Building Performance Software: Portfolio-Level Capabilities and Applications

BERKELEY LAB

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Participating Software Providers

Abisko

Audette

Brightly Software - Stream Product (Siemens)

Cadence OneFive Inc.

Cambio AI

Carbon Lighthouse

JLL - Carbon Pathfinder

Carbonsight by Autocase

CBRE Zero Platform

ClearlyEnergy - BEAM

Cleartrace

ICF - CO2Sight

Enertiv

HELiOS Exchange

IBM Envizi ESG Suite

InSite Intelligence

LL97.ai (Powered by VERTBUILD.ai)

Nantum AI

Partner Energy

Roble

Schneider Electric - Resource Advisor

Schneider Electric - Zeigo Activate

Siemens - Building X Sustainability Manager

Siemens - The Decarbonization Business Optimizer (DBO)

SINAI

Watershed

Executive Summary

Navigating the broad and rapidly evolving market landscape of software solutions is complex whether you are a sustainability leader, building owner, energy manager, or building engineer with energy and greenhouse gas (GHG) emissions reduction goals for a portfolio of buildings. The Department of Energy's Better Buildings partners have noted this complexity and the associated lack of publicly available information. In response, this report reviews the ecosystem of environmental, social, and governance (ESG), energy management information systems (EMIS), and decarbonization software with the goal of orienting prospective users to current offerings. Organizations can utilize this guidance to determine the specific capabilities needed to support decarbonization efforts and procure appropriate software to streamline the GHG emissions reduction process.

In this paper, we refer to "decarbonization software" as the category of software that meets an organization's needs for decarbonization planning, implementation, and tracking. This software may have a heritage in ESG or EMIS, or it may be an entirely new product. This report offers a snapshot of today's rapidly evolving decarbonization software capabilities, along with guidance for procuring and utilizing it that will remain relevant despite any future software changes.

Exploratory research was conducted on over 100 software providers, and interviews were held with 28 of them. Note that inclusion in this report does not indicate an endorsement, nor does a product's absence from this report indicate a lack of suitability.

State of Software in the Market

Three primary categories of software that support building portfolio decarbonization activities were identified: ESG, EMIS, and decarbonization software. Each software type has different primary capabilities, as shown in Table ES-1. Briefly, the state of software in the market is as follows:

- While ESG and EMIS have not historically focused on decarbonization, they are expanding capabilities in this area due to market demand
- Not every dedicated decarbonization software offering includes all decarbonization-related capabilities that are typically found in ESG and EMIS software
- ESG and EMIS software offer additional capabilities that serve broader needs than decarbonization
- No single software category available today covers all user needs associated with decarbonization, sustainability, facility management, and portfolio management.

Section 1 of this report includes details about each of these three software categories, the role of supporting software, and considerations for Building Performance Standards (BPS) compliance.[1]

Table ES-1. Primary Capabilities of ESG, EMIS, and Decarbonization Software

	Primary Capabilities
Environmental, Social, and Governance (ESG) Software 	ESG software streamlines data collection and tracks metrics for annual compliance reporting and improvement of an organization's ESG program, which includes activities beyond decarbonization such as sustainability management and transparency of corporate governance.
Energy Management Information Systems (EMIS) Software 	EMIS software monitors and analyzes building performance data, and may also optimize building controls (Lawrence Berkeley National Laboratory, 2021). EMIS includes utility bill tracking, energy data analytics, fault detection and diagnostics, and/or automated system optimization, with a focus on improving operational performance.
Decarbonization Software 	Decarbonization software aids in scenario analysis (of multiple ways of achieving GHG targets) and project planning to develop and execute a portfolio-level GHG emissions reduction plan.

1 BPSs are policies and laws aimed at reducing the carbon impact of the built environment by requiring existing buildings to meet energy and/or greenhouse gas emissions-based performance targets (Office of Energy Efficiency & Renewable Energy, n.d.).

Core Decarbonization Capabilities

Eleven capabilities were identified that characterize decarbonization software and support the development and implementation of a portfolio-level GHG emissions reduction plan (Table ES-2). Details on the multiple methods underlying each of these capabilities can be found in Section 2. For example, in some products emission reduction measure (ERM) identification and savings estimation is automated, while in others it is semi-automated or relies on findings from audits and facility condition assessments.

Table ES-2. Software Capabilities Supporting Decarbonization Planning and Implementation

Software Capability	Description
Data Acquisition & Management	Collects data including energy consumption and renewable energy production data, building automation system (BAS) data, building information data, and data from other sources.
GHG Accounting & Reporting	Calculates Scope 1, 2, and potentially Scope 3 GHG emissions following standard protocols to develop a GHG inventory and measure progress against targets. Reports data from GHG inventory for internal reporting and/or compliance reporting.
Target Setting	Establishes energy and GHG emissions reduction targets (absolute or intensity) relative to a baseline year at the building and/or portfolio level.
Portfolio Categorization	Filters and sorts buildings in a portfolio using site attributes such as region, building type, floor area, HVAC system type, and Building Performance Standard applicability.
Benchmarking Energy & GHG Emissions Intensity	Compares building energy use intensity and GHG emissions intensity to similar buildings or against the building's historic performance.
BPS Exposure Analysis	Incorporates regional Building Performance Standards (BPS) as targets and quantifies the level of exposure of a building to penalties.
Measure Identification and Savings Estimation	Identifies measures and estimates energy savings and emissions reduction based on data from audits, utility bills, interval meters, or the building automation system using semi-automated or automated analysis methods.
GHG Emissions Scenario Analysis	Models combinations of GHG emission reduction measures to develop and compare multiple scenarios and determine the level of effort needed to meet emission reduction goals at the building and/or portfolio level.
Financial Analysis	Analyzes cost-effectiveness of emissions reduction measures, either individually or in aggregate, for a building or portfolio for use in prioritizing actions and capital planning.
Ongoing GHG Emissions Tracking	Tracks energy consumption and carbon emissions on an ongoing basis (e.g., monthly, or in near real-time) using interval data.
Decarbonization Project Tracking	Manages and tracks the status of tasks related to implementing decarbonization projects.

Utilizing Software to Support Decarbonization

There are many ways an organization can utilize decarbonization software within existing processes and alongside existing tools. As adoption of these products increases, it will be possible to document specific implementation examples in case studies and other literature. Given what is currently understood about best practices for using ESG and EMIS software and the emerging capabilities of decarbonization software, Figure ES-1 illustrates how these complementary tools can be combined to support GHG emissions reductions at the portfolio level. As shown in the figure, decarbonization software performs four core tasks: inventorying GHG emissions, supporting analysis for emissions reduction plans, tracking progress of projects, and monitoring ongoing performance.

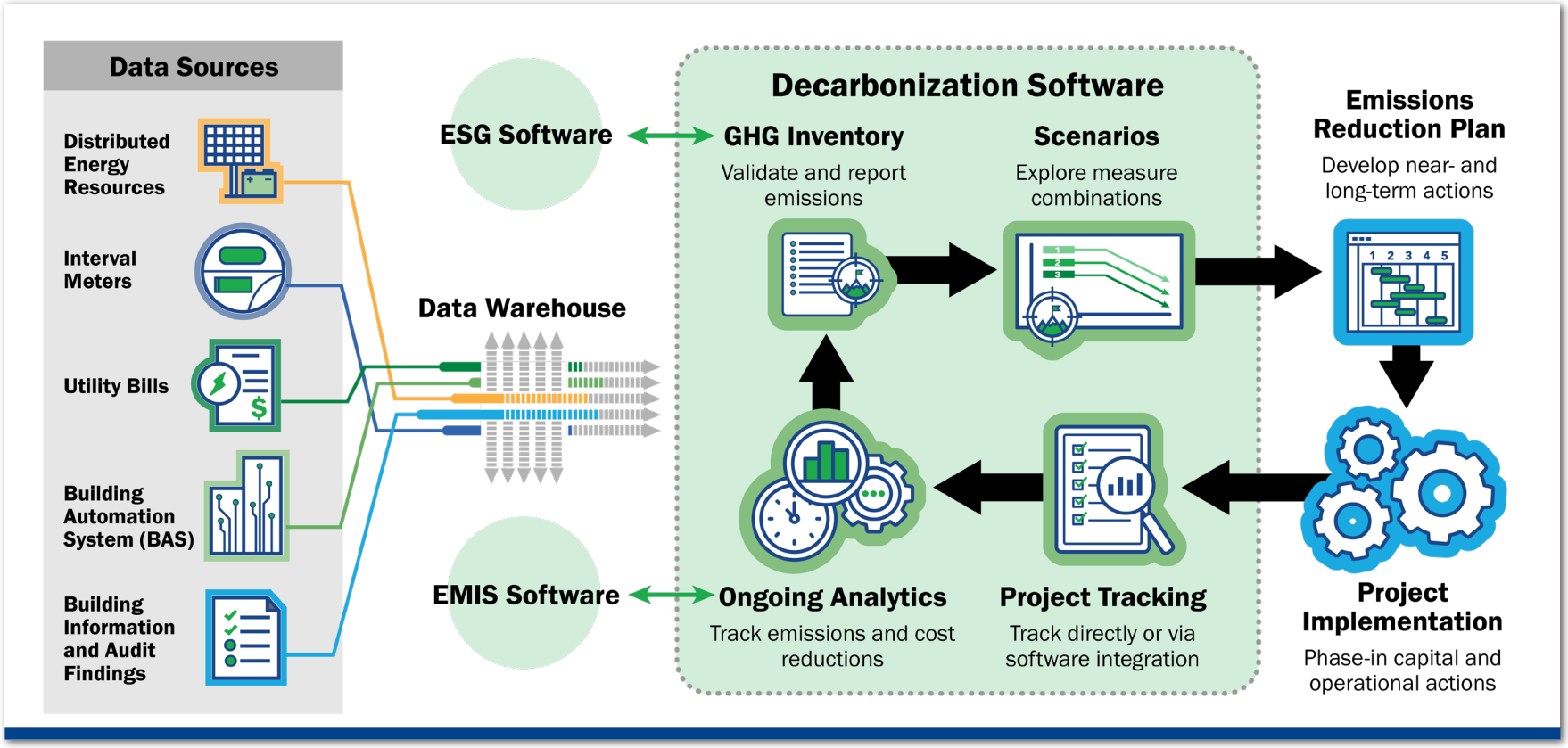


Figure ES-1. Process for using decarbonization software to support GHG emissions reduction

As an organization plans to procure a software solution, it's critical to understand the primary users, the software capabilities needed, and the available resources for implementing and utilizing the software.

There are three categories of primary users of decarbonization software: sustainability leadership and building owners, sustainability and energy managers, and building engineers and facility managers (see Section 3). Each role has different use cases for the software, which determine the capabilities and delivery model needed. For many software providers, the delivery model is Software-as-a-Service (SaaS), with various levels of consulting support. Some software providers offer consulting primarily for the initial onboarding and software set-up, while others offer full-service consulting from identification of measures and scenario analysis through implementation and results tracking.

The recommended steps for procuring decarbonization software are as follows:

- Define goals for decarbonization software
- Translate goals and needs to software capabilities
- Catalog existing tools and identify gaps in capabilities
- Finalize needed capabilities from decarbonization software
- Determine appropriate delivery model
- Execute software selection process.

Section 3 includes additional details on this process, which aims to support building owners in evaluating proposals across diverse products. As the decarbonization software market grows and evolves, users will benefit from matching software capabilities to organizational needs and integrating the software into their decarbonization planning and projects.

Key Takeaways

The analysis and insights delivered through automated decarbonization software can accelerate an organization's path to achieving decarbonization goals. This review of the current decarbonization software market showed that portfolio-level analysis is common among today's products. However, few products build up a portfolio-level analysis from building-level inputs and analysis. Scenario analysis is a defining feature of decarbonization software, helping users compare multiple ways of achieving GHG emissions reduction targets. Scenario analysis may be high-level or detailed, depending on the software's methodology and data requirements.

ESG software is expanding from a focus on quarterly or annual GHG emissions accounting and compliance reporting to decarbonization planning capabilities, while EMIS software is expanding from a focus on data analytics and energy savings identification into GHG emissions tracking. Decarbonization software may include a subset of the capabilities of ESG or EMIS software, in addition to the development and tracking of a GHG emissions reduction plan. As the use of decarbonization software increases, it will be possible to further identify best practices, common organizational uses, and costs and benefits, as has been documented for EMIS and other software types.

Introduction

The software market for buildings and portfolios is evolving quickly, driven by voluntary organizational commitments to reduce and report energy use and GHG emissions as well as by new market incentives, state and local Building Performance Standards (BPS) and other policies. Organizations such as those participating in the Department of Energy's Better Buildings program are being pressed to address climate change from regulators, investors, tenants, and employees.

In response, software providers are advancing new capabilities to meet growing demand for decarbonization solutions. Existing environmental, social, and governance (ESG) software now extends into decarbonization planning, while existing energy management information systems (EMIS) software now extends into emissions tracking. In this paper, we refer to "decarbonization software" as the category of software that meets an organization's needs for decarbonization planning, implementation, and tracking. This software may have a heritage in ESG or EMIS, or it may be an entirely new product.

Developing a clear and actionable plan to reduce GHG emissions is critical for meeting long-term decarbonization targets. To develop and implement such a plan, organizations must follow a five-step process as illustrated in Figure 1: (1) establish a GHG inventory and targets; (2) prioritize the building portfolio; (3) assess measures; (4) develop scenarios; and (5) define a plan. This process is thoroughly detailed in the U.S. Department of Energy's *Framework for GHG Emissions Reduction Planning* (Kramer et al., 2023).

Utilizing automated analysis and insights delivered through decarbonization software can provide support to staff with limited capacity or expertise while accelerating the achievement of decarbonization goals. This report characterizes the dynamic and fast-moving software market so users can better understand how emerging software offerings can help organizations streamline their GHG emissions reduction process.

This market landscape report is organized as follows:

- The Methodology section describes the research and the process for interviewing software providers
- Section 1 describes three software categories with decarbonization capabilities
- Section 2 defines decarbonization software capabilities according to the five-step process for developing and implementing a GHG emissions reduction plan, along with considerations for using software to support BPS compliance
- Section 3 provides guidance on integrating decarbonization software into organizational planning and projects, understanding primary software users and their needs, and various delivery models and procurement options
- The report concludes by summarizing key takeaways from the research.

