

SAP's Green ERP Initiative: How Sustainability Professionals Can Leverage SAP for ESG Reporting

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Abstract

SAP leads the way in sustainable business operations with its Green ERP initiative. The platform integrates Environmental, Social, and Governance features directly into Enterprise Resource Planning systems. Companies are now able to monitor their carbon emissions throughout the three scopes. The system is designed to handle ESG compliance reporting automatically. In this way, the need for manual data collection is totally removed.

Artificial intelligence is a major factor in the transformation of ESG reporting methods. The role of AI in ESG reporting has changed from one of necessary compliance to that of seizing sustainability opportunities. It is through the use of machine learning algorithms that companies are able to sift through voluminous operational data. They spot emission patterns and find ways to reduce them. Resources get optimized in real-time. The system watches energy, water, and waste streams constantly.

SAP's solutions work with major global reporting standards. These include GRI, SASB, CSRD, and SEC Climate Rules. The Sustainability Control Tower gives you centralized dashboards. You can monitor ESG performance in real-time. Product Footprint Management calculates emissions from cradle to grave. It uses integrated Bill of Materials data. Responsible Design and Production modules keep you compliant with changing regulations.

Cloud platforms extend sustainability management through entire supply chains. You need systematic data collection from IoT sensors and supplier networks. Carbon accounting covers direct emissions, purchased energy, and value chain activities. Blockchain technology fights greenwashing with auditable records. Digital transformation boosts ESG performance across organizational boundaries. Various sectors have identified the advantages of this innovation such as manufacturing, retail, oil and gas, and financial services.

Keywords: Green ERP, ESG Reporting, Sustainability Management, Carbon Accounting, SAP Enterprise Systems

1. Introduction to SAP's Green ERP Vision

SAP puts Environmental, Social, and Governance capabilities right into Enterprise Resource Planning systems. The Green ERP initiative changes how organizations handle sustainability management. Companies can move past manual tracking systems. They can leave behind fragmented reporting systems too. Modern enterprises face growing pressure to show environmental responsibility. They need transparent reporting.

The platform tracks carbon emissions across all three scopes. According to the Greenhouse Gas Protocol, these are the different scopes. Scope 1 refers to the direct emissions from the sources that you own or control. Scope 2 refers to the indirect emissions that result from energy that is purchased. Scope 3, on the other hand, includes all other indirect emissions that come from the value chain. You gain full

transparency of the environmental impact of the organization. The companies which will have to do this, will be those that operate within the II lateralecological system of emissions.

Artificial intelligence changes ESG reporting completely. It automates data collection and processing workflows. Old manual methods take too much time and resources. They also introduce human error. AI-driven systems analyze operational data in real-time. They spot emission sources and find reduction opportunities. Predictive analytics forecast future emissions. They use historical patterns and planned activities. Natural language processing pulls relevant sustainability information from unstructured documents. ESG reporting shifts from reactive compliance to proactive sustainability management [1].

Conventional corporate sustainable operations require evolutionary thinking about the reduction of carbon. Communicating sustainability issues effectively is also crucial for organizations in order to successfully implement the business strategies in question. It cannot just be a peripheral compliance activity. Evolutionary perspectives show that sustainability practices must adapt constantly. Regulations change. Stakeholder expectations change too. Companies using Green ERP systems manage carbon better than those using traditional approaches. Digital integration gives real-time visibility into emissions sources across global operations. This transparency supports data-driven decision-making for emissions reduction [2].

SAP's Green ERP works with multiple global reporting standards. The Global Reporting Initiative is widely recognized as the main structure. Apart from that, the Sustainability Accounting Standards Board (SASB) gives industry-specific standards that can be easily combined with GRI. These cover material ESG topics. The Corporate Sustainability Reporting Directive is the EU's mandatory requirement. The Securities and Exchange Commission Climate Rules handle climate-related disclosures for public companies. You need sophisticated data management capabilities to comply with these frameworks.

Automated ESG compliance reporting removes manual data collection burdens. Organizations respond quickly to regulatory requirements. They handle stakeholder inquiries faster, too. The system optimizes resource efficiency. It keeps track of energy consumption, water use, and waste production in real-time. This creates both environmental and economic benefits. Cost savings from efficiency improvements often exceed the investment needed for Green ERP implementation.

