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Net Zero & Climate Risk

Green Quadrant: Enterprise Carbon Management Software 2023

By Adam Barnard, Alice Saunders
With Ryan Skinner

November 2023

This version of the report contains Verdantix's summary of Sweep's offerings to help prospective customers evaluate whether the vendor is a good fit for their requirements. It does not contain other vendor profiles.

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This report provides a detailed, fact-based comparison of the 19 most prominent enterprise carbon management software vendors in the market. Based on the proprietary Verdantix Green Quadrant methodology, our analysis incorporated two-hour live briefings, desktop research and vendor responses to a 70-point questionnaire covering 12 capability and six market momentum categories. The enterprise carbon management software market is experiencing significant growth and transformation, driven by firms' voluntary and regulatory commitments towards carbon emissions reporting and decarbonization. The landscape of carbon management software vendors is adapting to suit, influenced by regulatory pressures, stakeholder expectations, industry-specific needs and technological advancements. This presents both challenges and opportunities for vendors and buyers in their pursuit of effective carbon management and decarbonization. Among the software vendors featured in this Green Quadrant, 11 firms – Benchmark Gensuite, Cority, IBM/Envizi, Persefoni, Salesforce, Schneider Electric, Sphera, Sweep, UL Solutions, Watershed and Wolters Kluwer Enablon – demonstrated the most advanced all-round carbon management software capabilities.

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Organizations mentioned

3Degrees, Accenture, Accuvio, AECOM, Airbnb, ALL4, Allied Irish Banks (AIB), Amazon, AMCS, Applied Value Group, Aramark, Arcadis, ArcelorMittal, Assent, Atos, ATS Corporation, Avanade, AXA Climate, Bain & Company, Balfour Beatty, Banco Bilbao Vizcaya Argentaria (BBVA), Banco Santander, Banque de France, BBC, BearingPoint, Benchmark Gensuite, Blackstone, Bloomberg, BNP Paribas, Buckman, Burlington, Campari Group, Capgemini, Carbon Call, CarbonChain, Carnrite Group, Casino, CDP, Celsia, CGI, Citi, Climatiq, Cognizant, Connor Group, Cority, Crédit Agricole, Creditsafe, CSRHub, CSW Industrials, Dell, Deloitte, DEPT, Dexco, Diligent, Docomo Business, Dropbox, DS Smith, Dun & Bradstreet, EcoAct, EDC, Eiffage, Electrolux, Emitwise, Enbridge, ENGIE Impact, Envizi, ERM, Estée Lauder, European Environment Agency, EXIOBASE, EY, FigBytes, Flying Tiger, Ford Motor Company, Fujitsu, General Mills, GHD, GHG Protocol, Global Reporting Initiative (GRI), GLYNT.AI, Golder, Greenly, Greenstone, GRESB, Grove, H&S Group, Hitachi, Hitachi Rail, Horizon, HP, HPE, Huco Consulting, IBM, Ideagen DevonWay, IKEA, Infosys, Ingredion, International Air Transport Association (IATA), International Council on Mining and Metals (ICMM), International Sustainability Standards Board (ISSB), Jacobs, JBA, J.S. Held, KPMG, Lacoste, Langan, Lear Corporation, L'Oreal, Lowercarbon Capital, LTIMindtree, Makersite, Malk Partners, Marks & Spencer, Microsoft, Minerva Foods, MSCI, Munich Re, Nestlé, Nexio Projects, Nike, Nordea Bank, Normative, nZero, Ocean Spray, Optera, Partnership for Carbon Accounting Financials (PCAF), PCL Construction, PCMA Partners, Persefoni, Philips, PwC, Quentic, Reporting21, Reynolds, RSM, Salesforce, S&P Global, Santander, SAP, Schneider Electric, Science Based Targets initiative (SBTi), Siemens, Skandinaviska Enskilda Banken (SEB), Södra, Sphera, Stantec, Sustainability Accounting Standards Board (SASB), Sweep, Task Force on Climate-related Financial Disclosures (TCFD), Tata Consultancy Services, TELUS, The Hertz Corporation, THG, TIME CO2, Toyota Tsusho, TRC Companies, Trinity Consultants, UL Solutions, UN Conference of the Parties (COP), UN Framework Convention on Climate Change (UN Climate Change Conference), US Department of Energy, US Securities and Exchange Commission (SEC), VelocityEHS, Vista Equity Partners, VitalMetrics, Viveo, Watershed, WayCarbon, Werner Enterprises, WeSustain, Wipro, Wolters Kluwer Enablon, Workiva, WSP, Xylem, Zurich Insurance Group.

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The state of the enterprise carbon management software market

The market for carbon management software is growing, thanks to firms' voluntary and regulatory commitments – and shifting, adding decarbonization to its core emissions measurement and reporting use cases. Many firms choose to report their carbon emissions to voluntary frameworks, such as those of the International Sustainability Standards Board (ISSB) or the Task Force on Climate-related Financial Disclosures (TCFD). These frameworks, the rigour of whose emissions measurement has led many new buyers to consider investing in software, then become the backbone to mandatory reporting rules, such as the EU's Corporate Sustainability Reporting Directive (CSRD) and the proposed rules from the US Securities and Exchange Commission (SEC). Many organizations have also chosen to make net zero commitments, as pressure from stakeholders ramps up. These commitments inspire corporate leaders to seek out broader software functionality, such as emissions forecasts, monitoring of decarbonization initiatives, financial metrics to support asset investment strategies, and investment-ready auditable financial disclosures. On top of this, there is the added wrinkle of industry vertical-specific needs from buyers, which presents a strategic dilemma for vendors – should they offer a less relevant generalist solution for a larger market, or a highly relevant industry solution for smaller markets?

Given these forces, the carbon management software market is in flux. Through this study, Verdantix aims to equip stakeholders involved in choosing, adopting and leveraging enterprise carbon management software with a comprehensive evaluation of 19 leading platform providers. This report seeks to address questions such as:

- **What is the current state of the carbon management software market?**
- **Which carbon management software applications lead the market?**
- **Which carbon management applications will best match the requirements of my firm?**
- **How can I benchmark the capabilities of carbon management software applications?**
- **What factors indicate that a carbon management software vendor is a reliable partner for the future?**

To answer these questions, Verdantix engaged in an exhaustive study, evaluating 19 vendors through a detailed 70-point survey, two-hour vendor-led demos, and feedback from more than 30 software users spanning sectors such as mining, real estate, private equity, retail, manufacturing, fashion and heavy industry. The resulting analysis is based on the proprietary Verdantix Green Quadrant methodology, which is designed to provide an evidence-based, objective assessment of vendors offering comparable products or services.

The market's expectations of core functionality rise, along with the stakes

Many firms are announcing plans to achieve net zero emissions, driven by increasing stakeholder expectations and new climate policies. Declarations and commitments emerging from the UN Climate Change Conference and annual Conference of the Parties (COP) over the past few years have intensified the corporate shift towards strategies centred on reaching net zero and reducing carbon footprints. Regulatory changes such as the SEC's proposed rules on emissions reporting, and the CSRD in the EU, are further accelerating this trend. These regulations mandate more rigorous and transparent reporting of emissions, pushing firms to adopt more robust carbon management practices.

