

# **Leveraging ChatGPT for Sustainability: A Framework for SMEs to Align with UN Sustainable Development Goals and tackle sustainable development challenges**

**Luis FONSECA**

*ISEP, Polytechnic of Porto, Porto, Portugal; Associate Laboratory for Energy, Transports and Aerospace (LAETA-INEGI), Porto/Portugal  
lmf@isep.ipp.pt*

**Eduardo OLIVEIRA**

*Associate Laboratory for Energy, Transports and Aerospace (LAETA-INEGI), Porto/Portugal*

**Teresa PEREIRA**

*ISEP, Polytechnic of Porto, Porto, Portugal; Associate Laboratory for Energy, Transports and Aerospace (LAETA-INEGI), Porto/Portugal*

**José Carlos SÁ**

*ISEP, Polytechnic of Porto, Porto, Portugal; Associate Laboratory for Energy, Transports and Aerospace (LAETA-INEGI), Porto/Portugal*

**Abstract.** *The United Nations Sustainable Development Goals (SDGs) outline a global agenda for sustainable development, but need more detailed implementation guidelines for businesses, particularly Small and Medium Enterprises (SMEs). Given their limited resources, SMEs face significant challenges in adopting sustainability practices aligned with the SDGs. This study explores the potential of ChatGPT, a large language model, to assist SMEs in overcoming these challenges. The research introduces a ChatGPT-aided framework through a novel methodological approach to help SMEs develop sustainability roadmaps, engage stakeholders, and identify key sustainability goals, risks, opportunities, and Key Process Indicators (KPIs). The case study of an SME in the electronic measurement equipment industry is used to validate the framework. The findings, corroborated by a Focus Group with the participation of academics and SME top managers, demonstrate the framework's potential to enhance SME sustainability practices, contributing to academic discourse and offering practical insights that will inform and empower industry stakeholders. Furthermore, several actions are presented to respond to concerns about the accuracy and reliability of AI-generated recommendations. Finally, future research should seek to validate the proposed framework across a broader range of industries and SME contexts and assess this methodology's application with organisations other than SMEs.*

**Keywords:** ChatGPT; sustainable development; Sustainable Development Goals; stakeholders' engagement; small and medium enterprises.

Please cite the article as follows: Fonseca, L., Oliveira, E., Pereira, T. and Sá, J.C. (2024), "Leveraging ChatGPT for Sustainability: A Framework for SMEs to Align with UN Sustainable Development Goals and tackle sustainable development challenges", *Management & Marketing*, Vol. 19, No. 3, pp. 471-497, DOI: 10.2478/mmcks-2024-0021.

## Introduction

In 2015, the General Assembly of the United Nations (UN) formally adopted “The 2030 Agenda for Sustainable Development,” which provides a framework for “peace and prosperity for people and the planet, now and into the future” (UN, 2018). As part of this agreement, the 17 SDGs (and 169 other goals, along with monitoring and review measures) were approved by 193 countries (Fonseca et al., 2020). The SDGs represent a shared expression of stakeholder needs at a global level, balancing economic, social, and environmental development (Fonseca & Carvalho, 2019) and provide an indication and measure of progress towards the main objective of Sustainable Development (SD) (Barbier & Burgess, 2017). The SDGs aim to operationalise and integrate sustainability into organisations worldwide and address current and future stakeholder needs, contributing to sustainable development by balancing economic, social, and environmental development (Schaltegger et al., 2013).

The SDGs emphasise prosperity promotion and elimination of inequity, are universal and apply to all (either developed or developing) countries. Hence, wealthy nations can meet most of their basic needs and social thresholds (e.g., zero hunger, no poverty and equality), and financially support health services, infrastructure, green economy, and fight against climate action (Lusseau & Mancini, 2019; Niessen et al., 2018; UN, 2022). Nevertheless, although developed countries are generally global sustainability leaders, they are also often responsible for unsustainable trade, supply chains, and tax systems that represent obstacles to developing countries' successful implementation of the SDGs (UN, 2021).

Conversely, the least developed countries lack infrastructure, have weaker education and health systems, and have less capacity to promote their sustainability. Nevertheless, those countries have made progress in eliminating poverty and improving the availability of basic services and infrastructure; however, they need additional support for their sustainability agendas (Soergel et al., 2021; UN, 2021; UN, 2022).

To sum up, a stronger emphasis on economic growth to deliver human well-being often creates trade-offs between SDG progress, e.g., higher gross domestic product may indeed lead to higher levels of human health and well-being, but are also associated with a more extensive environmental and climate footprint (Wu et al., 2022; Fonseca et al., 2020).

Govindan et al. (2013) posit that one of the leading sustainability challenges is operationalising the resolutions of the Brundtland Commission Report. According to Stafford-Smith et al. (2016), the SDGs defined an agenda for the sustainable development of all nations. They should be a significant driving force for SD framing political efforts and the dynamics of natural capital (Terama et al., 2015), as governments are expected to use these goals to fight extreme poverty and ensure environmental, social, and economic sustainable development for their populations (Choi et al., 2016; Cosma, 2024). However, academics, businesses, and other stakeholders have expressed concerns due to the lack of mechanisms to monitor and implement the SDGs within businesses and institutions (García-Sánchez et al., 2020; Sullivan et al., 2018).

Furthermore, the EU Corporate Sustainability Reporting Directive updates and reinforces the rules concerning the social and environmental information that companies must report. Large companies and listed Small and Medium Enterprises (SMEs) will now be required to report on sustainability to provide harmonised information and ensure that investors and other stakeholders have access to the information they need to assess the social and environmental impact of companies and for investors to assess financial risks and

opportunities due to climate change, resource scarcity, people inequality, and other sustainability issues (European Commission, 2023).

SMEs often lag larger companies in implementing sustainability management practices, limiting their capacity to mitigate negative social and environmental impacts (Moursellas et al., 2023). SMEs may be more ethical or discretionary than economic, when compared with major corporations (Jamali, Zanhour, & Keshishian, 2009) and adopt more informal and unconscious practices (Lee, Herold, & Yu, 2016). Moreover, due to SMEs' small visibility and the belief that their social and environmental impact is considerably smaller (Battisti & Perry, 2011; Bojan, 2024), they exhibit a small propensity to communicate CSR practices externally (Fassin, 2008).