Presented findings are based on a snapshot of the current market landscape, which will naturally change over time as software continues to evolve and develop.

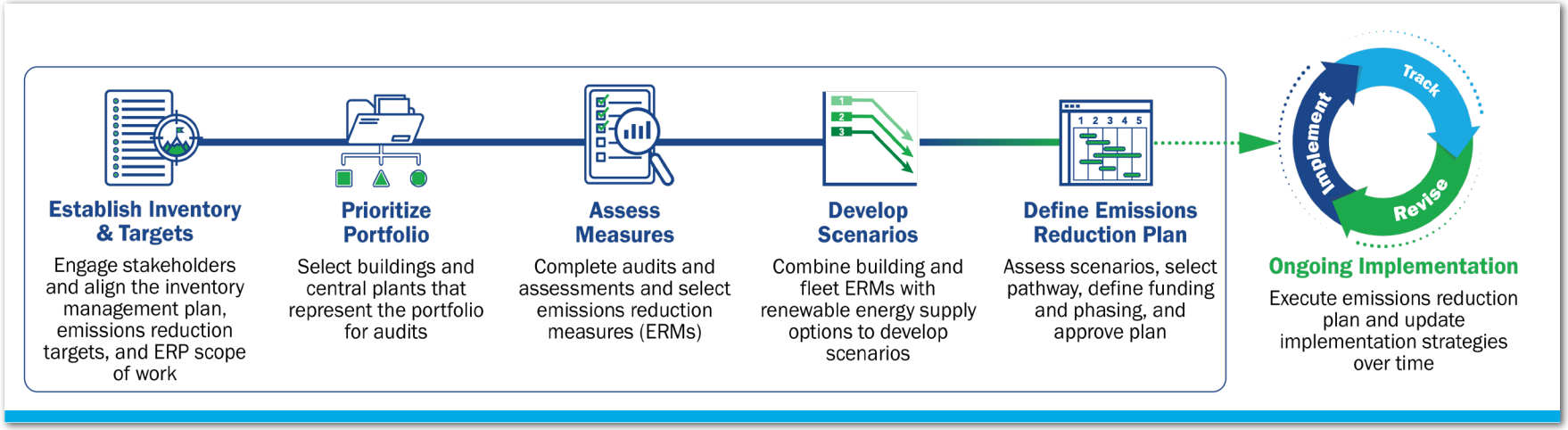


Figure 1. Process for developing a GHG emissions reduction plan
Source: Adapted from Kramer et al., 2023

Methodology

This report was developed based on three types of research: a literature review, Internet research of 101 software providers, and interviews with 28 software providers. Software offerings that support the reporting and reduction of Scope 1 (direct) and Scope 2 (indirect) GHG emissions were the focus of this work, while Scope 3 emissions fell outside our purview. Software providers were selected for interviews based on the following criteria:

- The software product offers multiple decarbonization capabilities
- The provider has an established market presence and has progressed beyond the start-up phase
- The point of contact agreed to provide a one-hour software demonstration and answer follow-up questions.

Interviews were guided by standardized questions to gain a systematic understanding of each software product's core decarbonization capabilities. Again, a product's inclusion in this report does not indicate endorsement, nor does a product's absence indicate a lack of suitability.

Section 1. State of Software in the Market

This section describes the market landscape for decarbonization software, and specifically its three main software categories. Since these categories overlap, identifying which capabilities an organization needs is instrumental in determining which software will meet those needs. This work identifies eleven distinct software capabilities that support decarbonization planning and implementation, which are described in detail in Section 2 and listed in Table 1.

Software Categories

This work identifies three primary categories of software that support emissions reduction planning and implementation: ESG software, energy management information systems software, and dedicated decarbonization software. ESG and EMIS software have been commercially available for decades and have recently added decarbonization-related capabilities, while dedicated decarbonization software is a relative newcomer to the market. Table 2 summarizes the primary software capabilities and emerging focus areas for the three software categories.

Table 1. Software Capabilities Supporting Decarbonization Planning and Implementation

Software Capability	Description
Data Acquisition & Management	Collects data including energy consumption and renewable energy production data, building automation system (BAS) data, building information data, and data from other sources.
GHG Accounting & Reporting	Calculates Scope 1, 2, and potentially Scope 3 GHG emissions following standard protocols to develop a GHG inventory and measure progress against targets. Reports data from GHG inventory for internal reporting and/or compliance reporting.
Target Setting	Establishes energy and GHG emissions reduction targets (absolute or intensity) relative to a baseline year at the building and/or portfolio level.
Portfolio Categorization	Filters and sorts buildings in a portfolio using site attributes such as region, building type, floor area, HVAC system type, and Building Performance Standard applicability.
Benchmarking Energy & GHG Emissions Intensity	Compares building energy use intensity and GHG emissions intensity to similar buildings or against the building's historic performance.
BPS Exposure Analysis	Incorporates regional Building Performance Standards (BPS) as targets and quantifies the level of exposure of a building to penalties.
Measure Identification and Savings Estimation	Identifies measures and estimates energy savings and emissions reduction based on data from audits, utility bills, interval meters, or the building automation system using semi-automated or automated analysis methods.
GHG Emissions Scenario Analysis	Models combinations of GHG emission reduction measures to develop and compare multiple scenarios and determine the level of effort needed to meet emission reduction goals at the building and/or portfolio level.
Financial Analysis	Analyzes cost-effectiveness of emissions reduction measures, either individually or in aggregate, for a building or portfolio for use in prioritizing actions and capital planning.
Ongoing GHG Emissions Tracking	Tracks energy consumption and carbon emissions on an ongoing basis (e.g., monthly, or in near real-time) using interval data.
Decarbonization Project Tracking	Manages and tracks the status of tasks related to implementing decarbonization projects.

Table 2. Primary Capabilities of ESG, EMIS, and Decarbonization Software

	 Environmental, Social, and Governance (ESG) Software	 Energy Management Information Systems (EMIS) Software	 Decarbonization Software
Primary Capabilities	ESG software streamlines data collection and tracks metrics for annual compliance reporting and improvement of an organization's ESG program, which includes activities beyond decarbonization such as sustainability management and transparency of corporate governance.	EMIS software monitors and analyzes building performance data and may also optimize building controls (Lawrence Berkeley National Laboratory, 2021). EMIS includes utility bill tracking, energy data analytics, fault detection and diagnostics, and/or automated system optimization, with a focus on improving operational performance.	Decarbonization software aids in scenario analysis (of multiple ways of achieving GHG targets) and project planning to develop and execute a portfolio-level GHG emissions reduction plan.
Decarbonization-related Focus Areas	Supports climate-related risk reporting in line with leading standards and frameworks[2] through GHG emissions accounting, automation of GHG compliance reporting, and customized internal reporting.	Supports decarbonization through ongoing energy and HVAC system monitoring and analytics, continuous identification of building- and system-level faults, and energy savings measures.	Decarbonization software may focus specifically on building-level and portfolio-level GHG emissions reductions, but its capabilities generally do not extend into ESG or EMIS functions.
Emerging Functionality	Tracking on-site renewables, RECs[3] and PPAs[4], BPS exposure analysis, transition risk assessment, and emissions from supply chain organizations (i.e., Scope 3 emissions).	Expanding energy savings estimates and verification of energy savings to include GHG emissions reduction calculations.	Capabilities that support BPS compliance including automatically identifying buildings subject to the BPS, identifying progress toward BPS targets, and potential compliance payments.
Data Frequency	Monthly data, quarterly to annual reporting.	Monthly, hourly, and sub-hourly interval data.	Scenario planning tends to utilize annual data.

2 Example leading standards and frameworks: the Carbon Disclosure Project (CDP Worldwide, 2024), Global Reporting Initiative (2024), and Task Force on Climate-related Financial Disclosures (2021).

3 A renewable energy certificate (REC) is a market-based instrument that represents the property rights to the environmental, social, and other non-power attributes of renewable electricity generation. RECs are issued when one megawatt-hour (MWh) of electricity is generated and delivered to the electricity grid from a renewable energy resource (U.S. Environmental Protection Agency, 2024a).

4 A power purchase agreement (PPA) is an arrangement in which a third-party developer installs, owns, and operates an energy system on a customer's property (Better Buildings Initiative, n.d.).

The decarbonization capabilities detailed previously may exist in multiple platforms, as shown in Figure 2 below. Note that not every dedicated decarbonization software includes all decarbonization-related software capabilities typically found in ESG and EMIS software, and that ESG and EMIS software have additional capabilities that serve broader needs than decarbonization. Further, no single software type available on the market today covers all user needs associated with decarbonization, sustainability, facility management, and portfolio management.

Many ESG and EMIS software providers can market their software as decarbonization software since they have significant decarbonization-related capabilities, but software that was created for the purpose of decarbonizing portfolios may offer a more comprehensive set of core capabilities.

Supporting Software

Project tracking and asset management software is not typically integrated into decarbonization software. Other supporting software platforms can fill these management needs, such as:

- **Project Management Software.** While decarbonization software can provide planning and tracking of a few key project attributes, this process is often manual. Dedicated project management software can help owners undertaking large retrofits or many projects at once.
- **Asset Management Software.** An important input for emission reduction plans is the remaining useful life of equipment, since implementation typically occurs in phases. This type of asset tracking may be included in software such as maintenance management systems or asset databases.

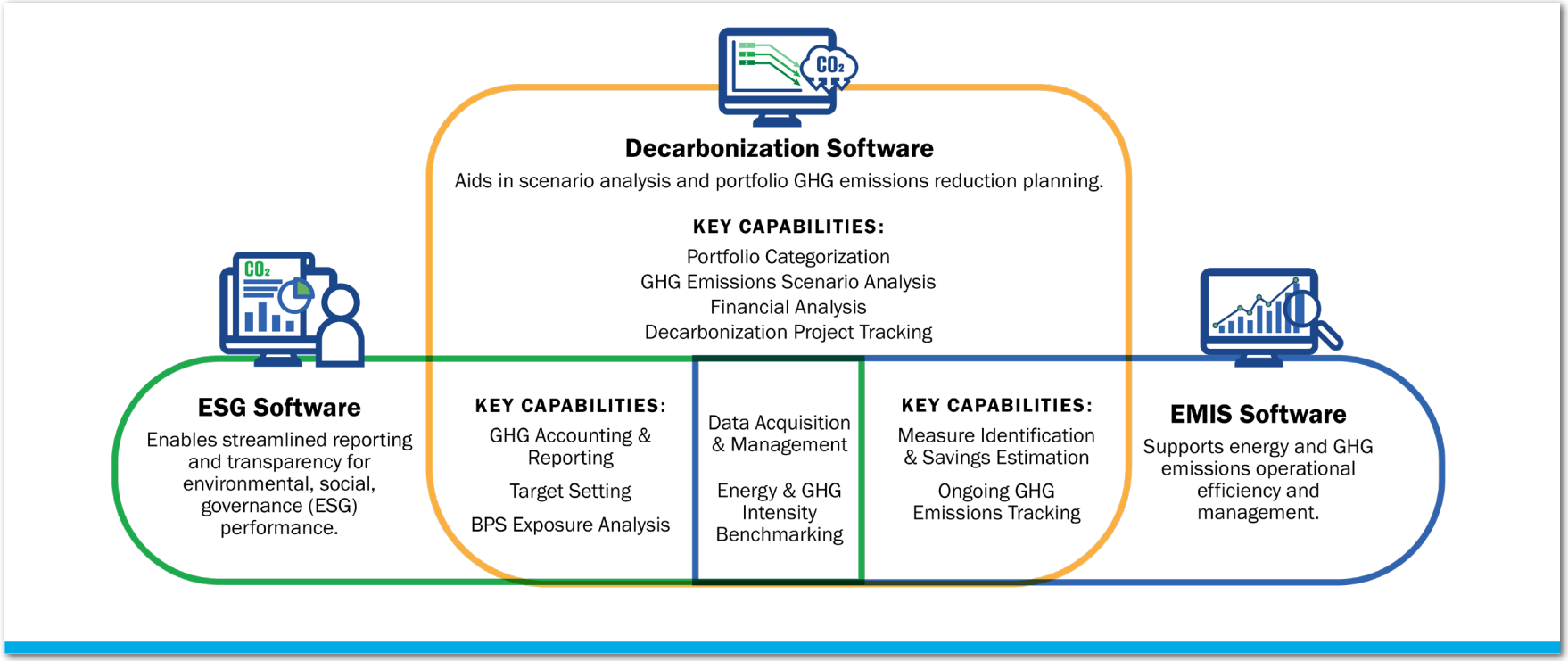


Figure 2. Decarbonization software capabilities and relationship to ESG and EMIS software

Publicly available tools provided by the U.S. Department of Energy, U.S. Environmental Protection Agency, national laboratories, and other agencies also support portfolio decarbonization. Appendix A summarizes some of the most relevant tools for decarbonization that are provided free of charge. These include building-level benchmarking tools, energy savings measure recommendations, and organizational energy management best practices.

Considerations for BPS Compliance

BPS regulations impose performance requirements for buildings in the form of energy and carbon targets. Compliance activities typically align with general energy management and decarbonization activities. Benchmarking performance towards a target, planning actions to achieve a target, and implementation of these actions are all core tenets of BPSs and the broader landscape of decarbonization software tools.

While software providers across all three software categories showed interest in supporting building owners in BPS compliance, this capability is now primarily found in decarbonization software. Key considerations in evaluating BPS impacts and actions are the manner in which performance targets are assigned to buildings and whether the primary user will be an owner, a jurisdiction, or both.

BPS policy modeling. Modeling the application of a BPS policy to a building or portfolio of buildings is challenging, as jurisdictions utilize a variety of metrics, adjustments, exemptions, alternative compliance pathways, and building types. BPS policy modeling is typically done in one of two ways:

- Top-down analysis occurs through target modeling in which the user directly enters their building-level targets. For portfolios of buildings, some software allows users to manually enter building-level targets from specific BPS regions, while other software allows a building to be evaluated relative to generalized transition risk frameworks (e.g., Carbon Risk Real Estate Monitor, or CRREM).
- Bottom-up analysis is performed by modeling each BPS policy individually. This tends to be more accurate than the top-down approach when considering specific BPS policies but does not cover all BPS policies in all regions.