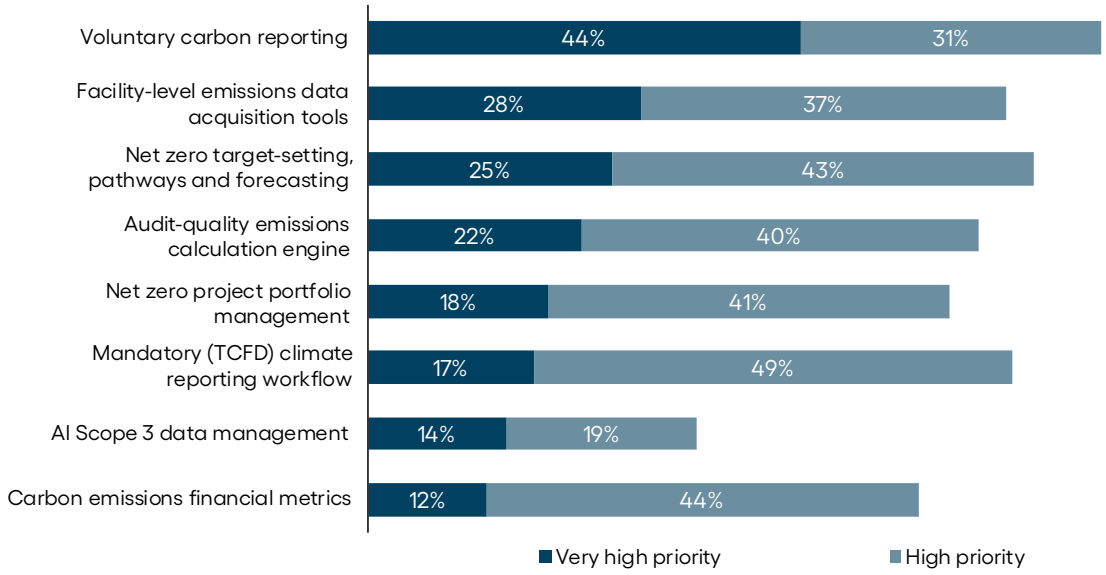
Buyers' primary motivation is voluntary reporting, although this is shifting

In a 2023 Verdantix survey of 350 corporate net zero decision-makers, respondents note that the primary feature of carbon accounting and net zero software that they seek over the next couple of years is voluntary carbon reporting (see Verdantix Global Corporate Survey 2023: Net Zero Budgets, Priorities and Tech Preferences) (see **Figure 1**). Functionality such as financial metrics for carbon emissions and tools for acquiring facility-level emissions data follow in buyers' priorities. The study also reveals that features preferred by decision-makers vary by industry and geography; for example, manufacturers keen to reduce their product carbon footprints need to know more about their Scope 3 supply chain carbon emissions in order to reduce them. Conversely, property managers require functionality to understand a building's energy consumption to achieve net zero emissions. Overall, buyers have begun to look ahead to new regulations, evidenced by a growing demand for audit-ready emission calculation engines. Taking all factors into account, buyers acquire carbon management software because:

- **Executive teams and boards are pushing for greater carbon emissions transparency.** The C-Suite, along with their boards, are accelerating transparency within organizations around the current state of their emissions and the potential future state under different action plans and scenarios. We are thus seeing greater demand for voluntary carbon reporting and carbon management software adoption, particularly to help facilitate the process of setting realistic targets. Executives and boards hand the head of sustainability the mandate to make progress on emissions goals and to direct organizational leaders towards the board's targets. Heads of sustainability are able to support other areas of the business too, such as procurement, strategy and financial planning, to help the board understand how various pressures might affect the organization and see why carbon management software would be useful.

Figure 1

Carbon management software buyers prioritize capabilities for voluntary carbon reporting



Note: Data labels are rounded to zero decimal places. Figure shows results for 'Very high priority' and 'High priority' responses only.
Source: Verdantix Global Corporate Survey: Net Zero Budgets, Priorities and Tech Preferences

N=350

- **Emerging regulatory requirements demand full carbon accounting.**
  In preparation for the CSRD, European firms, including large businesses and listed small and medium-sized enterprises (SMEs), must soon publish regular reports detailing their environmental and social impacts. This directive, impacting around 50,000 firms in Europe alone, mandates reporting of Scope 1, 2 and 3 emissions. The first wave of businesses are required to submit their FY 2024 reports by January 1, 2025. This has sparked a surge in demand for software solutions to facilitate data collection, aggregation and reporting. The directive's reach extends beyond Europe, due to global supply chains, influencing firms worldwide. Similar regulations are emerging globally, in the UK and through the potential SEC regulations in the US, as well as at more regional levels, such as through the California Climate Corporate Data Accountability Act (CCDAA).

- **Net zero target-setting, transition plans and decarbonization attract interest.**
  A second tier of priorities for potential buyers of carbon management software goes beyond measurement and reporting use cases to address emissions reduction. Around six in 10 sustainability and climate decision-makers assign 'high' or 'very high' priority to net zero target-setting, pathways and forecasting, as well as net zero project portfolio management. Verdantix sees these priorities as going hand in hand with firms' development of transition plans, which investors and other stakeholders increasingly expect to see, as a validation that real investment and operational decisions underpin climate promises. For example, IKEA has connected its objective of becoming climate positive by 2030 to selling more reusable, refurbished and recyclable products, and working with renewable or recycled materials.

- **More operational leaders are on the hook for actual carbon reductions.**
  As firms commit to ambitious net zero goals, the responsibility for tangible reductions in GHG emissions is increasingly falling on the shoulders of operational leaders, who are tasked with implementing practical, effective measures across day-to-day business activities. For instance, the chief procurement officer may play a crucial role in de-risking procurement by selecting low-emission service providers. The EU's carbon border adjustment mechanism (CBAM), coming into effect in 2026, makes this particularly pressing for procurement leads at European firms. Similarly, the chief operating officer has a pivotal role in reducing an organization's carbon footprint, by investing in renewable energy infrastructure, for example, or enhancing supply chain resilience and sustainability.