Small and medium-sized enterprises (SMEs) face several challenges when adopting sustainability practices and aligning with the UN SDGs. SMEs have limited financial and human resources compared to larger companies and a less clear understanding of sustainability concepts, the SDGs, and how to align those with their core business strategies (Seidel et al. 2009). Moreover, SMEs may need more awareness of the potential benefits or how to integrate sustainability into their business strategies. This can lead to concerns related to the high initial costs of implementing sustainability practices and how to evaluate financing and get a return from sustainability investments. Further obstacles may arise from difficulties complying with environmental and safety regulations, reporting requirements, and assessing their environmental and social impacts within complex supply chains. Finally, SMEs must account for resistance to change from employees, management, or other stakeholders and may lack the tools and expertise to accurately measure and report on their sustainability performance. This can be a barrier to effectively tracking progress toward the SDG targets (Gustafsson et al., 2001; Ismyrlis & Moschidis, 2015; Rizos et al., 2015; Fonseca et al., 2018). In response to this challenge, Küchler et al. (2023) proposed a set of recommendations for a sustainability management tool, including possible components such as assessment, reporting, and certification, for food manufacturing SMEs.

Although these challenges can vary depending on factors such as industry, location, and company size, many SMEs recognise the importance of sustainability (Fonseca et al., 2023). They are taking steps to overcome these obstacles. Governments, non-governmental organizations, and industry associations can support SMEs by providing education, incentives, financing options, and regulatory guidance to facilitate their journey toward adopting sustainable practices and contributing to achieving the SDGs. Moreover, authors such as Johnson (2015) and Fonseca et al. (2022) have also addressed the increased application of sustainability tools through the promotion of benefits. Furthermore, Cantele and Zardini (2020) found that different factors influencing the propensity of business owners/managers of SMS towards sustainability include both the expected potential benefits (e.g., employee motivation, competitive advantage, reputation, profitability, customer satisfaction, and improved compliance with regulation) and the perceived barriers (such as cost, time, or competitiveness loss). To sum up, SMEs need to apply models and solutions that these types of companies can easily understand and implement and promote possible roadmaps for future sustainability improvements.

Recognizing these challenges for SMEs, our study explores the potential of Large Language Models (LLMs) for improving SMEs' adoption of sustainability practices and aligning their core strategy and processes with the UN SDGs. LLMs deep learning algorithms can recognise, summarise, translate, predict, and generate text and other forms of content

based on knowledge gained from massive datasets. LLMs aim to understand and generate human-like text based on extensive data and have shown capabilities in various applications. The Generative Pretrained Transformer (GPT) is a LLM developed by OpenAI. It is framed in transformer architecture and performs well in understanding context, detecting nuances, and comprehending complex relationships between words. GPT models have been designed for various NLP tasks, namely text generation, translation, summarization, and sentiment analysis, with the ability to understand and generate human-like text (Imamguluyev, 2023). GPT applications cover many areas, such as education, the environment, and healthcare (Sohail et al., 2023).

By integrating deep learning and language models based on the GPT architecture, OpenAI's ChatGPT significantly extends the capabilities of chatbots (computer programs that simulate human conversation) (Radford et al., 2018). Experts from diverse fields acknowledge that ChatGPT's capabilities can enhance productivity, foster significant gains in the banking, hospitality and tourism, and information technology industries, and enhance business activities, such as management and marketing (Dwivedi et al., 2023). Nevertheless, while ChatGPT users mainly perceive it as a valuable tool that simplifies activities and reduces time and human errors, risks related to the reliability of the information provided, the need for more privacy for the requested personal data and the lack of empathy and human interaction, have also been identified (Pasca & Arcese, 2024).

Authors such as Fonseca and Azevedo (2020) state that successful companies will focus on creating new operational performance and minimising risks. Namely by accelerating the end-to-end digital transformation. Furthermore, micro and small enterprises to overcome disruptions (such as COVID-19 pandemic) need to be open to innovate and adapt to provide strong support for customers and communities (Bratu & Cunea, 2024).

Hence, simultaneously considering the sustainability challenge, the ongoing digital transformation, and the resource constraints from SMEs, this research is a novel effort in deploying ChatGPT for sustainability practices and provides a framework and solutions that SMEs can easily understand and implement for future sustainability improvements (Figure 1).

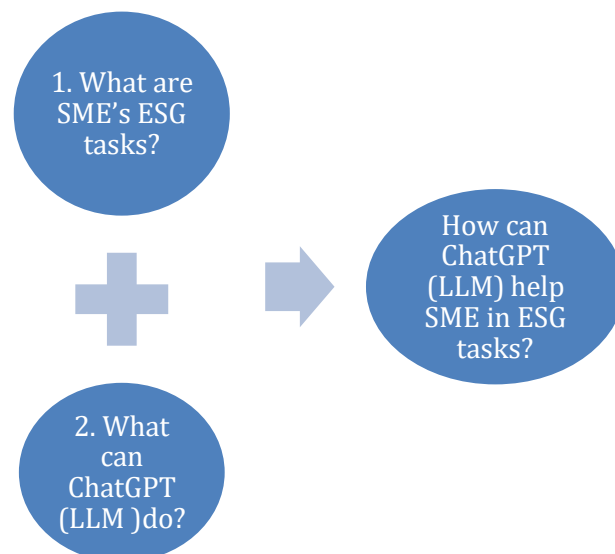


Figure 1. Framework for deploying GPT for sustainability practices

Source: Authors' own research.

To ensure more accurate answers from ChatGPT, the case of an SME that produces scales and other electronic measurement equipment was selected, considering the relevance of this type of industry with the ongoing digital transformation. The study's central research theme is to explore Chat GPT-aided solutions by introducing a novel methodological approach supported by a ChatGPT framework to help SMEs tackle sustainable development challenges.

Specifically, the research questions are as follows:

RQ1: To develop a sustainability roadmap for an SME company that produces scales and others.

RQ2: To create a communication directed towards the stakeholders of an SME that produces scales and other electronic measurement equipment about an initiative to incorporate fully recycled aluminium.

RQ3: Considering the United Nations Sustainable Development Goals, what are the top 5 goals an SME company that produces scales and other electronic measurement equipment should focus on?

RQ4: What are the risks and opportunities of an initiative made by an SME that produces scales and other electronic measurement equipment with the objective of incorporating fully recycled aluminium in its products?

RQ5: What sort of sustainability Key Process Indicator (KPI) should my company adopt? My company is an SME that produces scales and other electronic measurement equipment.

The remainder of this paper is structured as follows. Section 2 presents the literature review, followed by the Section 3, methodology. The results of the ChatGPT data analysis are presented and discussed in the next section (4). Finally, the conclusions containing implications of this research, the limitations of this study, and the future scope of further studies in this field are discussed in Section 5.

