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# Leveraging AI for sustainable public procurement: opportunities and challenges

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Even though sustainable public procurement is critical to achieving global climate goals, most public organizations struggle to implement it. While artificial intelligence holds promise for addressing these challenges, its use in the public sector remains limited and often confined to discrete stages of the procurement lifecycle. This paper critically examines artificial intelligence's potential to support sustainable public procurement across the full procurement lifecycle—from defining needs and assessing markets to issuing tenders, evaluating suppliers, and refining practices. Further, we examine the limitations and challenges posed by artificial intelligence technology for public procurement managers, recognizing concerns related to transparency, fairness, governance, and the impacts of artificial intelligence-driven decisions on market competition. Drawing on numerous examples in the practice, our findings show that artificial intelligence can be a powerful bridge between high-level sustainability aspirations and practical implementation, offering procurement officials the ability to access, interpret, and apply vast amounts of sustainability information across the entire procurement lifecycle. Our results provide understanding necessary to leverage artificial intelligence toward advancing sustainability across the entire procurement lifecycle, while highlighting the need for transparent, data-rich systems and collaborative engagement among technical experts, procurement professionals, and compliance and sustainability specialists. This analysis offers actionable insights into how AI can transform sustainable public procurement from aspiration to operational reality, enabling the public sector to use its considerable purchasing power to contribute meaningfully to global climate action.

KEYWORDS

**sustainable public procurement, artificial intelligence, public procurement, sustainability, innovation**

## 1 Introduction

As procurement accounts for between 92 and 96% of an organization's total climate emissions (CDP, 2021; CDP and BCG, 2024), sustainable public procurement stands out as a pivotal strategy to address the climate crisis. It involves the public sector procuring products and services that improve conditions for the natural environment and societal actors, while helping stimulate the global production of more sustainable products and services (Li and Geiser, 2005; UNEP, 2017). In spite of its societal benefits, sustainable public procurement is underutilized across all levels of government (UNEP, 2022), in part because of a critical bottleneck associated with a surge of sustainability information (Stritch et al., 2018). This information is typically contained within vendors' sustainability reports, government documents, and best practices reports. Assembling and evaluating these documents requires significant capacity and time (Andhov et al., 2020a), which many public procurement officials

lack. Capacity limitations also prevent procurement officials from integrating complex sustainability principles into procurement processes because they do not have access to the pertinent data and guidelines. Yet procurement officials have a vital role in assisting organizations with achieving their sustainability goals (Darnall et al., 2024; Stritch et al., 2024).

Artificial intelligence (AI) is a powerful tool that enhances human capabilities and decision-making. It is a potential solution to the sustainable public procurement problem, offering a bridge between high-level sustainability discussions and ground-level action. By integrating AI into the procurement process, officials can access and interpret volumes of sustainability information to make informed decisions. Procurement officials can also access tailored advice that is applicable across the procurement lifecycle, which can assist them with other practical aspects of their roles, such as sustainability reporting and compliance documentation.

Prior research assessing AI's application to procurement has primarily focused on the private sector (Guida et al., 2023). Related to public sector procurement, and sustainable procurement in particular, AI is largely underutilized (Darnall et al., 2024). Early applications have focused on the early stages of the procurement lifecycle with an emphasis on AI's ability to increase efficiency and performance assessment (Liu and Lin, 2021), and improve decision making transparency (Althabatah et al., 2023). However, AI can be utilized across all procurement lifecycle stages by enhancing data-driven insights that improve procurement strategy and decision making. These broader applications have largely gone unnoticed in prior research (Dimand et al., 2023; Darnall et al., 2024). Additionally, in leveraging AI for sustainable public procurement, the technology's critical limitations must be considered related to data privacy, biases, and algorithmic opacity (Lu, 2020; Andhov, 2025a). Other AI concerns relate to its transparency, fairness, governance, and the impacts of AI-driven decisions on market competition (Sanchez-Graells, 2024; UNEP, 2024). This research addresses these critical knowledge gaps by assessing the applicability of AI to the entire procurement lifecycle with a specific focus on the public sector sustainable procurement. We ask the following research question: *How can AI advance sustainable public procurement across the entire procurement lifecycle*.

We draw on scholarly research, literature in the practice, and diverse real-world examples to provide a more holistic understanding of how AI can support sustainable public procurement across the entire procurement lifecycle and what conditions are necessary for its effective integration. By addressing these issues systematically, public organizations can realize AI's capacity to align procurement practices with broader organizational sustainability goals—and, ultimately, to contribute to global climate action through the strategic use of public sector purchasing power.

Our findings illustrate the potential that AI offers for transforming sustainable public procurement from a high-level aspiration into a practical, operational reality. As public procurement systems increasingly contend with complex sustainability goals, AI can serve as a bridge—enabling procurement officials to access, interpret, and apply large volumes of sustainability information throughout the entire procurement lifecycle. From defining procurement needs and conducting market assessments to issuing tenders, evaluating suppliers, and refining processes, AI has the potential to support more informed and effective decision-making at every stage. Realizing this potential, however, depends on developing transparent systems built on relevant data, requiring close collaboration between technical experts, procurement specialists, and compliance and sustainability professionals.

Our findings significantly expand our existing understanding of public procurement, sustainability in public procurement, and the procurement lifecycle. Further, they provide important advice to practitioners and scholars alike as they consider how to leverage AI in sustainable public procurement to address global climate goals while ensuring that AI applications do not cause more harm than good (UNEP, 2024).

## 2 Literature review

### 2.1 Public procurement—the regulatory setting

Public procurement refers to the process by which government agencies and the public sector acquire goods, services, or works from external suppliers (Hafsa et al., 2021a) in their efforts to deliver among other public education, healthcare, infrastructure, and public transportation (Furneaux and Barraket, 2014). Public procurement accounts for about $9.5 trillion U. S. D. globally, or one-fifth of global GDP (World Bank, 2017).

Given its sheer size (Andhov and Muscaritoli, 2023; Hafsa et al., 2021a), public procurement accounts for a significant portion of total climate emissions (CDP, 2021; CDP and BCG, 2024), in addition to other negative sustainability impacts. Sustainable public procurement has emerged as a critical tool to address these impacts (Dimand et al., 2023) by embedding sustainability considerations (social, environmental, economic) across the entire procurement lifecycle, delivering inputs for core public services that are more sustainable, and thus adding greater overall public value (Andhov, 2019; Alkadry et al., 2019). *Environmental criteria* typically include procuring products that help mitigate climate change, reduce solid waste, avoid the extraction of natural resources, protect biodiversity, and conserve energy and water (Andhov and Muscaritoli, 2023), in addition to assessing suppliers for the environmental impacts of their production processes. *Social criteria* include promoting purchasing from historically disadvantaged groups, enforcement of human rights protection, promoting worker health and safety, and ensuring fair trade in the supply chain (Behravesh et al., 2022; Martin-Ortega and Treviño-Lozano, 2023). *Economic criteria* include improving economic outcomes by promoting small businesses and local economic development (Trybus and Andrecka, 2017; Hafsa et al., 2021b). Combined, each of these sustainable public procurement criteria works together to help public organizations meet the expectations of the Paris Agreement (United Nations Framework Convention on Climate Change, 2018) and the UN's Sustainable Development Goals (UNEP, 2017).

Given its potential impact, governments worldwide are promoting sustainable public procurement as an important lever to improve public sector sustainability and encourage the market expansion of sustainable products and services (United Nations, 2022; Hafsa et al., 2021b). For example, over the last decade, the European Union has heavily promoted sustainable public procurement to Member States through mandatory regulation, in addition to developing tools, and enhancing capacity (Andhov, 2023; Janssen and Caranta, 2023). In the United Nations

(2022) Global Review of Sustainable Public Procurement (UNEP, 2022), across OECD national governments, most (62%) have developed criteria or guidelines for at least one prioritized product or service category.

However, only half of these governments require the mandatory application of those criteria or guidelines. Europe leads in the number of sustainable procurement criteria and guidelines, yet fewer than half (47%) are enforced through mandatory application. By contrast, the Asia-Pacific region shows a stronger commitment to enforcement, with 83% of participating national governments mandating the use of their sustainable procurement criteria or guidelines. Additionally, despite growing attention to sustainability, the use of ecolabels remains limited. Only a modest increase was observed in their use as tools for developing technical specifications or verifying compliance, and just 18% of national governments reported requiring ecolabels (UNEP, 2022).

