each AHU; Fan coil + DOAS for hotel guest rooms; Electric water heaters; Heating coils always off in zones 0-1
Dormitory	Fan coil units with makeup air unit and district cooling and heating; Centralized natural gas-fired boiler system; Electric water heaters; Heating coils always off in zones 0-1; No wall insulation in zones 0-1

India

Use Category	**Baseline HVAC Systems**
Hospital	Hot water system with gas boilers; Chilled water system with water-cooled chillers and open cooling tower; Floor-by-floor VAV AHUs with hot water reheat and steam humidifiers; Electric water heaters; Energy recovery; Heating coils always off in zones 0-1
Hotel (small)	Packages terminal air conditioner with electric heating; Packaged rooftop air conditioner or packaged rooftop air conditioner with two fan speed; Warm air furnace, electric; Electric water heaters; Heating coils always off in zones 0-1; No wall insulation in zones 0-1
Hotel (large)	Hot water system with electric boilers; Chilled water system with air-cooled chillers; Guest rooms: four-pipe fan coils; Public spaces: VAV with hot water reheat; Electric water heaters; Energy recovery; Heating coils always off in zones 0-1; No wall insulation in zones 0-1
Office (small)	Packaged rooftop heat pump with gas auxiliary heat; No SHW energy; Heating coils always off in zones 0-1; No wall insulation in zones 0-1
Office (medium)	Packaged air conditioning unit with electric heating; Distribution via VAV terminals with electric reheat; No SHW energy; Heating coils always off in zones 0-1; No wall insulation in zones 0-1

Office (large)	Hot water system with electric boiler; Chilled water system with water-cooled chillers and open cooling tower; Fluid coolers for data centers; Distribution via VAV terminals with hot water reheat; Electric water heaters; Energy recovery; Heating coils always off in zones 0-1
Supermarket	Packaged single-zone rooftop units with DX cooling and electric furnaces; Electric water heaters; Heating coils always off in zones 0-1; No wall insulation in zones 0-1
Urban Grocery	Packaged central unit; Packaged rooftop units (RTUs); Electric water heaters; No wall insulation in zones 0-1
Storefront Retail	Packaged rooftop units (RTUs), equipped with electric DX coil for cooling and electric furnace for heating; No SHW energy; Heating coils always off in zones 0-1; No wall insulation in zones 0-1
Warehouse	Packaged single-zone rooftop units (RTUs); Instantaneous electric water heater; Heating coils always off in zones 0-1; No wall insulation in zones 0-1
Refrigerated Warehouse	Packaged rooftop units (RTUs) serving office spaces and loading areas; Instantaneous electric water heater; Central cooling system with screw compressors and evaporator units for cooler/freezer storage; Heating coils always off in zones 0-1; No wall insulation in zones 0-1
Quick Service Restaurant	Packaged single-zone rooftop units (RTUs); No SHW energy; Heating coils always off in zones 0-1; No wall insulation in zones 0-1
Mixed Use Super Tall Building	Centralized hydronic plant with electric boilers and water-cooled chillers; Floor-by-floor VAV AHUs for office, retail, and hotel common spaces; DOAS supplying OA to each AHU; Fan coil + DOAS for hotel guest rooms; Electric water heaters; Heating coils always off in zones 0-1
Dormitory	Split heat pumps/ACs; Electric water heaters; Heating coils always off in zones 0-1; No wall insulation in zones 0-1

Building Construction

The following summarizes the baseline exterior wall and roof construction assumptions used for each building type, along with the regional modifications applied in Argentina & Chile, Brazil, and India.

Building Type	Global Standard	Argentina & Chile	Brazil	India
Hotel (large)	Concrete mass wall with code-required insulation	Change exterior wall to mass wall construction	Remove wall insulation for climate zones 0 and 1	Remove wall insulation for climate zones 0 and 1
Hotel (small)	Steel framed walls with code-required insulation	Change exterior wall to mass wall construction	Remove wall insulation for climate zones 0 and 1	Remove wall insulation for climate zones 0 and 1, change exterior wall to mass wall construction
Hospital	Steel framed walls with code-required insulation	Change exterior wall to mass wall construction	Replace with mass wall construction	Same as Global Standard
Urban Hospital	Concrete mass wall with code-required insulation	Same as Global Standard	Same as Global Standard	Same as Global Standard
Supermarket	Concrete mass wall with code-required insulation	Same as Global Standard	Same as Global Standard	Remove wall insulation for climate zones 0 and 1
Office (large)	Concrete mass wall with code-required insulation	Same as Global Standard	Remove wall insulation for climate zones 0 and 1	Same as Global Standard
Office (medium)	Steel framed walls with code-required insulation	Change exterior wall to mass wall construction	Remove wall insulation for climate zones 0 and 1	Remove wall insulation for climate zones 0 and 1, change exterior wall to mass wall construction

Office (small)	Wood framed walls with code-required insulation	Change exterior wall to mass wall construction	Remove wall insulation for climate zones 0 and 1	Remove wall insulation for climate zones 0 and 1, change exterior wall to mass wall construction
Urban Grocery	Concrete mass wall with code-required insulation	Same as Global Standard	Remove wall insulation for climate zones 0 and 1, change glazing to single pane	Remove wall insulation for climate zones 0 and 1
Warehouse	Metal building wall and roof: metal surface + code-required insulation + gypsum board	Change glazing type to single pane	Remove wall insulation for climate zones 0 and 1, change glazing to single pane	Remove wall insulation for climate zones 0 and 1, change glazing type to single pane
Refrigerated Warehouse	Metal roof system with insulation, metal panels with insulation	Change glazing type to single pane	Change glazing to single pane	Remove wall insulation for climate zones 0 and 1, change glazing type to single pane
Quick Service Restaurant	Wood-framed wall & wood-joist attic roof - unconditioned attic with no insulation	Change exterior wall to mass wall construction, change glazing type to single pane	Replace with mass wall construction, change glazing to single pane	Remove wall insulation for climate zones 0 and 1, change exterior wall to mass wall construction, change glazing type to single pane
Mixed Use Super Tall Building	Steel-framed curtain walls, built-up metal roof with code insulation entirely above deck	Same as Global Standard	Same as Global Standard	Same as Global Standard

Storefront Retail	Metal-framed walls with gypsum board and code-required insulation, steel-joist supported metal-decked insulated roof	Change exterior wall to mass wall construction, change glazing type to single pane	Replace with mass wall construction, change glazing to single pane	Remove wall insulation for climate zones 0 and 1, change exterior wall to mass wall construction, change glazing type to single pane
Dormitory	Concrete exterior walls, steel-framed interior walls with gypsum board, built-up roof with rigid insulation on metal decking	Same as Global Standard	Remove wall insulation for climate zones 0 and 1	Remove wall insulation for climate zones 0 and 1, change exterior wall to mass wall construction

Representative Locations and Climate Zones

To fill in the location-specific climate data required for analysis, the Impact Building Calculator pairs a user's selected location with a representative location that is complete with ASHRAE climate zone data. Matching between selected and representative locations is completed using the following order of operations:

- **First:** the Calculator looks for the geographically closest representative city with the same climate zone. This matching type is considered a "Good match".
- **Second:** when there are no matching climate zones in proximity, the Calculator looks for a similar climate zones in the selected country. If multiple exist, the asset is matched with the similar representative location that is geographically-closest. This matching type is considered a "Decent Match".
- **Third:** when there are no similar climate zones in proximity, the Calculator will indicate the selected city is a poor match for the Calculator.

The following is the list of the representative cities for each ASHRAE Climate Zone modeled in the Calculator. More data on the ASHRAE Climate Zones is available online (pdf).

USA & AUS & CAN

Australia

- **2A** – Brisbane
- **3A** – Sydney
- **3B** – Adelaide

Canada

- **4C** – Vancouver
- **5A** – Toronto
- **6A** – Montreal
- **7** – Calgary

USA

- **1A** – Miami, FL
- **1B** – Phoenix, AZ
- **2A** – Houston and Dallas, TX; Jacksonville and Orlando, FL
- **2B** – Tucson, AZ; Las Vegas, NV
- **3A** – Atlanta, GA; Memphis and Nashville, TN; Raleigh, NC
- **3B** – El Paso, TX; Las Vegas, NV
- **3C** – Los Angeles and San Francisco, CA
- **4A** – Baltimore, MD; Nashville, TN; Louisville, KY; Wichita, KS; New York City, NY; Philadelphia, PA; Washington, DC
- **4B** – Albuquerque, NM
- **4C** – Seattle, WA; Portland, OR
- **5A** – Chicago, IL; Boston, MA; Omaha, NE; Des Moines, IA
- **5B** – Boulder, CO; Boise, ID; Salt Lake City, UT
- **5C** – Bremerton, WA
- **6A** – Minneapolis, MN; Burlington, VT
- **6B** – Helena, MT
- **7** – Duluth, MN