## Literature review

The sustainability concept highlights the relevance of adopting best practices and approaches for social, environmental, and economic aspects to ensure enduring business development, also identified as the three main pillars of corporate sustainability, also known as the "triple bottom line" (Anvari & Turkay, 2017; Fonseca, 2015). The literature identifies several drivers and benefits of adopting sustainable development practices from SMEs. Companies can obtain a positive customer perception if they are sustainability oriented (Gürlek et al., 2017; Vesal et al., 2020). Concerning the environmental dimension, SMEs can implement formal (e.g., Environmental Management Systems) or informal approaches to improve environmental performance and minimise waste (Han et al., 2014; Siegel et al., 2019). Regarding the social approach, SMEs can be involved with communities and make relevant contributions that can be valued by society at large (Gürlek et al., 2017; Salimzadeh et al., 2015). Furthermore, by successfully engaging in economic relationships with diverse organisations, SMEs can focus on cooperation that would benefit the economic dimension through business growth and prosperity (Moore & Manring, 2009).

Academic studies identified several vital findings concerning SMEs' sustainability. A successful managerial strategy that integrates sustainability with the key company strategies and goals is critical for enduring success (Berns et al., 2009; Shields & Shelleman, 2015). The legitimacy of stakeholders' expectations (Bansal & Clelland, 2004) and the need to identify

and monitor the risks and opportunities (Fonseca & Domingues, 2018) are considered highly relevant. Moreover, there is support for the view that formal, responsible economic, and social elements of sustainability positively affect competitive advantage and create value (Cantele & Zardini, 2018; Camilleri, 2017; Pernici & Stancu, 2024). However, there is limited empirical research addressing SMEs' business sustainability (Malesios et al., 2018) since most previous studies on business sustainability have mainly focused on large multinational enterprises with a critical focus on social and environmental perspectives (Al-Shaikh & Hanaysha, 2023; Ferro et al., 2019).

Contemporary organisations face unprecedented volatility, uncertainty, complexity, and ambiguity (VUCA) (Bennett & Lemoine, 2014). SMEs are confronted with sustainability challenges (e.g., climate change and resource scarcity), the massive diffusion of digital technologies, and the increasingly complex and volatile global environment. Therefore, firms, especially SMEs, struggle to keep pace with the fast-evolving environment by relying only on their internal capabilities with limited access to abundant material and financial resources (Brink, 2018). To overcome this problem, companies can collaborate with external partners to gain external knowledge resources (Troise et al., 2022).

Artificial Intelligence (AI) can support organizations in detecting and measuring social criticalities, optimising resources, and reducing waste in several activities. It has been used extensively in operations environments (Dhamija & Bag, 2020; Eriksson et al., 2020) and environmental (Zhong et al., 2021; Liu et al., 2022) and sustainability (Neis & Tanțău, 2023) research. By managing a considerable amount of data, ChatGPT provides a broader understanding of the reference context (Wang et al., 2023). Supported by plausible, credible, and personalized responses in real-time (Sobania et al., 2023), providing personalized responses in real-time (Kumar, 2023; Shen et al., 2023). The adoption of ChatGPT by companies has generated benefits for both the user and the organisation, as it impacts the organization's performance by supporting managers and employees in carrying out their strategic, tactical, and operational tasks and providing information and continuous support (Chu, 2023). Furthermore, academic research posits that ChatGPT has significant potential and is helpful if used wisely and ethically at the scientific and academic levels (Qasem, 2023).

Amongst the main benefits of AI-driven solutions like ChatGPT identified in the literature are (Ban et al., 2024; Dale, 2017; Iamandi et al., 2024; Istudor et al., 2024; Lee et al., 2023; Mammadov et al., 2024; Pelău, 2024; Popescu et al., 2024; Zhou et al., 2021):

1. **Increased Productivity:** AI handles repetitive tasks such as data entry, analysis, and customer support, freeing humans from more complex work that requires creativity and critical thinking.
2. **Innovation Acceleration:** AI analyses data quickly, leading to faster innovation.
3. **Strengthened Competitiveness:** AI improves efficiency by automating processes, enhances decision making by analysing large volumes of data, and improves customer experiences by providing personalised recommendations, giving companies a competitive edge.
4. AI has the potential to create new jobs, particularly in roles requiring specialised skills in its development and operation, offering a promising outlook for the job market.
5. AI's ability to perform tasks beyond human capability is a testament to its potential to significantly enhance operational efficiency, providing a reassuring perspective on its role in the workplace.

Conversely, academic research also identified several risks associated with AI-driven solutions (Ban et al., 2024; Dale, 2017; Iamandi et al., 2024; Istudor et al., 2024; Lee et al., 2023; Mammadov et al., 2024; Pelău, 2024; Popescu et al., 2024; Zhou et al., 2021):

1. Job Displacement: Automation can lead to job losses in roles that can be easily automated.
2. Skills Gap: Rapid AI adoption may outpace the development of necessary workforce skills.
3. Dehumanisation of Work: AI might reduce human-centric aspects of work, such as personal interactions and decision-making, potentially affecting job satisfaction and the organization's overall culture.
4. Organisational Tensions: AI integration can create internal conflicts if employees feel threatened or if alignment with existing processes is difficult.
5. Cultural Challenges: Cultural differences can affect AI adoption and related skills development.
6. Bias and Contextual Limitations: AI models can perpetuate biases and generate implausible outputs due to their statistical nature and limited understanding of context.
7. Resource Intensity and Confidentiality Issues: Operating AI at scale requires significant resources, and there are potential confidentiality risks if AI models are hosted online.

## Research methodology

### Overview

In line with the research questions, identifying the SMEs' Environmental, Social and Governance (ESG) tasks was performed to identify the prompts to present to GPT3.5 (Table 1).

Academic studies identified several vital findings concerning SMEs' sustainability. A successful managerial strategy that integrates sustainability with the key company strategies and goals is critical for enduring success (Berns et al., 2009; Shields & Shelleman, 2015). The legitimacy of stakeholders' expectations (Bansal & Clelland, 2004) and the need to identify and monitor the risks and opportunities (Fonseca & Domingues, 2018) are considered highly relevant. Moreover, there is support for the view that formal, responsible economic, and social elements of sustainability positively affect competitive advantage and create value (Cantele & Zardini, 2018; Camilleri, 2017).