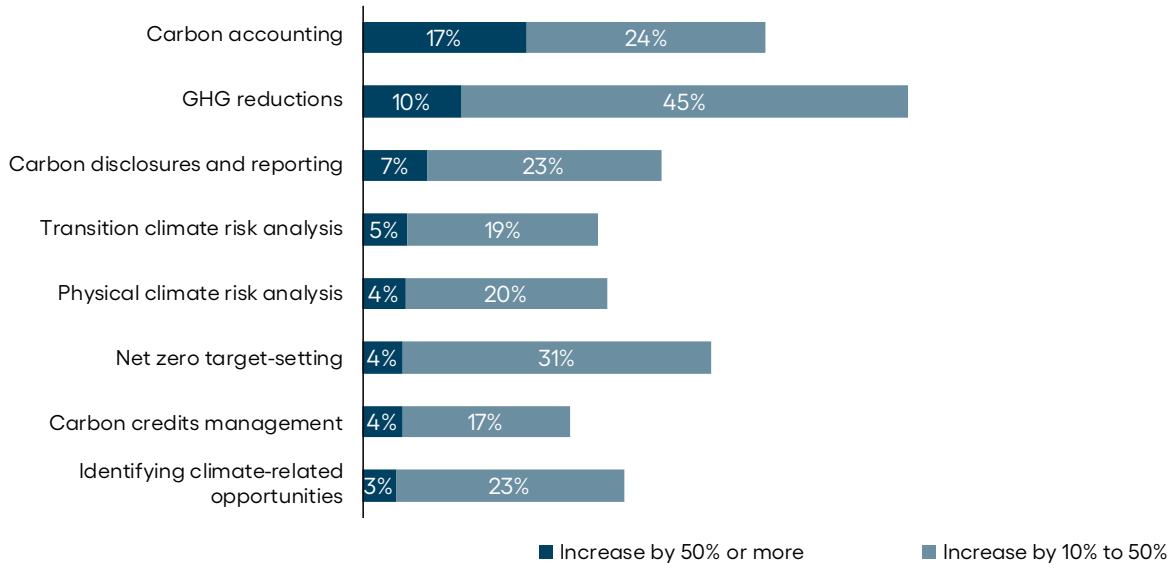
Buyers' core functionality needs cluster around accounting and reporting

Buyers prioritizing voluntary reporting in their sustainability activities look for specific functionality that supports that end. Undertaking the enterprise-wide carbon accounting that voluntary reporting demands often serves to demonstrate the limitations of manual and spreadsheet-based processes, helping to make the case for dedicated software. One out of every six sustainability decision-makers indicate that they will raise their spending on software for carbon-accounting-related functionality by more than 50% in the next two years; another one in every four say that they will increase their spend for this functionality by 10% to 50% (see **Figure 2**). The core jobs that buyers are looking to carry out with carbon management software are:

- **Aggregating and normalizing emissions data from across an enterprise.**
  As organizations expand and diversify, they often find themselves managing a complex web of data sources, each with its own format and level of detail. This complexity makes it challenging to obtain a clear, comprehensive view of a firm's carbon footprint. The buyers Verdantix spoke to are seeking software that can seamlessly gather data from various departments, facilities and countries, consolidating this information into a coherent, standardized format. One buyer commented: "A key feature I am looking for in carbon management software is tools that not only streamline data collection, but also digitize and automate the process, reducing manual errors and increasing efficiency".

Figure 2

Carbon accounting functionality will drive the greatest increase in carbon management software spend in 2023-24



Note: Data labels are rounded to zero decimal places. Figure shows results for 'Increase by 50% or more' and 'Increase by 10% to 50%' reponses only.
Source: Verdantix Global Corporate Survey: Net Zero Budgets, Priorities and Tech Preferences N=350

- **Calculating an enterprise carbon footprint.**
  Determining an enterprise's carbon footprint involves a dizzying number of varied calculations. Carbon management software streamlines this process. Further, addressing data gaps is critical; estimates and proxies are used when exact data are not available. Some solutions incorporate machine learning (ML) algorithms to identify patterns and trends, and then fill them based on pre-defined rules. Calculation also entails managing jurisdictional boundaries, taking into consideration the varying regulations and reporting standards across different regions.
- **Disclosing carbon performance to stakeholders.**
  Organizations need to communicate their GHG emissions transparently, both for regulatory compliance and to meet voluntary targets. Buyers therefore look for software that can generate comprehensive and comprehensible reports. Among the buyers we consulted, there was a clear inclination towards streamlined reporting, regardless of whether the reporting is integrated within the software or facilitated through third parties such as Workiva. Further, buyers want to automate the process of turning data into qualitative reporting statements. One buyer of carbon management software said: "What is vital is the capability to visually present our carbon performance in compelling ways that resonate with stakeholders, such as investors, offering them a clear and engaging understanding of our progress and impact."

Buyers select vendors based on service, industry focus and decarbonization capabilities

Some firms have used carbon management software for decades for compliance purposes, but many are relatively new to it. These look for tailored assistance, and a partner to work with to build the software around their needs. Each firm also has a unique operational context and sector-specific demands. Moreover, as businesses mature in carbon management, there is a marked shift in their priorities, from measurement and reporting to actual emission

reductions. This evolution in buyer preferences echoes the sentiment expressed by one buyer: "In today's dynamic market, the true value lies not just in the ability to understand your footprint, but in deeply understanding your unique trajectory, even within your industry, to decarbonize, and how this aligns with your overarching net zero goals." When considering which carbon management software solution to work with, buyers prioritize:

- **Strength of vendors' service offerings and partnerships.**
  Buyers, especially those new to the field, tend to opt for a consulting-led approach, preferring software bundled with service support. Providers such as ENGIE Impact, Schneider Electric and Siemens offer services around energy-efficient building strategies. The largest accounting and consulting firms are joining forces with carbon management vendors to enhance their service offerings (see **Figure 3**). Effective implementation may require support, particularly for application programming interface (API) integration or for connecting to enterprise resource planning (ERP) systems for data acquisition. In the financial sector, heavyweight firms such as Blackstone and Santander have made strategic acquisitions of firms such as Sphera and WayCarbon, to integrate consultancy with tailored software solutions, particularly for managed emissions.

- **Industry-specific datasets and collaborations.**
  Industry-specific datasets and collaborations are pivotal in carbon management, as each industry has a unique emissions profile and decarbonization challenges. The manufacturing sector may focus on curtailing production emissions, while the transportation sector might concentrate on fuel efficiency (see **Figure 4**). This diversity necessitates industry-specific accounting standards and tools; the International Council on Mining and Metals (ICMM), for example, maintains its own industry-specific accounting methodology. Collaborative features in carbon management software enable the sharing of insights and strategies within industry groups, while best practice libraries offer updated, industry-specific strategies, making them invaluable for buyers with challenges in their respective sectors.

Figure 3
Examples of public partnerships between carbon management software vendors and service providers

Benchmark Gensuite	AECOM, ALL4, Arcadis, ERM, Jacobs, Stantec, Trinity Consultants, Wipro, WSP Golder
Cority	AECOM, ALL4, Arcadis, ERM, Huco Consulting, Jacobs, J.S. Held, Langan, Trinity Consultants, WSP Golder
FigBytes	AECOM, ALL4, Celsia, CSRHub, GHD, Ideagen DevonWay, Infosys, RSM, TRC Companies
Microsoft Cloud For Sustainability	Accenture, Avanade, Capgemini, EY, PwC, Tata Consultancy Services
Persefoni	Bain & Company, Carnrite Group, CDP, CGI, Connor Group, Deloitte, Docomo Business, ERM, PwC
Salesforce	Accenture, Capgemini, Cognizant, Deloitte, DEPT, ERM, KPMG, PwC
Sphera	Accenture, Arcadis, Assent, Creditsafe, Dun & Bradstreet, ERM, JBA, Munich RE, PwC, SAP, Siemens
Sweep	3Degrees, AXA Climate, BearingPoint, Capgemini, EcoAct, Malk Partners
Watershed	Applied Value Group, KPMG, Lowercarbon Capital
Wolters Kluwer Enablon	Accenture, AECOM, ALL4, Arcadis, Atos, ERM, EY, Huco Consulting, Infosys, Jacobs, J.S. Held, LTIMindtree, Wipro, WSP