2. Key SAP Solutions for ESG & Sustainability

2.1 SAP Sustainability Control Tower

The Sustainability Control Tower is the central point of ESG management from where you can actually operate. It provides you with a combined, live monitoring dashboard. You get a very clear view of sustainability metrics. The decision-makers are given access to the exhaustive data pool without the need for them to change systems multiple times. The dashboard itself is a consolidation of data sources from different departments of the enterprise. Executive teams need immediate visibility into sustainability performance indicators.

Carbon footprint analytics are a core function of the Control Tower. The system breaks down emissions by product line. It shows emissions by manufacturing facility and supplier, too. This detailed view helps you target interventions. Organizations can spot high-impact areas for immediate action. Prioritization becomes straightforward when you quantify emissions sources accurately.

The system reduces compliance risks and administrative overhead. It generates reports that comply with EU Taxonomy requirements. It produces SEC climate disclosure documents in the right formats. Updates to reporting standards get incorporated automatically. Manufacturing companies use SAP Product Footprint Management to calculate carbon dioxide emissions per product line. The results show which

raw materials contribute too much to total emissions. Companies can start material substitution programs based on these insights.

2.2 SAP Product Footprint Management and Life Cycle Assessment Integration

Product Footprint Management is a system that figures out the carbon emissions that come from a product or service throughout its lifecycle. The system gets the data of the materials used directly from SAP S/4HANA. This integration keeps things accurate. It eliminates manual data entry. Emission factors come from established databases. EcoInvent and the GHG Protocol are common sources. Manufacturing organizations need complete visibility into product-level environmental impacts.

Life Cycle Assessment integration within ERP systems presents real technical challenges. Moroccan manufacturing companies highlight difficulties connecting LCA databases with operational ERP systems. Data format incompatibilities create barriers to smooth integration. In-the-moment LCA calculations are very demanding in terms of computing power. Nevertheless, Industry 4.0 technologies can be a source of solutions. Improved communication and greater processing power are among the factors that help. Companies must invest in middleware solutions. These bridge LCA and ERP platforms [3].

The system supports circular economy initiatives. It tracks recycled content in products. It monitors refurbishment activities and component reuse. Companies can quantify environmental benefits of circular business models. This functionality helps meet Extended Producer Responsibility requirements. Circular economy reporting shows commitment to sustainable production practices.

Material provenance tracking extends through the entire supply chain. Organizations can identify conflict minerals. They ensure compliance with regulations. Suppliers provide material composition data through integrated portals. The system flags non-compliant materials before they enter production. Supply chain transparency becomes achievable through systematic data collection.

2.3 SAP Responsible Design & Production

This module helps companies handle complex product compliance requirements. Extended Producer Responsibility laws vary a lot across jurisdictions. The system maintains current regulations for all operating regions. It alerts product designers to compliance requirements early in development. By being proactive in compliance, a company is less likely to have to recall products at a high cost.

Conflict minerals compliance is a necessary regulatory requirement that affects a lot of different industries. Companies have to disclose their use of certain minerals under the Dodd-Frank Act. These minerals are tin, tantalum, tungsten, and gold. They must track minerals from conflict regions. The European Union Conflict Minerals Regulation imposes similar obligations. SAP systems track mineral sourcing through multi-tier supply chains. Companies must establish Reasonable Country of Origin Inquiry processes. Due diligence procedures verify supplier representations about mineral origins. Conflict Minerals Reporting Templates standardize information exchange across supply chains [4].

Plastic tax regulations keep evolving across multiple countries. SAP tracks plastic content in products and packaging. It calculates tax liability based on recycled content percentages. Companies can model the financial impact of design changes. Packaging optimization reduces both environmental impact and tax exposure.

The system maintains supplier declarations and audit documentation. It generates the required reports for regulatory submissions. Risk assessment algorithms identify suppliers needing additional scrutiny. High-risk suppliers get enhanced monitoring and audit frequency. Compliance management becomes systematic instead of reactive. Table 1 presents the primary SAP solutions designed for comprehensive ESG management, detailing their core functionalities and organizational benefits across different sustainability domains.