*Table 1. ESGs SMEs selected tasks (RQs)*

ESG task (Deloitte, 2023)	ESG task (Sustana, 2023)	Academic literature	ESG SMEs selected tasks (RQS)
Develop sustainability roadmaps	Codify purpose and principles	Companies' sustainability depends on managerial strategies (Berns et al. 2009); SMEs can achieve sustainability by applying a sustainability strategy or a model (Shields and Shelleman, 2015).	Sustainability roadmap (RQ1)

ESG task (Deloitte, 2023)	ESG task (Sustana, 2023)	Academic literature	ESG SMEs selected tasks (RQS)
Evaluate necessary capabilities	Build business case internally	Formal, economic, and social elements of sustainability positively affect competitive advantage (Cantele and Zardini 2018); Sustainability can be built through responsible business practices (Camilleri, 2017).	Strategic Positioning - five top goals considering UN SDGs (RQ3)
Identify synergies between existing systems/processes and sustainability initiatives	Track progress (KPI)	Businesses use sustainability practices to create value (Sull and Escobari 2004).	KPIs (RQ5)
Communication with stakeholders	Engage with stakeholders and peers	Environmental sustainability depends on legitimacy and stakeholders' expectations (Bansal and Clelland 2004).	Communication with stakeholders (RQ2)
Risk and opportunities evaluation	Establish ESG governance and risk oversight	Companies need to monitor their determination of risks and opportunities for successful environment management (Fonseca & Domingues, 2018).	Risks and opportunities (RQ4)

Source: Authors' own research.

After analysing GPT3.5 answers (A, “text between quotation marks”), subsequent prompts were submitted in some cases to gather a more detailed answer. Finally, the answers were summarised to identify the main contributions. To validate the proposed framework, actions, and KPIs, a focus group was set up with the participation of two professors and two top managers of SMEs, all familiar with sustainability and ChatGPT.

### **Data Analysis - ChatGPT-Tests (3.5. turbo)**

#### **Sustainability Roadmap**

RQ1: Develop a sustainability roadmap for an SME company that produces scales and other electronic measurement equipment.

“A1: Developing a sustainability roadmap for a SME company that produces scales and other electronic measurement equipment involves considering various aspects of sustainability. Here is a comprehensive roadmap that you can follow:

1. Assess Current Sustainability Performance:
  - Conduct a sustainability audit to understand the company's current environmental impact, resource consumption, waste generation, and social responsibilities.
  - Identify key areas where improvements can be made, such as energy efficiency, waste management, supply chain sustainability, and employee well-being.
2. Set Clear Sustainability Goals:
  - Define specific, measurable, attainable, relevant, and time-bound (SMART) sustainability goals.

Prioritise areas with the most significant impact, such as reducing greenhouse gas emissions, minimising waste, and promoting responsible sourcing and manufacturing practices.

- Align the goals with international standards and frameworks like the UN Sustainable Development Goals (SDGs) and ISO 14001.

### 3. Develop an Environmental Management System (EMS):

- Implement an EMS, such as ISO 14001, to establish a systematic approach to manage environmental impacts.

- Assign responsibilities, create processes, and set up procedures to monitor, measure, and continuously improve environmental performance.

- Regularly review and update the EMS to ensure it remains effective and aligned with sustainability objectives.

### 4. Enhance Energy Efficiency:

- Conduct an energy audit to identify areas of energy waste and inefficiency.

- Invest in energy-efficient equipment and technologies.

- Implement energy management practices, such as setting energy-saving targets, optimizing processes, and promoting energy-conscious behaviour among employees.

- Explore the use of renewable energy sources, such as solar or wind power, to reduce reliance on fossil fuels.

### 5. Optimise Waste Management:

- Implement a waste management strategy to reduce, reuse, and recycle waste generated during manufacturing processes.

- Provide recycling facilities for employees and encourage proper waste sorting and disposal.

- Explore partnerships with recycling and waste management companies to ensure proper handling of electronic waste (e-waste).

### 6. Promote Responsible Sourcing and Supply Chain Management:

- Establish sustainability criteria for selecting suppliers based on their environmental and social practices.

- Encourage suppliers to adhere to sustainability standards and certifications, such as ISO 14001 and ISO 26000.

- Collaborate with suppliers to identify opportunities to reduce environmental impact and improve the overall sustainability of the supply chain.

### 7. Engage Employees and Stakeholders:

- Raise awareness among employees about the importance of sustainability and provide training on sustainable practices.

- Encourage employee participation in sustainability initiatives and reward environmentally responsible behaviour.

- Communicate sustainability efforts and progress transparently to stakeholders, including customers, suppliers, and local communities.

### 8. Foster Innovation and Product Design:

- Integrate sustainability principles into the product design process to develop more eco-friendly and energy-efficient products.

- Explore opportunities for product life extension, repairability, and recycling.

- Encourage customer feedback and collaboration to drive sustainable innovation.

### 9. Monitor, Measure, and Report Progress:

- Establish key performance indicators (KPIs) to measure progress towards sustainability goals.

- Implement a monitoring system to track and analyse sustainability metrics regularly.

- Publish an annual sustainability report to communicate achievements, challenges, and future targets to stakeholders.

#### 10. Continuously Improve and Collaborate:

- Regularly review and update the sustainability roadmap to ensure that it remains relevant and aligned with evolving sustainability trends and regulations.

- Collaborate with industry peers, NGOs, and government agencies to share best practices, exchange knowledge, and collectively address sustainability challenges.

Remember, sustainability is an ongoing journey, and continuous improvement is crucial. By following this roadmap, your SME company can make significant progress in integrating sustainability into its operations and contribute to a more sustainable future”.

RQ1.1.: Make it more specific, considering what the company does.

“A1.1.: Certainly! Here is a more specific sustainability roadmap tailored to a SME company that produces scales and other electronic measurement equipment:

#### 1. Assess Current Sustainability Performance:

- Conduct a lifecycle assessment to understand the environmental impact of your products throughout their entire lifecycle, including raw material extraction, manufacturing, use, and disposal.

- Evaluate the energy consumption and efficiency of your production processes.

- Assess waste generation and disposal practices, particularly regarding electronic waste (e-waste).

#### 2. Set Clear Sustainability Goals:

- Reduce the carbon footprint of your products by a certain percentage (e.g., 20%) over the next five years.

- Increase the use of recycled or recyclable materials in your product design by a specific amount (e.g., 30%) within the next three years.

- Implement measures to minimize electronic waste generated by your products, aiming for zero waste to landfill.