EU & UK

Belgium

- **4A** – Brussels

Denmark

- **5A** – Copenhagen

France

- **3A** – Bordeaux
- **4A** – Paris
- **5A** – Belfort

Finland

- **6A** – Helsinki

Germany

- **4A** – Frankfurt
- **5A** – Berlin

Italy

- **3A** – Rome
- **3B** – Cozzo Spadaro
- **4A** – Milano

Norway

- **6A** – Oslo

Poland

- **5A** – Warsaw

Portugal

- **3A** – Lisbon

Spain

- **3A** – Barcelona

Sweden

- **7** – Kiruna

United Kingdom

- **4A** – London
- **5A** – Birmingham

Singapore

- **0A** – Singapore, Singapore

UAE

- **0B** – Dubai

Saudi Arabia

- **1B** – Bisha
- **2B** – Taif

South America

Argentina

- **2A** – San Miguel de Tucuman
- **2B** – Santiago del Estero
- **3A** – Buenos Aires
- **3B** – Mendoza
- **4B** – La Quiaca
- **4C** – Comodoro Rivadavia
- **5B** – Río Gallegos
- **5C** – Bariloche
- **6A** – Ushuaia

Brazil

- **0A** – Salvador
- **0B** – Petrolina
- **1A** – Rio de Janeiro
- **2A** – São Paulo

Chile

- 2A – Isla de Pascua
- 3B – Santiago
- 3C – Concepción
- 4A – Puerto Montt
- 4C – Temuco
- **6A** – Punta Arenas

India

- **0A** – Mumbai
- **0B** – Ahmedabad
- **1A** – Hyderabad
- **1B** – New Delhi
- **2A** – Dehradun
- **2B** – Amritsar
- **4A** – Srinagar

Hong Kong

- **2A** – Hong Kong

Building Vintages

Assets in the tool have either one or two building vintages to choose from, namely, those built or renovated before 2004, 2005-2009, and 2010-2015. The following table describes how the vintages were constructed.

Region	Vintage Label	PNNL Prototype Label	HVAC Modifications

EU & UK	Pre-2004	PNNL 1980-2004 *	*+ relevant HVAC modifications. *See* Typical Baseline Systems *for HVAC systems per use type.*
EU & UK	2004-2009	PNNL 2010 *	2004-2009 vintage in EU is assumed to be on par with 2010 PNNL prototype *+ relevant HVAC modifications. *See* Typical Baseline Systems *for HVAC systems per use type.*
USA & AUS & CAN	Pre-2004	PNNL 1980-2004	
USA & AUS & CAN	2004-2009	PNNL 2004	
Singapore, UAE, and Saudi Arabia	2004-2009	PNNL 2004*	*+ relevant HVAC modifications. *See* Typical Baseline Systems *for HVAC systems per use type.*
Singapore, UAE, and Saudi Arabia	2010-2015	PNNL 2010*	*+ relevant HVAC modifications. *See* Typical Baseline Systems *for HVAC systems per use type.*

Column Header Key:

- **Region:** the country in which the asset is located.
- **Vintage Label:** the asset's year of original construction or last major renovation

- **PNNL Prototype Label:** prototype building models developed by the Pacific Northwest National Laboratory (PNNL) have been utilized as typical examples of existing buildings for all typologies.
- **HVAC Modifications:** notes on variances from the PNNL prototype building models.

Carbon Emissions Modeling

C.Scale

Carbon emission modeling in the Impact Building Calculator is performed via the C.Scale API, a whole life carbon data model for buildings. Full documentation on the methodology behind C.Scale is available here.

Operational Emissions

The Calculator includes operational emissions from two sources: the combustion of fossil fuels on the building site, and the upstream emissions incurred by electricity used by the building.

Fossil Fuel Emissions

Fossil fuel emissions are assessed on an annual basis as:

$$Emissions_{f,i} = (Use_{f,i}) \times (CI_{ff} + r_{leakage} \times GWP_{100,ff})$$

Where ***Emissionsf,i*** is the annual fossil fuel use of fuel type ***f*** in year ***i***, ***Usef,i*** is the annual fossil fuel use of fuel type ***f*** in year ***i*** in units volume, ***CIff*** is the emissions from combustion per unit volume of fossil fuels, ***rleakage*** is the leakage rate of that fossil fuel (assumed to be 2.5% for natural gas), and ***GWP100,ff*** is the GWP-100 value for that fossil fuel when leaked directly into the atmosphere.

Cumulative fossil fuel emissions over the time series is:

$$Emissions_{ff,total} = \sum_{i=m}^{n} Emissions_{f,i}$$

Where ***m*** is the year of implementation and ***n*** is the target year.

In the Impact Building Calculator, all on-site combustion is assumed to be natural gas.

Electricity Emissions

Upstream emissions from electricity use are assessed on an annual basis. Electricity demand from the asset each year is assumed to be constant, but the emissions associated that demand are expected to decrease over time as the electrical grid decarbonizes. Methods and data sources for determining the pace of utility grid decarbonization vary regionally:

- **United States:** C.Scale uses data from **NREL Cambium 2024** to model emissions over time. These estimates are highly regionalized and reflect the local and national policy commitments, as well as techno-economic constraints. The Calculator uses Long-Run Marginal Emission Rates in the United States, the metric most appropriate for modeling emissions from long duration loads (e.g. like that incurred by buildings).
- **Australia:** C.Scale uses present-day electrical grid emissions from data provided by the Australian Energy Market Operator. As of 2024, Australia is developing a **2050 Net Zero Plan**, but it is not yet published.
- **Canada:** C.Scale uses a similar method to incorporating U.S. Grid Data was employed. Using **measured Grid Data and future projection data**, yearly Canadian Grid emissions are estimated through 2110 so that operational emissions of any C.Scale project started before 2050 can be effectively estimated over a 60 year lifetime.
- **EU:** C.Scale uses present-day grid emission factors from the **European Environment Agency**. These metrics are different for each country. We assume that all EU countries will decarbonize their electrical grids to converge of full decarbonization of the power sector by 2050.
- **Saudi Arabia:** C.Scale uses present-day grid emission factors from **EMBER**. Saudi Arabia has a **goal of a net zero economy by 2060**, but data is not published on emissions rates on a kWh-basis.
- **Singapore:** C.Scale uses present-day grid emission factors from **EMA**. Singapore has a goal of a net zero electricity sector by 2045.
- **UAE:** The UAE has a plan to achieve a electricity grid carbon intensity of 0.27 kgCO2e/kWh by the year 2030, and net zero by 2050. However, these plans indicate a percentage of gas and coal remaining on the grid in 2050, suggesting that the actual incurred emissions will not be zero.
- **UK:** C.Scale uses present-day grid emission factors from the **UK Department for Energy Security and Net Zero**. We assume that decarbonization of UK electricity

supply will achieve the government's stated commitment of full decarbonization of the power sector by 2035.

- Electricity emissions over the time series are assessed as:

$$Emissions_{elec,total} = \sum_{i=m}^{n} Emissions_{elec,i}$$

District Heating Emissions

In Nordic countries, the user can indicate the presence of a district heating system. **Emissions associated with district heating are highly variable**; the Calculator assumes a medium emissions intensity of 0.285 kgCO2e/kWh.

Embodied Emissions

"Embodied emissions" is common parlance for the upstream emissions associated with the manufacturing, transportation, and installation of materials in a buildings (as well as their maintenance over time). In the Impact Building Calculator, embodied emissions are factored into the calculation in two ways:

- **Embodied carbon of ECCMs**. When an ECCM requires the installation of additional material (e.g., for envelope and glazing upgrades), the embodied emissions of this measure are calculated via the C.Scale API. For ECCMs associated with products from Schneider Electric, the relevant published environmental product data will be used to estimate the embodied carbon (to be incorporated into the Calculator in 2026).
- **Embodied carbon of cyclic refurbishments**. For commercial buildings, we assume a regular retrofit cycle which the interiors are refreshed every 15 years, MEP systems every 20 years, and the building envelope every 50 years. These regular replacement cycles give the carbon emissions time series charts their characteristic "stepping" pattern.

Cost Modeling

Cost modeling for the Impact Building Calculator is supported by both industry-wide and SE specific data. The cost model is regionalized and available in many currencies.

ECCM Implementation Costs

SE Measures

The investment required for SE solutions are based on reference architectures and scalable cost models using geographically-specific data from SE's database of project costs, collected from across the organization's team of solutions and system architects and pricing experts.

Envelope and Glazing Upgrades

Generic building envelope upgrades are based on the same building prototypes as the baseline energy model, using data from RSMeans. These estimates were performed by a cost estimator internal to SE.

Annual Energy Use Costs

Annual energy costs are based on country-level data as of 2023. We assume no year-over-year utility rate escalation, have no breakout for demand charges or time of use, and perform no discounting to determine net present value. More detailed energy cost modeling may be available in a future versions, if you would like to request these features, please reach out.