SAP Solution	Primary Functionality	Key Organizational Benefits
Sustainability Control Tower	Centralized dashboard for real-time ESG monitoring across enterprise data sources	Provides executive teams immediate visibility into sustainability performance indicators with reduced compliance risks
Product Footprint Management	Calculates carbon emissions throughout product lifecycle using integrated Bill of Materials data	Enables circular economy initiatives and tracks recycled content, refurbishment activities, and component reuse
Responsible Design & Production	Manages product compliance requirements and Extended Producer Responsibility regulations	Ensures proactive compliance reducing costly product recalls and maintains supplier declarations automatically
SAP Analytics Cloud	Maps emission factors correctly using established databases like DEFRA and GHG Protocol	Delivers accurate emissions reporting with regional variation consideration for global operations
Blockchain Integration	Creates immutable records for ESG data verification through distributed ledger systems	Prevents unauthorized data modifications and enables third-party auditor access without data exposure risks

Table 1: Core SAP Solutions for Environmental, Social, and Governance Management [3, 4]

3. How Sustainability Professionals Can Implement Green ERP

3.1 Data Collection & Integration

Successful implementation starts with comprehensive data collection. Organizations must connect SAP ERP to Internet of Things sensors throughout operations. Energy meters deliver up-to-date consumption data that are up-to-date. Fleet telematics systems are the fuel usage and routing efficiency trackers for vehicles. Manufacturing sensors monitor process efficiency and waste generation. Sensor networks create the foundation for accurate emissions tracking.

Supplier ESG data flows into the system through SAP Business Network. This network connects millions of suppliers globally. Standardized data formats ensure consistency across the supply chain. Automated data validation reduces errors. It improves reliability, too. Supply chain data quality determines overall ESG reporting accuracy.

Water risk assessment capabilities evaluate supply chain vulnerabilities. That companies want to buy from the most sustainable water suppliers has led them to have to understand water availability in the places where these suppliers operate. The physical water risks that may exist are scarcity, flooding, and quality degradation. Regulatory water risks involve pricing changes and allocation restrictions. Reputational water risks emerge from community conflicts over water access. SAP integrates geographical water stress indices with supplier location data. Risk scoring algorithms prioritize suppliers

in high-stress regions for engagement. Companies can implement water stewardship programs targeting highest-risk areas [5].

Emission factors must be mapped correctly in SAP Analytics Cloud. The Department for Environment, Food and Rural Affairs issues detailed emission factors for UK operations. The GHG Protocol offers methodologies that are recognized worldwide. Regional variations need careful attention during configuration. Factor accuracy directly impacts reported emissions quantities.

3.2 Carbon Accounting & Reporting

Scope 1 emissions include direct emissions from company-owned sources. SAP Enterprise Asset Management tracks fuel consumption for vehicles and equipment. Natural gas usage for heating appears in facility management records. Process emissions from chemical reactions get calculated using engineering specifications. Direct emissions typically represent the easiest category to measure accurately.

Scope 2 emissions result from purchased electricity and steam. Electricity bills flow into SAP S/4HANA Financial Accounting automatically. The system applies appropriate emission factors. These are based on grid composition. Location-based and market-based calculations are both supported. Market-based methods account for renewable energy purchases.

Multiple carbon accounting methodologies exist for different organizational needs. The Greenhouse Gas Protocol Corporate Standard is the main framework that is being built upon. ISO 14064 specifies the requirements for a quantification of emissions that is ready for certification. The Carbon Disclosure Project is aimed at standardizing the reporting of climate changes by corporations. Sector-specific methodologies address unique industry characteristics. Companies must select appropriate methodologies. This depends on reporting objectives and stakeholder requirements [6].

Scope 3 emissions present the greatest calculation challenge. Supplier-provided data enters through SAP Ariba procurement systems. Transportation emissions get calculated using SAP Transportation Management data. Business travel emissions come from integrated travel booking systems. Employee commuting requires survey data or estimation methodologies. Comprehensive Scope 3 accounting demands extensive supply chain collaboration.

3.3 Compliance & Disclosure

The Corporate Sustainability Reporting Directive puts European companies under the obligation to disclose detailed ESG information. SAP Sustainability Control Tower is a solution that completely automates reporting in line with CSRD requirements. Materiality assessments based on double dimensions help in identifying relevant topics for reporting. The system is also designed to keep track of the trails of all the data that has been reported. Thus, it can be said that European companies have to face a whole new set of challenges when it comes to reporting sustainability issues.