#### 3. Develop an Environmental Management System (EMS):

- Implement an EMS, such as ISO 14001, to manage and monitor your environmental performance systematically.

- Establish procedures to ensure compliance with relevant environmental regulations and standards.

- Regularly review and update the EMS to reflect changing sustainability goals and best practices.

#### 4. Enhance Energy Efficiency:

- Invest in energy-efficient manufacturing equipment and technologies.

- Implement energy management practices, such as optimising production processes, utilizing energy-efficient lighting, and improving insulation and HVAC systems in facilities.

- Set targets for reducing energy consumption per unit of production.

#### 5. Optimise Waste Management:

- Implement a waste management strategy to minimise waste generation during manufacturing processes.

- Establish processes for sorting and recycling waste materials, including electronic components, batteries, and packaging.

- Collaborate with recycling companies specialised in handling electronic waste to ensure proper disposal and recycling of end-of-life products.

#### 6. Promote Responsible Sourcing and Supply Chain Management:

- Establish sustainable sourcing criteria for your suppliers, considering factors such as environmental certifications, responsible mining practices, and conflict mineral-free sourcing.

- Encourage suppliers to adopt sustainable practices, including waste reduction, energy efficiency, and ethical labour standards.

- Regularly communicate and engage with suppliers to ensure adherence to sustainability criteria and encourage continuous improvement.

#### 7. Engage Employees and Stakeholders:

- Conduct sustainability training programmes for employees to raise awareness about the importance of sustainability and provide them with the knowledge to implement sustainable practices.

- Involve employees in identifying and implementing sustainability initiatives within their respective areas of expertise.

- Seek input from customers and stakeholders on sustainability priorities and integrate their feedback into decision-making processes.

#### 8. Foster Innovation and Product Design:

- Integrate sustainable design principles, such as material efficiency, product durability, and energy efficiency, into your product development process.

Explore opportunities for product life extension, repairability, and upgradeability to minimise product obsolescence.

- Engage with customers and industry partners to identify emerging sustainability trends and incorporate them into your product offerings.

#### 9. Monitor, Measure, and Report Progress:

- Develop key performance indicators (KPIs) to track and measure progress toward sustainability goals, such as carbon emissions per product unit, waste reduction rates, and percentage of recycled materials used.

- Implement regular monitoring and reporting systems to measure and analyse sustainability metrics.

- Publish an annual sustainability report that highlights achievements, challenges, and future targets, demonstrating transparency to stakeholders.

#### 10. Continuously Improve and Collaborate:

- Regularly evaluate the effectiveness of sustainability initiatives and make necessary adjustments to achieve better results.

- Collaborate with industry associations, research institutions, and sustainability networks to share best practices and learn from others in the field.

- Stay informed about evolving regulations and industry standards related to sustainability and adapt your practices accordingly.

By following this specific roadmap, your SME company can make significant progress towards sustainability, reduce environmental impact, and improve the overall sustainability of your scales and electronic measurement equipment”.

Table 2 summarises the main topics of the suggested SME (company producing scales and other electronic equipment) sustainability roadmap, highlighting the PDCA (Plan-Do-Check-Act) nature of the suggested roadmap (with an additional first check) which is consistent with the major ISO Quality, Environmental and Health and Safety ISO management Standards (Fonseca et al., 2022).

*Table 2. Sustainability roadmap summary*

<b>Actions</b>	<b>Phase</b>
1. Assess Current Sustainability Performance	Check
2. Set Clear Sustainability Goals	Plan
3. Develop an Environmental Management System (EMS)	
4. Enhance Energy Efficiency	Do
5. Optimize Waste Management	
6. Promote Responsible Sourcing and Supply Chain Management	
7. Engage Employees and Stakeholders	
8. Foster Innovation and Product Design	Check
9. Monitor, Measure, and Report Progress	
10. Continuously Improve and Collaborate	Act

Source: Authors' own research based on ChatGPT answers.

### *Communication with stakeholders*

RQ2: Create a communication directed towards the stakeholders of a SME that produces scales and other electronic measurement equipment, about an initiative to incorporate fully recycled aluminum. The company's mission is "To add value to the weighing world by innovating through the development, production, and commercialisation of instruments and services that our customers are proud to use." Its values are "One Group, One Family; Integrity and Rigor; Innovation and Excellence".

"A2: Subject: Introducing Our Sustainable Initiative: Incorporating Fully Recycled Aluminum

Dear Valued Stakeholders,

We hope this message finds you well. As a dedicated stakeholder of our SME company, we are excited to share an important development that aligns with our mission of adding value to the weighing world through innovation. We are proud to announce the launch of our sustainable initiative to incorporate fully recycled aluminum into our scales and electronic measurement equipment.

At [Company Name], we believe that sustainability and innovation go hand in hand. With a deep commitment to environmental responsibility, we strive to continuously improve our products and services while reducing our carbon footprint. By adopting fully recycled aluminum, we are taking a significant step towards achieving our sustainability goals and fulfilling our promise to develop instruments and services that our customers are proud to use.

#### Why Fully Recycled Aluminum?

Using fully recycled aluminum offers numerous environmental benefits. By incorporating recycled materials into our production processes, we can significantly reduce energy consumption, decrease greenhouse gas emissions, and conserve natural resources. This initiative aligns with our values of integrity and rigour, as our objective is to create positive change by minimising our impact on the environment.

### How This Initiative Aligns with Our Mission and Values:

Our mission, "To add value to the weighing world by innovating through the development, production, and commercialisation of instruments and services that our customers are proud to use," underscores our commitment to innovation and excellence. By incorporating fully recycled aluminum, we are introducing sustainable practices into our manufacturing process, enhancing our product quality, and ensuring that our customers have access to environmentally friendly solutions.

Moreover, our values of "One Group, One Family," "Integrity and Rigor," and "Innovation and Excellence" are at the core of this initiative. We believe in the power of collaboration, and by adopting recycled aluminum, we are actively contributing to a more sustainable future for our industry and communities. This step reflects our integrity and rigour in making responsible choices while upholding the highest standards of excellence.

### Our Commitment to Sustainability:

Incorporating fully recycled aluminum is just one part of our broader sustainability strategy. We are committed to continuously improving our environmental performance, improving energy efficiency, optimizing waste management practices, and promoting responsible sourcing throughout our supply chain. By doing so, we aim to create a positive impact on the environment, our stakeholders, and society as a whole.