Region	Electricity (€/kWh)	Natural Gas (€/kWh)	District Systems (€/kWh)
USA	0.15	0.0357	
Argentina	0.068	0.014	
Australia	0.247	0.02	

Belgium	0.233	0.056	
Brazil	0.102	0.079	
Canada	0.090	0.018	
Chile	0.175	0.053	
Denmark	0.200	0.122	0.074 (Heating)
Finland	0.100	0.128	0.104 (Heating)
France	0.149	0.099	
Germany	0.248	0.089	
Hong Kong	0.193	0.0521	
India	0.082	0.045	
Italy	0.250	0.101	
Norway	0.067	0.063	0.081 (Heating)
Poland	0.197	0.086	
Portugal	0.149	0.103	
Saudi Arabia	0.058	0.011	
Singapore	0.189	0.151	
Spain	0.126	0.076	
Sweden	0.096	0.15	0.074 (Heating)
UAE	0.093	0.011	0.26 (Cooling)
United Kingdom	0.405	0.078	

Background Data

Currency Support

The Calculator includes the following currencies:

- Argentine Peso (ARS)
- Australian Dollar (AUD)
- Brazilian Real (BRL)
- British Pound Sterling (GBP)
- Canadian Dollar (CAD)

- Chilean Peso (CLP)
- Danish Krone (DKK)
- Euro (EUR)
- Hong Kong Dollar (HKD)
- Indian Rupee (INR)
- Norwegian Krone (NOK)
- Saudi Riyal (SAR)
- Singapore Dollar (SGD)
- Swedish Krona (SEK)
- United Arab Emirates Dirham (AED)
- United States Dollar (USD)

The Calculator does all internal calculations in Euros, converting to other currencies at standard rates established at the beginning of 2024.

Cost Regionalization

Cost calculations are regionalized using data from RSMeans. These data are used to increase or decrease the base cost calculations in the tool using a region-specific percentage factor. For regions beyond the United States, RSMeans is used to develope proxy regionalization factors informed by the development team's professional judgement.

CRREM

The Carbon Risk Real Estate Monitor (CRREM) is a framework designed to help real estate owners, investors, and managers align the operational ("in use") carbon emissions of their assets with the ambitions of the Paris agreement. CRREM publicly released decarbonization pathways that translate the ambitions of limiting global warming to 1.5°C and 2°C by the end of the century into regionally- and property-type-specific trajectories against which real estate assets and portfolios can benchmark themselves.

The "CRREM Curve", which is plotted within the Impact Building Calculator, represents the calculated carbon intensity limit ($kgCO2e/m^2$) for a specific building over time, or what is sometimes referred to as an asset's carbon budget. Assets with operational emissions that remain less than (below) the CRREM Curve are considered to be "Paris-Proof", while assets with operation emissions greater than (above) the curve are considered to be "Stranded Assets". Stranded assets are more likely to face regulatory risks, such as fines or devaluation, as global carbon reduction mandates tighten.

The CRREM curve is created through a three-step process. First, global carbon budgets are set based on climate goals to limit warming to 1.5°C or 2°C by 2100, using data from sources like the IEA's 2DS, 1.5°C FotE analysis. These budgets define the total allowable carbon emissions up to 2050. Next, the global budget is allocated to the real estate sector, breaking it down by country and building use type to establish national pathways for CO2 emissions per square meter. Lastly, these pathways are

further refined for different building types (e.g., office, retail) based on energy usage and growth projections, providing tailored decarbonization targets for each sector.

The regionally- and property-type-specific CRREM curves have been extracted from the excel-based CRREM tool and uploaded within the Calculator

For more on CRREM's methodology, click **here**.

LL97

Local Law 97 (LL97) is a landmark piece of legislation in New York City aimed at reducing greenhouse gas emissions from buildings, which are responsible for nearly 70% of the city's total emissions. The law sets strict emissions limits for buildings over 25,000 square feet, with penalties for non-compliance having started in 2024 and progressively tightening through 2050. LL97 helps building owners and operators by providing a clear framework to reduce their carbon footprint and avoid substantial fines.

The Impact Building Calculator incorporates LL97's methodology and emissions limits, enabling users to easily evaluate how their assets perform against these standards. By instantly testing various carbon reduction measures, users can align their projects with LL97 requirements, ensuring compliance while optimizing energy efficiency and financial outcomes.

The Calculator integrates Local Law 97 (LL97) by taking the tool's calculated energy usage and applying LL97-specific carbon factors for electricity and fossil fuels.

For more information on LL97, click **here**.

Glossary of ECCMs

Each retrofit scenario includes the energy, carbon, and cost implications of implementing one or more Energy and Carbon Conservation Measures (ECCMs).

Abbreviated descriptions of each ECCM can be viewed in the application by hovering over the information icon. Full descriptions of each ECCM are below.

ECCM Descriptions

Building Management

Occupancy-based lighting and HVAC control	**Occupancy-based controls** for both lighting and HVAC systems ensure that lighting and temperature settings are optimized based on actual or predicted occupancy, eliminating unnecessary energy use in unoccupied areas. Lighting systems are equipped with **occupancy sensors** to ensure lights are active only when spaces are in use. When areas are unoccupied, lights are automatically turned off or dimmed to reduce energy waste. HVAC operation is adjusted dynamically based on occupancy data from sensors. Temperature setpoints are relaxed when spaces are unoccupied, reducing heating and cooling loads. These occupancy-based temperature setbacks are in addition to schedule-based setbacks.
Daylighting-based lighting control	Reduce artificial lighting energy use by leveraging **natural daylight**. The system automatically adjusts the intensity of electric lighting in real-time based on measured daylight availability, ensuring optimal illumination while minimizing energy consumption. Applicable to **perimeter zones and areas with skylights**, this measure excludes spaces where specific lighting levels are critical for operations (requiring fixed lighting). Lighting systems in daylit zones are equipped with continuous dimming capabilities, with lux sensors installed approximately 15 feet / 4.5 meters from the perimeter to measure light levels and provide real-time feedback.

Airside HVAC resets and demand-controlled ventilation	Upgrade existing Variable Air Volume (VAV) systems to comply with ASHRAE Guideline 36, which defines high-performance sequences of operation for HVAC systems. The goal is to optimize airflow, temperature control, and ventilation strategies to reduce energy consumption while maintaining occupant comfort.Key Enhancements include **Supply Air Temperature Reset:** Zone load-based reset strategy that dynamically adjusts supply air temperature based on real-time zone cooling demands. This approach optimizes energy performance by responding directly to actual building loads rather than outdoor air temperature alone. In addition to the multizone VAV systems governed by ASHRAE Guideline 36, load-based SAT reset is also applied to DOAS systems. **Demand-Control Ventilation (DCV):** Zonal and system-level CO_2 monitoring to adjust ventilation rates dynamically. VAV Box Minimum Airflow Reduction: Minimum airflow reduced from 30% to 20%, improving part-load efficiency. Excludes critical spaces requiring constant airflow.
Chilled and hot water temperature resets	Traditional chilled water and heating hot water systems often maintain fixed supply temperature setpoints, regardless of outdoor conditions or building load. This measure introduces dynamic setpoint reset strategies for both chilled water and hot water loops, using outdoor air temperature (OA) as the controlling parameter to optimize system efficiency.
Continuous commissioning of HVAC system	Over time, HVAC systems can drift from optimal performance due to equipment wear, sensor inaccuracies, or control sequence issues, leading to higher energy costs and potential operational disruptions. **Continuous commissioning** ensures that all critical building systems operate efficiently by proactively identifying inefficiencies and faults. This ECCM helps prevent equipment failures that could impact operations by continuously monitoring the HVAC equipment performance, applying advanced analytics to identify deviations from optimal operation, such as incorrect setpoints, sensor drift, or failing components. Issues are then prioritized and communicated to facility teams for corrective action, ensuring systems remain tuned for efficiency. Savings for this measure are estimated to increase HVAC system performance: Pump efficiency improved by 5%, Chiller and boiler efficiency improved by 5%, fan power static pressure reduced by 0.05”-0.15” based on fan type.

Power Management

Power factor corrrection and harmonic filtering	Electrical quality issues such as Total Harmonic Distortion (THD) and poor Power Factor (PF) can significantly impact building performance. High THD reduces equipment efficiency, increases thermal losses, and can lead to premature failure of sensitive electronics. Similarly, low PF results in higher apparent power demand, increasing utility costs and upstream energy losses. This measure equips buildings with advanced harmonic filtering and power factor correction systems to reduce THD and improve electrical system stability. Harmonic filtering delivers an average 1.5% reduction in hourly power consumption by improving system efficiency, and power factor correction achieves a target power factor of 0.96 or higher, minimizing penalties and reducing source energy emissions.
Power monitoring software with submetering	**Submetering** provides visibility into specific loads and zones—such as HVAC systems, lighting circuits, elevators, and plug loads—enabling building operators to benchmark performance, detect anomalies, and implement targeted energy-saving strategies. All meters connect to **power monitoring software**, enabling real-time energy dashboards, automated alerts for anomalies, and historical trend analysis for benchmarking. This measure estimates a 5% reduction in non-critical plug loads (e.g., receptacle loads, elevators/escalators) through improved monitoring and automated control strategies.
High efficiency UPS	Uninterruptible Power Supply (UPS) systems are critical for buildings to maintain business continuity during power interruptions, protecting IT infrastructure, IT-Rooms, and essential building systems such as elevators, security, and HVAC controls. Many facilities have oversized UPS units, resulting in **low-load operation**, where efficiency can drop below 85%. This measures assumes UPS units are resized and replaced with high efficiency units, with an upgrade from 83% efficiency to 92%.
Power SCADA controls	A Power SCADA system provides real-time visibility and control over the electrical infrastructure, enabling building operators to make manual or automated adjustments to optimize power usage, reduce energy waste, and enhance operational efficiency. This measure estimates 3% annual electricity savings based on manual operational adjustments.