SEC climate risk filings require specific disclosures. These cover climate-related risks and opportunities. SAP Disclosure Management streamlines the preparation of these filings. Scenario capabilities support climate risk assessment. Integration with financial systems ensures consistency. Financial reporting aligns with sustainability reporting. American companies must align climate disclosures with financial reporting standards.

Blockchain technology provides immutable records for ESG data verification. Distributed ledger systems prevent unauthorized data modifications. Smart contracts automate verification processes. These use predefined criteria. Besides that, blockchain records are available for inspection by third-party auditors without the risk of data being leaked. The use of decentralized storage elevates the security level of data

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and makes it more accessible. The technology comes in handy in dealing with the issue of increasing customer skepticism with regard to corporate sustainability claims that are [7].

The system also documents assumptions and data sources thoroughly. The auditor's ledger records capture any changes made to the reported data. This openness is what enables the stakeholders to have faith in the ESG disclosures. At the same time, it becomes less complicated for independent verification when thorough documentation is at hand. Verizon can go to the source, i.e., the original transactions, to confirm the figures that are in the report. Table 2 outlines the critical implementation components for successful Green ERP deployment, emphasizing data integration strategies and carbon accounting methodologies across different emission scopes.

Implementation Component	Data Sources and Integration	Management Approach
IoT Sensor Networks	Energy meters, fleet telematics systems, and manufacturing sensors throughout operations	Creates foundation for accurate emissions tracking with real-time consumption data delivery
Supplier ESG Data Collection	SAP Business Network connecting millions of suppliers with standardized data formats	Ensures consistency across supply chain with automated data validation reducing errors
Scope 1 Emissions Tracking	SAP Enterprise Asset Management tracking fuel consumption and natural gas usage	Captures direct emissions from company-owned sources representing easiest measurement category
Scope 2 Emissions Accounting	Electricity bills flowing into SAP S/4HANA with appropriate emission factors based on grid composition	Supports both location-based and market-based calculations accounting for renewable energy purchases
Scope 3 Emissions Calculation	Supplier data through SAP Ariba, transportation data, and business travel systems	Demands extensive supply chain collaboration addressing greatest calculation challenge

Table 2: Implementation Framework for Green ERP Systems [5, 6]

4. Industry-Specific Applications

4.1 Manufacturing Sector

Manufacturing operations benefit significantly from detailed energy tracking. SAP Manufacturing Execution integrates with IoT sensors on individual machines. Energy consumption per unit of production becomes visible. Maintenance schedules can be optimized. This improves energy efficiency. Equipment optimization reduces both emissions and operating costs.

IoT-enhanced energy management transforms manufacturing sustainability. Wireless sensor networks monitor equipment energy consumption in real-time. Edge computing devices process sensor data locally. This reduces network bandwidth requirements. Machine learning algorithms identify abnormal energy

consumption patterns. These indicate an equipment malfunction. Predictive maintenance prevents energy waste from deteriorating equipment. Digital twins simulate production scenarios. They optimize energy-efficient operations. Smart manufacturing platforms integrate energy data with production planning systems [8].

Process optimization algorithms identify inefficient operating parameters. Machine learning models predict optimal settings for minimum energy use. Quality metrics ensure that efficiency improvements do not hurt product quality. Real-time dashboards let operators adjust processes immediately. Continuous improvement requires systematic performance monitoring.

4.2 Retail and Financial Services Industries

Retail organizations face complex logistics emissions. SAP Logistics Business Network tracks shipments across multiple carriers. The system calculates emissions for each delivery route. Modal shift comparisons evaluate truck, rail, and ship transport options. Transportation represents a major emissions source for retail companies.

Store-level energy management reduces Scope 2 emissions. Point-of-sale data correlates with HVAC usage patterns. Lighting controls adjust based on customer traffic. Refrigeration optimization balances food safety with energy efficiency. Retail energy management requires coordination across thousands of locations.

Financial services institutions assess ESG portfolio risks through advanced analytics. SAP Sustainability Data Exchange aggregates ESG data from multiple sources. Machine learning models predict ESG-related financial risks. Portfolio managers incorporate these scores into investment decisions. ESG integration transforms investment management practices.