Over time, as capabilities evolve, these methods are expected to converge into a generalized approach that is both accurate across individual BPS policies and comprehensive for portfolios spanning multiple BPS regions.

Software serving both owners and jurisdictions. Unique to the BPS compliance landscape, some software providers are creating two-way solutions for building owners and state and local jurisdictions. By providing jurisdictions with a compliance tracking platform for their own BPS policy, a software provider can also offer specific BPS guidance and services to building owners within that jurisdiction.

BPS policies are an important lever for driving decarbonization and energy efficiency in existing buildings, and a significant market opportunity exists for software providers to guide building owners on achieving BPS compliance. While software providers have implemented some BPS compliance capabilities, a large opportunity still exists to offer end-to-end support for buildings across the BPS lifecycle and across the diversity of BPS policies that exist nationally.

Section 2: Capabilities of Decarbonization Software

Eleven capabilities were found to support organizational decarbonization planning and implementation, as listed below. (For full definitions, see Table 1.) These capabilities exist in one or more of the three main software categories described in this report (ESG software, EMIS software, and dedicated decarbonization software). Again, no single software type or product covers all capabilities associated with decarbonization, sustainability, facility management, and portfolio management.

- Data Acquisition & Management
- GHG Accounting & Reporting
- Target Setting
- Portfolio Categorization
- Benchmarking Energy & GHG Emissions Intensity
- BPS Exposure Analysis
- Measure Identification and Savings Estimation
- GHG Emissions Scenario Analysis
- Financial Analysis
- Ongoing GHG Emissions Tracking
- Decarbonization Project Tracking

In Figure 3, decarbonization software capabilities are mapped to the process steps they support in developing a GHG emissions reduction plan. This helps organizations define both where they are in the process and which capabilities are needed to facilitate goal attainment. Focusing on capabilities needed, as opposed to software types, will help organizations better define and meet their needs.

The following sections describe these capabilities in further detail and provide examples, via screenshots, of how software provides them. (See the Acknowledgements for a full list of software providers we interviewed. Again, inclusion in this report does not indicate an endorsement, nor does a product's absence from this report indicate a lack of suitability.) More research is needed to understand the prevalence of these capabilities, their value propositions, and how they are utilized in practice.

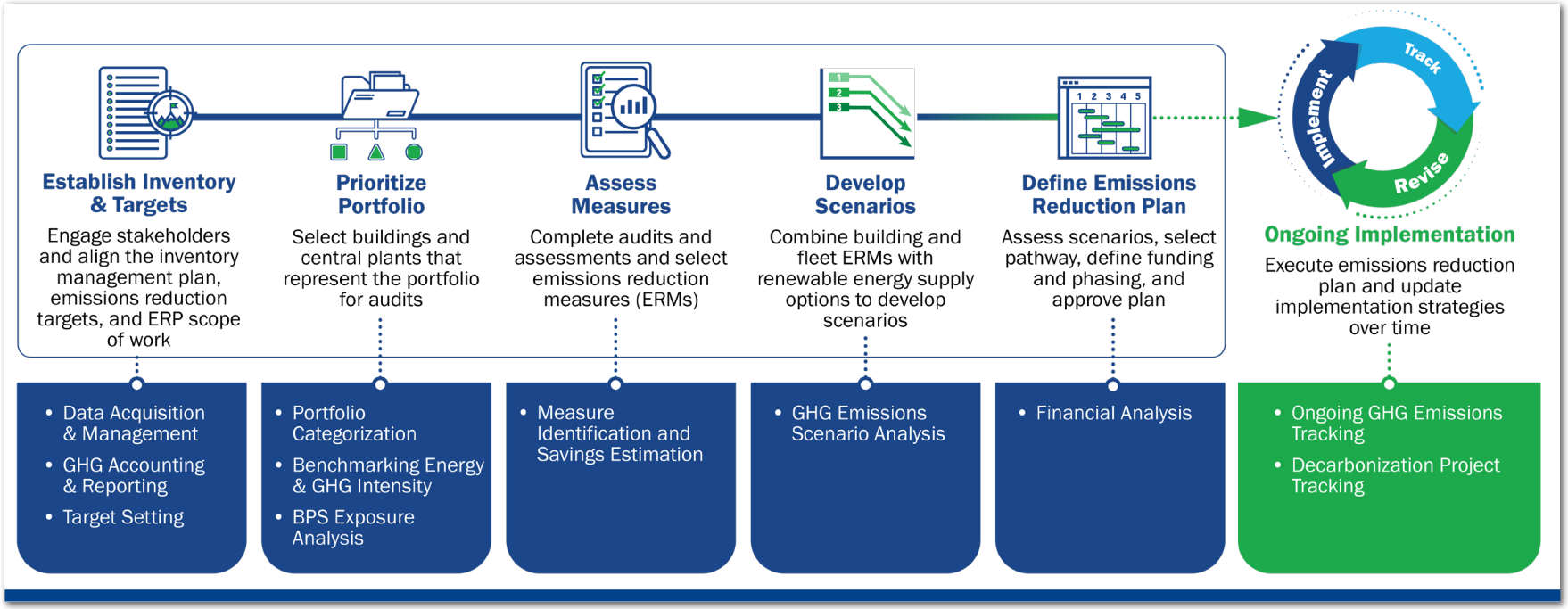


Figure 3. How decarbonization software capabilities map to GHG emissions reduction planning and implementation
Source: Adapted from Kramer et al., 2023

Process Step 1: Establish Inventory & Targets

Decarbonization software capabilities that support the development of a transparent and auditable GHG emissions inventory include data acquisition and management, GHG accounting and reporting, and emissions reduction target setting.

Capability: Data Acquisition & Management

A GHG emissions reduction plan requires the collection of operational energy and GHG emissions data, as well as site-level information such as audit reports and equipment-level operational trend data. Relevant data sources include:

1. **Energy meters.** This category includes three types of data streams: utility bill data (e.g., electricity, natural gas, steam, hot water, chilled water, and other fuels), utility interval meter data (typically electric-only), and submeter data.
2. **Building automation system.** Equipment-level operational data from the BAS.
3. **Facility and asset information.** Site characteristics typically include building location, area, vintage, building type, system type and condition, and occupancy.
4. **Audits.** This includes information from reports such as on-site surveys, energy audits, facility condition assessments, or existing building commissioning reports.
5. **Onsite and offsite renewable energy.** Data on renewable energy generated onsite or offsite, such as renewable energy certificates (RECs) or generation from a power purchase agreement (PPA).
6. **Other data sources.** In addition to onsite fossil fuels, Scope 1 data sources also include vehicle fleet emissions and fugitive emissions such as refrigerant leakage.

Software platforms acquire data through various means and may only be able to ingest certain data sources or formats. Almost all software reviewed can collect utility bills and interval meter data through direct connection with the utility or an application programming interface (API). Most software platforms possess the ability to manually upload data using a template. Further, all software categories have the ability to track onsite renewables using one or more of the following methods:

- Monthly utility bills or reports from renewable energy providers
- Direct measurements from a meter installed at the renewable energy system
- An API that monitors renewable energy generation.

REC data enters the software by being manually inputted or via API connection to a regional REC electronic tracking system. Some software providers offer consulting to support the purchase of clean energy through partner companies. Additionally, a small number of software providers have built-in clean energy marketplaces to streamline the exploration, product vetting, and purchase of the various market-based instruments for clean energy for individual sites or for the overall portfolio.

Capability: GHG Accounting & Reporting

Creating a comprehensive and transparent GHG emissions inventory requires the collection of emissions source data, application of appropriate emissions factors to calculate emissions, and data quality audits for completeness and accuracy. A transparent data audit trail – including data sources, calculation methodologies, and emissions factors – was included in the majority of software and is considered best practice for GHG accounting. Software typically follows the GHG Protocol methods for GHG accounting and reporting emissions (World Resources Institute and World Business Council for Sustainable Development, 2004).

Software collates GHG emissions data for voluntary and compliance reporting in two ways:

- Most software calculates and tracks Scope 1 and 2 emissions; some also includes Scope 3 emissions
- Some software products, typically those with an ESG heritage, provide automated voluntary reporting (e.g., the Carbon Disclosure Project) and compliance reporting (e.g., New York City Local Law 97) or organize the required data and information into formats that can be easily uploaded to reporting websites.

Figures 4 and 5 provide examples of software dashboards displaying GHG emissions for a portfolio of buildings and a single building.

Capability: Target Setting

Software allows users to define energy and GHG emissions reduction targets relative to a baseline year. Multiple targets can often be set, allowing the user to explore the ambition of various targets, including separate targets for Scope 1, Scope 2, or Scope 3 emissions.

Software providers typically include GHG emissions target setting functionality at the portfolio level and allow for absolute or normalized (i.e., intensity) targets, as well as near-term and long-term targets.

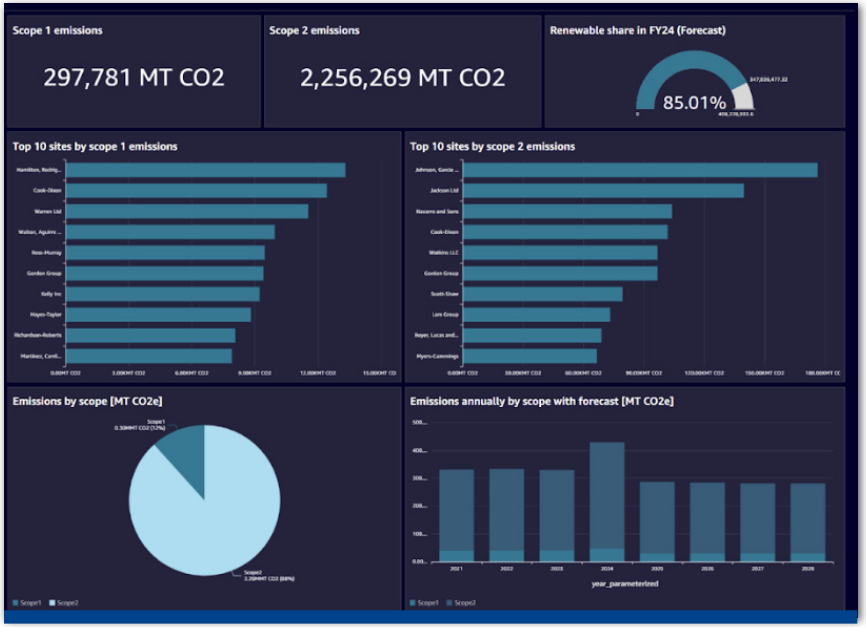


Figure 4. Example of portfolio-level GHG emissions dashboard
Source: Siemens Building X

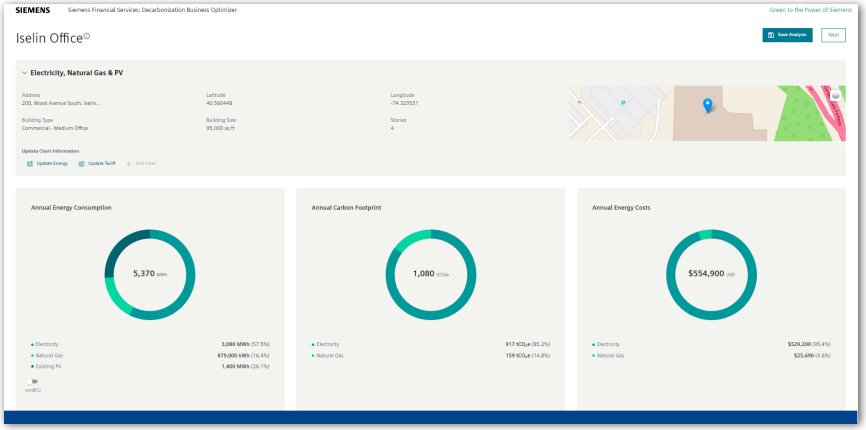


Figure 5. Example of building-level GHG emissions dashboard
Source: Siemens Financial Services: Decarbonization Business Optimizer

Some software can set targets at both the portfolio and building levels. Figure 6 shows an example chart illustrating both an energy intensity target and a CO_2 target. Some products offered pre-populated targets based on leading carbon reduction frameworks such as the Science Based Targets Initiative (SBTi) (2024) and the CRREM (Carbon Risk Real Estate Monitor, n.d.). Figure 7 provides an example dashboard of an SBTi-aligned target.

Target setting is also a key capability for BPS compliance since these policies establish building-specific targets for energy or GHG emissions intensity and tracking performance relative to targets is critical for ongoing BPS compliance. For example, Figure 8 shows an emission target line based on Boston's local Building Performance Standard.