Automatic receptacle control	Automatic receptacle control (ARC) eliminates energy waste by disconnecting non-critical equipment in non-critical spaces when spaces are unoccupied. This measure implements smart outlet controls or intelligent panelboards to automatically cut power to selected receptacles during unoccupied hours (typically midnight to 6:00 AM).

Prosumer

Solar PV, Battery Energy Storage System, and Microgrid	This measure includes **Rooftop PV Panels** sized to utilize ~70% of available roof area, with 16% panel efficiency and 1 kWh/m² solar radiation, aligned with NREL PVWatts guidance. The **Battery Energy Storage System (BESS)** is sized at 2× PV capacity, with a roundtrip efficiency of ~86%, with daily discharge cycles. The **Microgrid Management System** controls onsite generation, storage, and grid interaction for optimal performance and cost savings.
EV Charging	EV chargers are installed and connected to the building's electrical infrastructure with smart load management for dynamic load balancing to prevent overloading circuits, scheduling, and demand-response participation to align charging with low-carbon grid periods. This measure assumes each Level 2 AC charger has a power rating of 11 kW (user adjustable), with efficiency determined based on usage and session duration which varies by building type. Chargers increase building electricity consumption and associated emissions (included in the Calculator), but enable EVs to offset emissions from fossil-fuel-based commuting (not accounted for in the Calculator).

Electrification

Space heating electrification	This measure replaces natural gas-powered heating systems with electric Air-Source Heat Pumps with coefficient of performance (COP) of 2.8, connected to the Building Management System for optimized control and scheduling.
Service hot water electrification	This measure replaces gas-fired and electric resistance water heaters with heat pump water heaters, which operate at a COP of 2.8, and integrate to the Building Management System for optimized control and monitoring.

High efficiency transformer	Implementation of high-efficiency transformers typically as part of a broader electrical distribution upgrade reduces electrical losses and improves energy transfer efficiency, with savings applied as a reduction to overall building electrical energy consumption. For Pre-2004 baseline vintages, this ECCM assumes 0.5% reduction in total electricity use, while for the 2004-2009 and 2010-2015 baseline vintages, this ECCM assumes 0.25% reduction in total electricity use.

Refrigeration and Cooling

Refrigerant monitoring and leak detection	This ECCM focuses on proactive monitoring and maintenance of the refrigeration system to **maintain optimal refrigerant charge,** ensuring peak system efficiency, and **prevent refrigerant loss,** with early leak detection enabling repairs and preventing major failures.
Refrigeration system advanced controls	This ECCM focuses on optimizing refrigeration system performance through advanced control strategies that reduce energy consumption and improve operational efficiency. In detail, savings are delivered with the following control strategies: **High-Pressure Modulation (Floating Head Pressure):** The system adjusts the high-pressure setpoint based on outside air temperature to maximize heat exchange at the condenser. **Suction Pressure Modulation (Floating Low Pressure):** Dynamically adjusts suction pressure based on real-time load demand across connected refrigeration units to optimize compressor performance without compromising cooling or defrost cycles.

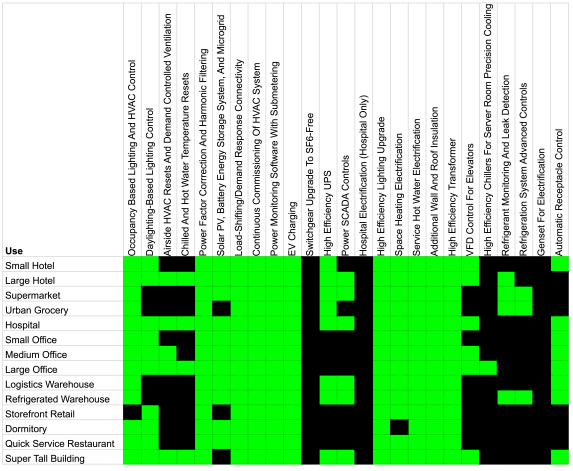
Other

High efficiency lighting upgrade	This ECCM includes the replacement of inefficient lighting systems with high-efficient alternatives in compliance with ASHRAE 90.1-2019 lighting power density requirements, reducing lighting power density 10%.

Additional wall and roof insulation	Upgrading the building envelope is typically one of the most carbon-intensive strategies to reduce energy demand when analyzed based on whole life carbon, but has additional benefits of improving occupant comfort and supporting compliance with building performance standards. This measure includes an upgrade to ASHRAE 90.1-2022 compliant envelope, improving the U-values and R-values for walls and roofs by adding R-5 insulation for walls and R-10 insulation for roofs.
VFD control for elevators	Conventional elevator systems run at fixed speeds, wasting energy during partial-load conditions. Implementing Variable Frequency Drives (VFDs) optimizes motor speed, reducing energy use without compromising performance or peak capacity. This measure includes VFDs on elevator motors to enable variable speed operation.

Summary Table of ECCM Availability

The following table describes which ECCMs are available for which building use types.



Goal and Scope

The SRI/EPC Estimator is a web-based implementation of the MS Excel-based GTool v3. Based on a comprehensive questionnaire of building systems, the SRI/EPC Estimator provides automated cost, carbon, and energy analyses of building automation systems. These analyses are aligned with three reporting methodologies:

- **EU Smart Readiness Indicator** (SRI) Reporting
  - More information on SRI Ratings (European Commission)
- **ISO 52120** Energy Performance of Buildings Reporting
  - More information on ISO 52120 (International Standards Organization)
- **EU Energy Performance Certificate** (EPC)
  - More information on EPC (European Commission)

Uses and Limitations

The SRI/EPC Estimator is not a replacement for your professional judgement.

The SRI/EPC Estimator is a "desk audit" tool to approximate results from these methodologies, not a replacements thereof. When using results from the GTool in client-facing conversations, extra caution should be taken to confirm the tool's results against common sense, local regulations, the specifics of the building asset in question, and client expectations.

The SRI/EPC Estimator is a comparative tool for decision making, not an absolute source of truth.

The SRI/EPC Estimator is meant to help sales teams make directionally accurate decisions, not provide a verified source of truth. The tool is structured around a comparison between the building "Before Implementation" and "After Implementation".

Accessing the SRI/EPC Estimator

The SRI/EPC Estimator can be added to the Impact Building Calculator from within the Settings panel. Access that panel by clicking the Gear ⚙ icon at the bottom of the left navigation bar. Toggling **Load SRI/EPC Estimator** to the ON position will add the SRI/EPC Estimator to the left navigation bar and add a **+ Create SRI/EPC Report** to the Dashboard tab. By default, the SRI/EPC Estimator is OFF.

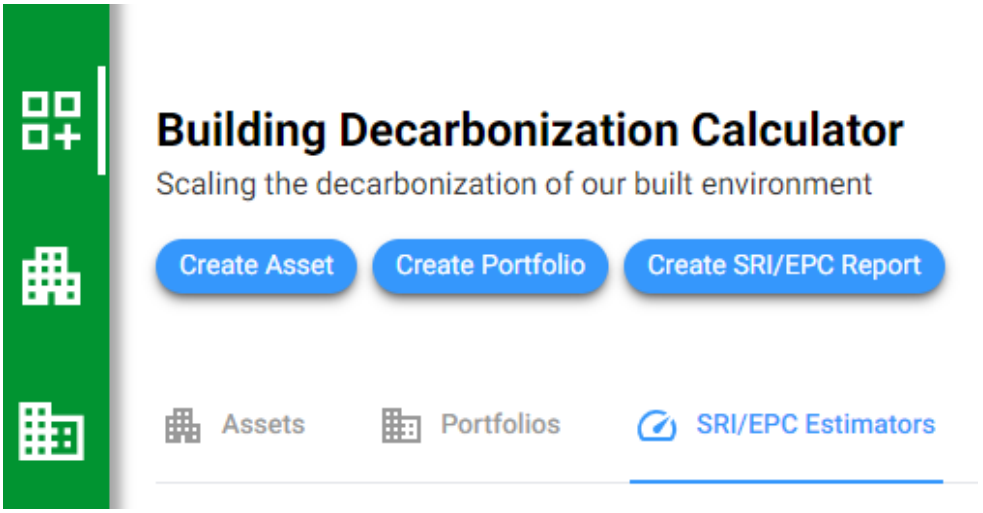
User's Guide

Creating or Loading an SRI/EPC Estimator Report

In the Dashboard tab, click the **Generate SRI/EPC Report** button at the top of the project list.

To open an existing SRI/EPC Estimator Report, scroll to the desired report in the project list and click the **Load Estimator** button within that project's card.

If you have many projects saved with your dashboard, you can view only the SRI/EPC Estimator Reports by selecting **View SRI/EPC Estimator Reports** from the view selector at the top of the project list. This is the view represented in the screenshot below.



SRI/EPC Reports listed in the Dashboard tab.