### We Value Your Partnership:

As a valued stakeholder, your support and collaboration are integral to our sustainability journey. We encourage you to share your insights, ideas, and feedback as we work together to drive positive change. We firmly believe that by uniting our efforts, we can achieve remarkable outcomes and create a more sustainable future for generations to come.

Thank you for your continued trust in [Company Name]. We remain committed to our mission, values, and sustainability goals. Together, let us make a difference in the weighing world and leave a lasting positive impact on our planet.

Sincerely,

[Your Name]

[Your Title]

[Company Name]"

To sum-up, the proposed communication strategy emphasizes the company mission, values, and stakeholder engagement. ChatGPT highlights the company commitment to improve its environmental performance proposes and promote responsible sourcing throughout the supply chain, aiming to deliver enduring value to the environment, their stakeholders, and society. A critical analysis of these ChatGPT recommendations can detect a stronger emphasis on the environmental dimension, when compared to the social dimension, which is consistent with the findings of Fonseca et al. (2023) that found an emphasis on the environmental dimension within SDG disclosure by Portuguese organisations with integrated management systems (IMSS).

### *Strategic Positioning*

RQ3: Considering the United Nations Sustainable Development Goals, what are the top 5 goals a SME company that produces scales and other electronic measurement equipment should focus on?

“A3: For a SME company that produces scales and other electronic measurement equipment, the following are the top five United Nations Sustainable Development Goals (SDGs) that should be prioritized:

1. Goal 9: Industry, Innovation, and Infrastructure

- This goal focuses on promoting inclusive and sustainable industrialization, fostering innovation, and enhancing infrastructure. It aligns with the company's mission of adding value to the weighing world through innovation and development of instruments and services.

2. Goal 12: Responsible Consumption and Production

This goal emphasises sustainable consumption and production patterns. As a company producing electronic measurement equipment, focusing on responsible production practices, waste reduction, and recycling initiatives aligns with this goal.

3. Goal 13: Climate Action

- This goal addresses the urgent need to combat climate change and its impacts. For a company in the manufacturing sector, reducing greenhouse gas emissions, adopting energy-efficient practices, and minimising the carbon footprint are vital steps to contribute to climate action.

4. Goal 8: Decent Work and Economic Growth

- This goal focuses on promoting inclusive and sustainable economic growth, employment, and decent work for all. By creating employment opportunities, providing fair wages, and ensuring safe working conditions, the company can contribute to achieving this goal.

5. Goal 17: Partnerships for the Goals

- This goal emphasizes the importance of collaboration and partnerships to achieve the SDGs. Engaging in partnerships with suppliers, customers, industry associations, and sustainability networks can help the company leverage collective knowledge and resources to address sustainability challenges effectively.

While these five SDGs are particularly relevant to a company producing scales and electronic measurement equipment, it is important to note that the SDGs are interconnected and should be pursued holistically. Considering the broader SDG framework and integrating sustainability practices in multiple goals will contribute to a more comprehensive and impactful approach to sustainability”.

Table 3 presents the summary of the top five suggested priority SDGs.

*Table 3. Summary of the top five suggested priority SDGs.*

<b>Priority SDG</b>	<b>SD Dimension</b>	<b>Relationship with Literature</b>
Goal 9: Industry, Innovation, and Infrastructure	Economic	Top SDG disclose (Fonseca et al., 2023; Hummel and Szekely, 2022; Izzo et al., 2020; Manes-Rossi and Nicolò, 2022)
Goal 12: Responsible Consumption and Production	Economic and social	Top SDG disclose (Fonseca et al., 2023; Hummel and Szekely, 2022; Izzo et al., 2020; Manes-Rossi and Nicolò, 2022)
Goal 13: Climate Action	Environmental	Goal 13 calls for urgent action to combat climate change and its impacts and is linked to all the other 16 SDGs (UN, 2023).
Goal 8: Decent Work and Economic Growth	Economic and social	The promotion of inclusive and sustainable economic

Priority SDG	SD Dimension	Relationship with Literature
		growth, employment and decent work is critical for equality and socioeconomic development, namely by eradicating poverty and ensuring the importance of labor rights for all (Yin et al., 2022)
Goal 17: Partnerships for the Goals	Economic, environmental, and social	Top SDG disclose (Fonseca et al., 2023)

Source: Authors' own research based on ChatGPT answers.

RQ3.1.: Suggest 5 initiatives that allow the company to contribute towards these goals.

"A3.1.: Certainly! Here are five initiatives that a company producing scales and other electronic measurement equipment can implement to contribute towards the United Nations Sustainable Development Goals (SDGs):

1. Sustainable Product Design and Development:
  - Initiative: Incorporate eco-design principles into the product development process, focusing on energy efficiency, durability, use of recycled materials, and end-of-life recyclability.
  - Contribution to the SDGs: Goal 9 (Industry, Innovation, and Infrastructure), Goal 12 (Responsible Consumption and Production).
2. Energy Efficiency and Renewable Energy:
  - Initiative: Implement energy-efficient practices in manufacturing processes, such as optimising equipment, using energy management systems, and investing in renewable energy sources (e.g., solar panels).
  - Contribution to the SDGs: Goal 9 (Industry, Innovation, and Infrastructure), Goal 13 (Climate Action).
3. Waste Reduction and Recycling:
  - Initiative: Establish a comprehensive waste management system that focuses on reducing waste generation, segregating recyclable materials, and collaborating with recycling partners to ensure proper disposal of electronic waste (e-waste).
  - Contribution to the SDGs: Goal 12 (Responsible Consumption and Production), Goal 13 (Climate Action).
4. Responsible Supply Chain Management:
  - Initiative: Develop sustainability criteria for supplier selection, considering environmental and social factors. Collaborate with suppliers to promote responsible sourcing, ethical labour practices, and environmental stewardship throughout the supply chain.
  - Contribution to the SDGs: Goal 12 (Responsible Consumption and Production), Goal 17 (Partnerships for the Goals).
5. Stakeholder Engagement and Awareness:
  - Initiative: Engage with employees, customers, suppliers, and the local community to raise awareness of sustainability initiatives, provide training on responsible practices, and encourage active participation in sustainability efforts.
  - Contribution to the SDGs: Goal 8 (Decent Work and Economic Growth), Goal 17 (Partnerships for the Goals).

By implementing these initiatives, the company can make meaningful contributions towards sustainable development, align with the SDGs, and create a positive impact on the environment, society, and the industry as a whole”.

### *Identify risks and opportunities*

RQ4: What are the risks and opportunities of an initiative made by a SME that produces scales and other electronic measurement equipment, with the objective of incorporating fully recycled aluminum in their products?