Additionally, international multilateral governance organizations, such as the United Nations (United Nations, 2022) and the OECD (2021), are actively promoting sustainable public procurement through their programs, collaborative initiatives, and endorsements. They also produce governance guidance documents that help integrate sustainability into procurement processes by defining environmental and social standards and outlining steps for implementation (UNEP, 2022). These governments and governance bodies are motivated by the idea that leveraging public authorities' purchasing power can incentivize new market behaviors toward more sustainable consumption and production (Andhov, 2022; Andhov and Andhov, 2019).

Related to AI in procurement, the European Union established the AI Act with risk-based categories for AI systems, requiring extensive compliance measures for "high-risk" applications that may include many procurement uses (European Parliament and Council of the European Union, 2024). Similarly, the United States has issued comprehensive federal guidance through White House Office of Management and Budget memoranda establishing requirements for government AI procurement, including minimum risk management practices for "high-impact AI" systems (OMB, 2025). Yet most other jurisdictions have adopted a "wait and see" approach, observing how these early regulatory frameworks perform before committing to their own comprehensive AI governance systems. This creates a patchwork of regulatory requirements that varies dramatically across jurisdictions, leaving many public organizations operating in regulatory uncertainty. Current AI governance frameworks remain fragmented and largely underdeveloped globally, creating significant uncertainty about compliance requirements (Hacker, 2024; Andhov, 2022). The "black box" nature of many AI systems poses challenges for public sector transparency and accountability requirements (Calo and Citron, 2021; Coglianese, 2024; Sanchez-Graells, 2024). While establishing comprehensive AI regulatory and governance frameworks should be the foundational first step for any public organization considering AI adoption, this regulatory prerequisite represents a separate and complex undertaking beyond the scope of this analysis.

## 2.2 AI in procurement—the scholarly setting

In spite of the ambiguous regulatory setting, organizations increasingly report using AI, especially in the private sector (McKinsey and Company, 2024; Maslej et al., 2025). However, its applications related to procurement remain in their infancy (Guida et al., 2023), as evidenced by attention being cast at the initial stages of needs assessment and market analysis rather than across the entire procurement lifecycle (Yılmaz et al., 2024). Other areas of limited focus relate to issuing tenders and supplier vetting—including enhanced global supply chain transparency (Althabatah et al., 2023). An overarching theme across all this research is that, despite its limited study, significant promise exists for AI to improve efficiencies, optimize decision making (Liu and Lin, 2021), and enhance decision making transparency.

For instance, prior scholarship has identified how AI can identify suppliers by scraping global databases for procurement risks to predict spend and order forecasts for 6 months, optimizing procurement decisions (Matthew, 2020). Natural language processing (NLP) algorithms can analyze geopolitical reports and commodity price trends to anticipate market disruptions (Parvini, 2024). Other scholars emphasize how AI enhances efficiencies through real-time data exchange between suppliers and buyers (Herold et al., 2023), optimizing logistics sourcing from suppliers (Segun-Ajao, 2024; Li et al., 2023). Similarly, prior researchers offer support for AI's beneficial role assisting with market intelligence and costing tools for improved performance assessment and increased efficiency (Colombo et al., 2023), while optimizing bid selection (Segun-Ajao, 2024). In other instances, AI has been used to more effectively predict supplier responses to incentives or penalties (Miao et al., 2025).

Related to its ability to improve decision making transparency, scholars have noted AI's importance for managing supplier relationships, as it can enhance shared understanding and verification (Colombo et al., 2023), while simulating bidder behavior through reinforcement learning (García Rodríguez et al., 2020b). This allows organizations to structure tenders, balancing cost competitiveness while meeting the organization's broader strategic goals (Stritch et al., 2024).

AI significantly enhances supplier vetting by utilizing advanced data analytics, machine learning, and knowledge graph technologies to improve transparency, risk detection (Riad et al., 2023), and compliance automation. Machine learning models, such as ensemble classifiers, analyze large datasets to identify suspicious patterns indicative of fraud, collusion, or unethical practices, reducing risks in supplier selection (Liu and Lin, 2021). AI-driven supply chain mapping and semantic relationship analysis enable procurement officials to uncover indirect connections, conflicts of interest, and reputational risks, facilitating more proactive and precise vetting processes. AI's capacity to aggregate and structure vast, diverse datasets—including compliance records, performance metrics, and external risk information—supports continuous monitoring and dynamic risk assessment throughout the procurement lifecycle (Wang et al., 2024). These systems enable real-time updates and contextual insights, empowering procurement officials to make informed decisions based on comprehensive, current information. By automating routine vetting tasks and providing deeper analytical capabilities, AI streamlines the process while enhancing accuracy, fairness, and adherence to sustainability goals, ultimately fostering more ethical and resilient procurement practices (Chen et al., 2024).

While these studies suggest AI can improve procurement efficiency, the technology remains relatively non-existent within the public sector (Darnall et al., 2024; Sava, 2023; Sanchez-Graells, 2024),

despite general support for AI's role in government procurement (Coglianese, 2024), and leadership enthusiasm for its promise (Darnall et al., 2024). The limited studies that exist illustrate on one hand that AI has promise for improving public service delivery and societal outcomes (Lungu, 2024) while mitigating procurement risk (Sava, 2023). Other research that has focused on the more granular applicability of AI to public procurement has considered how AI can improve bid evaluation and selection (e.g., García Rodríguez et al., 2020b). These systems enhance evaluation rigor by applying consistent weighting to predefined criteria while automatically flagging proposals containing contradictory terms or non-compliant pricing structures (Siciliani et al., 2023a). Other studies have focused on AI's applicability to vetting suppliers to determine whether they have been debarred or suspended (Ageh, 2019). However, other important aspects of the procurement lifecycle remain unaddressed, namely, how AI might assist with defining the procurement need and assessing the market, issuing tenders, vetting suppliers, and assessing and refining the procurement process.

The failure to consider all procurement lifecycle steps to fully understand the AI opportunity landscape presents a significant research gap that needs addressing prior to procurement leaders understanding the benefits and potential shortcomings of this technology. An additional research gap relates to limited research directly assessing AI's opportunities for sustainable procurement. While several studies address related aspects or different types of AI tools (e.g., Suchith and Ganesha, 2024; Riad et al., 2023; Suchith and Ganesha, 2024; Sipola et al., 2023; Segun-Ajao, 2024), none apply their ideas to the public sector or consider the applicability of AI across the procurement lifecycle. Rather, these studies focus on general aspects of AI's appropriateness for sustainable procurement without considering specifics related to the procurement lifecycle (e.g., Darnall et al., 2022; Singh et al., 2023; Cao et al., 2022). This limited view may stem from the fact that, despite AI's promise and government executives' desire to utilize these digital technologies, AI remains underutilized in the public sector, even among governments recognized as sustainable public procurement leaders (Darnall et al., 2022; Vinuesa et al., 2020). Indeed, of 112 national policies requiring sustainable public procurement, the United Nations notes that only 3% leverage digital development (UNEP, 2022).

This research addresses these gaps by identifying potential opportunities for applying AI across the entire procurement lifecycle to advance public sector sustainability while critically examining challenges posed by AI technology, including transparency, fairness, governance, and impacts of AI-driven decisions on market competition (Sanchez-Graells, 2024; UNEP, 2024). Additionally, the paper offers critical advice to scholars and practitioners considering how to leverage AI in sustainable public procurement to address global climate goals while ensuring AI applications do not cause more harm than good (UNEP, 2024). Table 1 describes the existing literature and illustrates this paper's contributions by addressing gaps across the three spaces—AI, public procurement, sustainable public procurement, and the procurement lifecycle.

In the following sections we critically engage with a wide body of literature to provide informed, evidence-based insights, drawing on scholarly research, literature in the practice, and diverse real-world examples. We provide important understanding about the ways in which sustainability can be embedded into government procurement across the procurement lifecycle and how this necessarily leads to greater procurement complexity. We then discuss how artificial intelligence can potentially reduce these complexities to more effectively meet global sustainability goals and the conditions that are necessary for its effective integration, while providing cautions about its application and a framework for moving ahead.