Describing an SRI/EPC Estimator Building Asset

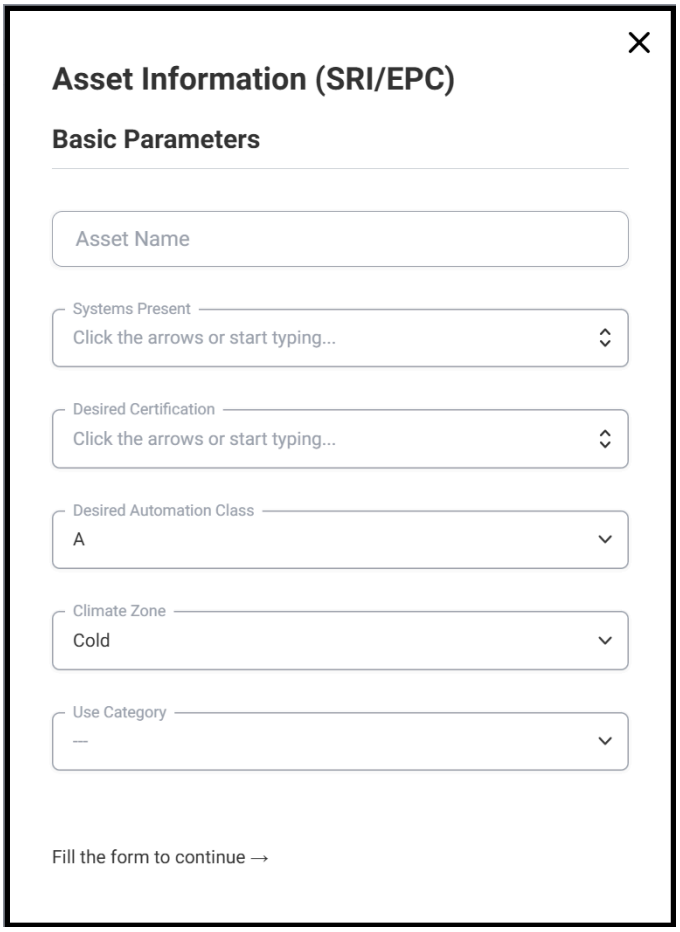
When you create a new SRI/EPC Estimator report, you will be instructed to enter some basic information about that asset its building systems, and the spaces within it.

Once you have saved the your definition of the GTool building asset, you can bring up the same editing panel by clicking the **Edit Asset** button at the top of the SRI/EPC Estimator.

Basic Information

The first half of the entry is basic information about the building.

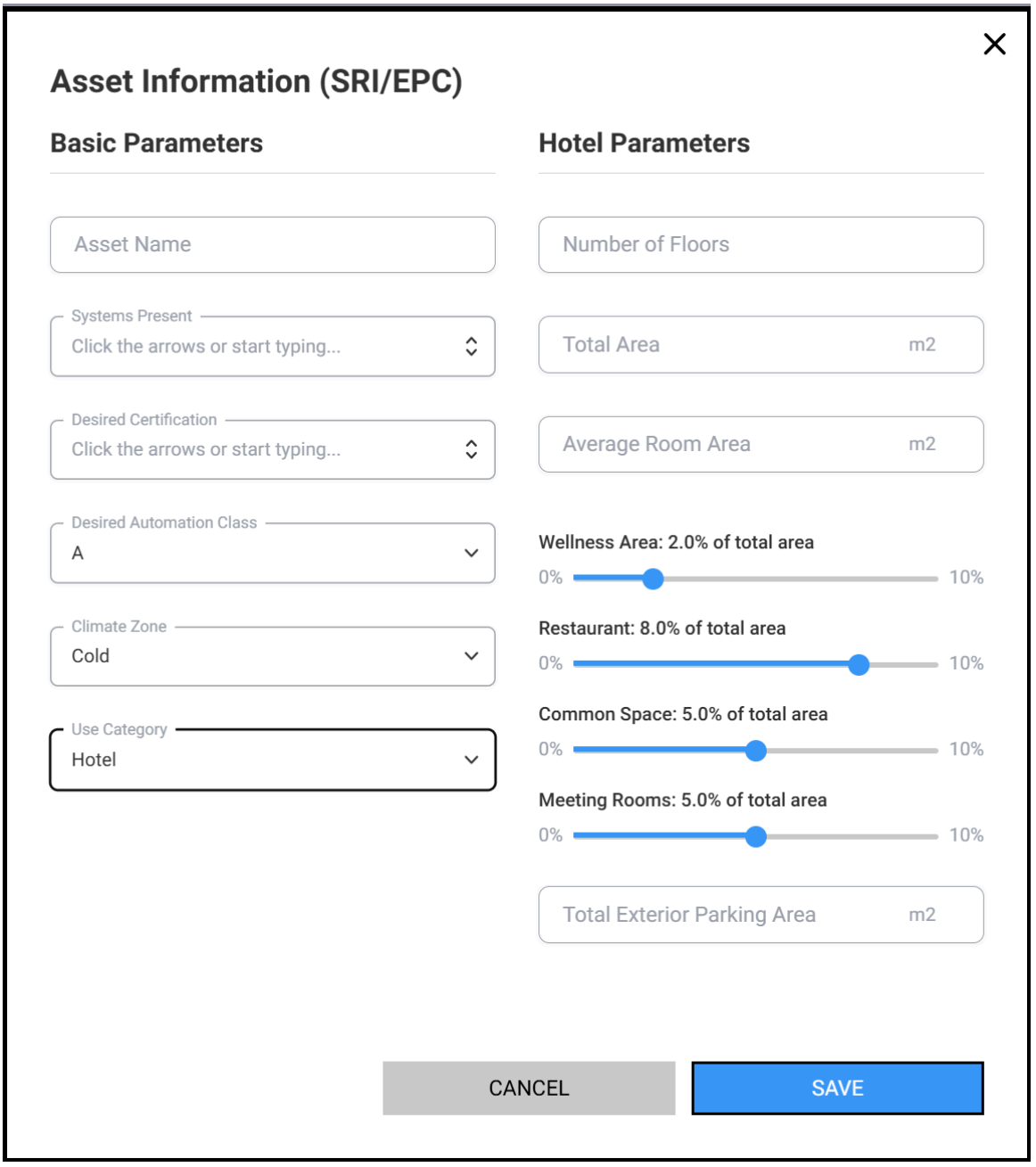
- **Asset Name**: A name for the report. For confidential projects, use a project designation known only to you.
- **Systems Present**: A multiselect field to list building systems present in the asset. You can select no systems, one system, or many systems. If you want to remove a system from the list, click the red X to the right of its name.
- **Desired Certification**: A multiselect field to list certifications desired by the building asset. You can select no certifications, one certification, or many certifications. If you want to remove acertification from the list, click the red X to the right of its name.
- **Desired Automation Class**: The ISO 52120 automation class desired to be achieved by the building asset. This class is used to determine the "target" scenario.
- **Climate Zone**: The current implementaiton of the SRI/EPC Estimator is specific to Italy, and these climate zones describe three major climate zones across the Italian peninsula.
- **Use Category**: You may select either Office or Hotel.



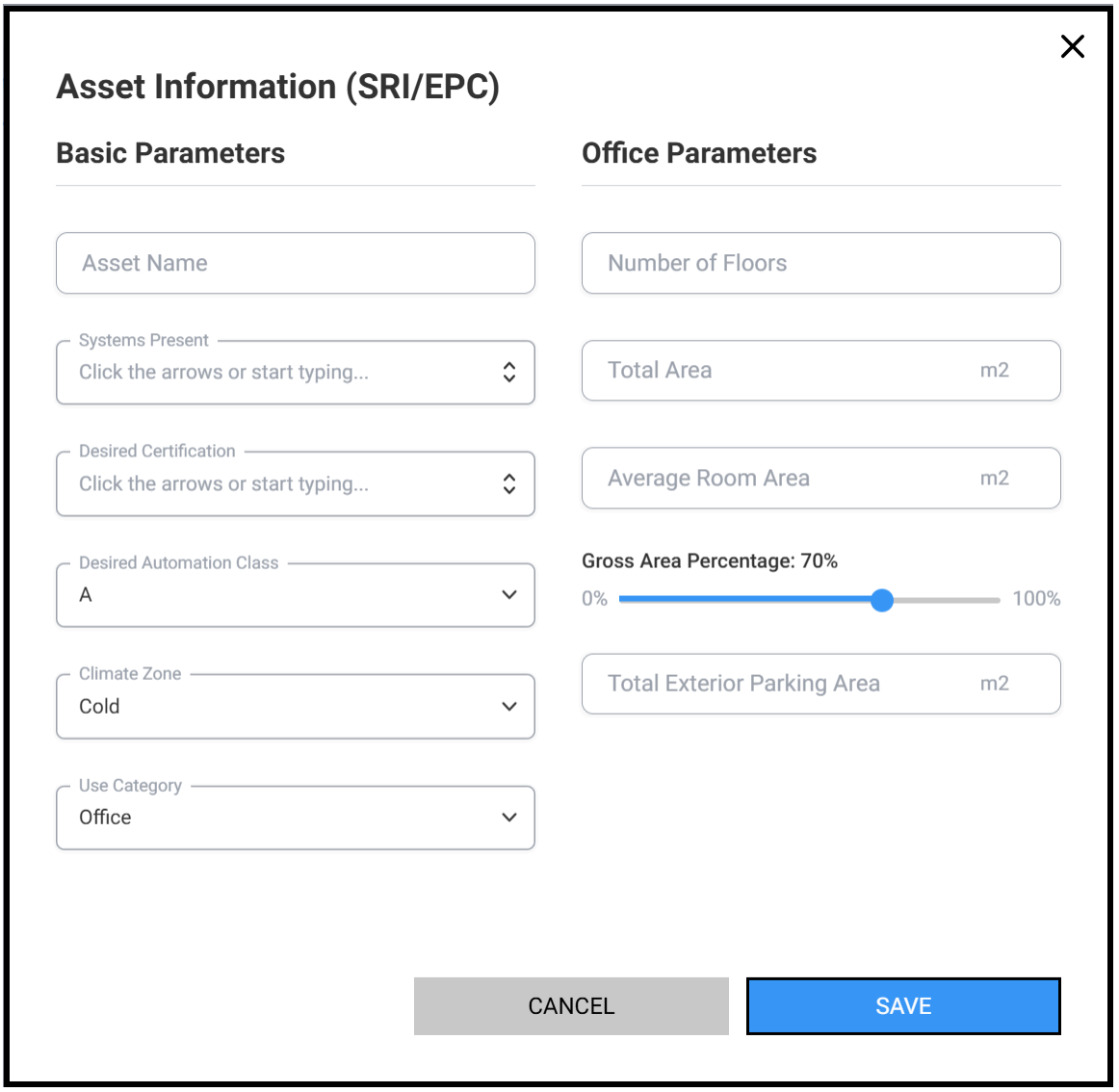
The basic information required for the GTool Report