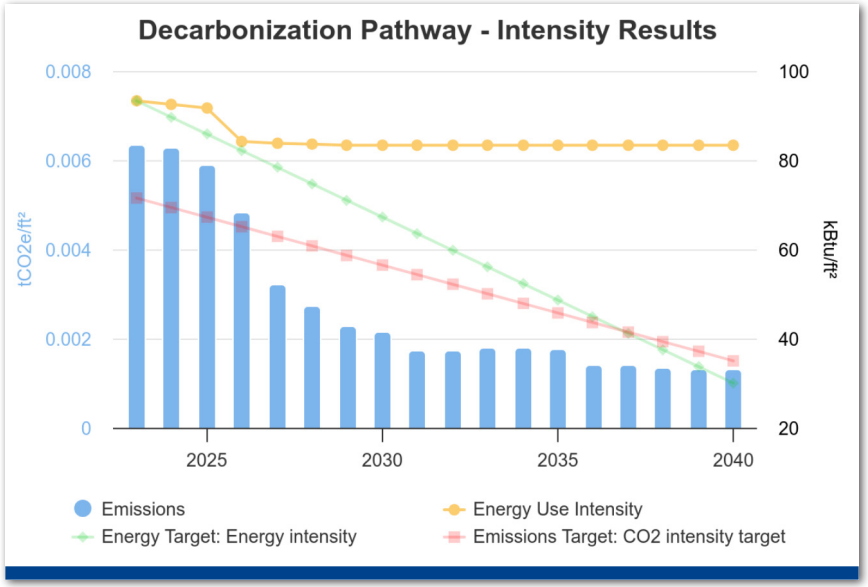


Figure 6. Example chart illustrating an energy intensity target and a CO_2 target
Source: Carbonsight by Autocase

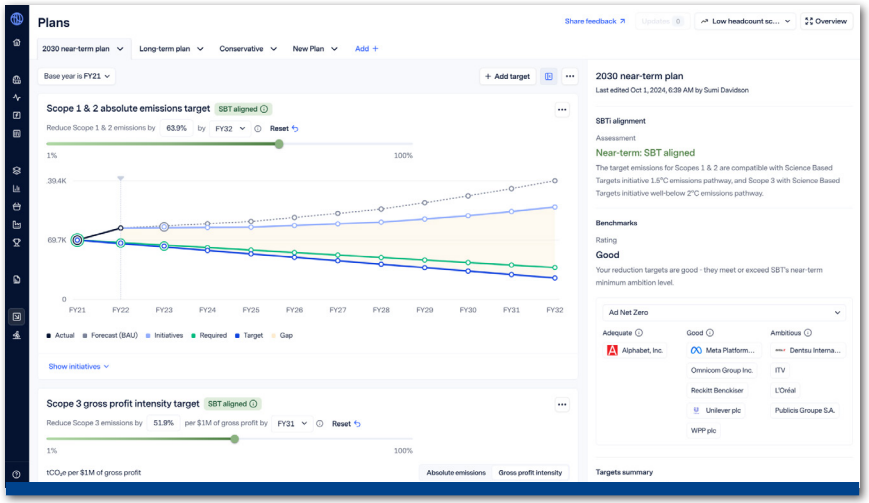


Figure 7. Example dashboard of an SBTi-aligned target
Source: Watershed

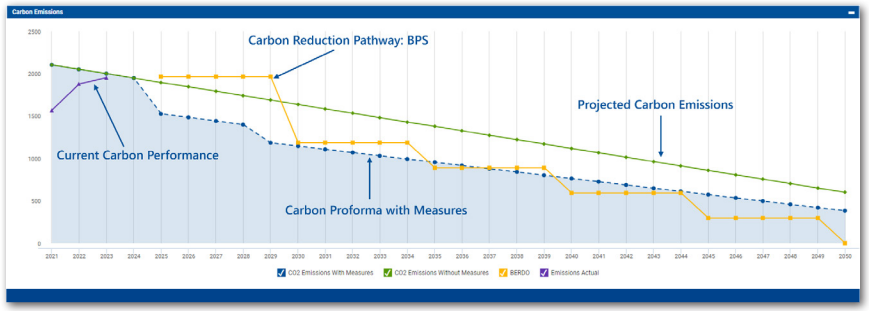


Figure 8. Example dashboard showing multiple targets, including one based on Boston's local BPS (BERDO)
Source: Partner Energy

Process Step 2: Prioritize Portfolio

Categorizing buildings within a portfolio by key attributes helps identify their impact on overall emissions. Further, users can prioritize buildings for study within each category. Prioritization capabilities in this section include portfolio categorization, benchmarking energy and emissions intensity, and BPS exposure analysis.

Capability: Portfolio Categorization

This capability allows users to categorize a portfolio by key site attributes such as region, building type, floor area and HVAC system type. Categorization supports the development and scaling of standard emissions reduction approaches to similar buildings in the portfolio.

Figures 9 and 10 illustrate how users can create different categories of buildings within software based on building attributes and/or tags.

Capability: Benchmarking Energy & GHG Emissions Intensity

Traditionally, benchmarking has focused on energy use intensity (EUI), which is measured in kBtu/sq ft. For a decarbonization focus, GHG emissions intensity (GHGI) is utilized, measured in Mt CO_2e/sq ft. Most software can filter sites by attributes (e.g., building type, region, HVAC equipment type, etc.) and then compare the data in order to benchmark energy consumption, GHG emissions, and operational cost. “Internal” benchmarking is based on a building’s historical performance or a peer group of sites within the user’s portfolio. By contrast, “external” benchmarking uses broader regional or national peer groups such as ENERGY STAR Portfolio Manager

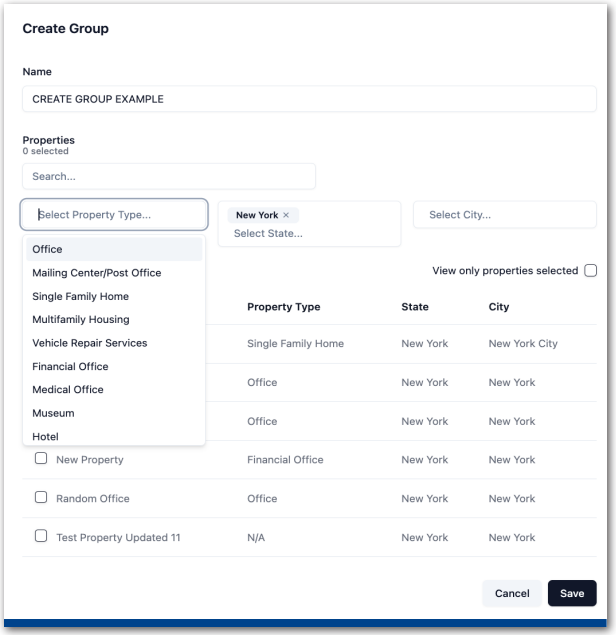


Figure 9. Example of creating a custom group based on attributes such as property type and location
Source: Abisko

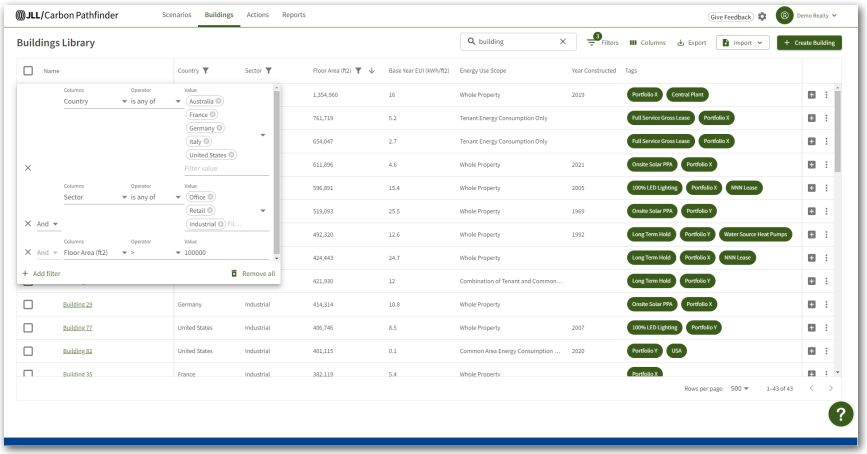


Figure 10. Example of filtering and adding tags to buildings to categorize a building portfolio
Source: JLL Carbon Pathfinder.

(U.S. Environmental Protection Agency, n.d.) or the U.S. Department of Energy Building Performance Database (Lawrence Berkeley National Laboratory, n.d.). Figures 11 and 12 show examples of internal benchmarking, while Figure 13 shows an example of utilizing ENERGY STAR as a benchmark for a single building. Internal and external benchmarking are typically offered in the decarbonization software products reviewed.

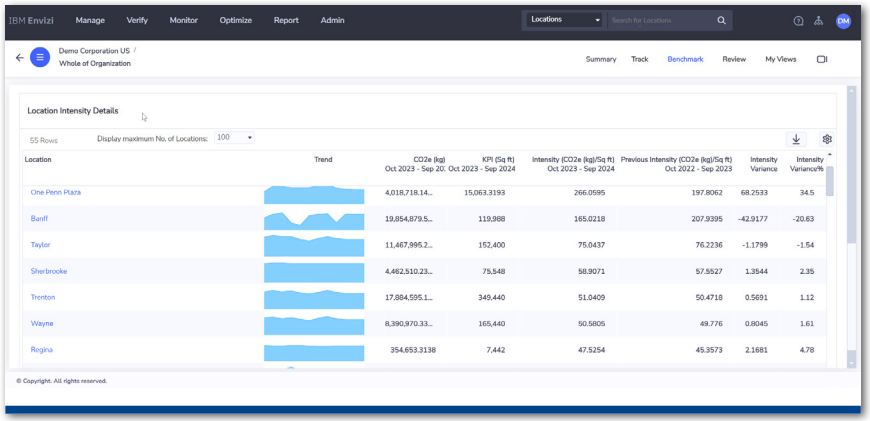


Figure 11. Example of benchmarking buildings against their own historical emissions and those of other buildings within a portfolio
Source: IBM Envizi

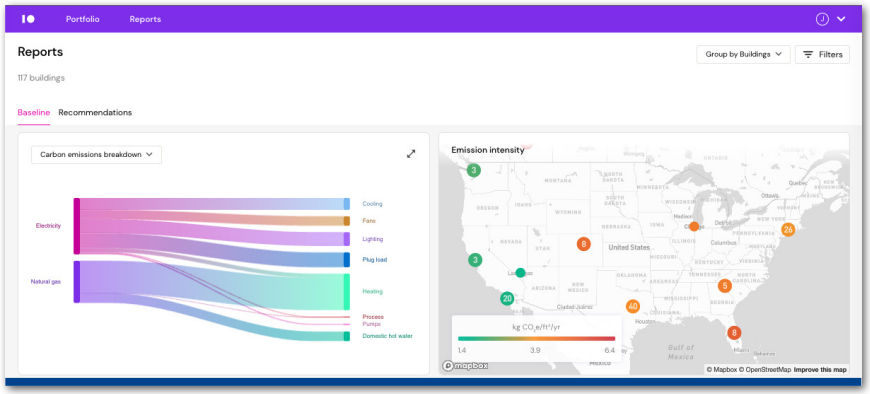


Figure 12. The right side of this dashboard benchmarks the emissions intensity of a portfolio of buildings by city, while the left side shows the breakdown of overall portfolio emissions by end use
Source: Audette

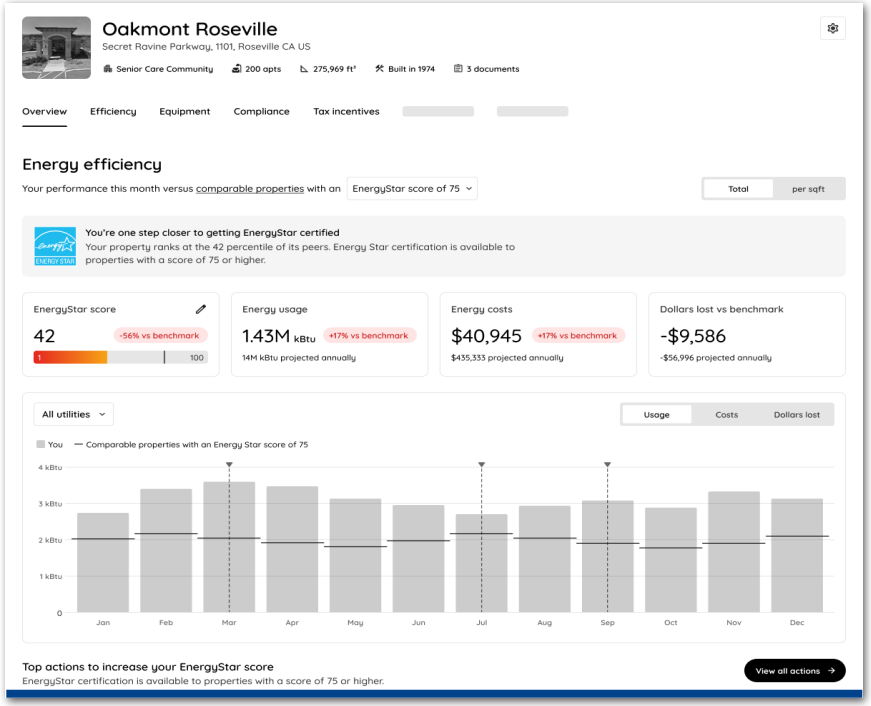


Figure 13. Example dashboard utilizing ENERGY STAR for benchmarking a single property
Source: Roble

Capability: Building Performance Standards Exposure Analysis

Software was reviewed for the ability to quantify an asset's level of exposure to penalty payments for exceeding BPS performance requirements. Software with this capability can help portfolio managers:

- Assess the risk of not satisfying current or impending BPS policies
- Calculate projected alternative compliance payments
- Prioritize buildings for implementation of energy efficiency measures.

Most software providers that offer BPS exposure analysis capability can flag which buildings in a portfolio are subject to a BPS and when it is expected to take effect. Fewer can evaluate a building's existing performance relative to BPS targets, calculate projected alternative compliance payments based on BPS target exceedance, or provide clear goals for emissions/energy reductions to meet BPS targets. Figures 14 and 15 show examples of a single-building exposure dashboard and a portfolio-level exposure dashboard, respectively. Projected emissions reductions and any potential compliance payments can help users prioritize capital planning and operational changes. Some software also relays information about alternative compliance pathways for a BPS policy.

BPSs are a relatively new policy mechanism but have significant adoption momentum nationally. Of the nine BPS-specific software providers interviewed, seven entered the market in the last five years. With over a quarter of U.S. floor area located in jurisdictions considering or actively pursuing BPS policies, the demand for this capability is expected to increase.