Source: Verdantix analysis

Figure 4

Industries decarbonize in specific ways

Verdantix decarbonization segment	Description	Example industries	Decarbonization journey
Built assets	Industries for which most GHG emissions are attributable to built assets	Education Healthcare Professional services Real estate (owners)	Decarbonize by retrofitting and improving building efficiency
Electrification	Industries with high potential for electrification	Food and beverage Manufacturing	Transition to electric processes and energy sources
Energy-intensive	Industries for which emissions are not intrinsic to the business but involve very high, hard to abate, energy requirements	Chemicals Construction Electric power generation Metals Mining	Implement high-efficiency and low-emission technologies
Fossil-fuel-centric	Industries for which fossil fuels are intrinsic to the business	Automotives Aviation Freight Oil and gas Plastics	Shift towards alternative, cleaner energy sources
Hybrid	Industries for which emissions are spread across multiple assets	Agriculture Retail Tourism Waste Wholesale trade	Diversify and reduce emissions across operations
Investments	Industries for which emissions come mostly or entirely from investments	Financial services Insurance Pension funds Real estate (investors)	Focus on low-carbon portfolios and funding
Renewables (or net negative)	Industries with high potential to meet energy needs using renewables	Media Technology Telecoms	Adopt renewable energy and carbon capture

Note: The Verdantix decarbonization segmentation is based on the extent to which the processes intrinsic to an industry's products and services can be electrified, the degree to which products and services can operate with low- or no-carbon power, the carbon intensity of inputs and the level of circularity in outputs.
Source: Verdantix analysis

- **Decarbonization and net zero programme management capabilities.**
  As of November 2023, 3,776 firms and financial institutions have set science-based targets; 2,559 are aiming for net zero; and over 6,000 are currently taking action. To meet their goals, organizations are looking for advanced net zero programme management tools, to aid in managing and tracking a wide array of decarbonization projects and initiatives, from building improvements to logistics optimization. Tools that allow for the creation and analysis of custom decarbonization scenarios provide data-driven insights and help climate leaders evaluate potential outcomes based on different timelines, return on investment (ROI) projections and impact assessments. Many firms expressed their desire to be able to incorporate financial data; one buyer told us: "To be able to communicate why certain decarbonization projects should go forward, we need functionality that compares the financial aspects of those projects, and translates that into insight for budget-holders".

- **Audit and quality assurance.**
  As carbon disclosures transition from being voluntary to mandatory, there is a growing need for investor-grade, auditable data. The shift elevates both the necessity for high-quality data and the legal implications of inaccurate disclosures. The latest generation of carbon management software is equipped with features that securely store data, link emissions data to operational assets and legal entities, fill data gaps, and support data audits and process assurances, including providing auditors with secure software access for transparency into emission calculation methodologies. Buyers have shown interest in vendors that have worked with and are trusted by the Big 4 accounting firms. Vendors with an EHS background, meanwhile, already provide audits.

Vendors strive to translate diverse buyer needs into a scaled software solution

Carbon management software vendors are navigating a complex landscape, striving to translate the diverse needs of buyers into scalable software solutions. Given the variation in buyer requirements by industry and geography, and the market's relative immaturity, this is a challenge. Vendor strategies differ, and lead to varied commercial propositions. Greenly, for example, offers a low-cost solution, making carbon management accessible to SMEs. By contrast, Schneider Electric usually bundles services and software for organizations that seek a more hands-on, guided approach. Specialists such as Climatiq and Makersite focus on narrow but technically thorny use cases, and partner extensively. This diversity in business models reflects the wide spectrum of buyer needs.

Despite setbacks, the carbon management space gains players, investment and clients

The market in general, as well as the market for software – and, in particular, the market for climate-focused software – are all plagued by uncertainty. High interest rates have cooled markets globally, and the tech sector has struggled; S&P Global's tech sector index stopped climbing in late 2021. Venture funding has also slowed; deal counts across all stages of venture capital funding are down. Furthermore, repeated delays to the US's climate disclosure legislation may lead many potential software buyers to hesitate. All this uncertainty creates risk, which could ultimately founder some start-ups. However, the carbon management software market's fundamentals are strong: existing buyers are spending more, and new buyers continue to come. The most recent Verdantix five-year forecast for the space shows a 20% CAGR. Further, vendors continue to invest in their products. In all, despite headwinds, the market is showing signs of rude health, as:

- **Most existing vendors report revenue increases of double-digit percentages, or more.**
  Carbon management software vendors from varied backgrounds are thriving. Vendors consistently report double-digit revenue growth in carbon management, and those rooted in EHS and energy are

seeing accelerated growth in their carbon sectors compared with their overall business. Dedicated carbon management software vendors, often backed by venture capital, are recording particularly high growth rates. These numbers, although influenced by a low initial base, underscore rapid adoption. The diversity in vendor backgrounds highlights the ability of providers to tap into their core strengths and meet rising carbon management software demands.

- **New players enter the market from large, known entities.**
  Tech giants such as Microsoft and SAP have recently launched dedicated carbon management software offerings, alongside Salesforce. Microsoft, for example, offers data integration from various software solutions, enhanced with Power BI visualization, optical character recognition (OCR) for invoices, and quality check automation. It is also incorporating its generative AI Copilot feature in development plans. SAP, meanwhile, is capitalizing on its established ERP system. The firm has launched the SAP Sustainability Data Exchange to share verified carbon data throughout a value chain, and is exploring the 'green ledger' concept, which lets organizations manage emissions data bottom-up, with actual data on a transactional level, rather than using estimates or averages.

- **Investment rounds and acquisitions demonstrate dynamism in the space.**
  Persefoni, Sweep and Watershed have secured $164 million, $100 million and $139 million in funding, respectively, since their inceptions less than five years ago. Normative, nZero and Optera have also successfully raised $45 million, $16 million and $16 million, respectively, underscoring investor interest in more focused carbon management software offerings. In October 2023, AMCS, a global frontrunner in integrated cloud-based software and vehicle technology for the environmental, utilities, waste, recycling and resources industries, acquired FigBytes. Likewise, in recent years, Spanish bank Santander has taken a 90% stake in WayCarbon, and private equity firm Blackstone has acquired Sphera. This flurry of investment and merger and acquisition (M&A) activity demonstrates the sector's dynamic nature.

- **New start-ups enter the arena to address as-yet unsolved opportunities.**
  New carbon management software vendors continue to appear in the space, often aligning with a functionality or commercial approach that they see as unaddressed. Climatiq, for example, provides core carbon accounting and calculation capabilities as a third-party service for larger software vendors. Emitwise has recently emerged with a specific focus on manufacturers with complex supply chains, developing functionality to suit. Greenly is a start-up that saw another kind of opportunity, focusing on the small and midsize business (SMB) side of the carbon management market.