Use-Specific Building Information

After selecting a Use Category, another set of options appears which are specific to the use category of the building.



Hotel-Specific Parameters.



Office-Specific Parameters.

When you've filled out all the necessary data, click **SAVE** and proceed to the SRI/EPC analysis screen.

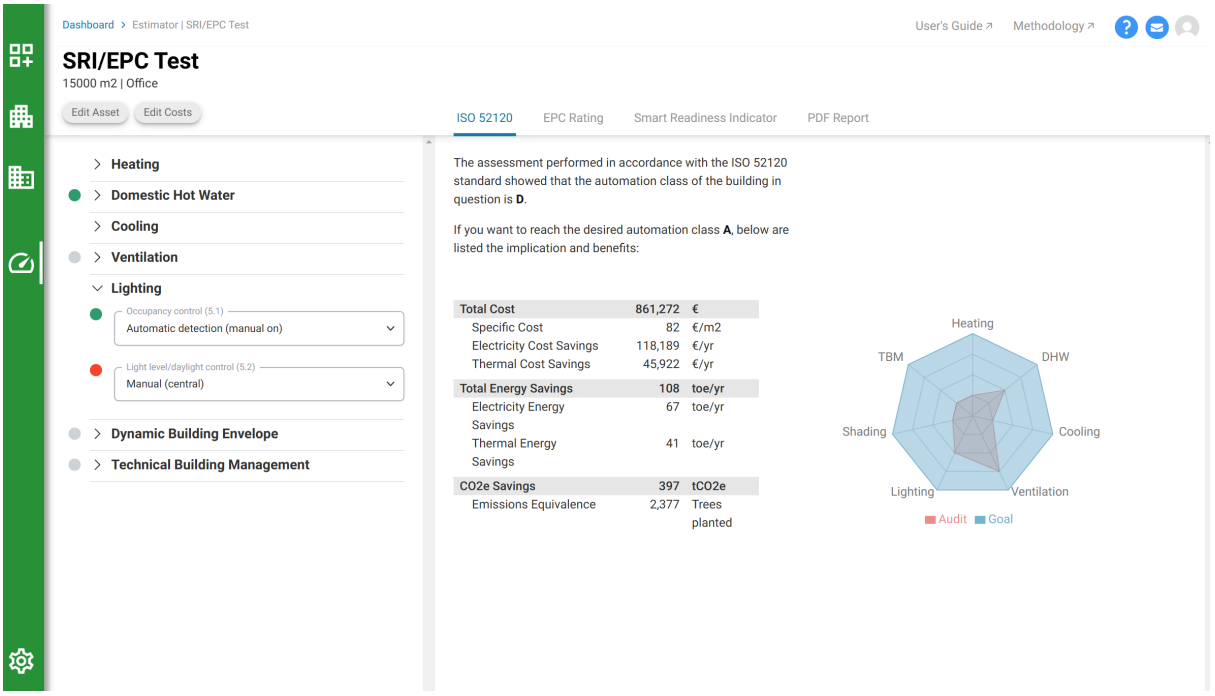
Filling the SRI/EPC Estimator Audit

On the SRI/EPC Estimator report page, the left column has 42 questions related to the function of the building systems. The choices available for these questions can be limited by the parameters defined in the SRI/EPC Estimator Asset Information panel (e.g., if a BMS is not present, BMS-related choices are not available).

The audit entries should describe the building as it exists before any intervention, as they determine the SRI/EPC Estimator results "Before Implementation." Each question

and section of the audit uses an "indicator light" to alert you for the status of that section of the audit:

- A gray dot means that the section has not yet been filled.
- A white dot means the section is not applicable to the asset.
- A red dot means that the section is filled with at least one low-performance options.
- A green dot means the section is filled with with all higher-performance options.



Example of indicator lights.

Interpreting and Sharing SRI/EPC Estimator Results

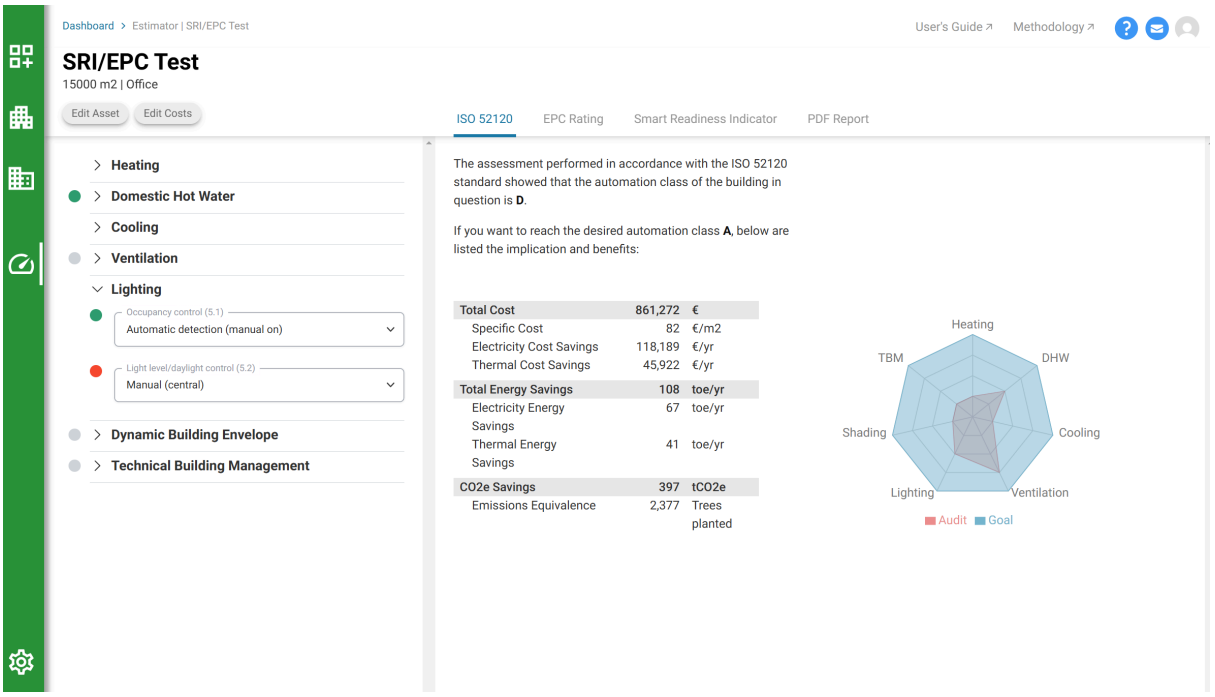
As information is filled (even partially) in the audit, the figures to the right will update automatically.

The results can be viewed in the application's interface, or exported within a PDF report.

ISO 52120

ISO 52120 results can be viewed by clicking the **ISO 52120** header.