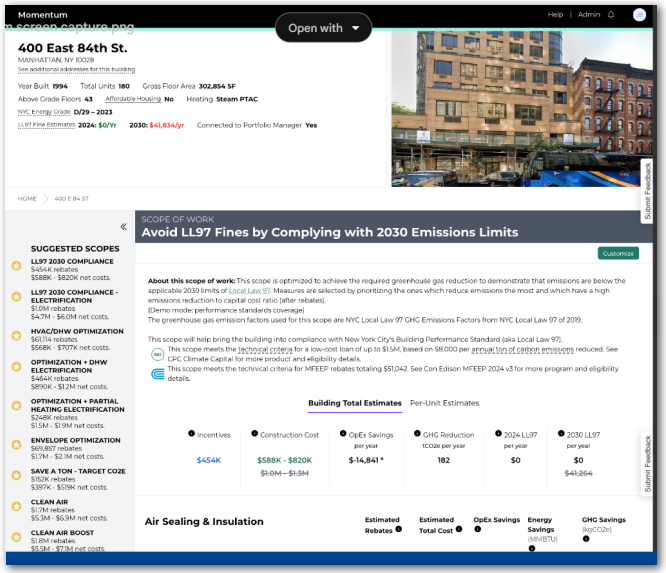


Figure 14. Example of Local Law 97 exposure analysis for a single building

Source: Cadence OneFive Inc. Momentum

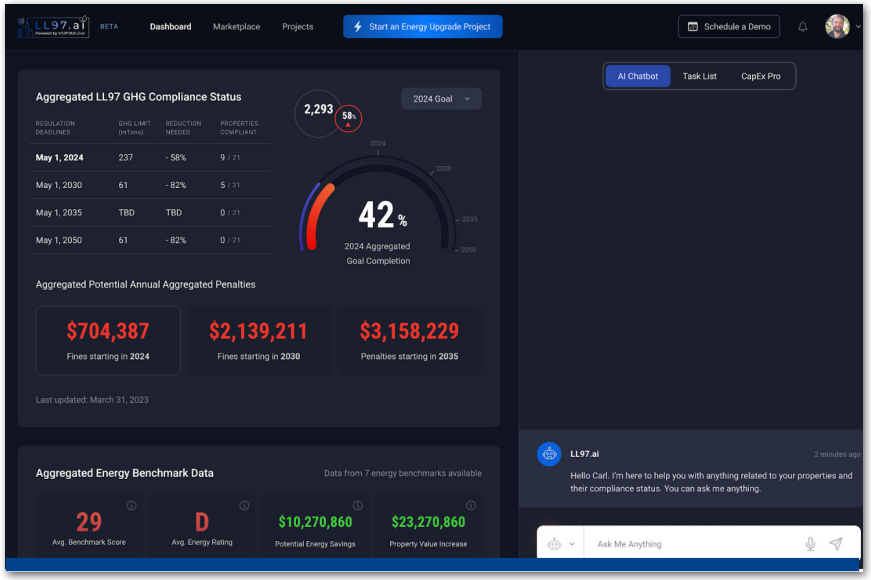


Figure 15. Example of Local Law 97 exposure analysis for a portfolio of buildings

Source: LL97.ai

Process Step 3: Assess Measures

GHG emissions reduction measure (ERM) identification and savings estimation are critical capabilities for decarbonization software, along with the ability to prioritize measures by savings and applicability. Software providers utilize a variety of methodologies to identify and rank measures.

Capability: Measure Identification & Savings Estimation

Software identifies ERMs through automated and semi-automated methods. The ERMs may be solely focused on operational improvements to controls or may also include major retrofit measures. Measure analysis typically includes one or more of these four methods:

1. **Monthly utility bill analysis** can provide high-level indications of energy waste and seasonal trends. This method can help determine when additional analysis is warranted.
2. **Interval meter data analytics** identifies operational issues such as high baseload energy use, scheduling issues, or excessive energy use relative to baseline operation or benchmarks.
3. **Fault detection diagnostics (FDD)** ingests equipment-level trend data continuously, allowing operational measures to be identified in near real-time through a set of expert rules or algorithms. Energy waste is summed over time as the fault condition continues to be met.
4. **Energy models** estimate how energy savings measures impact energy use. These models have a range of rigor, from engineering calculations to hourly simulation. Inputs may include information collected from energy or decarbonization audits and/or general building and existing system characteristics.

Where software does not recommend measures automatically, users can manually input results from prior energy audits, facility condition assessments (FCAs), or decarbonization audits to develop measures for utilization in scenario analysis. Some software providers will complete an onsite survey as part of initial set up, which can then be utilized as inputs for measure identification. When software provides automatic, high-level estimates of retrofit opportunities, these are intended to be refined by further on-site auditing.

To calculate GHG emissions reductions from energy savings measures, software typically applies annual emissions factors to energy savings. These factors can reference regional data sources such as the U.S. Environmental Protection Agency (2024b) eGrid or be customized to the local grid's energy mix.

The use of machine learning (ML) algorithms to identify ERMs is an emerging function. Today, software providers generally review ML algorithms for accuracy before potential ERMs are sent to users. Some software includes consulting services to vet software-generated measures for feasibility and prioritize measures for implementation. Consulting services are described further in Section 3.

Figure 16 is an example of a user-input screen related to measures and Figure 17 is an example dashboard of measures for a single building.

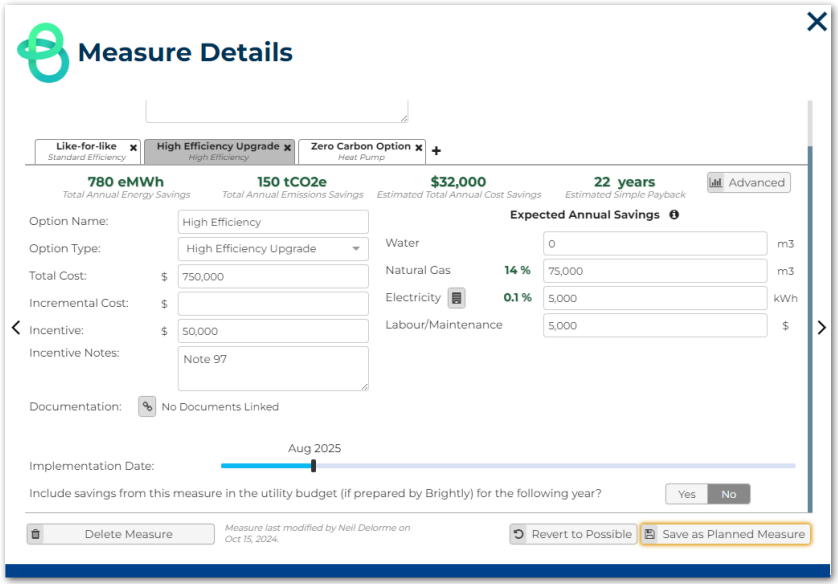


Figure 16. Screen where users can input multiple options for an HVAC retrofit for use in scenario analysis
Source: Brightly

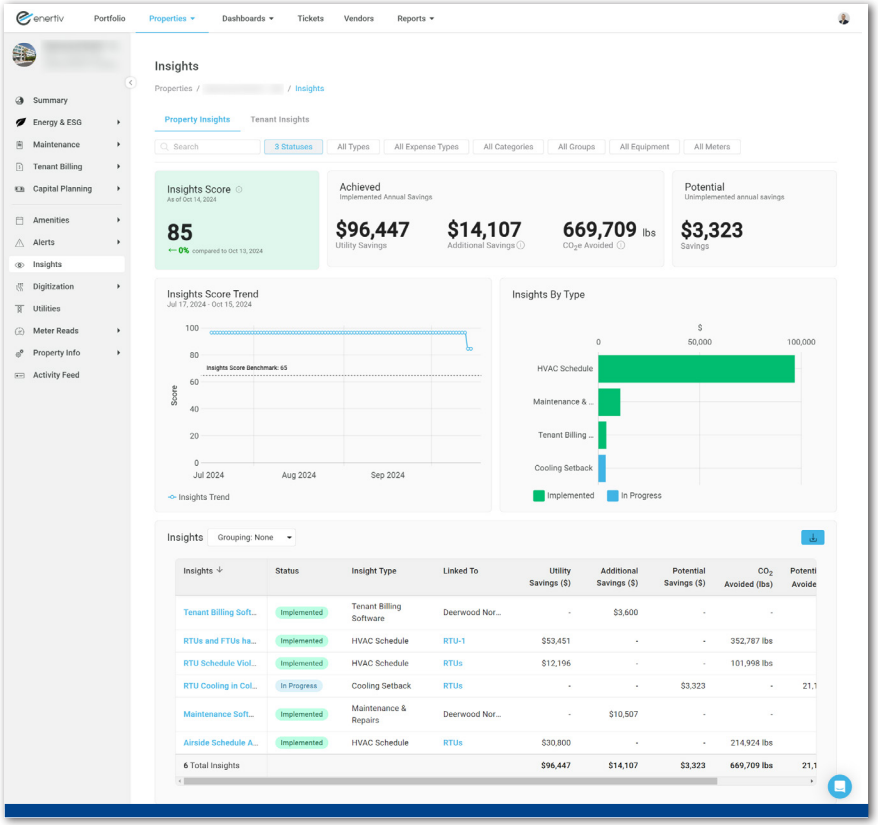


Figure 17. Measures dashboard for a single building
Source: Enertiv

Process Step 4: Develop Scenarios

Decarbonization scenario development involves bundling diverse GHG emission reduction measures to determine their impact on emissions trajectories over time. This allows users to understand the different ways that measures can be combined, scaled, and phased to meet targets. Other criteria to consider may include implementation costs, operational costs, and timeline. Through analysis of multiple scenarios, users can provide justification and confidence in the decarbonization plans selected to reach their goals.

Capability: GHG Emissions Scenario Analysis

Scenario analysis is an emerging capability for decarbonization software providers, and one in which methods vary significantly across software. Scenario analysis offers significant promise for helping owners develop emissions reduction plans. Without support from software or detailed engineering studies, scenario analysis is challenging to perform.

This capability helps users understand how multiple options for reducing GHG emissions compare in terms of magnitude and what timeline would be required to achieve emission reduction goal(s) for local BPS and/or portfolio-level targets.

Users can analyze the impact of different technical strategies (e.g., energy efficiency, electrification, renewables) as well as phasing. Scenario planning is offered at two levels that are highly dependent on the software provider:

- **Building-level.** Allows users to assign measures to a site and roll up site-specific measures into a portfolio-level scenario.
- **Portfolio-level.** Allows users to apply top-down savings projections broadly across all sites.

Where software provides bottom-up measures applied at a building level, they generally do not roll up those measures to show portfolio-level impacts. Some software providers can only support building-level GHG emissions scenario development. The products offering more robust scenario analysis capabilities include the following attributes:

- Forecasts of grid emissions factors, and the ability to modify those forecasts for more conservative or aggressive representations of “greening of the grid” over time
- Utility rate forecasts, and the ability to modify those forecasts for more conservative or aggressive representations of rate changes over time
- Performance degradation rates applied to ERMs
- Impacts of changing occupancy rates and loss or gain of portfolio square footage
- Indication of whether the scenario is SBTi-aligned
- Quantification of energy and emissions reductions from site-specific measures
- Aggregation of site-specific measures into a portfolio-level scenario.

Figures 18 and 19 visualize a decarbonization pathway by measure type for a group of buildings.

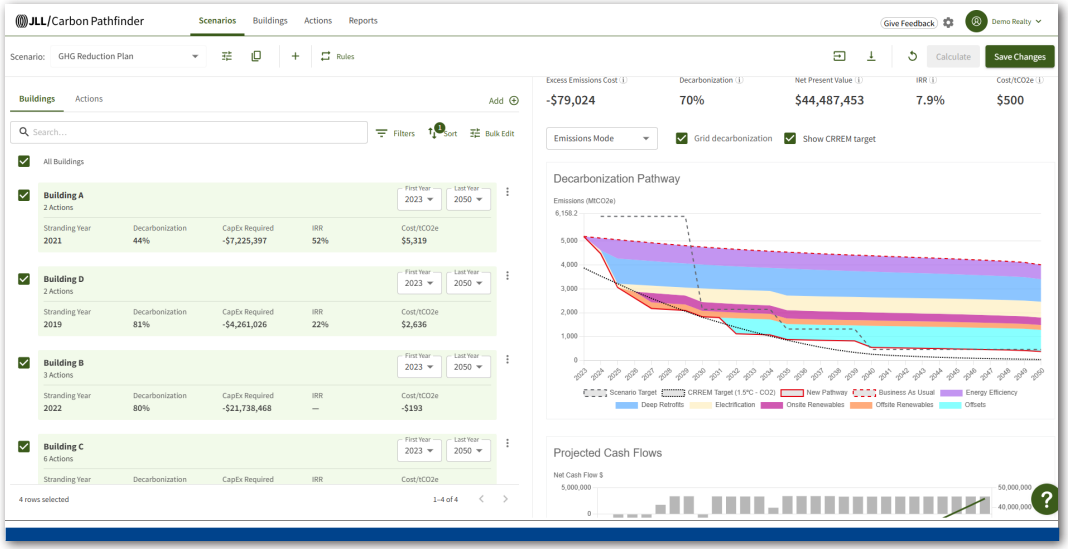


Figure 18. Dashboard showing a list of measures and an accompanying pathway chart for a portfolio of buildings that can drill down to the building level
Source: JLL Carbon Pathfinder

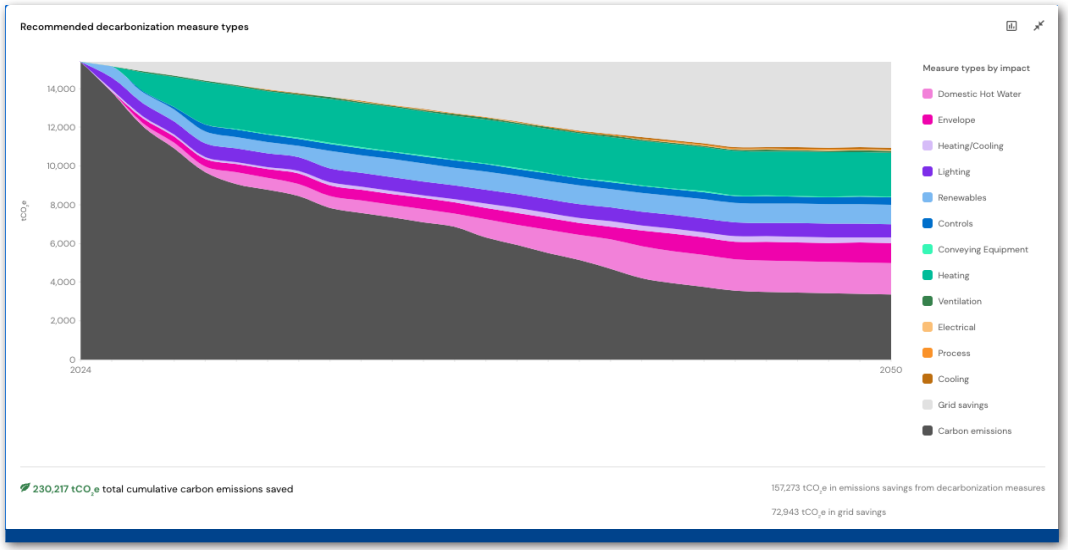
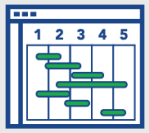


Figure 19. Pathway dashboard visualizing measure types by end use for a portfolio of buildings
Source: Audette



Process Step 5: Define Emissions Reduction Plan

Decarbonization software offers capabilities that help users identify which ERMs to implement for a chosen scenario. However, software does not necessarily document all phases of planning and implementation. For example, an organization may keep portions of their plan in decarbonization software but also utilize project management software for execution. (See Section 3 for more information.) Software providers are beginning to incorporate projected building life-cycle events (e.g., end of equipment useful life, tenant move-outs, etc.) and upcoming capital expenditure (CapEx) and operational expenditure (OpEx) measures to support the phasing of these activities. Decarbonization software may also include financial analysis and BPS exposure analysis to help prioritize actions.