## 3 Embedding sustainability in the procurement lifecycle

Public procurement typically involves six steps that follow a "lifecycle," or a structured process by which public organizations acquire goods, services, or works from external sources (Grandia and Meehan, 2017). Throughout the procurement lifecycle, contract management is crucial, involving monitoring supplier performance, auditing, addressing delays and other issues, and ensuring contract conformance (EL Bizri et al., 2023). Each step is underpinned by traditional public procurement principles and objectives that include equal treatment and non-discrimination of suppliers, transparency, accountability, open competition, and a focus on achieving value for money (Andhov et al., 2020b; Andhov et al., 2022; Grandia and Meehan, 2017).

The sections below elaborate on the procurement lifecycle steps and how sustainable public procurement can be embedded within each to help meet global climate goals. Each of these steps is also summarized in Figure 1.

### 3.1 Step 1: defining the need and assessing the market

Defining the need and assessing the market involves the public organization identifying the needs that must be fulfilled and determining how best a procurement decision might fulfill them. This step ensures that sustainability is considered at the outset of the procurement process. Public procurement officials assess how a procurement might align with sustainability goals and the organization's overall sustainability strategy (e.g., reducing the organization's overall carbon footprint or promoting ethical sourcing). This process requires access to data related to how reducing the sustainability impacts of some types of procurements (e.g., construction materials) might reduce the organization's total sustainability impacts to a greater extent than reducing the sustainability impacts of other types of procurements (e.g., office supplies).

Also, part of this step is market research, which involves examining the commercial market to identify available procurement options, prices, and product characteristics. For instance, before beginning a procurement, public officials may engage in market consultations to inform potential suppliers about their sustainable public procurement plans, including sustainability requirements and long-term sustainability objectives. Doing so not only helps suppliers anticipate and adapt to stricter sustainability requirements in future procurements but also fosters a more competitive and well-prepared marketplace. Additionally, public procurement officials can ensure greater alignment with their organization's sustainability goals while maintaining healthy competition among market players, ultimately leading to better value and sustainability in public procurement. Market consultations can

TABLE 1 Summary of prior research and the unique focus of this research.

| Published research | AI in private sector procurement | AI in public sector procurement | AI in sustainable public procurement | AI in sustainable public procurement across the procurement lifecycle |
|---|---|---|---|---|
| Current paper | | X | X | X |
| Previous research | | | | |
| • Colombo et al. (2023) | X | | | |
| • García Rodríguez et al. (2020b) | X | | | |
| • García Rodríguez et al. (2020a) | X | | | |
| • Guida et al. (2023) | X | | | |
| • Herold et al. (2023) | X | | | |
| • Matthew (2020) | X | | | |
| • MIT Technology Review Insights (2023) | X | | | |
| • Parvini (2024) | X | | | |
| • Riad et al. (2023) | X | | | |
| • Segun-Ajao (2024) | X | | | |
| • Yılmaz et al. (2024) | X | | | |
| • Ageh (2019) | | X | | |
| • Andersson et al. (2025) | | X | | |
| • Coglianese (2024) | | X | | |
| • Lungu (2024) | | X | | |
| • Sanchez-Graells (2024) | | X | | |
| • Sava (2023) | | X | | |
| • Siciliani et al. (2023a) | | X | | |
| • Cao et al. (2022) | | X | X | |
| • Darnall et al. (2024) | | X | X | |
| • Darnall et al. (2022) | | X | X | |
| • Singh et al. (2023) | | X | X | |
| • Suchith and Ganesha (2024) | | X | X | |
| • Vinuesa et al. (2020) | | X | X | |

involve seeking input from independent experts, relevant authorities, or market participants to address contracting authorities' potential gaps in expertise and capacity for developing sustainable public procurement requirements and documentation (Andhov, 2022a).

## 3.2 Step 2: issuing tender

Issuing a tender involves developing detailed specifications for the required goods or services and publishing an advertisement that requests submissions of interest (Grandia and Meehan, 2017). When preparing tender documentation, the procurement officials must define the subject matter of the contract. This involves formalizing the required characteristics by including technical specifications, which describe the attributes of the works, supplies, or services the public buyer intends to procure. These specifications can include references to processes or methods of production, provision, or other lifecycle steps, even if such factors are not part of the material substance of the product or service (Andhov, 2022b).

When embedding sustainability into tenders, detailed sustainability technical specifications and criteria are included alongside typical specifications within the tender, which might include recyclable materials or energy-efficient options. Sustainability technical specifications might also require the use of organic food, renewable electricity, biodegradable packaging, or recyclable construction materials.

To be effective, sustainable public procurement criteria must be observable, measurable, and based on robust information. These specifications can be defined by referencing international or national sustainability standards (e.g., ISO 14001, EU Ecolabel, Green Seal Certification) or by specifying performance or functionality criteria. Sustainable public procurement technical specifications and criteria are then detailed in contract clauses, in addition to other terms and conditions. Procurement officials balance these specifications against other types of sustainability criteria, such as diversity and inclusion in

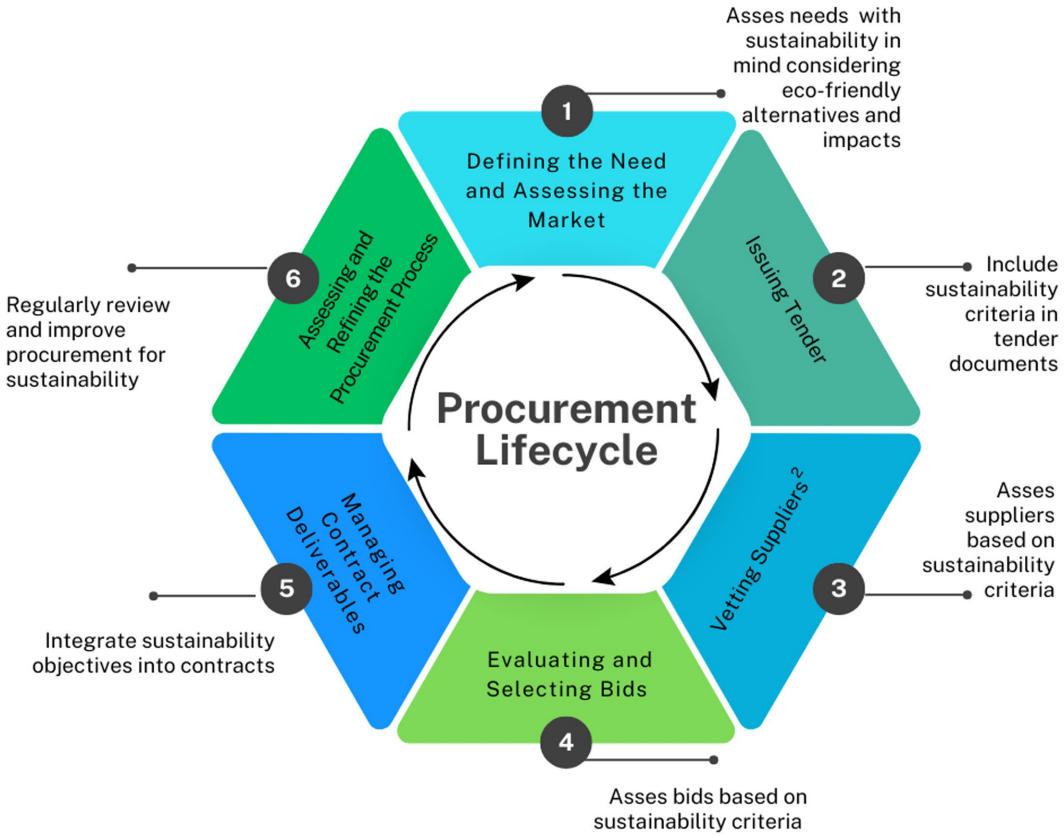


FIGURE 1
Embedding sustainability into the procurement lifecycle.

the production process, and alongside traditional procurement criteria, such as quality and price metrics.