Scope 3 emission challenges dominate vendors' roadmaps

In the carbon management software sphere, acquiring accurate Scope 3 emissions data presents significant challenges. For spend-based approaches to measuring these emissions, firms struggle to obtain comprehensive spending data across their entire supply chain. This is compounded by varying levels of environmental transparency among suppliers, leading to gaps or inaccuracies in emissions data. Activity-based measurement methods, while potentially more precise, require detailed information about specific activities and their associated emission factors. This granularity demands extensive data collection and expertise in diverse production processes. Both methods grapple with issues of data quality, availability and consistency, making the accurate calculation of Scope 3 emissions a complex and resource-intensive task for businesses. Vendors are responding to these challenges through:

- **Upstream supply chain carbon data collection.**
  Vendors are creating software tools that facilitate deeper supplier engagement and more robust data collection. These solutions provide interactive platforms for education and communication with suppliers, fostering transparency and the sharing of emissions data. They also streamline the ingestion of data from multiple sources, both internal and external, through seamless integrations with ERP systems and databases such as those of CDP and the Science Based Targets initiative (SBTi). Firms are increasingly employing

supplier targets as an engagement strategy for data collection. To facilitate this, software tools that include dashboards, maps and Sankey diagrams are highly valued. These features enable the analysis of emissions data across various suppliers and locations, focusing on crucial metrics such as emissions intensity and absolute emissions (see Verdantix Smart Innovators: Supply Chain Carbon Management).

- **Downstream financed emissions management.**
  Financial data and analytics providers such as Bloomberg, MSCI and S&P Global facilitate the assessment of financed emissions for financial institutions by analysing public filings and leveraging industry benchmarks. However, these methods face challenges, particularly in accurately gauging emissions from privately held assets. Carbon management firms such as Persefoni, Sphera, Sweep and Watershed aim to fill the gaps by offering comprehensive Scope 3 emissions data tailored to financial entities, using granular, bottom-up data collection techniques. Large private equity groups and sovereign wealth funds work with these vendors to fine-tune their methods for managing the emission footprints of their extensive portfolios, which often include a mix of private and public investments.

- **More and better primary data and better secondary estimates.**
  Employing proxy variables to estimate missing data helps refine carbon footprint calculations. Carbon management software can leverage historical data, utilizing complex extrapolation methods when these data are absent. Formula-based estimation, involving calculation rules and logical statements, helps in choosing between primary or user-inputted data. Additionally, these tools feature data gap-filling capabilities. IBM's software, for example, offers data accrual features that estimate emissions data when primary activity data are unavailable. It includes several built-in methodologies for consumption and cost accruals, based on historical data. The software calculates accruals by multiplying the daily average value from a chosen historical period by the number of missing days in a month.

The ground continues to shift around carbon management vendors

On top of adapting to changing buyer requirements, carbon management software vendors must address how the technological, legislative and methodological foundations for carbon management are shifting. For example, until the EU formalized value chain emissions in its disclosure rules, few vendors focused on Scope 3 emissions measurement. For buyers, this is a unique partner-based transition risk – that a vendor will struggle or fail to keep up with the pace of carbon-management-specific changes. Verdantix sees the most significant forces of change as:

- **AI reinventing the capabilities and insights possible from carbon management software.**
  AI can streamline validations, spot anomalies and improve data precision in carbon management. IBM's Envizi, for instance, taps into large language models (LLMs) to categorize ERP and supplier data, while considering weather-driven data adjustments. Its Data Quality for AI API further conducts quality checks and rectifications. Salesforce's Net Zero Cloud integrates Einstein Analytics to support predictive modelling of energy consumption and corporate travel. Meanwhile, Benchmark Gensuite partners with GLYNT.AI to detect discrepancies and generate alerts.

- **Accounting methodologies altering the underpinnings for carbon footprints.**
  The GHG Protocol, once the sole standard for global carbon emissions accounting, is increasingly being supplemented by additional methodologies. Carbon Call, for instance, has attracted industry leaders and carbon management firms to its push for improved data comparability. Partnerships with groups such as the Sustainability Accounting Standards Board (SASB) emphasize adaptable, industry-specific approaches. Adding to this landscape are specific methodologies such as EXIOBASE, a detailed, global, multi-regional, environmentally extended, supply-use table; CarbonChain's Shipping Methodology, tailored for maritime emissions; the Passenger CO2 Standard Methodology of the International Air Transport Association (IATA) for transport sectors; and the Partnership for Carbon Accounting Financials (PCAF), which focuses on the financial industry.

- **Net zero programme management changing as decarbonization opportunities develop.**
  As more businesses set net zero targets, they increasingly seek carbon management software to manage their journey to net zero. These offerings integrate goal-setting features, allowing organizations to set and monitor performance targets and explore what-if scenarios – helping them understand the potential impacts of different strategies and decarbonization initiatives on their goals. Sphera, for example, offers features that track decarbonization programme metrics (costs, savings and payback periods), analyse ROI against marginal cost abatement curves, and enable progress-tracking with auditability. Its solution also allows customers to model and share optimal decarbonization scenarios across business units such as procurement, logistics and production, enhancing collective efforts towards net zero targets.

Green Quadrant for enterprise carbon management software

Corporates across all industries and geographies will benefit from implementing enterprise-wide carbon management software to meet the data-intensive needs associated with TCFD-based requirements, delivery on SBTi pledges, and stakeholder pressure. For the purposes of this report, Verdantix defines carbon management software as:

> *"Enterprise-scale software that enables firms to capture, analyse and report carbon data, manage climate risks, and track progress towards net zero goals across all business operations."*

This definition does not include software designed to be deployed on a site-by-site basis, desktop software, applications used for regulatory content management, ESG data aggregation platforms (unless they have a specific focus on carbon) or applications with a focus on a single impact area such as supply chain management or energy management.

Verdantix research shows that the functionality of carbon management software covers data acquisition and management capabilities, the ability to calculate and model Scope 1 to 3 emissions, and data quality control. Vendors with software that does not have capabilities in these functional areas were excluded from the study. Additionally, this study focuses on the technology and usability of carbon management software and does not assess the service or consulting capabilities offered by vendors.

Green Quadrant methodology

The Verdantix Green Quadrant methodology provides buyers of specific products or services with a structured assessment of comparable offerings at a certain point in time. The methodology supports investment decisions by identifying potential software vendors, structuring relevant purchase criteria through discussions with buyers and providing an evidence-based assessment of the products or services in the market. To ensure objectivity in the study results, the research process is guided by:

- **Transparent inclusion criteria.**
  We worked to analyse all providers that would qualify for inclusion in this research. Due to the relatively nascent market and limited amount of publicly available information on the specific capabilities of vendors, we excluded from this study those firms that did not provide sufficient information or which were unwilling to cooperate fully on the 70-point questionnaire and two-hour product demonstration.
- **Analysis from the buyer's perspective.**
  The buyer personas for carbon management software are expanding, and research into this market is ongoing. As part of this Green Quadrant, we interviewed reference customers and individuals who have bought or are planning to buy the product or service analysed. We used their answers to define relevant buying criteria and to weight the evaluation criteria in the model that drives the Green Quadrant graphic.