Capability: Financial Analysis

Financial analyses may be presented using metrics such as return on investment (ROI), simple payback, and internal rate of return (IRR) for the identified ERMs. Financial analysis is utilized to prioritize and plan for CapEx and OpEx and can be rolled up from the measure level to the building level and even the portfolio level, depending on the software.

There are three main methods for populating financial metrics, which vary in rigor and accuracy:

- **Manual entry.** Most software providers have a manual entry field for estimated implementation costs. These can be input based on recommended measures from completed decarbonization audits or FCAs. Some software can scrape PDFs of audits for measure and cost information, accompanied by some manual validation for accuracy.
- **Databases.** Some software provides costs based on the software provider's internal library of implemented measures (adjusted by climate zone) or from external databases.
- **Artificial intelligence (AI).** A few software providers utilize AI to make cost and savings estimates more accurate over time by applying a learning algorithm to their database of project data.

Some software providers offer cash flow projections for each measure through a target year. Fewer of them automatically apply applicable rebates or incentives to financial metrics without the use of their consulting services. Software is beginning to utilize marginal abatement cost (MAC) curves to help prioritize measures.

In addition, some products support annual CapEx and OpEx planning at the site level by organizing the identified measures and associated financials in a useful way. Figures 20 and 21 provide examples of financial dashboards.

Figure 20. Dashboard showing annual CapEx and OpEx forecasts
Source: Carbonsight by Autocase

Ongoing Implementation

Beyond helping to create an emissions reduction plan, decarbonization software also supports implementing that plan and tracking results over time to verify alignment with the plan. This near real-time operational tracking provides valuable feedback compared to standard GHG reporting, which typically occurs on an annual basis.

Capability: Ongoing GHG Emissions Tracking

Many products allow for hourly energy use visualization and analysis, but few support similar features for ongoing emissions tracking at such a granular level. Rather, most software we reviewed provides emissions reports aligned with standard reporting cycles (i.e., annual or quarterly).

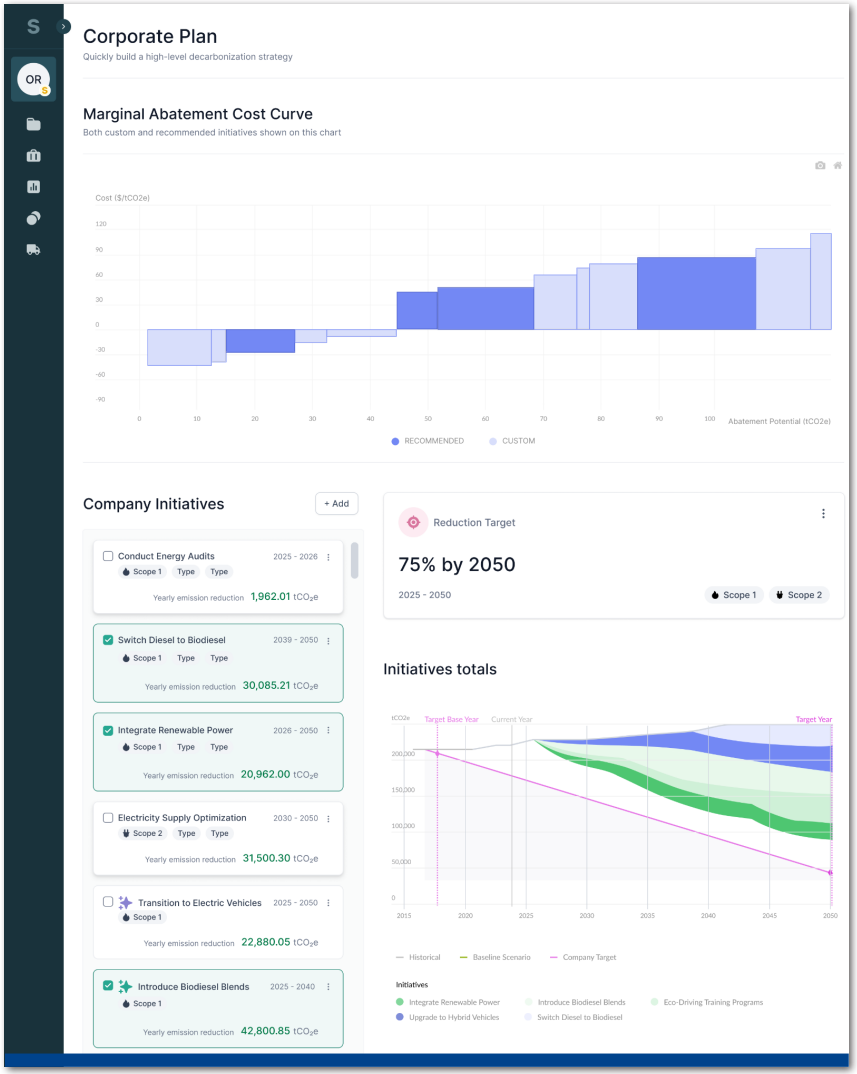


Figure 21. Example dashboard showing measures plotted on a MAC curve and an accompanying pathway chart
Source: Sinai

Few of the software products reviewed provide automated measurement and verification (M&V)[5] of energy savings at the project level or the whole building level; instead, users must manually review energy data to confirm savings from ERMs. However, some EMIS software offers savings verification using whole building interval meter data analysis. Figures 22 and 23 provide examples of software visualizations and comparisons of ongoing energy use and GHG emissions.

Capability: Decarbonization Project Tracking

Tracking the status of multiple decarbonization projects can be complex and span project development, pricing, and budget approval to coordinating contractors and project completion. Software that supports tracking can typically monitor the following project attributes:

- Designation of project type (e.g., CapEx, OpEx)
- Project status (e.g., developed vs. approved project, bids received, contract executed, implementation in progress, project complete, etc.)
- Project costs, with some software indicating the certainty of the data source
- Expected carbon reduction and cost savings from the project, either calculated automatically or entered manually.

In some software, measures can be tagged and categorized by attribute (e.g., OpEx, CapEx, like-for-like replacements, high-efficiency replacements).

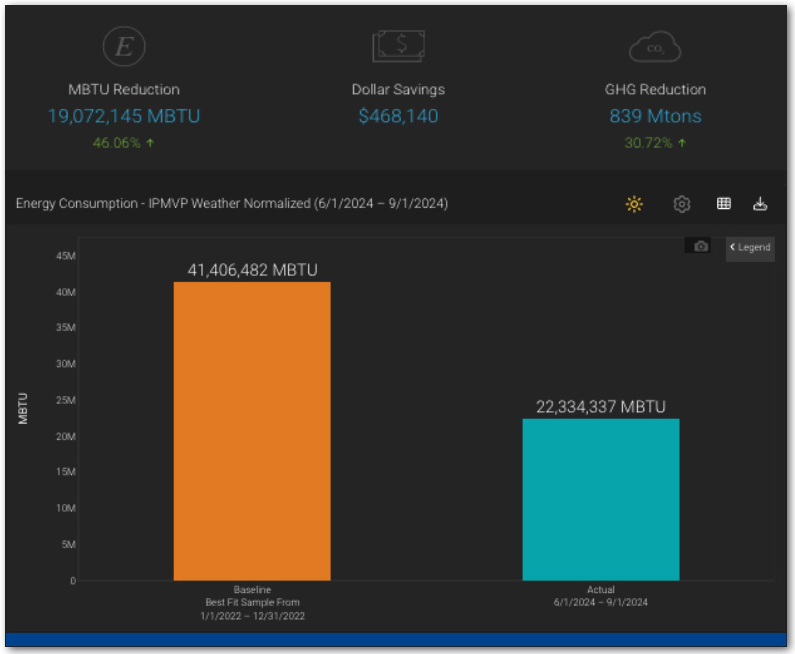


Figure 22. Dashboard tracking ongoing energy consumption against a baseline
Source: Nantum AI

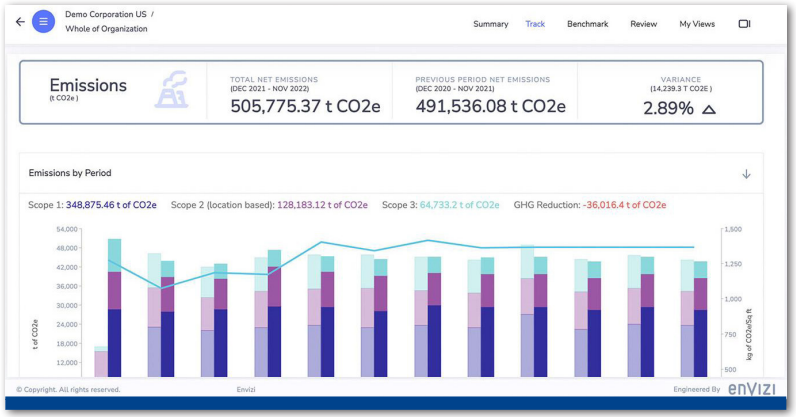


Figure 23. Dashboard comparing an organization's Scope 1, 2, and 3 emissions over a specified time period
Source: IBM Envizi

5 Efficiency Valuation Organization defines measurement and verification (M&V) as a process of planning, measuring, collecting and analyzing data for the purpose of verifying and reporting energy savings within an individual facility resulting from the implementation of energy conservation measures, or ECMs (Efficiency Valuation Organization, 2022).

To streamline implementation, some software providers can integrate tracked projects and their associated attributes with existing work order systems when a given measure is approved. Few decarbonization or EMIS software offerings provide RFP language to streamline the procurement of measures or notify designated stakeholders on the status of their implementation.

Overall, most software platforms do not provide comprehensive tracking of project budget, tasks, roles and timelines, since this has historically been provided by project or asset management software. (See Section 3 for more information.) Further, current decarbonization software may not integrate with external capital planning or asset management software.

Figure 24 shows an example of decarbonization software project tracking functionality, which includes information such as project description and status, project type (i.e., HVAC, water, appliances), and cost. Figure 25 provides an example dashboard of project planning and tracking of capital expenditures.

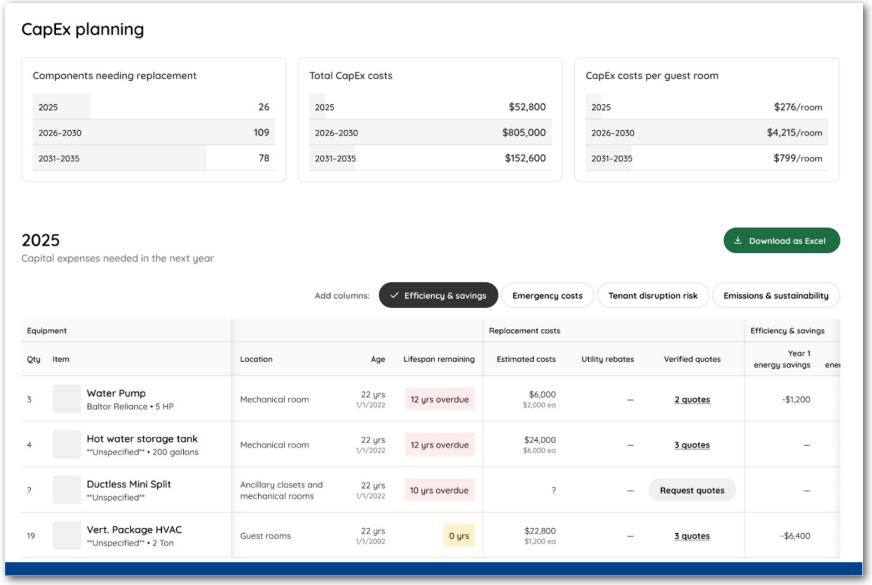


Figure 25. Dashboard showing project planning and tracking of capital expenditures
Source: Roble

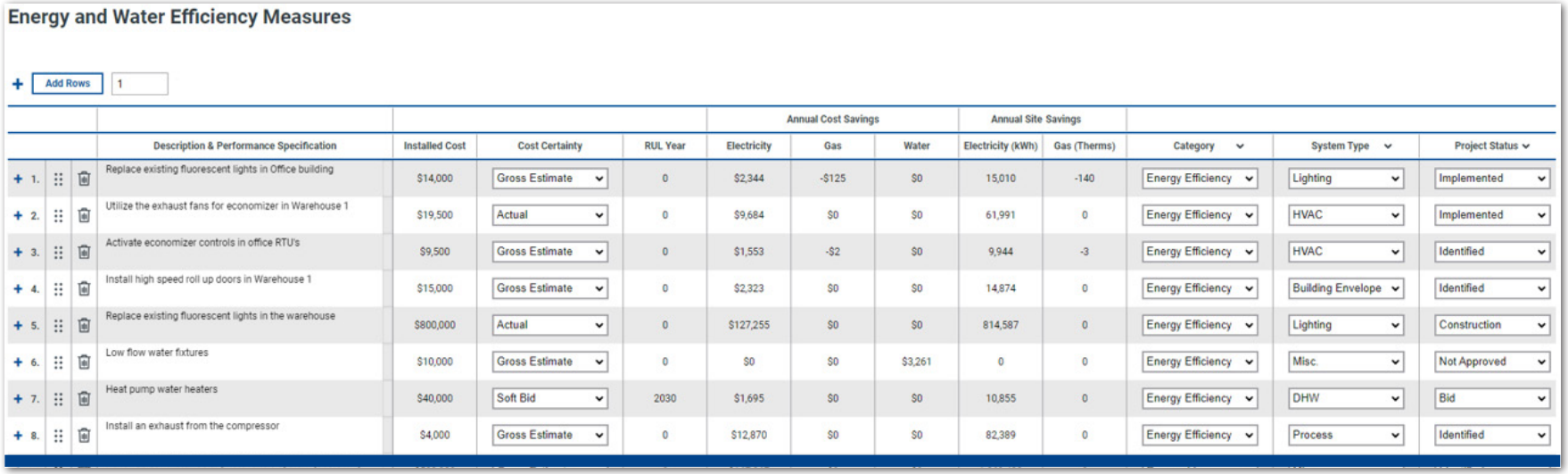


Figure 24. Dashboard showing project tracking
Source: Partner Energy

Section 3. Utilizing Software to Support Decarbonization

Integrating decarbonization software into an organization's existing business and operational processes is critical to fully benefiting from the software's capabilities. Organizations can utilize decarbonization software in many ways, and more examples are needed of successfully integrating decarbonization software with existing organizational tools and processes. Prospective decarbonization software should be examined for how it could be integrated with existing ESG and/or EMIS software. If minimal decarbonization capabilities are included in an organization's existing software solutions, then prioritizing a dedicated decarbonization software with more comprehensive capabilities may be warranted.