“A4: Initiative: Incorporating Fully Recycled Aluminum in Products

#### Risks:

1. **Supply Chain Challenges:** The availability of fully recycled aluminum may be limited, which could pose challenges in sourcing a consistent supply of the material. This could lead to potential disruptions or increased costs if alternative supply chains are not established.
2. **Quality and Performance:** Using recycled aluminum may have implications on the quality and performance of the final products. Variations in material properties or impurities in the recycled aluminum could affect product durability, accuracy, or functionality. Thorough testing and quality control measures are necessary to ensure that the products meet the required standards.
3. **Cost Considerations:** The cost of fully recycled aluminum may be higher than that of primary aluminum due to the additional processing steps involved. This could potentially increase manufacturing costs, which may need to be carefully managed to maintain competitiveness in the market.

#### Opportunities:

1. **Environmental Benefits:** Incorporating fully recycled aluminum aligns with sustainability objectives and demonstrates the company's commitment to environmental responsibility. It reduces the demand for virgin aluminum, conserves natural resources, and decreases the carbon footprint associated with primary aluminum production.
2. **Enhanced Brand Reputation:** Adopting sustainable practices can enhance the company's brand reputation as a socially and environmentally responsible organisation. Customers, stakeholders, and environmentally conscious consumers are increasingly valuing products made with recycled materials, providing opportunities for market differentiation and increased sales.
3. **Regulatory Compliance:** Many countries and regions are implementing regulations and incentives to promote the use of recycled materials. By proactively incorporating fully recycled aluminum, the company can ensure compliance with existing and future regulations, avoiding potential penalties or market access restrictions.
4. **Innovation and Product Differentiation:** Incorporating fully recycled aluminum can drive product innovation and differentiation. It allows the company to position itself as a leader in sustainability, attracting environmentally conscious customers who prioritise products with lower environmental impacts.
5. **Access to Sustainability-Focused Markets:** Some industries or customers have sustainability requirements and preferences. By offering products made with fully recycled aluminum, the company can gain access to these markets and strengthen relationships with sustainability-focused customers, opening new business opportunities.

To mitigate risks and maximise opportunities, the company should conduct thorough research, collaborate with knowledgeable suppliers, and invest in product testing and quality

control measures. Additionally, ongoing monitoring and evaluation of the initiative's outcomes will help identify areas for improvement and ensure that the expected benefits are realized”.

### *Key Process Indicators (KPI)*

RQ5: What sort of sustainability KPI should my company adopt? My company is a SME that produces scales and other electronic measurement equipment.

“A5: When adopting sustainability Key Performance Indicators (KPIs) for your SME company that produces scales and other electronic measurement equipment, it is important to consider metrics that align with your sustainability goals and are relevant to your industry. Here are some suggested sustainability KPIs that you can consider:

1. Carbon Footprint:
  - Measure and track the company's greenhouse gas emissions, including direct (Scope 1) and indirect (Scope 2 and 3) emissions.
  - Express the carbon footprint as metric tons of CO<sub>2</sub> equivalent (tCO<sub>2</sub>e) per unit of production or revenue.
  - Set targets to reduce the carbon footprint over time, aiming for year-on-year improvements.
2. Energy Efficiency:
  - Measure energy consumption and track energy usage per unit of production or revenue.
  - Set targets to improve energy efficiency, such as reducing energy consumption by a certain percentage or achieving energy intensity reductions over specific timeframes.
  - Monitor progress through regular energy audits and metering systems.
3. Waste Reduction:
  - Measure and track the amount of waste generated, including general waste, hazardous waste, and electronic waste (e-waste).
  - Express waste generation as weight or volume per unit of production or revenue.
  - Set targets to reduce waste generation, increase recycling rates, and minimise e-waste sent to landfill.
4. Sustainable Material Sourcing:
  - Measure the percentage of recycled or sustainably sourced materials used in your products.
  - Track the proportion of materials sourced from suppliers with responsible and ethical practices.
  - Set targets to increase the use of recycled materials or sustainable alternatives in product manufacturing.
5. Product End-of-Life Management:
  - Measure the percentage of products that are designed for recyclability or can be easily repaired and upgraded.
  - Track the proportion of products that are properly disposed of or recycled at the end of their lifecycle.
  - Set targets to increase the circularity and recyclability of products, aiming for zero waste to landfill.

#### 6. Supplier Sustainability Performance:

- Develop a supplier assessment framework and measure the sustainability performance of your key suppliers.
- Evaluate suppliers based on environmental criteria, labour practices, ethical sourcing, and compliance with sustainability standards.
- Set targets to work with suppliers to improve their sustainability performance over time.

#### 7. Employee Engagement:

- Measure employee engagement and awareness levels on sustainability initiatives through surveys or feedback mechanisms.
- Track the participation of employees in sustainability-related training programmes or volunteer activities.
- Set targets to increase employee engagement and incorporate sustainability into the company culture.

Remember, these KPIs serve as examples, and you should select the ones that are most relevant to your company's sustainability goals, operations, and stakeholder expectations. It is important to regularly review and update your KPIs to ensure that they remain aligned with your evolving sustainability strategy”.

## Discussion

To evaluate the value of the proposed framework, actions, and KPIs, a focus group was set up with the participation of two professors and two SMEs' top managers, all familiar with sustainability and ChatGPT. The conclusions of this focus group are as follows:

1. This study is unique in that it addresses a critical gap in the literature by focusing on the unique sustainability challenges SMEs face in the context of the UN SDGs. The novel application of ChatGPT as a tool for supporting SMEs in this endeavour is particularly innovative, offering a fresh perspective on how AI can be leveraged to promote sustainable practices in smaller enterprises. The research is grounded in a comprehensive literature review, highlighting SMEs' limitations and barriers, such as resource constraints and a lack of clear sustainability guidelines.

2. The academicians regard the methodological approach, centered around the use of ChatGPT, as well-conceived and appropriately tailored to the needs of SMEs. For the two practitioners, selecting a case study of an SME in the electronic measurement equipment industry has provided a practical example that enhances the relevance and applicability of the study's findings. The development of a sustainability roadmap, communication strategies, and the identification of key SDGs and KPIs are valuable contributions that SMEs can confidently implement.

3. As an overall conclusion, the focus group participants view this study as making a significant contribution to both academic and practical discussions on sustainability in SMEs. It offers a promising approach to overcoming and aligning SMEs' challenges with the UN SDGs. However, further empirical validation and exploration of the framework's limitations are needed. The participants recommend further research to empirically validate this framework within different industries and contexts, highlighting the potential for future research and development.