- **Reliance on professional integrity.**
  As it is not feasible to check all data and claims made by vendors, we emphasize the need for professional integrity. Assertions made by software vendors are put in the public domain via this Verdantix report and can be checked by competitors and existing customers.
- **Scores founded on evidence.**
  To assess the expertise, resources, business results and strategies of individual providers, we collected evidence from public sources and conducted interviews with multiple representatives of the actively participating software firms, as well as industry experts. When providers claimed to be 'best in class', we collated relevant evidence.
- **Comparison based on relative capabilities.**
  We construct measurement scales ranging from 'worst in class' to 'best in class' performance at a certain point in time. A provider's position in the market can change over time, depending on how its offering and success evolves relative to its competitors. A vendor's Quadrant positioning may not necessarily improve – even if it adds new capabilities, makes a strategic acquisition or receives investment – as the assessment is relative to what other vendors are offering. The Green Quadrant analysis is typically repeated every one-and-a-half to two years.

Evaluated firms and selection criteria

Verdantix defines vendor inclusion criteria to ensure that the Green Quadrant analysis only compares firms providing similar services. We believe that all of the organizations in this report offer significant value in the enterprise carbon management software market. The 19 providers included in this study were selected because they have:

- **At least 50 employees and/or $20 million in funding.**
  This Green Quadrant is intended to assess the most prominent vendors offering enterprise carbon management software solutions. Due to the evolving nature of the carbon software market, we established this hurdle to screen out small software providers and start-ups that have only recently entered the space. Although smaller firms may offer capabilities similar to those of their larger counterparts, without stronger organizational or financial resources, our research finds that they cannot truly deliver an enterprise-wide solution. The vendors included in this Green Quadrant study have at least 50 full-time employees to support their solution, or at least $20 million in funding, indicating that they are capable of hiring additional staff to support their solution and to meet the needs of diverse customers for the foreseeable future.
- **A global presence.**
  To qualify for this benchmark study, the vendors needed to operate in at least two countries.

Based on the inclusion criteria above, this report evaluated 19 carbon management software solutions, from the following providers: Benchmark Gensuite, Cority, Diligent, FigBytes, IBM, Microsoft, Normative, Optera, Persefoni, Salesforce, SAP, Schneider Electric, Sphera, Sweep, UL Solutions, VelocityEHS, Watershed, WayCarbon and Wolters Kluwer Enablon.

All the enterprise carbon management software providers in this study actively participated in an interview, digital tool demonstrations, and a 70-point questionnaire.

Evaluation criteria

Verdantix defined the evaluation criteria for the Green Quadrant carbon management software study through a combination of interviews with corporate managers, desk research, discussions with multiple customers and staff expertise. In full, this year's Green Quadrant analysis compares offerings from 19 software firms, using a 70-point questionnaire covering 12 categories of capabilities and six categories of market momentum. Individual metrics were classified as:

- **Capabilities metrics.**
  The Capabilities dimension, plotted on the vertical axis of the Green Quadrant graphic, measures each software vendor on the breadth and depth of its functionality, its differentiators against other providers, and its proven experience in each area. Verdantix assessed 12 technical capabilities: data acquisition; data management; data aggregation – Scope 1 and 2; data aggregation – Scope 3; data quality control; carbon calculation standards and methodologies; carbon emissions calculation engine; carbon financial management; net zero strategy development; net zero programme management; carbon disclosure management; and organizational structure. The Verdantix Green Quadrant considers the evolution of the market and customer requirements to ensure that the weighting of all high-level criteria mirrors the importance of all software components to users globally.

- **Momentum metrics.**
  The Momentum dimension of the analysis, as captured on the horizontal axis of the Green Quadrant graphic, measures each software firm on their vision and strategy; product strategy; innovation process; organizational resources and growth; revenue growth; and customers. Evidence was either provided by software firms or through desk research and was assessed using a quantitative model that started with the sub-criteria scores.

Verdantix weighted each sub-criterion to generate the overall score for each capability area.

We scored all sub-criteria between the values of zero ('no capability') and three ('best in class'). Each sub-criteria has a percentage weighting that dictates how much of a contribution it makes to the high-level Capability or Momentum score. The combination of high-level criteria scores in the Capabilities and Momentum sections generates the Green Quadrant graphic and rankings. **Figure 5** and **Figure 6** give details of the study criteria; **Figure 7** and **Figure 8** provide the scoring for all participants for each criteria. **Figure 9** shows the Green Quadrant graphic, summarizing the positioning of all carbon management software vendors in this benchmark study.

Figure 5

Capabilities criteria for carbon management software applications

Capabilities	Questions
Data acquisition (5%)	What functionality is available to facilitate data acquisition for Scope 1 and Scope 2 emissions? Please can you also demonstrate what vertical industry-specific functionality there is? What functionality is available to facilitate data acquisition for Scope 3 emissions? Please can you also demonstrate what vertical industry-specific functionality there is? What functionality is available to facilitate data acquisition from other software platform systems?
Data management (10%)	What data privacy and security credentials and controls do you have? How does the software control permissions for different user groups? Describe any capabilities of your software to perform XBRL tagging.
Data aggregation - Scope 1 and Scope 2 (5%)	What functionality is available to aggregate Scope 1 and Scope 2 data? What functionality is provided to engage suppliers to reduce carbon intensity and support net zero goals? Please can you also demonstrate what vertical industry-specific functionality there is? What functionality is available to identify highest-emitting suppliers and supply chain components? How does the software facilitate product carbon footprinting? Please can you also demonstrate what vertical industry-specific functionality there is? What capabilities do you offer for financed emissions management, specifically?
Data aggregation - Scope 3 (5%)	What functionality is available to aggregate Scope 3 data? What functionality is provided to engage suppliers to reduce carbon intensity and support net zero goals? Please can you also demonstrate what vertical industry-specific functionality there is? What functionality is available to identify highest-emitting suppliers and supply chain components? How does the software facilitate product carbon footprinting? Please can you also demonstrate what vertical industry-specific functionality there is? What capabilities do you offer for financed emissions management, specifically?
Data quality control (5%)	How does your software facilitate identification of missing input data? How does the software enable estimation where primary data are not available? Please can you also demonstrate what vertical industry-specific functionality there is? How does the software enable auditors to test data sources and calculations? What AI capabilities enable data quality enhancement? What functionality is available for manual data quality enhancement? (e.g. where data do not match reporting period)
Carbon calculation standards and methodologies (5%)	How is the GHG Protocol Corporate Standard embedded in the software? How is the GHG Protocol Value Chain (Scope 3) Standard embedded in the software? How is the PCAF framework embedded in the software? Are any other methodologies included in the software, for example, SASB? Please can you also demonstrate what vertical industry-specific functionality there is?
Carbon emissions calculation engine (10%)	How are emissions factors stored? (e.g. editable, auditable?) Where do you source your emissions factors from and what is your commitment to keep them up to date? Which greenhouse gases do you cover in your emission factors library? For which power grids do you provide emissions factors? How do you ensure a broad range of emissions factors are available, suited to the operations of different industries? How do you create and update emission calculations? What tools do you provide to design new emissions calculators?
Carbon financial management (15%)	How does the software apply an internal price on carbon and integrate with finance and IT systems? What functionality is available to perform financial analysis on carbon data such as carbon/revenue intensity metrics? How can the user allocate carbon emission costs to different divisions? How can the user track cost-savings from carbon reduction projects?