## 3.3 Step 3: vetting suppliers

Vetting suppliers involves assessing the extent to which suppliers meet specified criteria. After the request for tenders (or bids) is published and the deadline passes, public procurement officials assess the suppliers before evaluating their bids. Vetting suppliers might take place outside of individual procurement processes, based on jurisdiction, serving as a prerequisite for eligibility to bid on any public procurements (see, for example, U. S. vendor databases or lists).[1]

Related to sustainable public procurement, suppliers are assessed for their professional and technical capacity criteria related to sustainability. This may include their commitment to a lifecycle costing approach or having adopted an environmental management system (Andhov et al., 2020b), or having a diversity hiring policy. In some countries, procurement officials might utilize preferential scoring during supplier vetting, which gives additional preferences to minority- and women-owned businesses (Resh and Marvel, 2012; Smith and Fernandez, 2010). They may also establish set-asides that promote small, locally owned enterprises (Nijaki and Worrel, 2012).

## 3.4 Step 4: evaluating and selecting bids

During Step 4, bids are evaluated for whether they meet the specified criteria, such as price, quality, and reliability. The winning bid is then selected, and the contract is awarded (EL Bizri et al., 2023). This step in the procurement lifecycle marks the culmination of the competitive process, where the public procurement officials must determine which bid is the best based on predetermined award criteria (Andhov, 2023). These criteria are central to any procurement procedure, serving as the foundation upon which bids are compared for their ability to fulfill the contract requirements and their associated costs.

Related to sustainable public procurement, for instance, a government aiming to reduce the climate impact of its procurement while promoting social equity and economic development might

1 Some governments may require supplier pre-screening based on specific criteria – usually embedded in law which provide grounds for exclusion from procurement process (using criteria such as final judgements for human trafficking, malperformance of previous contract, corruption etc.) prior to being included in a centralized database of suppliers that are interested in pursuing contracts with that government. Registration to the database is a requirement for bidding eligibility and procurement officials use the database to assess the market as part of the first step of the procurement lifecycle (see Figure 1). For other governments, pre-screening may be exclusively part of the supplier review and selection process.

incorporate sustainability criteria into its procurement evaluation process. For example by granting additional preference to a supplier that (a) demonstrates a larger percentage of its production is powered by clean, renewable energy sources or that has implemented measures to minimize their carbon footprint across the supply chain (Brammer and Walker, 2011; Stritch et al., 2018; Darnall et al., 2018); (b) commits to paying livable wages rather than the statutory minimum wage; (c) uses a significant proportion of recycled or sustainably sourced materials in its products. For example, a requirement might state that products made from at least 50% recycled content receive additional evaluation points.

Sustainability criteria are considered along with traditional procurement criteria such as lowest price and delivery time.

## 3.5 Step 5: managing contract deliverables

In Step 5 of the procurement lifecycle, managing contract deliverables, orders are placed with the chosen supplier(s), and the procurement officials inspect the received goods or services to ensure they meet the specified requirements. Doing so ensures that contractual obligations are fulfilled in accordance with the stipulated terms and conditions outlined in the procurement documents (Andhov, 2023). Additionally, invoices are processed for payment, adhering to established protocols (Oteki, 2021).

When applied to sustainable public procurement, this step includes verifying sustainability claims of goods or services, such as ensuring certifications for sustainable production methods are valid. Invoices are processed with attention to sustainable practices, such as prioritizing electronic invoicing over traditional paper-based methods. To discourage contract breaches, sustainability-related contractual clauses are enforced during this stage by linking contract compliance to either sanctions (e.g., damages or termination of the contract) or incentives (e.g., tax deductions).

This step also involves ongoing sustainability performance monitoring and auditing, which encourages suppliers to continuously improve their sustainability impacts. Contractual clauses should clearly outline the responsibility for compliance and sustainability reporting (Andhov, 2021). These mechanisms ensure that public funds are used efficiently and effectively, and sustainability goals are realized (Andhov, 2023).

## 3.6 Step 6: assessing and refining the procurement process

Finally, during Step 6, public procurement officials reflect on the delivered contract by evaluating supplier performance and documenting lessons learned for future procurements (Oteki, 2021). If used strategically, this step looks beyond the individual procurement procedure to consider how the procurement fits within the public organization's entire procurement system and develops new procurement strategies or improves existing ones.

When embedding sustainable public procurement into this step of the procurement lifecycle, procurement officials holistically evaluate the procurement's sustainability performance. This process involves documenting successes and identifying areas for improvement in future procurements. Key considerations include whether the specific sustainability requirements were appropriately calibrated, whether their inclusion was justified in terms of cost and effectiveness, and whether adjustments or refinements are needed. For instance, procurement officials might assess if a different approach would better align with sustainability goals and provide greater value in future contracts.

Each of these actions requires that the procurement official access sustainability data, including suppliers' sustainability reporting, during the contract period. These data are assembled, assessed, and monitored over time, which can be costly, and is the reason why this step is often deemphasized over other aspects of the contract management. However, completing this step is essential to the procurement lifecycle and to meeting the public organization's sustainability goals.

## 3.7 Complexities of embedding sustainability in the procurement lifecycle

The previous section illustrates that embedding sustainability into each step of the procurement lifecycle (across the three sustainable public procurement dimensions—environmental, social, and economic) necessarily increases the complexity of the procurement process (Stritch et al., 2020). It also requires greater sustainability expertise and resources to manage contract deliverables effectively. These are reasons why sustainable public procurement implementation has been slow, despite significant global government interest (Darnall et al., 2017; Hsueh et al., 2020). For instance, only 19 percent of national governments have instituted regulations for mandatory sustainable public procurement (UNEP, 2022). At the local level, only 28 percent of local governments have taken strides to adopt sustainable public procurement and, of these, only 58 percent indicate that their efforts have been successful (Darnall et al., 2017). Across all organizations that adopt sustainable public procurement, 97 percent report facing implementation obstacles (ProSearch, 2021), with access to information being one of the primary factors (Stritch et al., 2018). These obstacles must be addressed for sustainable public procurement to be successful.

Additionally, introducing sustainable public procurement into the procurement lifecycle also raises questions about *how* procurement officials can efficiently assess the volume of their suppliers' sustainability data (Darnall et al., 2024). For instance, if a municipality were to ask its top 100 suppliers to reduce their carbon impacts, and also request its second-tier suppliers to do the same, by the time the municipality got to its third-tier suppliers (which is likely not the end of its supply chain) the municipality would need to assess more than 1 million companies (Galea-Pace, 2024). Similar data assessment approaches would be needed to evaluate the municipality's sustainability impacts related to human rights and other sustainability criteria. Given the limited capacity and resources of most public organizations (Dimand et al., 2023), manual data collection and assessment are not feasible.

For these reasons, increasingly, governments and scholars are asking how technologies such as AI can potentially serve as important tools to address sustainability integration, enhance data assessment capabilities, and accelerate sustainable public procurement success (Darnall et al., 2024; Witkinson and Giuffre, 2022) through improved efficiency, data access, and estimation precision, and lower costs.

# 4 Leveraging artificial intelligence to embed sustainability across the procurement lifecycle—actionable recommendations

AI refers to the simulation of human cognitive processes by computer systems, which perform tasks such as learning, reasoning, problem-solving, and perception (ACM, 2012). When applied to procurement, AI has the potential to support and transform existing processes, enabling better data integration, facilitating more effective communication, and automating some of the decision-making tasks (Russell and Norvig, 2020). However, realizing this potential for sustainability advancement requires careful consideration of development and implementation risks and governance frameworks. Unlike basic automation, AI offers adaptability and learning capabilities, which allow systems to automate routine tasks while analyzing historical procurement data, assessing supplier performance, and flagging potential risks.

The strategic deployment of AI for sustainability purposes must balance innovation with accountability. The following sections provide a more detailed analysis of AI's applicability to advancing sustainable public procurement at each stage of the procurement lifecycle, acknowledging both the transformative potential and inherent risks of each application. When implemented with appropriate safeguards, AI has a potential to serve as a tool that transforms dense (and often inaccessible) sustainability information into actionable knowledge and decision-support tools to meet organizations' climate and social responsibility goals.