Section 3 covers key aspects of implementing any type of decarbonization software, whether it is dedicated decarbonization software or capabilities within ESG or EMIS software. This section also offers an introduction to primary software users, delivery models, and software procurement.

Integrating Decarbonization Software

The process graphic in Figure 26 illustrates how decarbonization software supports the development and execution of a data-driven GHG emissions reduction plan. Each organization will incorporate decarbonization software differently depending on availability and access to data sources and existing ESG or EMIS software. At today's state of decarbonization software use and maturity, the process defined in Figure 26 is generally done in parts and pieces among different projects and departments. Using decarbonization software as a platform to pull together the many parts of decarbonization planning can streamline and facilitate implementation.

As Figure 26 shows, decarbonization software typically ingests data sources such as energy data, BAS trends, and building characteristics and audit findings. (Note that the data sources any given product supports should be confirmed, as not all may be covered.) The data warehouse centralizes the storage and organization of the input data. Data streams associated with building-level energy use are used to develop a GHG inventory and report results, providing a baseline for decarbonization planning.

GHG inventory management and reporting have historically been conducted using spreadsheets or ESG software, the latter of which may be part of or external to the decarbonization software. Using software to develop a GHG inventory and report Scope 1 and Scope 2 emissions can lead to improved data organization and automation of tasks, saving significant effort for owner teams.

Based on a comprehensive accounting of portfolio GHG emissions, decarbonization software performs both measure analysis and scenario analysis to help users consider options in defining their plan. An actionable emissions reduction plan can be developed (generally outside of the software) using the scenario and measure analysis results. The plan is then implemented as ERM projects by in-house teams or through contractors. Tracking the progress of those ERMs occurs within the decarbonization software or by an existing project management process.

The ongoing performance monitoring and analytics step captures near real-time data streams to help owners track performance and ensure enduring benefit from investments. Automated analytics may be delivered through an EMIS that is external or built into the decarbonization software. This ongoing performance data can again

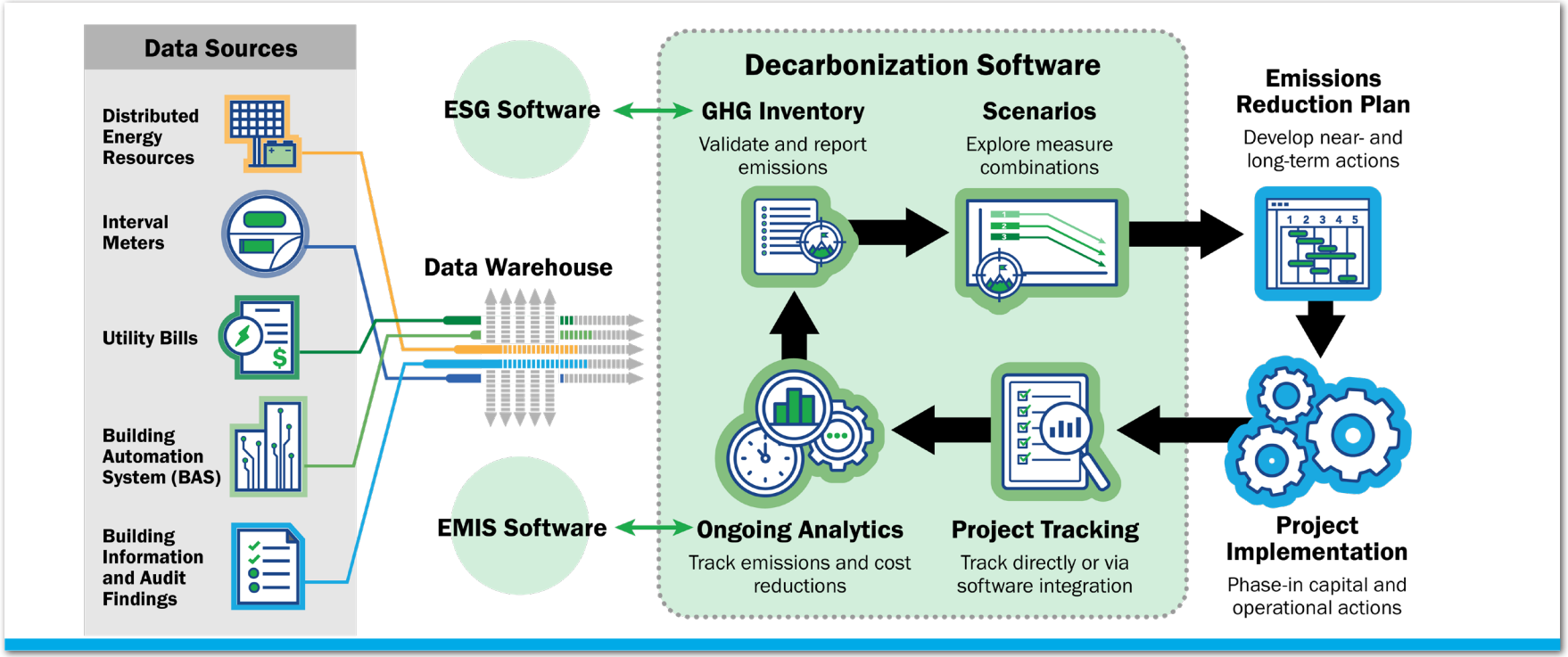


Figure 26. Process for using decarbonization software to support GHG emissions reduction

inform the decarbonization scenario planning step as well as provide granular analysis to inform GHG emissions reporting.

Primary Users

There are three categories of primary users of decarbonization software, each of which has varying needs. Examples of decarbonization software capabilities that support these primary users and the achievement of their objectives are shown in Figure 27.

Sustainability leadership is typically responsible for reviewing and reporting GHG emissions to all applicable frameworks, communicating progress and performance on GHG emissions reduction goals, and gaining buy-in from senior leadership on targets and overall decarbonization strategy. Decarbonization software informs an organization's overall emissions reduction strategy.

Sustainability and energy managers support leadership by summarizing key information and identifying ERMs for implementation with supporting financial analysis. These users benefit from capabilities such as GHG accounting and reporting, measure identification, scenario analysis, and ongoing emissions tracking.

Building engineers and facilities managers may serve as energy managers but also can utilize software to identify operational inefficiencies and potential ERMs.

Additional users of decarbonization software could include asset managers, who are interested in maintaining building or portfolio value through tenant retention and meeting performance targets and sustainability commitments. Other financial leadership roles could be interested in understanding risks associated with BPS compliance or GHG emissions.

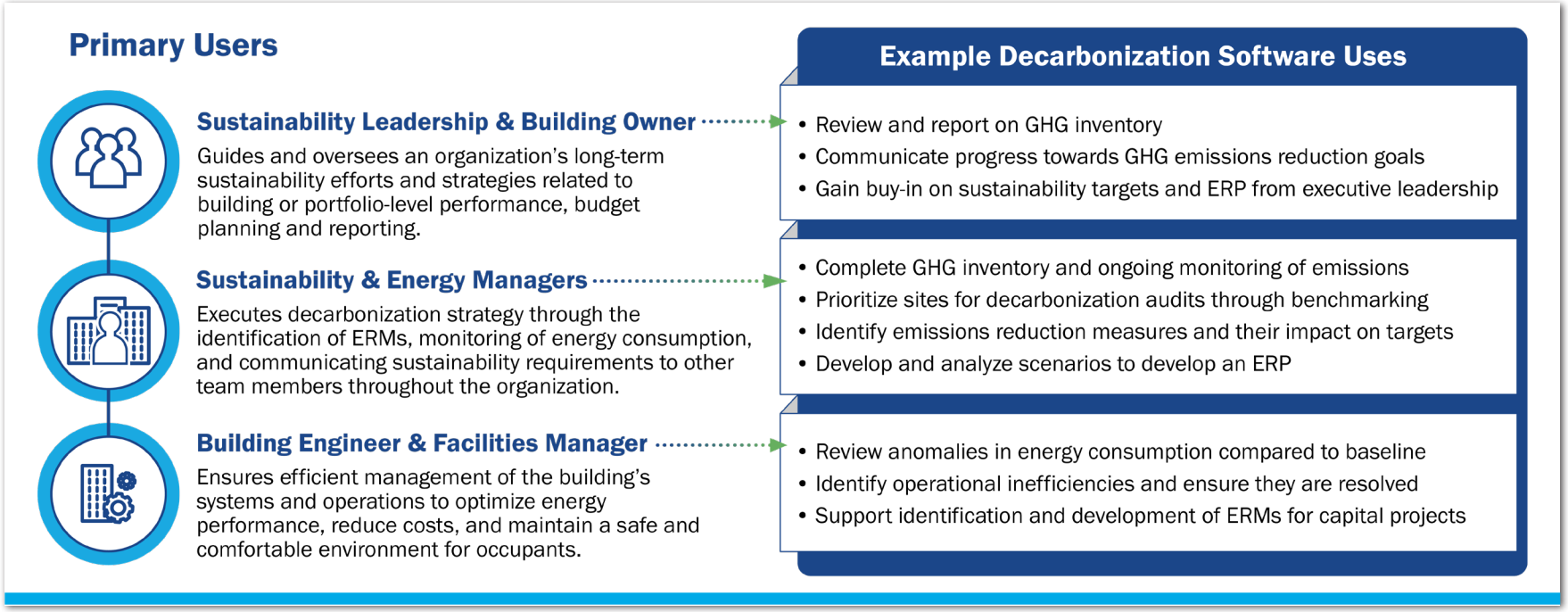


Figure 27. Primary users mapped to example decarbonization software uses

Delivery Models

The delivery model offered by most decarbonization software providers is Software-as-a-Service (SaaS), with various levels of consulting support. A wide range of consulting services is available to support the installation and use of decarbonization software. Some software providers offer consulting primarily for initial onboarding and software set-up, while others have full-service consulting spanning identification of measures and scenario analysis through measure implementation and results tracking. In addition, owners may have sustainability and engineering consultants who can use these tools with them. As an organization planning to procure a software solution, it's critical to understand not only the software capabilities needed and the primary users, but also the organizational resources available to implement and utilize the software.

Figure 28 summarizes the primary software capabilities supported by each delivery model. Organizations should review the capabilities listed under each delivery model to understand the needs and implications for their workflow.

In the consulting delivery model, the software provider installs and helps the owner utilize the software. The most comprehensive delivery model offers software installation, consulting, and implementation support. The software provider proposes projects and oversees their implementation for a "turnkey" user experience. This delivery model supports organizations that are ready to implement the identified measures but may lack the requisite staff capacity or expertise to do so. Notably, in response to market demand, some facilities management companies have begun including decarbonization capabilities within their facilities management software offerings.

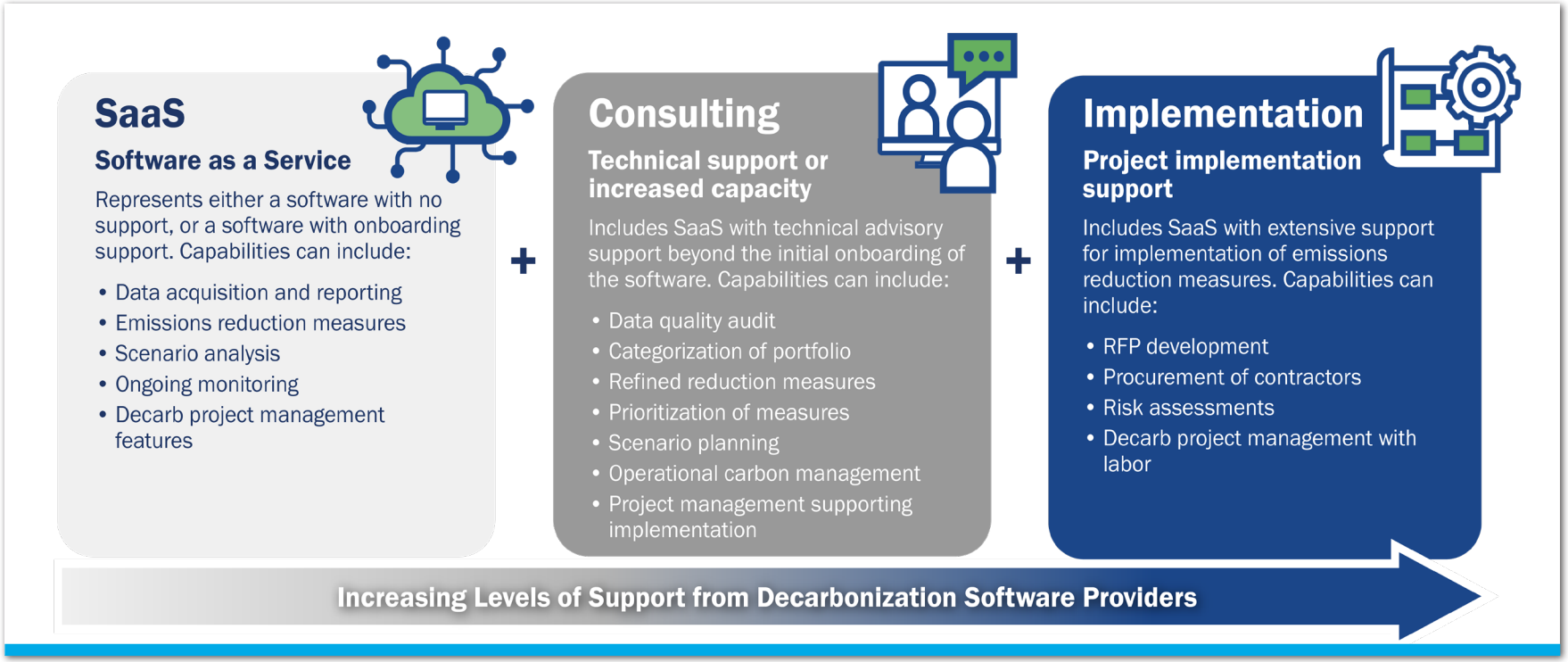


Figure 28: Decarbonization software delivery models and typical supporting capabilities

Software Procurement

Before selecting and purchasing a decarbonization software product, organizations should define the capabilities available from existing tools and assess how well those tools are supporting GHG reduction goals. Figure 29 illustrates a process that organizations can follow to identify their software capability needs in support of their decarbonization efforts.