Figure 5 (continued) ↓

Figure 5 (continued)

Net zero strategy development (15%)	How does the software support forecasted calculations for emissions/operations scenario-planning? How does the software create and track CO_2 reduction pathways? How does the software enable users to set interim and final targets for net zero? How does the software store baseline data and enable updates subsequent to disposals and acquisitions? How does the software facilitate peer-group benchmarks? Please can you also demonstrate what vertical industry-specific functionality there is? How does the software facilitate internal benchmarks? What functionality is available to optimize net zero programme certification?
Net zero programme management (15%)	What net zero performance metrics are available to analyse progress? What capabilities are available to create, link and monitor decarbonization projects? How does the software help identify carbon abatement opportunities across diverse product portfolios? How does the software store, share and utilize best practices content? Please can you also demonstrate what vertical industry-specific functionality there is?
Carbon disclosure management (5%)	What functionality is available to manage the approval process for regulated carbon disclosures? What functionality is offered to support regulatory reporting for mandatory disclosures aligned with the TCFD framework? Which frameworks and standards does your software support with pre-defined configurations? Which regulated carbon disclosure templates are pre-loaded? Describe any functionality in place to help corporates prepare for upcoming approved and proposed regulations.
Organizational structure (5%)	How does your software link physical asset data to legal entities and jurisdiction-level reporting requirements? How does the software store data on part-owned subsidiaries and joint ventures? How does the software facilitate organizational changes such as acquisitions, divestments and reorganizations? How are operating assets such as vehicles, plants and buildings stored in the system? How is information on CO_2 emissions associated with reporting entities in different jurisdictions?

Source: Verdantix analysis

Figure 6

Momentum criteria for carbon management software applications

Momentum	Questions
Vision and strategy (15%)	What is your firm's vision for the target customers/addressable market opportunity you seek to target over the next five years? How do you intend to achieve the vision? What is your firm's strategy to meet the needs of your target customers over the next five years? How do you intend to achieve the vision?
Product strategy (10%)	What is your firm's CM product strategy for the next two to five years? What does your product roadmap look like?
Innovation process (15%)	What is your firm's innovation framework and strategy? Comment on whether your firm has global innovation hubs, runs hackathons and other initiatives? What is your firm's strategy when it comes to R&D investment allocations to support long-term viability and maintain competitive advantage(s)?
Organizational resources and growth (20%)	What is your number of employees? What is your number of employees dedicated to carbon management software? What is your change in employees in the last two years? In how many/which countries does your firm have an office?
Revenue growth (20%)	What were your firm's annual revenues for your most recent reporting year? What were your firm's revenues from CM software for your most recent reporting year? By how much did your firm's total revenues grow in the most recent reporting year compared with the year prior?
Customers (20%)	How many CM customers do you have? Provide a few publicly disclosed customer names. How many customers/logos have you added over the past 12 months? Please provide the top three industries that best represent the industries in which your customers operate. Please provide a breakdown of your customer base across the listed regions.

Source: Verdantix analysis

Figure 7

Vendor criteria scores (Capabilities)

	Benchmark Gensuite	Cority	Diligent	FigBytes	IBM/Envizi	Microsoft	Normative	Optera	Persefoni	Salesforce	SAP	Schneider Electric	Sphera	Sweep	UL Solutions	VelocityEHS	Watershed	WayCarbon	Wolters Kluwer Enablon
Data acquisition	2.0	2.0	1.7	1.3	2.7	2.3	1.3	1.7	1.7	2.0	2.3	2.3	2.7	2.3	2.7	2.3	2.3	1.3	2.7
Data management	2.3	2.0	1.3	1.7	2.3	2.0	1.0	1.0	1.7	2.0	1.7	2.3	2.7	2.0	2.0	2.0	1.7	0.7	2.0
Data aggregation - Scope 1 and Scope 2	2.0	3.0	2.0	2.0	3.0	2.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	3.0	3.0	2.0	3.0
Data aggregation - Scope 3	2.0	2.4	1.1	1.8	2.2	1.5	1.8	2.0	2.4	2.0	1.5	1.3	2.8	2.6	1.7	1.7	2.8	0.4	1.9
Data quality control	2.0	2.2	1.2	1.8	2.6	2.2	1.4	1.0	2.2	2.2	1.2	1.8	2.2	2.2	2.0	1.6	2.0	0.6	2.0
Carbon calculation standards and methodologies	1.7	1.3	1.3	1.7	2.2	1.7	1.3	1.3	2.5	2.0	1.2	1.7	2.0	2.4	2.0	1.7	2.5	1.3	2.0
Carbon emissions calculation engine	2.0	2.6	1.6	2.0	2.6	1.8	1.6	1.5	2.5	1.7	0.7	2.0	2.6	2.3	2.3	2.3	1.9	1.6	2.7
Carbon financial management	2.3	2.0	1.5	1.3	1.8	1.5	0.5	0.8	2.0	1.5	1.5	2.0	2.0	2.0	2.0	1.8	1.8	1.5	2.0
Net zero strategy development	2.2	2.3	1.2	1.9	2.3	1.5	1.1	1.9	2.0	1.9	0.2	1.8	2.6	2.0	1.6	1.7	1.9	1.2	2.0
Net zero programme management	2.0	2.0	0.8	0.6	1.1	1.1	1.1	1.8	2.5	1.8	0.0	1.6	1.9	2.5	1.8	1.5	2.0	1.3	2.5
Carbon disclosure management	2.0	2.6	1.5	1.3	2.0	2.0	1.8	1.8	1.7	2.0	0.6	1.9	2.5	1.8	2.3	1.6	2.3	1.5	1.9
Organizational structure	2.4	2.8	1.4	1.5	2.5	1.6	1.5	1.6	2.4	2.0	1.9	2.1	2.7	2.4	2.3	2.4	2.0	1.5	2.2

Vendor provides evidence of market-leading capability, supported by a broad set of references to customer examples	3
Vendor provides evidence of strong capability, supported by a broad set of references to customer examples	2
Vendor provides evidence of moderate capability, with limited references to customer examples	1
No response provided or publicly available, or supplier has a weak offering	0

Source: Verdantix analysis

Figure 8

Vendor criteria scores (Momentum)