## 4.1 AI and Step 1: defining the need and assessing the market

AI can analyze historical data from previous public procurement projects to assess past procurement patterns, such as the quantity and longevity of previously purchased goods (Siciliani et al., 2023a). This analysis may potentially improve predictions of actual needs, enabling better inventory management and cost savings. By understanding the utilization patterns and lifespan of goods and services, AI can enhance forecasting accuracy, ensuring that procurement aligns more closely with actual requirements. For example, Pentair, a specialist in water and thermal management, implemented an AI procurement solution, *Sievo*, that analyzed their complex spending data across business units. According to their report, the system provided over 90% accuracy in spend classification by examining historical procurement patterns and identifying opportunities for supplier consolidation and improved payment terms (Sievo, 2024).

Related to the market consultation process, AI can generate sustainability knowledge that would otherwise need to be directly obtained from market participants (Goel et al., 2023). Doing so helps automate and enhance the market analysis by defining sustainable public procurement needs and assessing the market more effectively. AI systems have potential to also extract and synthesize information from multiple data sources, enabling more informed decision-making (Soori et al., 2024) and integrating insights from external market trends and internal organizational priorities, including supplier sustainability performance, demand specifications, and sustainability risk factors (Perifanis and Kitsios, 2023).

## 4.2 AI and Step 2: issuing tender

To accelerate sustainable public procurement, AI systems can potentially streamline the tendering process by automating the creation of customized documents, such as tender advertisements or requests for proposals (RFPs). For example, the consulting company, McKinsey, has developed an RFP engine that utilizes clean templates and cost factors from a database of over 10,000 RFPs and their responses (McKinsey and Company, 2024). This AI technology performs complex "best of best" analyses faster than traditional methods, identifying factors that contribute to successful bids and refining the details of future RFPs. The technology can also anticipate and prevent potential errors/omissions in bids (McKinsey and Company, 2024). These processes can be adapted to include sustainability information that helps procurement officials meet their sustainable public procurement goals.

Related to drafting sustainable tender documents, AI can incorporate guides, blueprints, and other technical reports to provide examples of "green criteria" or "green specifications" tailored to the specific needs of the buyer. It can also develop draft contract terms and conditions. AI systems trained on extensive databases of existing contracts can quickly produce initial drafts and tailor specific sustainability clauses to reflect individual supplier agreements. Numerous companies have developed practical, effective tools that are readily available and claim to require minimal customization for sustainable public procurement (i.e., Ironclad CLM, LinkSquares Cloud, or ContractPodAI).

Furthermore, AI can analyze potential sustainability risks associated with contracts, subject matter (e.g., apparel), suppliers, and market conditions (Sipola et al., 2023) by helping procurement officials identify and mitigate potential issues early in the procurement process design. This proactive approach may enhance the robustness, security, and fairness of sustainable public procurement strategies while reducing the time required to formulate them.

## 4.3 AI and Step 3: vetting suppliers

AI technology can potentially enhance the supplier vetting by automating and improving the assessments associated with a vendor's financial, technical, professional, and sustainability standing (Sipola et al., 2023). For instance, AI can more quickly assess whether suppliers should be excluded from consideration. By cross-referencing publicly available databases, such as government watchlists, legal records, and international sanctions lists, AI can quickly identify suppliers that have been involved in fraudulent activities, levied environmental fines, sentenced for child labor or other forms of trafficking in human beings, fined for poor worker conditions, or identified for other disqualifying sustainability conditions—as long as this information is in publicly available records. Furthermore, AI has a potential to flag potential conflicts of interest, maintain up-to-date records, and continuously monitor suppliers for any changes in their sustainability status, ensuring that procurement officials have access to the most current information. The flagging itself is not 100% correct, but ongoing monitoring can alert procurement teams to emerging sustainability risks, thus allowing them to take proactive measures. For instance, several AI tools can continuously monitor suppliers and identify potential conflicts of interest, maintain up-to-date records, and alert

procurement teams to emerging risks, including solutions as Interos.ai, SupplyWisdom or Everstream Analytics.

Additionally, AI can evaluate a supplier's professional standing, such as various sustainability certifications (e.g., EMAS, ISO 14001), while leveraging historical data to forecast future sustainability trends and procurement decision outcomes. AI's potential to decipher complex certification data may enable a thorough appraisal of suppliers' adherence to sustainability standards, as seen in the deployment of platforms like EcoVadis. The latter developed an AI system that analyzes corporate sustainability reports and third-party data sources to identify supply chain risks related to environmental and ethical concerns. The platform uses machine learning models to compare supplier data against industry benchmarks and assigns sustainability rating, enabling procurement managers to make informed decisions about supplier sustainability performance.

This can help procurement officials align their procurement decisions with sustainability goals, anticipating the impacts of their decisions on economic, social, and environmental factors. This process is possible if the AI system was designed utilizing a layered model, which ensures the integration of multiple data sources, adaptability to changing conditions, and the ability to refine predictions as new information becomes available (Gasser and Almeida, 2017).

Additionally, natural language processing has a potential to analyze unstructured sustainability data, such as news articles and reviews, to gain insights into the supplier's sustainability reputation and reliability (Guida et al., 2023). For instance, AI can be deployed to automate the extraction and analysis of procurement data relevant to sustainability reporting standards, including data related to suppliers' sustainability practices, environmental impacts, and social responsibility outcomes.

## 4.4 AI and Step 4: evaluating and selecting bid

In circumstances where negotiations are permitted during the public procurement process, AI may enhance supplier negotiation strategies by simulating different scenarios and recommending effective approaches that balance sustainable public procurement priorities. It can do so by using predictive analytics to forecast the outcomes of various negotiation strategies (Goel et al., 2023). By modeling different scenarios, AI can help procurement officials anticipate supplier responses and identify effective negotiation approaches (Cummins and Jensen, 2024; Burger et al., 2023), thus increasing the potential for securing favorable terms that advance sustainability goals.

AI can also assist in generating proposals and counteroffers by analyzing suppliers' preliminary or conditional offers and identifying areas for sustainability improvement. By suggesting alternative sustainable public procurement terms and conditions, AI may provide a strong foundation for negotiations that advance sustainability goals.

When selecting bids, AI-driven systems can potentially enhance the supplier evaluation process by analyzing submitted offers for their sustainability content (Vinuesa et al., 2020). These systems can also assist with relative sustainability scoring to compare competing offers. Specifically, AI can aggregate and analyze big data, including pricing, delivery schedules, alongside compliance with sustainability technical specifications and other sustainability data. By presenting these data in a clear, concise format, AI may help procurement officials develop scoring algorithms that assess based on predefined sustainability criteria alongside more traditional criteria such as cost-effectiveness and quality, technical capability, and past performance (Siciliani et al., 2023b). Additionally, AI can detect anomalies and outliers in submitted bids, such as unusually low or high sustainability impacts, which may indicate potential issues. By flagging these anomalies, AI can assist procurement officials in conducting further investigations before making a decision. Similar approaches have been used in determining potential fraud in public procurement (Velasco et al., 2021). AI has a potential to also be used to cross-reference bids against relevant sustainability laws, regulations, procurement policies, and standards by checking that all bids meet the necessary compliance expectations.

To facilitate decision-making, AI can present complex bid evaluation data through visual analytics dashboards, making it easier for procurement officials to compare bids across multiple dimensions simultaneously and highlighting key sustainability differences and similarities between bids. This visual representation aids in a more intuitive and comprehensive decision-making process, helping procurement officials to make well-informed choices, especially when coupled with careful human oversight and verification.

## 4.5 AI and Step 5: managing contract deliverables

AI systems also have the potential to play a crucial role in the contract performance phase, particularly in contract management, sustainability monitoring and compliance, and systematizing data for controls and audits (Burger et al., 2023). AI tools can automate the tracking of sustainability deliverables against contractual milestones, analyze contract clauses, and alert managers to discrepancies or non-compliance issues, ensuring suppliers meet their agreed sustainability commitments (Bestek Public Procurement Podcast, 2022). They may also enable continuous monitoring of suppliers' sustainability performance and procurement activities, providing real-time feedback for adjustments to maintain compliance with standards, such as clean vehicles or energy-efficient buildings (Díaz, 2023). By leveraging historical contractor performance data and training machine-learning algorithms, public organizations may be able to predict sustainability risks and identify contractors requiring further scrutiny and closer monitoring during contract performance.