Climate scenario capabilities evaluate portfolio resilience under different futures. Physical risk assessment considers asset locations and climate projections. Transition risk evaluation examines policy and technology changes. Stress testing incorporates climate scenarios alongside traditional financial scenarios. Financial institutions must understand climate risks to investment portfolios.

4.3 Oil & Gas Sector Applications

One of the scenarios where methane leak detection is a necessity is the oil and gas companies' case. Methane, if it were evaluated over 100 years, would have 25 times the global warming potential of carbon dioxide. Methods of leak detection have included optical gas imaging cameras and laser-based systems. Satellite monitoring provides wide-area surveillance of production facilities. Aircraft-mounted sensors survey pipeline infrastructure for emissions. Ground-based continuous monitoring systems track facility-level emissions in real-time. SAP integrates data from these diverse monitoring technologies [9].

Field teams receive automated alerts for investigation and repair. Prioritization algorithms direct resources toward the highest-impact leaks. Repair verification confirms emissions elimination after intervention. Regulatory reporting documents leak detection and repair activities. Methane management programs demonstrate environmental stewardship.

Flaring reduction programs track gas capture and utilization. The system monitors regulatory compliance with flaring limits. Economic modeling compares flaring costs with gas utilization revenue. Carbon credit calculations incorporate avoided methane emissions. Reducing flaring contributes to both the environment and the company's wallet. Table 3 demonstrates sector-specific implementations of SAP Green ERP solutions, highlighting unique operational requirements and sustainability challenges across manufacturing, retail, financial services, and energy sectors.

Industry Sector	Primary Application Focus	Technology Integration
Manufacturing	SAP Manufacturing Execution integrates with IoT sensors monitoring individual machine energy consumption	Machine learning algorithms identify abnormal consumption patterns enabling predictive maintenance for energy waste prevention
Retail	SAP Logistics Business Network tracks shipments calculating emissions for each delivery route	Store-level energy management correlates point-of-sale data with HVAC usage patterns across thousands of locations
Financial Services	SAP Sustainability Data Exchange aggregates ESG data for portfolio risk assessment	Climate scenario capabilities evaluate portfolio resilience under different futures incorporating physical and transition risks
Oil and Gas	Methane leak detection integrating optical gas imaging, satellite monitoring, and aircraft-mounted sensors	Field teams receive automated alerts with prioritization algorithms directing resources toward highest-impact leaks
Cross-Industry Supply Chain	Water risk assessment evaluating vulnerabilities with geographical water stress indices	Risk scoring algorithms prioritize suppliers in high-stress regions for targeted water stewardship programs

Table 3: Industry-Specific Applications of SAP Green ERP [7, 8]

5. Challenges & Solutions

5.1 Scope 3 Data Gaps and Manual Reporting

Scope 3 emissions often make up most of an organization's carbon footprint. Supplier engagement remains the primary challenge in getting accurate data. SAP Business Network facilitates collaboration with suppliers at scale. Standardized questionnaires reduce the burden on suppliers. Supply chain emissions require systematic data collection programs.

Industry-average data provides estimates where supplier-specific data is unavailable. The system flags estimated data for transparency in reporting. Engagement programs gradually replace estimates with actual measurements. Incentive structures encourage supplier participation in data collection. Progressive improvement in data quality supports credible emissions reporting.

Traditional ESG reporting requires significant manual effort. Data collection from different systems consumes substantial staff time. SAP Granta automates material compliance reporting. Integration across SAP modules eliminates redundant data entry. Automation reduces reporting cycle times dramatically.

Report generation tools produce compliant outputs with minimal human intervention. Templates align with major reporting frameworks. Custom reports address unique stakeholder requirements. Version control ensures consistency across multiple reporting channels. Standardized reporting improves comparability across reporting periods.

5.2 Digital Transformation and External Governance

Digital transformation acts as a catalyst for ESG performance improvements. Companies implementing advanced digital technologies show superior ESG ratings. External governance mechanisms amplify digital transformation benefits for sustainability. Institutional investors exert pressure on companies with the aim that they will adopt transparent ESG practices. Regulator intervention is there as a back-up if that is the case. By contrast, holding the companies accountable for their environmental actions, the media plays the role of a watchdog in front of the general public. Digital platforms enable stakeholder monitoring of corporate sustainability commitments [10].