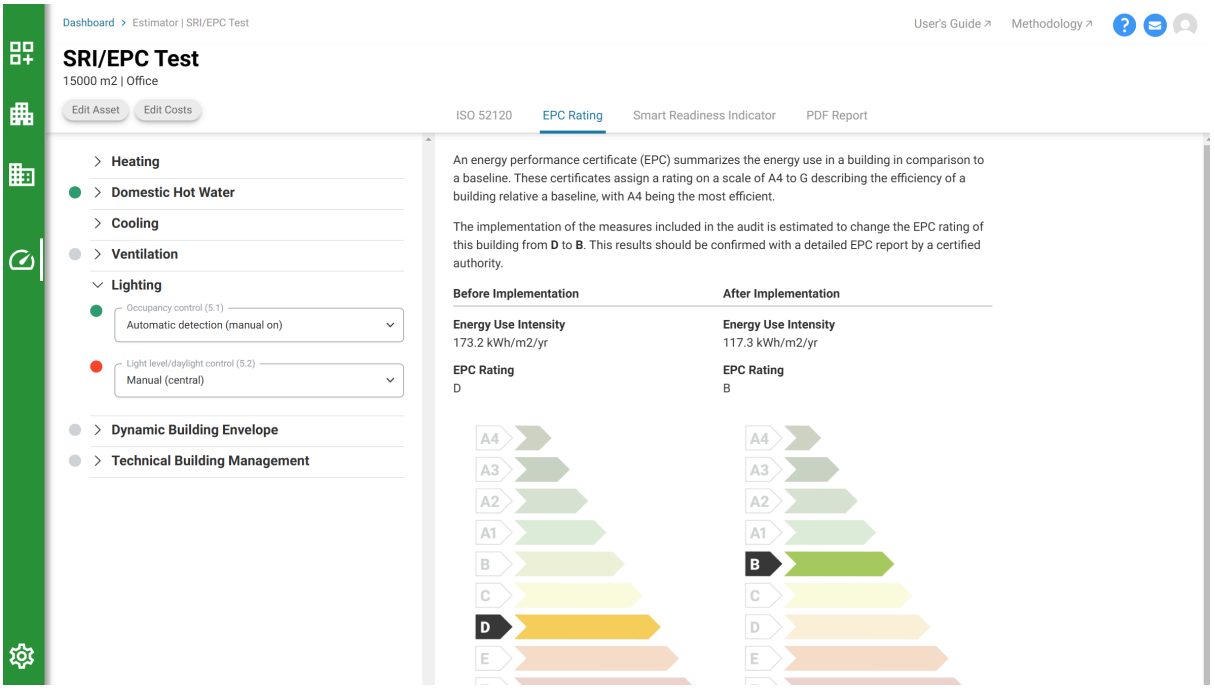
ISO 52120 report within the GTool dashboard.



ISO 52120 report within the GTool Dashboard.

EPC Rating

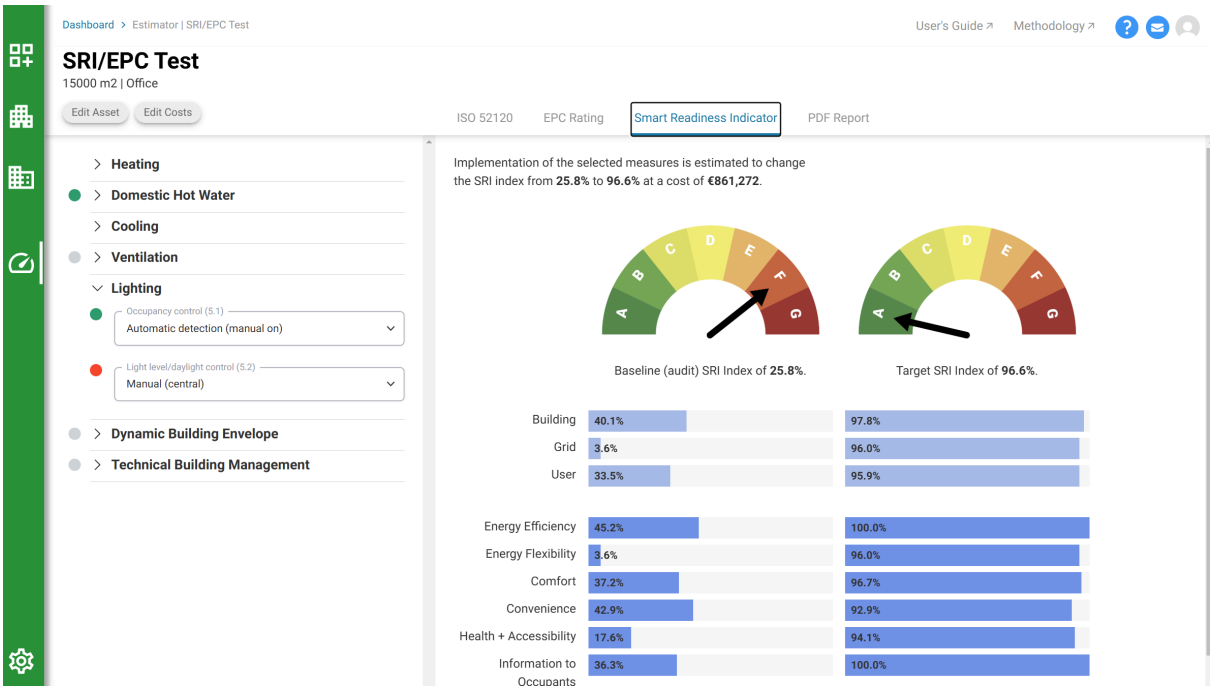
EPC Rating results can be viewed by clicking the **EPC Rating** header.



EPC report within the GTool Dashboard.

Smart Readiness Indicator (SRI)

SRI results can be viewed by clicking the **Smart Readiness Indicator** header.



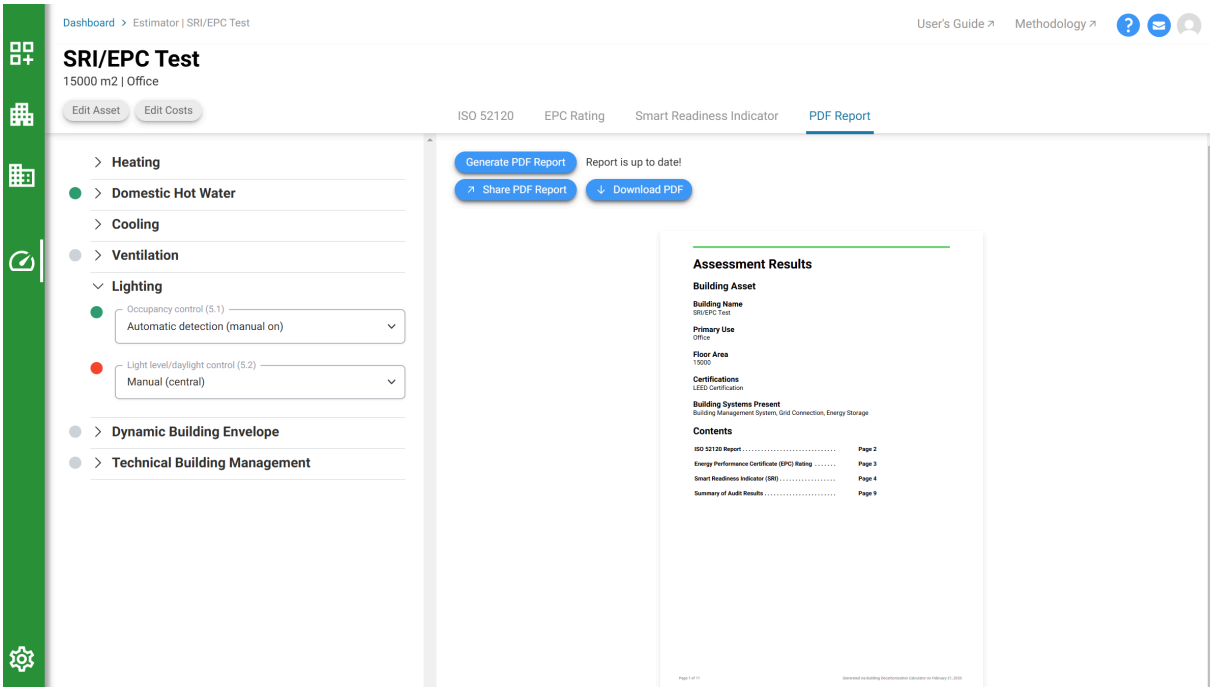
SRI report within the GTool dashboard.

Exporting a PDF Report

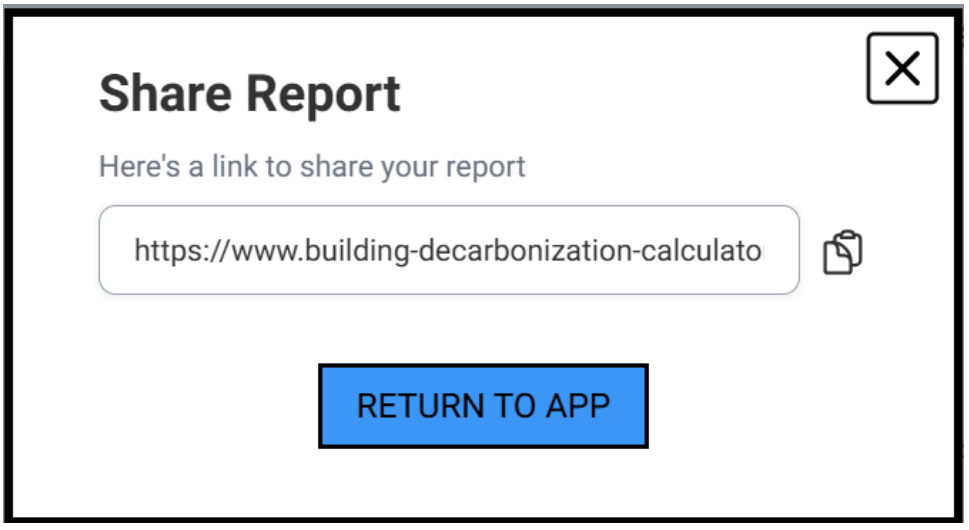
A shareable PDF report can be generated under the **PDF Report** header. This PDF contains a summary of the ISO 52120, EPC, and SRI results. Additionally, it contains a full summary of the Audit choices made by the user.