Appendix B provides a set of questions that can be used in conversations with software providers during the software selection process.

With products adding new features and new software entering the market, software users may find it difficult to determine the best product for their organization. By specifying needed capabilities and a delivery model, organizations can objectively evaluate proposals across diverse software products.

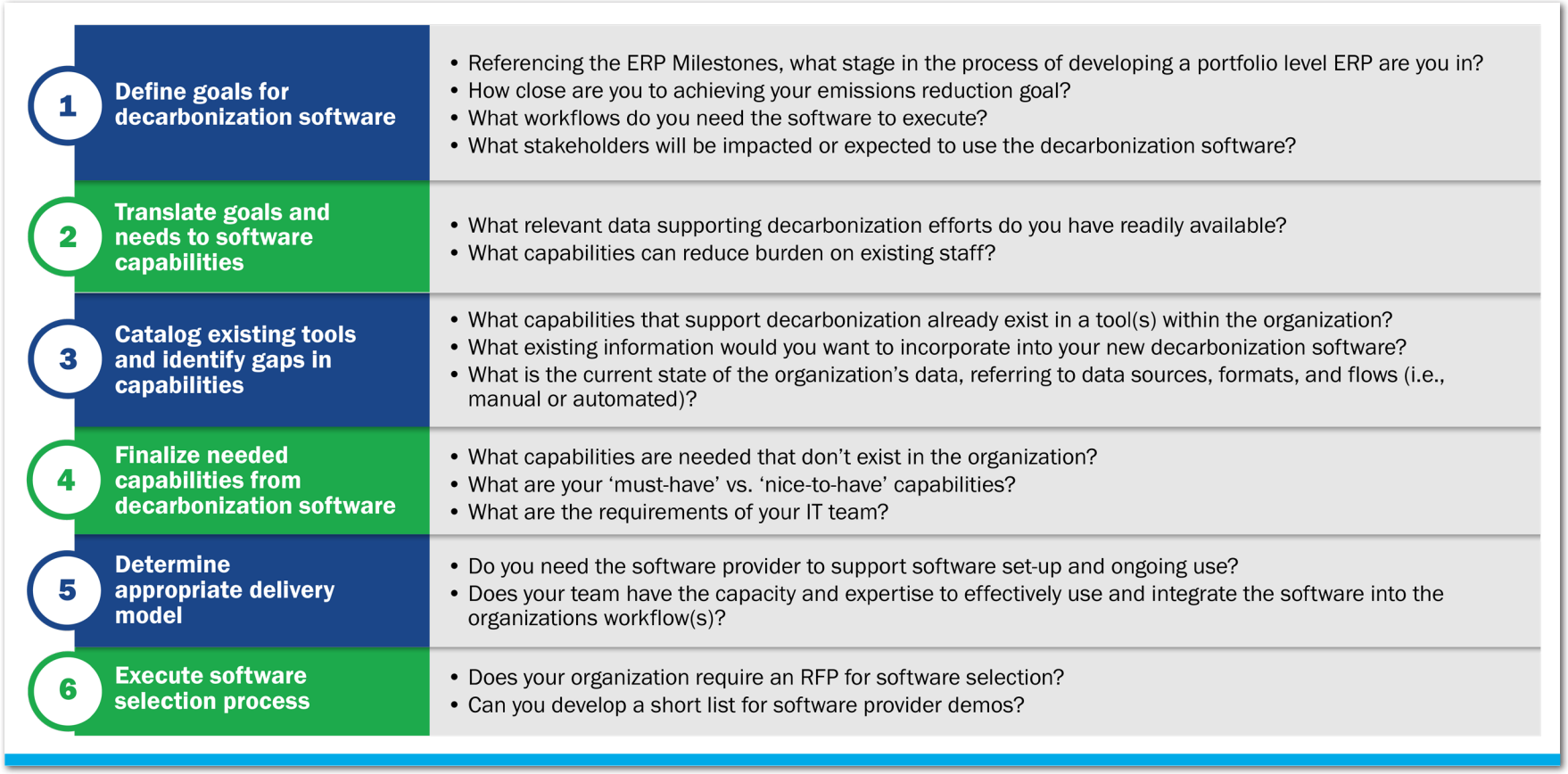


Figure 29: Suggested approach for procuring decarbonization software

Conclusion

The automated analysis and insights delivered through decarbonization software solutions can accelerate the achievement of organizational decarbonization goals. As the decarbonization software market grows and evolves, users will benefit from matching software capabilities to organizational needs and integrating the software into their decarbonization planning and projects.

Key takeaways about software and capabilities include the following:

- Portfolio-level analysis is common among decarbonization software solutions. However, few software products can build up portfolio-level analysis from building-level inputs and analysis.
- Scenario analysis is a key defining feature of decarbonization software, helping users compare multiple ways of achieving GHG emissions reduction targets. Scenario analysis may be high-level or detailed, depending on the software provider's methodology and data requirements.
- ESG software is expanding from its historical focus on quarterly or annual GHG emissions accounting and compliance reporting to decarbonization planning capabilities.
- EMIS software is expanding from its historical focus on data analytics and energy savings identification into GHG emissions tracking.
- Decarbonization software may include capabilities of ESG or EMIS software, in addition to its focus on developing and tracking the implementation of a GHG emissions reduction plan.

Similarly, the following are key takeaways about software integration:

- **Integration practices vary.** Methods for integrating decarbonization software into existing practices are emerging and more research is needed to further identify best practices. Ideally, the software will connect activities between facility management, building operations, and sustainability teams. Some decarbonization software can integrate directly with existing software through an API.
- **Creating a decarbonization plan.** The process for creating a GHG emissions reduction plan from decarbonization software insights is not automated. However, the software does help track progress toward targets and provides key data, insights, and documentation of an organization's decarbonization plan.
- **Delivery model and users.** Decarbonization software providers employ a Software-as-a-Service delivery model, with varying levels of consulting support. Primary users of the software are sustainability managers, facility managers, and building engineers. Depending on the delivery model, an external consultant or the software provider may support software use.

This report summarizes the existing capabilities in today's decarbonization software market and how they can help organizations reach emissions reduction goals. Because the market is dynamic, this report is inherently a snapshot in time. However, the methods described herein – for reviewing capabilities against needs and integrating software into organizational practices – will endure. In the ongoing effort to streamline and strengthen decarbonization approaches for building portfolios, decarbonization software can be a key tool for inventorying, defining a plan, and tracking progress toward goals.

Appendix A: Publicly Available Software

Name	Description	Related Step in Developing a GHG Emissions Reduction Plan
ENERGY STAR Portfolio Manager (EPA)	Benchmarks building energy use with an ENERGY STAR score, sets performance targets, and prioritizes buildings for upgrades.	Prioritize Portfolio
ENERGY STAR Building Emissions Calculator (EPA)	Estimates historical, current, and future annual emissions from building energy use.	Establish Inventory Prioritize Portfolio
BETTER (LBNL)	Software toolkit that enables building operators to easily identify cost-saving energy efficiency measures in buildings and portfolios.	Prioritize Portfolio Assess Measures
Building Energy Asset Score (DOE)	Assesses the physical and structural energy efficiency of buildings and identifies opportunities to invest in energy efficiency upgrades.	Assess Measures
Building Energy Audit Template (DOE)	Web-based tool that collects, stores, and reports building energy audit data. Produces reports that can be used to illustrate ordinance compliance directly.	Assess Measures Define Emissions Reduction Plan
SEED (DOE)	Open-source software application that manages building performance data (i.e., energy and emissions data, asset data).	Establish Inventory
50001 Ready Navigator (LBNL)	Online application that provides guidance for implementing an ISO 50001-based energy management system to achieve continual improvement of energy performance and decarbonization objectives.	All Milestones
SLOPE (NREL)	Online platform that helps energy planners make data-driven decisions to achieve community energy goals.	Develop Scenarios
PVWatts Calculator (NREL)	Estimates the energy production of grid-connected photovoltaic (PV) energy systems and integrates with BETTER.	Assess Measures
Electrification Calculator (ORNL)	Estimates the high-level costs and GHG emissions from electrification projects.	Assess Measures
CBES Pro (LBNL)	Evaluates the energy use of a building and identifies retrofit measures.	Assess Measures

Appendix B: Procurement Support

The questions in the table below are provided to support your assessment of each software capability in discussions with software providers.

Milestone	Capability	Assessment Questions
Establish Inventory & Targets	**Data Acquisition & Management**	• What data sources (i.e., utility bills, utility interval data, BAS equipment data) and formats are supported? • What is the data acquisition process if the organization has data in many different workflows and formats? • Once the data sources are connected to the software, will the data continue flowing, assuming no changes to sites in the portfolio, or is it a one-time connection to gain the data to generate the GHG inventory for that year? • Is the software able to ingest monthly generation bills, or actual production interval data from a meter on the renewable system or through an API integration? • How does the software collect information about purchased RECs: manual entry or connection to regional tracking systems? • What attributes of the REC are tracked? • Can RECs be assigned to specific buildings?
	GHG Accounting & Reporting	• Does the software track Scope 1, 2, and 3 emissions? Can the software track market-based emissions data? Does it support custom emissions factors, such as those that might come from a utility? • Can the software create a rolled-up inventory for both market-based and location-based emissions? • Can the software provide an auditable data trail to support compliance reporting and assurance? • Are data quality audits built into the software? • Does the software have an emissions factor library that includes common emissions factors such as eGrid, and can custom factors be created or imported? • Does the software provider offer additional resources to gather and integrate the necessary information and data (i.e., all site energy data) into the software? • What is included in standard reports? • Does the software provide both compliance reporting and customizable internal reporting? • Does the software have a direct connection to voluntary frameworks and regulatory bodies for submission of reports?
	Target Setting	• Does the software allow users to set multiple emissions reduction targets at both the portfolio level and the building level? • Does the software provide pre-populated options for targets? • Does the software provide the ability to set both energy and carbon reduction targets? • How are targets for time scale and ambition entered?

Milestone	Capability	Assessment Questions
Prioritize Portfolio	Portfolio Categorization	• What are the out-of-the-box attributes by which the software categorizes the portfolio's sites? Can customizations be made to category filters? • Can the software categorize by building-level characteristics like HVAC system type, sites that use fossil fuel, etc.?
	Benchmarking Energy & GHG Emissions Intensity	• Can the software provide both internal and external benchmarking of portfolio sites? • What external benchmarking data sets and standards are used? Is there ability to customize? • How is benchmarking handled for sites that are leased or only have partial data available?
	BPS Exposure Analysis	• Can the software automatically identify if a building is subject to a BPS? • Can the software evaluate my building's performance relative to BPS targets? • Can the software quantify alternative compliance payments associated with BPS policies? • Is the software able to flag/highlight alternative compliance pathways that might be available for my building within a BPS region? • Which BPS policies are you currently modeling? Do you intend to incorporate new BPS policies as they are enacted?
Assess Measures	Measure Identification & Savings Estimation	• Can the software identify both operational measures (low/no-cost) as well as capital measures for each site? What level of detail is provided about the measures? • What data inputs are required to provide these measure recommendations? • Does the software incorporate electrification measures? If so, how does it identify these opportunities? • What methods are used to calculate energy savings? How specific are the inputs to the building's systems? • What is the source of the emissions factors used to calculate GHG emissions reduction? • Do the savings calculated for ERMs account for future potential changes in regional electric grid emissions (i.e., "greening of the grid")? • Can the software quantify the emissions reductions from site-specific measures and aggregate them at the portfolio level? • Are measures automatically prioritized according to energy savings or other method? • Can measures be tagged, or assigned a keyword or identifier, for categorizing and prioritization?

Milestone	Capability	Assessment Questions
Develop Scenarios	GHG Emission Scenario Analysis	• How many scenarios can be modeled and compared simultaneously? • Can the user easily alter scenarios to model a range of possible emissions reduction measures? (In other words, do users have the ability to change the amount of EE, electrification, and renewables projects applied?) • Is there a limit to the number of scenarios that can be modeled simultaneously?
Define Plan	Financial Analysis	• Which financial metrics are provided for each measure? • How are costs determined for measures? • Does the software include payments in the overall financial analysis that could be incurred regionally for BPS non-compliance? • Can the software forecast a measure's financial impact over time (i.e., cash flow)? If so, what assumptions are made and/or are they customizable? • Does the software include the impact of applicable incentives on the identified measure(s)?
Ongoing Implementation	Ongoing GHG Emissions Tracking	• Does the software continuously monitor energy use and carbon emissions compared to the set building energy and carbon target(s)? • How frequently can energy and carbon data be monitored (e.g., monthly, hourly, every 15 minutes)?
	Project Tracking	• Can the software interface with existing project tracking software? • Does the software provide progress tracking for the implementation of emission reduction projects? • What project or measure attributes or metrics (i.e., costs, savings) are provided for the purpose of tracking progress? Are these customizable? • How are the inputs for the project attributes populated (i.e., manually or from a database)?

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