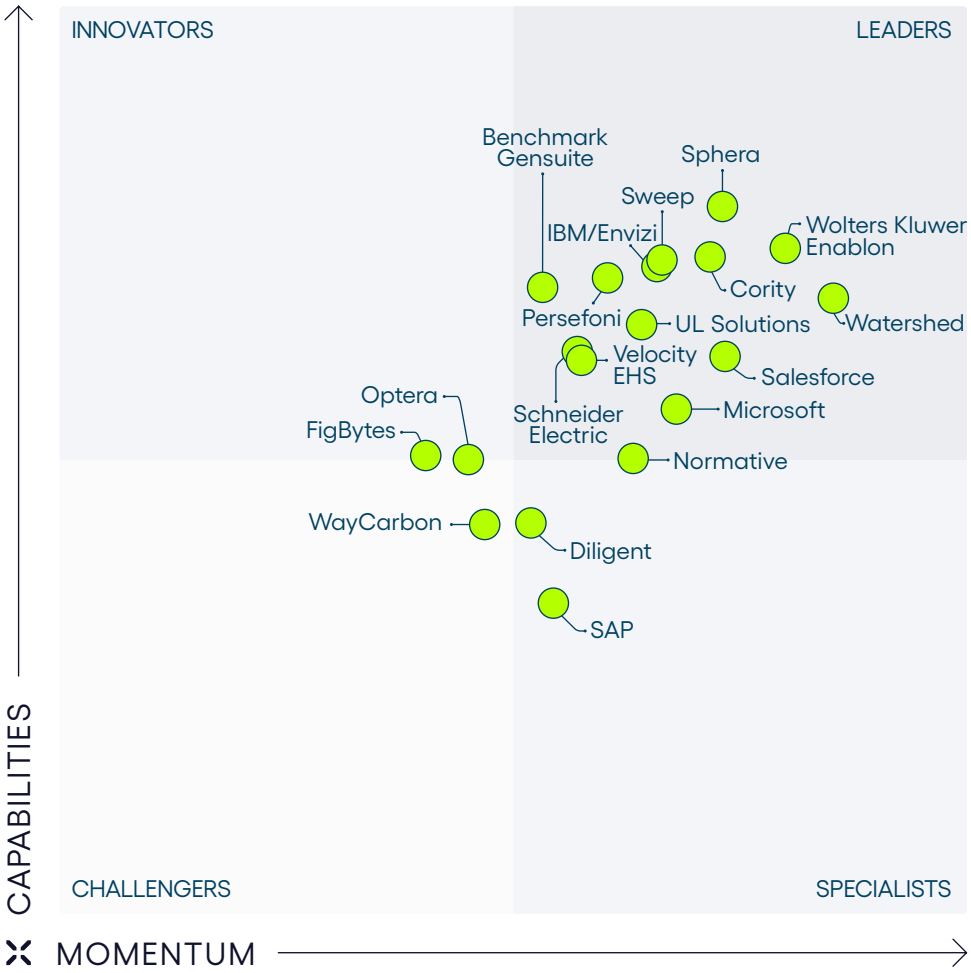
	Benchmark Gensuite	Cority	Diligent	FigBytes	IBM/Envizi	Microsoft	Normative	Optera	Persefoni	Salesforce	SAP	Schneider Electric	Sphera	Sweep	UL Solutions	VelocityEHS	Watershed	WayCarbon	Wolters Kluwer Enablon
Vision and strategy	2.5	2.0	1.5	2.0	3.0	3.0	1.0	1.5	1.0	3.0	3.0	3.0	2.0	2.0	1.5	2.0	3.0	1.5	2.5
Product strategy	2.0	2.0	1.0	2.0	3.0	3.0	2.0	2.0	1.0	3.0	3.0	2.0	3.0	2.0	1.0	2.0	3.0	2.0	2.0
Innovation process	3.0	2.0	2.0	1.2	1.2	2.2	1.2	2.0	1.2	2.2	2.2	2.2	1.2	2.0	1.0	2.0	3.0	1.8	2.2
Organizational resources and growth	0.9	2.0	1.7	0.2	1.7	1.7	2.0	1.4	1.3	1.7	1.8	1.7	2.3	2.0	2.3	1.4	2.5	1.3	2.5
Revenue growth	1.0	2.0	2.0	1.2	1.8	1.4	1.8	1.2	2.6	2.2	1.0	1.0	2.0	1.6	2.2	1.2	2.2	1.0	2.2
Customers	1.0	2.7	1.0	1.3	1.7	2.0	3.0	0.6	3.0	2.0	0.0	1.0	2.7	2.3	2.7	2.0	2.0	1.3	2.7

Vendor provides evidence of market-leading capability, supported by a broad set of references to customer examples	3
Vendor provides evidence of strong capability, supported by a broad set of references to customer examples	2
Vendor provides evidence of moderate capability, with limited references to customer examples	1
No response provided or publicly available, or supplier has a weak offering	0

Source: Verdantix analysis

Figure 9

Green Quadrant for carbon management software 2023



Capabilities

This dimension measures each software supplier on the breadth and depth of its software functionality across 12 capability areas, as outlined in **Figure 5**.

Momentum

This dimension measures each software supplier on six strategic success factors, as outlined in **Figure 6**.

Source: Verdantix analysis

Sweep enterprise carbon management software overview

Analyst insight

Sweep is a Paris-based carbon management software provider, founded in 2020, that has received a total of $100 million in fundraising to date and is currently serving around 350 customers, including Banque de France, HP and L'Oréal. Sweep was a top scorer in net zero programme management. The software's abatement optimization tool firstly offers project tracking and secondly allows users to model the costs and emissions reductions of projects and create a marginal abatement cost curve linking the two. Additionally, Sweep offers an abatement best practices library with predefined and customizable reduction initiatives. The library can be configured based on industry-specific needs; for example, Sweep offers specialized tools and strategies for waste reduction and energy efficiency for manufacturing firms. European buyers looking for a flexible and scalable platform should include Sweep on their shortlist. The solution allows users to create Sweep Trees, which offer a hierarchical and adaptable view of a client's organization to help them visually understand their footprint. In the immediate future, Sweep is planning to implement AI-driven insights and predictive analytics.

Vendor info

Firm name	Sweep
Headquarters	Paris, France
Employees	101-500
Revenues	$5m to <$10m (Estimated)
No. of offices	3
Example customers	Casino, Crédit Agricole, Lacoste

Customer regional presence

North America	◑
South America & Caribbean	◔
Europe	●
Middle East & Africa	◔
India & Central Asia	○
China & Southeast Asia	◔
Japan, Australia & New Zealand	◔

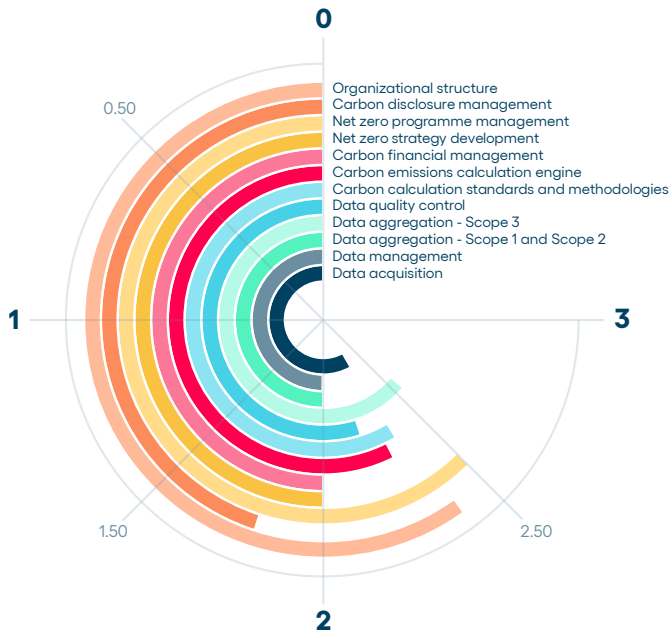
% Customer base

○ 0% ◔ <10% ◑ 10%-25% ◕ 25%-50% ● above 50%

Sweep's highest industry penetration

1. Manufacturing
2. Food & beverage manufacturing
3. Financial services

Technical capability scores



Capability scores on a 0 to 3 scale.
A score of 0 means no capability and 3 means market-leading capability.

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