These AI tools can integrate historical sustainability data with real-time market analytics and supplier-specific information, forecasting potential risks like environmental accidents before they become critical (Vinuesa et al., 2020). Using AI in this way has a potential to increases procurement efficiency, ensure goods and services align with sustainability expectations, and optimize auditing and oversight activities, which might lead to improving resource allocation and overall procurement practices.

## 4.6 AI and Step 6: assessing and refining procurement processes

Related to this last step of assessing and refining procurement processes, AI may offer opportunities for public organizations to

assess the effectiveness of sustainability criteria used in past contracts. AI can determine whether these criteria achieved desired outcomes, such as reduced emissions or enhanced resource efficiency (Vinuesa et al., 2020). It can also highlight inefficiencies, identify best practices, and inform refinements to sustainability standards for future procurement lifecycles. Additionally, machine learning models can automate the evaluation of contract milestones and sustainability deliverables, potentially ensuring that performance data is systematized for controls and audits. By synthesizing historical contract data with real-time analytics, AI provides insights into pricing trends, supplier sustainability performance, and compliance with environmental objectives (Siciliani et al., 2023a; Sipola et al., 2023). These insights may enable procurement officials to address gaps and establish stronger sustainability frameworks for upcoming contracts.

Additionally, AI has the potential to facilitate the review of sustainability impacts by analyzing how contract decisions influenced broader goals. For example, AI can evaluate whether specific contract clauses led to measurable progress in areas like energy efficiency or material sustainability. Predictive analytics further can enhance this process by forecasting sustainability risks and trends, allowing organizations to proactively mitigate potential challenges and incorporate these insights into future strategies.

A systematic review of completed contracts and procurement projects can identify gaps in sustainable public procurement knowledge and highlight areas for improvement. AI may support this by enabling the development of tailored training programs that address evolving sustainability needs, by analyzing large volumes of historical procurement data to identify patterns and trends, and by revealing inefficiencies or gaps in sustainability practices. AI can then assist in creating tailored training programs that evolve with the changing sustainability needs of procurement professionals. These AI-driven training tools can recommend personalized learning modules, track progress, and adapt content based on individual learning patterns, ensuring that procurement officials gain the most relevant knowledge for their roles.

AI systems can integrate scarce knowledge by aggregating sustainability data from external sources, such as international organizations, consultancy firms, and academia. Resources like the open-access Sustainable Public Procurement Law course[2] enable procurement officials to access a broader knowledge base, adopt innovative practices, and learn from the experiences of others. By utilizing AI in this way, training tools can ensure procurement officials are not only compliant with regulations but are also able to anticipate and adapt to emerging sustainability trends and best practices.

Finally, AI allows organizations to uncover and disseminate information about their most effective sustainable practices. This type of information diffusion allows procurement officials to accelerate continuous improvement in their procurement processes, thus potentially ensuring that future strategies align with the highest sustainability standards and long-term sustainable public procurement objectives. Figure 2 summarizes AI's applicability to advancing sustainability throughout the sustainable procurement lifecycle.

2 https://bestek-procurement.com/spp-law-course/

# 5 Challenges to using AI to advance sustainable public procurement

Despite AI's promising potential to advance sustainable public procurement, its implementation presents several challenges. The adoption of AI in the public sector demands particular caution (Sanchez-Graells, 2024; Coglianese, 2024) as public institutions are fundamentally designed to address societal needs while safeguarding citizen safety, fundamental rights, and wellbeing (Dor and Coglianese, 2021). Therefore, it might be advisable to embrace the AI only after regulation or the creation of government guidelines.

This caution is particularly important given the complexity of the challenges involved, which are exacerbated by the current lack of robust regulatory and governance frameworks. Academic analyses increasingly highlight that AI systems are being implemented across various administrative levels without sufficient due diligence, oversight, or transparency (Ng, 2025).

Particularly as the complexity of the challenges is compounded by the current absence of robust regulatory and/or governance frameworks, with academic analysis emphasizing that AI systems are being deployed across various administrative levels without adequate due diligence, monitoring or transparency.

Six interrelated challenges are of notable concern as they relate to the use of AI for sustainable public procurement: data privacy and security as the foundational layer (6.1); bias, non-discrimination, and fairness (6.2); transparency, accountability, and due process (6.3); market power and competition (6.3); distributed responsibility and fragmentation (6.4); and sustainability impacts of AI systems (6.5). These challenges become especially critical given that AI-driven procurement decisions can significantly impact individuals' access to opportunities and benefit, fundamental rights (access to justice), and broader market fairness and competition.

## 5.1 Data privacy and security

Data privacy and data security concerns constitute the most fundamental technical challenge in AI-driven procurement systems. Public procurement managers have specifically expressed significant concerns about data quality, security, and confidentiality challenges when implementing AI systems in government agencies (Andersson et al., 2025). The collection and processing of supplier data, bidder information, and procurement histories for AI training and operation raises critical questions about consent, data minimization, and purpose limitation.

In public procurement contexts, where environmental and social performance data may include sensitive information about corporate practices, supply chain relationships, and proprietary sustainability innovations, the privacy implications become particularly complex. The challenge is compounded by the recognition that every dataset involving people implies power relationships between those who collect data and those who comprise the collected population (Lu, 2020; Andhov, 2022), creating inherent vulnerabilities for suppliers, particularly smaller businesses that may lack resources to protect their interests in data processing agreements.

The concerns of data privacy and security is compounded by AI's data-hungry nature, requiring astronomical amounts of personal and non-personal information for training, creating enormous incentives

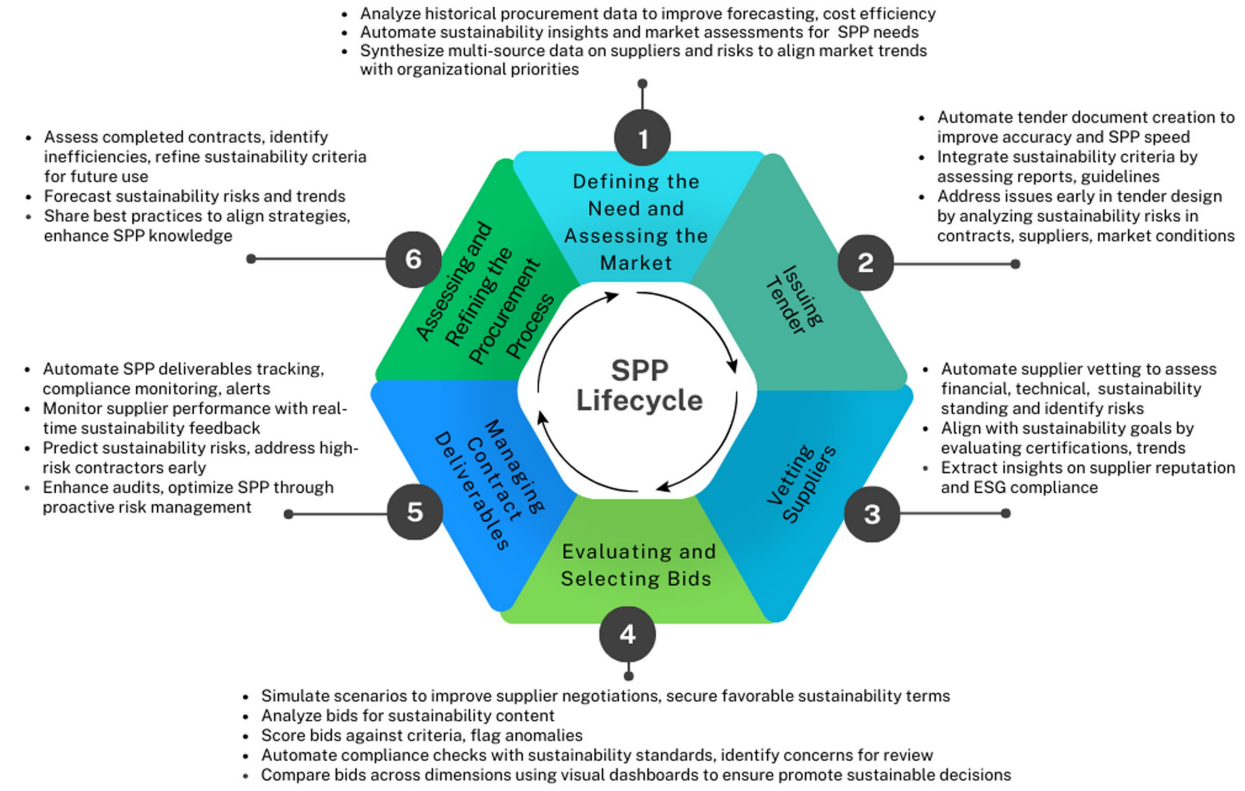


FIGURE 2
AI's applicability to advancing sustainability throughout the procurement lifecycle.