Technology adoption accelerates when external governance pressure intensifies. Companies facing strong external oversight invest more heavily in sustainability technologies. Modern digital ESG platforms make the company more transparent to external stakeholders. Real-time data access allows for a quick reaction to stakeholder concerns. External governance and digital transformation are the key elements that facilitate progress in ESG performance. Stakeholders are increasingly doubting the truth of corporate sustainability claims. SAP Blockchain technology provides auditable ESG records. Each data point maintains a complete provenance trail. Third-party verifiers access blockchain records without compromising data security. Immutable records prevent unauthorized modifications to reported data.

External audits serve as a confirmation of the quality of the underlying data and the methodologies used for their calculation. Independent verification is a way to gain trust in corporate sustainability statements. The auditing process can be performed at a quicker pace when the documentation is already there in the integrated systems. Companies implementing Green ERP demonstrate superior audit readiness. Transparent data management reduces greenwashing risks. Table 4 addresses major implementation challenges in Green ERP adoption while presenting corresponding technological solutions and governance mechanisms that enhance ESG performance and stakeholder confidence.

Challenge Category	Core Problem	Solution Approach
Scope 3 Data Gaps	Supplier-specific emissions data unavailable for most value chain activities	SAP Business Network facilitates standardized questionnaires with industry-average estimates flagged until actual measurements replace them
Manual Reporting Burden	Data collection from disparate systems consuming substantial staff time	SAP Granta automates material compliance with integration across modules eliminating redundant data entry
Greenwashing Concerns	Stakeholder skepticism regarding corporate sustainability claims validity	Blockchain technology provides complete provenance trails with immutable records preventing unauthorized modifications
External Governance Pressure	Institutional investors and regulators demanding transparent ESG practices	Digital platforms enable stakeholder monitoring with real-time data access allowing quick response to concerns
Audit Readiness	Independent verification requiring extensive documentation and data quality confirmation	Integrated systems maintain thorough documentation enabling faster auditing with superior audit trail capabilities

Table 4: Strategic Challenges and Digital Transformation Solutions [9, 10]

Conclusion

SAP's Green ERP initiative transforms sustainability from a compliance burden into a strategic advantage. Real-time carbon tracking enables immediate response to environmental issues and operational inefficiencies. Automated regulatory reporting cuts administrative costs. One of the benefits is the improvement in disclosure, which is more accurate and consistent across different channels. AI-driven insights can be a powerful tool in steering the investments in the initiatives that will result in the greatest environmental impact. ESG professionals now have the tools to convince the management of the worth of ESG initiatives. They use metrics and performance indicators that are measurable and quantifiable. Energy efficiency measures result in cost savings that are immediate. These savings can be used to pay for the implementation costs. Supply chain optimization is a process that reduces both emissions and logistics costs at the same time.

A better brand reputation draws more customers and investors who are environmentally conscious. Such stakeholders are the ones who put sustainable business practices at the top of their priorities. Digital transformation will facilitate ESG performance improvement only when there are strong external governance mechanisms in place. Institutional pressure accelerates technology adoption for sustainability management. Transparent reporting builds stakeholder confidence in corporate environmental

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commitments. Blockchain technology addresses greenwashing concerns. It provides immutable audit trails. IoT sensors make detailed monitoring of energy consumption and emissions sources. Machine learning algorithms locate optimization opportunities that human analysts might not recognize.

Life cycle assessment integration ensures that the environmental impact evaluation is comprehensive. Conflict minerals tracking shows supply chain responsibility and compliance with regulations. Water risk assessment is a way of protecting operations from climate-related disruptions. Companies that are implementing Green ERP today are in a better position to take advantage of future innovations. Apart from that, they are getting ready for regulatory changes as well. Early adopters are the ones who will benefit from the edge they will have in the sustainability- oriented markets that are to come. Environmental performance influences purchasing decisions there. The integration of sustainability into core business systems represents the future of corporate environmental management and strategic planning. Organizations must view ESG reporting as a strategic capability. It cannot just be an administrative obligation.

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