The PDF is not generated automatically as the audit changes. If the PDF does not reflect recent changes, you will be warned that the "report does not reflect recent changes." Clicking **Generate Report** will generate an updated report. Reports can take a few moments to generate.

View PDF report within the GTool dashboard.



Clicking **Share PDF Report** will generate a sharable web link. This link can be shared with outside collaborators, and should be considered as confidential as the data in the report. Use caution before sharing these links externally.



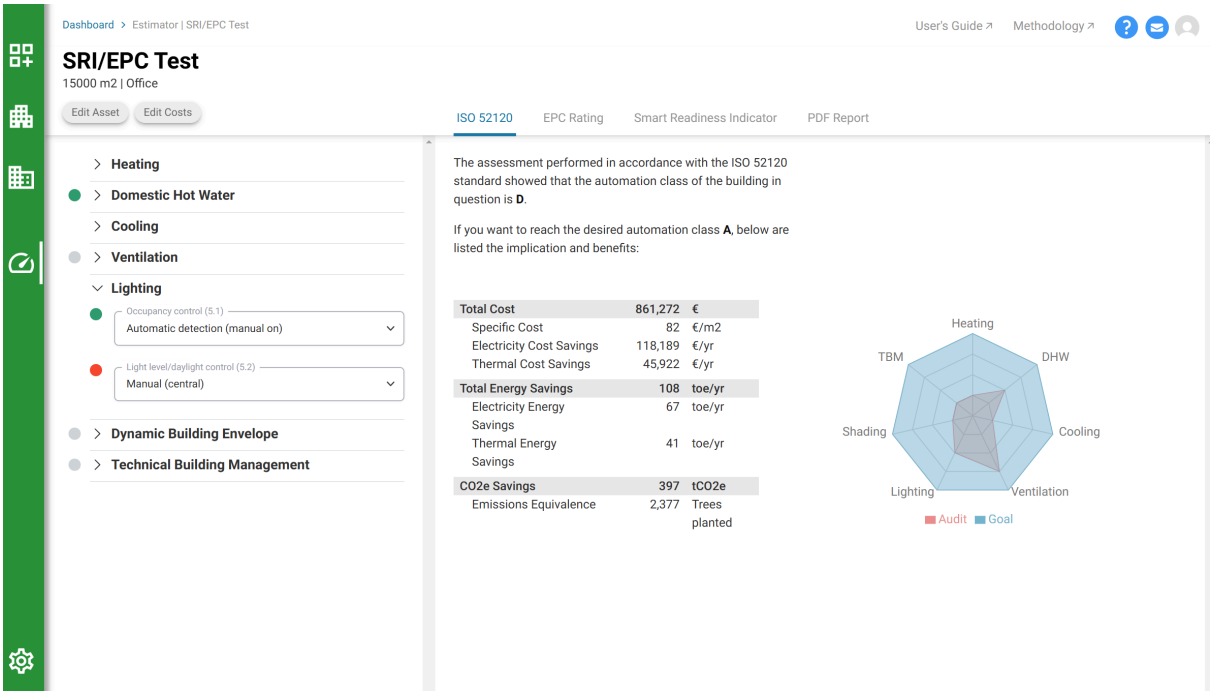
Share a link to the PDF report.

Methodology

ISO 52120

The legislation outlines a set of control functions critical for analyzing the building's various technical systems, such as heating, domestic hot water production, cooling, ventilation, lighting, sun shading, and the centralized technical building management. For each of these control functions, performance levels are assigned, ranging from zero to a maximum of four, alongside a corresponding Building Automation and Control (BAC) class, distinguishing between residential and non-residential buildings.

This framework helps in determining the building's automation level. The automation system is categorized into Class D, C, B, or A, based on the minimum performance level across all implemented functions. In this hierarchical system, the lowest class predominates. For instance, if all control functions meet the criteria for Class B, but one is rated Class C, the entire building is classified as Class C. This approach ensures a comprehensive assessment of the building's automation capabilities, highlighting the importance of each control function's performance level in achieving optimal efficiency and management.



Example performance levels from the ISO 52120 standard.

Calculating Cost of ISO 52120 Implementation

To estimate the total investment for meeting a higher ISO 52120 rating, the building was segmented into four key areas:

- **Central Unit**: This encompasses the main control unit that hosts and manages the entire building management program.
- **Production**: This area includes all components that handle hot or cold fluids, from their generation to the point they reach the collection collectors where usage begins.
- **Distribution**: This covers components that manage the movement of hot or cold fluids from the collectors to their designated environments.
- **Environment**: This pertains to components within the environments responsible for their management.

The presence or absence of equipment is determined based on the difference between the audit (which describes what is already present) and the desired automation class. The investment cost is determined from this bill of quantities (including the cost of necessary software). Additionally, the need for air handling units is also calculated, based on standard architecture of SE offerings.

Smart Readiness Indicator

To determine the Smart Readiness Indicator (SRI) scores, we developed tables for each domain, outlining the correlations between the control functions defined by the ISO 52120 standard and those relevant to the SRI. This effort was underpinned by an in-depth analysis of the various levels of control functions, adopting an engineering approach that goes beyond merely noting the presence or absence of external factors such as Building Management Systems (BMS), grid connections, renewable energy sources, storage systems, electric vehicle (EV) charging stations, and building certifications. Instead, it emphasized the complex interactions among multiple control functions.

The next step involved establishing connections with the SRI to calculate its related percentage scores, utilizing the SRI spreadsheet for this process. In aligning with the SRI, a deliberate choice was made to use Method B from the service catalog, taking full advantage of all control features available. In the calculation, these functions were applied to 100% of the building. However, the SRI allows for adjustments based on the percentage of presence, offering flexibility in the assessment. A revised SRI spreadsheet was introduced to evaluate how enhancements in the ISO classification affect the SRI percentage. This included selecting various SRI target classes for specific functions, based on the upgraded classifications provided by the standard.

Calculating Additional Cost of achieving SRI Class

The investment required to implement the Smart Readiness Indicator (SRI) accounts for external factors not considered in ISO 52120 calculations, such as EV charging stations and renewable energy systems with storage. These elements contribute to the desired SRI class but do not influence ISO ratings directly. Here's a simplified breakdown of the cost calculations and assumptions for achieving SRI targets:

- **EV Charging Stations**: Initially, it was estimated that 30% of the total parking area would be dedicated to parking spaces. Assuming an average parking space size of 12.5 square meters, the total number of parking spaces was calculated. The number of needed charging stations was determined by halving the total parking spaces, with each station serving two spaces. The installation cost for these columns was then calculated by multiplying the number of columns by the unit price provided by the Schneider Electric.
- **Photovoltaic System**: The assumption here is that up to 35% of the roof area can be covered with photovoltaic panels. By calculating 35% of the total roof area and dividing by the average area of a panel (about 2 square meters), the total number of panels required was estimated. Multiplying the number of panels by their

average power output (approximately 400 Watts) and assuming a cost of €1. per Watt, the installation cost of the photovoltaic system was determined.

- **Batteries**: The cost of energy production from the photovoltaic system was applied to the average annual production for the building's climate zone. This figure was then divided by 365 to get the daily production cost (kWh/day), which was further divided by the cost of the battery (about 0.3 €/Wh) to estimate the battery system's cost.

The final investment cost includes the sum of expenses for EV charging stations, photovoltaic panels, and batteries, depending on their presence in the building. This total cost was then divided by the building's total area to derive a cost per square meter. It's important to note that this expense is in addition to the costs associated with achieving the ISO rating.

Energy Performance Certificate (EPC)

The energy efficiency of buildings is rated on a scale from A4 (highest efficiency, lowest energy consumption) to G (lowest efficiency, highest energy consumption). Our current tool does not the full assessment required by legislation, as it does not include information on the geometry of the buildings.

Instead, the SRI/EPC Estimator implements a heuristic approach that estimates energy consumption and class based on expected consumption for a given ISO 52120 class. This involves comparing a building's energy use and fuel mix against a predefined energy class table to estimate its baseline energy category.

To predict the building's energy class after implementing energy-saving measures, we first calculate the energy savings resulting from moving up ISO classes. These savings are quantified in annual energy savings (kWh/year) and tonnes of oil equivalent savings per year (toe/year), then normalized to energy savings per square meter by dividing by the building's total area. Subtracting these savings from the building's original energy consumption (kWh/year) provides an estimated post-intervention energy use, which is then compared to the energy class table to approximate the building's new energy class.

It's important to note that this method offers a rough estimate and doesn't replace a detailed energy performance analysis conducted by a certified professional. The estimated energy class after interventions serves as an initial guide to the potential for enhancing the building's energy efficiency.