to collect, share, and store precise datasets for lengthy periods (King and Meinhardt, 2024). For example, healthcare AI research demonstrates similar concerns, noting that AI technologies often end up owned and controlled by private entities, raising privacy issues relating to implementation and data security when such corporations have greater than typical roles in obtaining and protecting sensitive information (Murdoch, 2021). Consumer research reveals that 81% believe information collected by AI companies will be used in ways people are uncomfortable with and in ways not originally intended (IAPP, 2024), highlighting fundamental trust issues in AI data handling. Research from Australia's Victorian Information Commissioner emphasizes that AI technologies need to be implemented strategically and thoughtfully, with particular care given to information management, including privacy and data security (OVIC, 2025). Moreover, empirical studies reveal that AI use in public administration, including procurement, generates ethical tensions surrounding privacy alongside fairness and transparency, with significant knowledge gaps remaining in understanding how these AI-related tensions relate to public value creation (Andersson et al., 2025).

## 5.2 Bias, non-discrimination, and fairness

Integrating AI into public procurement processes presents significant ethical challenges concerning bias, non-discrimination, and fairness. These challenges are especially critical to the public sector due to societal expectations for government transparency and openness (Dor and Coglianese, 2021; Hickok, 2022). Bias and fairness concerns emerge as critical limitations in AI-driven procurement systems, with algorithmic fairness discussions spanning multiple public system use cases including welfare eligibility, immigration detention, and recidivism assessment (Hickok, 2022).

The fundamental challenge lies in how humans encode their values within all systems they build. Value encoding that fails to consider diversity of perspectives results in empowering one group's values over others (Andhov, 2024), which in the context of public procurement could have major negative implications, particularly on under-served groups. AI systems can inadvertently perpetuate and even exacerbate existing societal biases (Heaven, 2020) because human values and biases are often embedded in the training data. It is well recognized that data used for training AI models reflects historical and structural inequities, as every dataset involving people implies power relationships between those who collect and those who make up the collected (Lu, 2020; Andhov, 2022).

When AI algorithms learn from these imperfect datasets, they can produce discriminatory results, inadvertently privileging or harming certain suppliers (Lu, 2020). The interconnected nature of these systems means that one faulty decision can trigger a cascade of adverse effects across multiple sectors. In sustainable public procurement contexts, where supplier sustainability practices remain poorly understood and inconsistently measured, this can lead to AI-generated vendor assessments that are skewed or misrepresentative and do not improve sustainability at all.

Biases in the application of AI in public procurement are particularly acute when AI decision-making is robust. Predictive algorithms that use biased historical data can disproportionately and unintentionally exclude minority- or women-owned businesses from procurement opportunities (Heaven, 2020; Lu, 2020). Known as disparate impact, this concern also affects other aspects of sustainable public procurement. For instance, AI algorithms that detect procurement risk may disproportionately exclude smaller businesses, which could lead to inadvertently harmful consequences to local communities.

Academic research demonstrates that different definitions of algorithmic fairness cannot be simultaneously achieved, with the meaning of fairness being context-dependent and lacking widely accepted definitions (Hickok, 2022). Empirical studies reveal that the use of AI in public administration, including procurement, is riddled with ethical tensions of fairness, transparency, and privacy, with significant knowledge gaps remaining in understanding how AI tensions relate to public value creation (Andersson et al., 2025). Public procurement managers have specifically expressed concerns about data quality, security, and confidentiality challenges, alongside legal concerns surrounding AI implementation in government agencies (Andersson et al., 2025).

## 5.3 Transparency, accountability, and due process

The use of AI-driven predictive analytics platforms in sustainable public procurement introduces challenges related to transparency, accountability, and due process. Although AI platforms are designed to forecast market trends and evaluate suppliers, they often lack clarity regarding their data sources and algorithmic design. This "algorithmic opacity" restricts the procurement official's ability to scrutinize decision-making processes, thereby weakening accountability in AI-driven systems (Lu, 2020; Andhov, 2025a). As AI learning tends to evolve autonomously and can produce unpredictable outcomes, opacity further reduces the public procurement official's ability to assess AI-generated output. For instance, AI systems, while designed to process large volumes of data efficiently, are highly dependent on the quality and representativeness of their input data (Colombo et al., 2023).[3] In such settings, AI may fail to accurately assess supplier performance or detect emerging risks, thereby compromising the integrity of procurement decisions. Moreover, because public procurement officials often have limited technical expertise, their ability to evaluate the operation of these systems is compromised (Zuiderwijk et al., 2021; Andhov, 2025a).

Further complicating matters is that the private companies, which design the AI machine learning models, often protect their algorithms, claiming that they are proprietary trade secrets. Such protection further amplifies opacity and all the problems that come with it.

In sustainable public procurement, the lack of transparency is especially problematic for ensuring due process. AI systems that make decisions without clear justification or explanation challenge fundamental principles of fairness and accountability (Coglianese and Lehr, 2019).

If procurement officials cannot verify algorithmic accuracy or understand how AI-generated scores and recommendations are derived, public trust in government can erode (Calo and Citron, 2021; Coglianese, 2024). Without transparency, procurement officials face difficulties identifying and addressing biases, undermining trust in AI solutions and appropriate decision-making. Additionally, a lack of transparency further restricts public oversight, increasing difficulties associated with evaluating the societal impacts of AI systems and increasing the risk of bias, discrimination, and unfairness (noted in 6.2, above).

## 5.4 Market power and competition

The current landscape of AI systems is dominated by a few large companies that own numerous subsidiaries, creating significant market imbalances (Andhov, 2025b). Often operating through extensive networks of subsidiaries, these companies enjoy substantial market advantages, particularly when they gain early access to public resources such as large datasets, which helps them to refine their algorithms and consolidate their market position, creating barriers for smaller or emerging competitors. For example, DeepMind, a British American AI research lab that develops general-purpose AI technology, gained access to the personal medical records of approximately 1.6 million patients from the Royal Free London NHS Foundation Trust (BBC, 2021). DeepMind's data access created an advantage against competitors in its ability to further develop its algorithmic tools, which cemented its market dominance (Powles and Hodson, 2017).

In the context of sustainable public procurement, concentrated market power in the AI industry is particularly concerning, as it can marginalize smaller, diverse, and innovative suppliers that offer more sustainable market solutions but lack the resources to compete against less sustainable competitors. As a result, public procurement processes may fail to meet broader societal goals (Liu and Lin, 2021). Indeed, smaller suppliers, which are often nimbler and more innovative in providing sustainability-driven solutions (Schoenmaekers, 2015), face significant barriers to entry perpetuated by an industry dominated by a select few.

Concentrated market power across the AI industry also allows dominant players to dictate prices and terms (OECD, 2017: Sabockis, 2023), thereby increasing procurement costs for public entities (Coglianese, 2024). Related to sustainable public procurement, the concentration of market power in the AI industry creates opportunities for AI developers to dictate the terms of their products. In such settings, firms tend to prioritize cost-efficiency over sustainability, designing systems that neglect environmental or social considerations (Andhov, 2023) or relying on poor data that lead to the opacity problems noted in Section 5.2, above.

3 This issue is especially relevant to public procurement, which tends to suffer from data low availability and data quality (Chehbi-Gamoura et al., 2020; Kache and Seuring, 2017).

### 5.5 Distributed responsibility and fragmentation

The deployment of AI systems in public procurement involves multiple stakeholders, creating a complex web of accountability. However, outside of the EU, the development, operationalization, and usage of AI systems are largely unregulated,[4] creating distributed responsibilities across administrative levels within countries. Distributed responsibility is characterized by actors who are involved in the AI system's design and development, and different types of big data systems (Hickok, 2022). For example, in the U. S., federal, state, and local governments each have their own AI tools and systems. As of 2020, 157 AI tools were documented across 64 federal entities with no agency having clear oversight, making it difficult to assign responsibility when issues arise (Engstrom and Ho, 2020; Coglianese and Lehr, 2016; Coglianese and Lampmann, 2021). This setting also creates blind spots related to the value of public sector data in that private sector companies can more easily acquire public data to amplify their market power and discourage competition (Powles and Hodson, 2017).

### 5.6 Sustainability impacts of AI systems

Finally, the promotion of AI as a tool for sustainable public procurement carries a certain irony in that the technology itself suffers from significant sustainability impacts. The immense energy demands of training and running sophisticated AI models involve sizable data centers requiring significant amounts of electricity. Much of this energy is still sourced from non-renewable energy, thus contributing to the very carbon footprint that sustainable public procurement aims to reduce. Nevertheless, there is a growing trend toward greening AI operations. Initiatives such as Google's employment of DeepMind's machine learning to improve the energy efficiency of its data centers have shown potential, reportedly reducing the energy used for cooling by up to 40% (Evans and Gao, 2016). Companies like VIRTUS and Equinix have achieved 100% renewable electricity usage across their data center networks, with VIRTUS saving millions of tons of carbon emissions annually using zero-carbon electricity suppliers (Walbank, 2022). Additionally, Amazon Web Services data centers in U. S. states such as Oregon are already powered with at least 95% renewable energy, and Amazon has a commitment to reaching 100% renewable energy by 2025 for its global operations (Amazon, 2023).

Other sustainability impacts relate to the manufacturing and disposal of AI hardware. Related to social equity, access costs may prevent some public entities from accessing AI, particularly those in lower-income regions. This can further widen the digital divide, where only certain organizations can afford to leverage AI for sustainable public procurement.

4 While there have been regulatory attempts to regulate AI, these attempts have been limited, see U.S. Executive Order on the Safe, Secure, and Trustworthy Development and Use of AI.

## 6 Discussion

Although sustainable public procurement is critical to achieving global climate goals (UNEP, 2022), most public organizations struggle to implement it because they lack data (Darnall et al., 2017; Stritch et al., 2024) or have access to the wrong types of information (Andhov et al., 2020a). While prior research assessing AI's application to sustainable public procurement has identified that AI may carry a potential to be an important solution to this problem, its scholars have focused on a limited portion of the procurement lifecycle (Liu and Lin, 2021) and generally ignore important challenges to implementing AI in sustainable public procurement.

This research identifies both the opportunities and challenges associated with how AI can be applied to advance sustainability in public procurement. It critically assesses AI's application to the entire procurement lifecycle and identifies how each aspect needs consideration to fully understand the AI-sustainable public procurement opportunity landscape. Our analysis reveals that while AI offers transformative potential for sustainable public procurement, realizing this potential requires systemic attention to the six interconnected challenge areas. These insights are relevant to scholars and practitioners alike as they consider how to leverage AI to meet global sustainability expectations.

Several open problems exist ahead. First, to fully realize the significant opportunities that AI potentially offers to advance sustainable public procurement, public entities will need to be able to access reliable and quality data. It is highly plausible that governments will need to actively seek and harvest the data themselves. The EU has announced its aim to strengthen the EU's data ecosystem and establish sovereign Data Labs across the EU (AI Continent Action Plan, 2025). Additionally, for privacy and security concerns, public entities must implement robust data governance frameworks that prioritize consent, data minimization, and purpose limitation while establishing clear protocols for protecting sensitive data.

Secondly, public entities will need to mitigate bias and ensure fairness while adopting comprehensive standards for AI procurement and deployment. Researchers and practitioners would benefit from conducting thorough impact assessments to identify potential biases and implementing measures to address them. Engaging diverse stakeholders in the development and evaluation of AI systems can also help ensure that different perspectives and values are considered, reducing the risk of biased outcomes. Counteracting market concentration requires promoting interoperability standards and supporting diverse AI solutions in the marketplace. Open-source AI platforms, though representing additional data security concerns, could democratize data access, allowing a wider range of public entities to adopt AI for sustainable public procurement without prohibitive costs. International cooperation and knowledge sharing can further aid under resourced entities in overcoming barriers in AI adoption. Addressing the sustainability paradox necessitates focusing on local data centers, energy-efficient AI algorithms that require less computational power and less water. Public entities need to consider expanding renewable energy sources for data centers, and investing in circular economy approaches for AI hardware to reduce e-waste through recycling and repurposing efforts.

Related to the challenges arising from the issues of inequality, the data democratization that comes with the development of

open-source AI platforms may help address these concerns. So too might fostering international cooperation and knowledge sharing can aid under-resourced entities in overcoming the barriers to AI adoption. While not exhaustive, these solutions can serve as starting points for reconciling the sustainability paradoxes of AI in the context of sustainable public procurement. Understanding these relationships is another area ripe for additional examination.

Finally, designing a transparent system focused on relevant data necessitates close collaboration between these groups. Addressing this open problem will require a dedicated team is essential for supervising the deployment and initial operation of the AI system. Continuous oversight and learning are vital for adapting and refining AI applications in governmental procurement, ensuring they meet evolving needs and address emerging challenges effectively. Future research would benefit from assessing which types of procurement systems and which combinations of stakeholders (technical experts, procurement professionals, and sustainability professionals) are more likely to the data-rich systems that support artificial intelligence solutions for sustainable public procurement. Addressing these challenges head-on is essential to leverage AI to its full sustainable public procurement potential to meet our global climate goals.

## 7 Conclusion

The imperative to implement sustainable public procurement is critical, as procurement activities account for the significant majority of organizations' total climate emissions (CDP, 2021; CDP and BCG, 2024). Yet public organizations continue to struggle with sustainable public procurement implementation due to data limitations (Darnall et al., 2017; Stritch et al., 2024) and the overwhelming volume of sustainability information contained in vendor reports, government documents, and best practices guidelines (Andhov et al., 2020a). This information bottleneck prevents procurement officials from effectively integrating sustainability principles into procurement processes despite their vital role in helping organizations achieve sustainability goals.

This research addresses the important (but understudied) question of how AI can advance sustainable public procurement across the entire procurement lifecycle. By doing so, our research makes a significant contribution by mapping both the opportunities and challenges of AI application beyond the narrow focus on bid selection and supplier vetting that has dominated previous studies.

Drawing on numerous examples in the practice, our findings show that artificial intelligence has a potential to be a powerful bridge between high-level sustainability aspirations and practical implementation, offering procurement officials the possibility to access, interpret, and apply vast amounts of sustainability information across the entire procurement lifecycle. Our results provide the understanding necessary for procurement officers to leverage AI's capabilities toward advancing sustainability across the entire procurement lifecycle, including defining procurement needs, market assessment, tender issuance, supplier evaluation, and process refinement.

Successful AI integration in public procurement ultimately depends on transparent systems built on relevant data, requiring close collaboration between technical experts, procurement specialists, and sustainability professionals. By addressing these challenges systematically, public organizations can leverage AI's potential to advance sustainable procurement practices across the entire procurement lifecycle, transforming sustainable public procurement from an aspirational goal to an operational reality. This transformation is essential not only for meeting organizational sustainability targets but for making meaningful progress toward our shared global climate goals through the public sector's considerable purchasing power.

## Author contributions

MA: Conceptualization, Formal analysis, Funding acquisition, Investigation, Project administration, Resources, Visualization, Writing – original draft, Writing – review & editing. ND: Conceptualization, Formal analysis, Investigation, Resources, Visualization, Writing – original draft, Writing – review & editing. AA: Conceptualization, Formal analysis, Investigation, Validation, Writing – original draft, Writing – review & editing.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Generative AI statement

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