Finally, the focus group participants recommended the need for actions to successfully manage AI implementations, which is consistent with the views of academicians

(Ban et al., 2024; Dale, 2017; Iamandi et al., 2024; Istudor et al., 2024; Lee et al., 2023; Mammadov et al., 2024; Pelău, 2024; Popescu et al., 2024; Zhou et al., 2021). Upon a subsequent analysis and discussion, the following actions were identified to support SMEs in crafting their strategies to manage AI Implementation:

1. **Invest in Training and Upskilling:** By investing in continuous learning and development programmes, SMEs can equip their employees with the necessary skills to work alongside AI. This includes technical skills for AI operation and transversal skills like problem-solving and critical thinking, which can significantly enhance the workforce's efficiency and productivity.

2. **Promote a Culture of Adaptability:** SME leaders play an essential role in fostering a culture that embraces change and continuous learning. Their proactive communication of AI's benefits and employees' involvement in the transition process can significantly reduce resistance and make them feel influential and integral to the AI adoption process.

3. **Balance Automation with Human-Centric Work:** SME leaders and managers should strive to balance AI with human-centric tasks to maintain job satisfaction and engagement. By viewing AI as a tool to enhance human capabilities, not replace them, leaders can foster a sense of responsibility and consideration toward their employees.

4. **Anticipate and Address Organizational Tensions:** Proactively identifying potential sources of tension, such as fears of job loss or changes in work dynamics, can help SMEs manage these challenges. Open communication and involving employees in AI implementation decisions can reduce resistance.

5. **Develop Strategic Partnerships:** Collaborating with universities, research centers, or technology providers can help SMEs access the latest AI technologies and expertise, making the transition smoother and more effective.

6. **Tailor AI Adoption to Organisational Needs:** SMEs should assess their business needs and workforce capabilities before implementing AI. Customising AI solutions to fit the company's unique company context can maximise benefits and minimise disruptions.

7. **Monitor and Evaluate AI Impact:** Regularly assessing AI's impact on business processes and employee satisfaction can help SMEs adjust their strategies as needed, ensuring that AI integration supports long-term business goals.

## Conclusion

Small and medium-sized companies (SMEs) face several challenges when adopting sustainability practices and aligning with the UN SDGs. While these challenges can vary depending on factors such as the industry, location, and company size, many SMEs recognise the importance of sustainability. They will benefit from the support of models, roadmaps, and solutions that these types of companies can easily understand and adopt to plan and promote future sustainability improvements and monitor the implementation of the SDGs.

This research introduces a novel methodological approach supported by a Generative Pretrained Transformer (GPT) and presents a ChatGPT framework to support SMEs in tackling sustainability challenges. The research is framed on a) developing a sustainability roadmap for SMEs, b) creating a communication directed toward the stakeholders, c) identifying the top five SMEs' goals considering the UN SDGs, d) identifying the subsequent significant risks and opportunities, and finally, f) proposing the primary set of related KPIs.

Concerning the SME sustainability roadmap, ten actions are identified as top priorities, starting with the assessment of the current sustainability performance, followed

by the definition of clear sustainability goals, the development of an EMS, energy efficiency, and waste management improvement. In addition to these actions, SMEs should promote responsible sourcing and supply chain management, engage with employees and stakeholders, and promote innovation and product design, ending with monitoring, measuring, and reporting progress, as well as continuous improvement and collaboration.

SDGs 9 (Industry, Innovation, and Infrastructure), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), SDG 8 (Decent Work and Economic Growth) and SDG 17 (Partnerships for the Goals) are identified by GPT as the top 5 priority SDGs for SMEs, which is consistent with several academic works (e.g., Fonseca et al., 2023; Hummel & Szekely, 2022; Izzo et al., 2020; Manes-Rossi & Nicolò, 2022; Yin et al., 2022 and the UN (UN, 2023).

Finally, concerning the proposal for the key KPIs (within the specific example of a company), the monitoring of carbon footprint, energy efficiency, waste reduction, sustainable material sourcing, product end-of-life management, supplier sustainability performance, and employee engagement are considered the leading priority suggestions. Moreover, these KPIs align with the top suggested five SDGs by focusing on environmental and social performance improvement (e.g., industry, innovation, and infrastructure responsible consumption and production, climate action, decent work, and economic growth) and enhanced stakeholder management (decent work; partnerships for the goals).

To conclude, this study highlights the potential of using the ChatGPT framework for supporting SMEs' sustainability challenges. Hence, it contributes to the SDGs literature by addressing how SMEs can adopt sustainability practices to respond to the call to plan and promote the UN SDGs effectively. Furthermore, it contributes to the incipient research addressing the application of ChatGPT to tackle sustainability challenges. From a practitioner perspective, our findings provide important implications for managers by developing a sustainability roadmap for SMEs, identifying the top five SMEs' goals considering the UN SDGs, and the subsequent significant risks and opportunities.

Nevertheless, there are some limitations to this study. Firstly, since the SDGs are framed at a strategic level, and do not include plans with details on how the Small and Medium Enterprises (SMEs) should implement them, this is a complex task due to their extensive scope and relationships. Moreover, the world encompasses different worldviews and cultural, social, and political diversity. Therefore, there might be several approaches to successful SDG implementation. In an era of intense competition, increased stakeholder demands, and technological disruption, SMEs need appropriate support to adopt sustainability practices and improve performance. However, sustainability is an ongoing journey, and continuous improvement is crucial. By following this roadmap, an SME company can make significant progress in integrating sustainability into its operations and contribute to a more sustainable future. Nevertheless, it must monitor and adapt to its external and internal environments, strategy, and resources.

Second, this research is a novel effort in implementing ChatGPT for sustainability practices and aims to provide understandable and applicable frameworks and solutions for SMEs, although the methodology could be applied to other types of organisations. However, the reliance on ChatGPT, while innovative, raises questions about the accuracy and reliability of AI-generated recommendations. Potential biases and limitations inherent in ChatGPT, such as its occasional lack of common sense or logical reasoning, should be acknowledged. Additionally, the focus on a single industry limits the generalisability of the findings. Hence,

the solutions may vary for each specific company and context (e.g., the case of an SME that produces scales and other electronic measurement equipment was selected). Moreover, there are some limitations of ChatGPT technology, such as the risks of conveying biases and stereotypes in the data (Lucy & Bamman, 2021) and performing poorly in tasks requiring common sense or logical reasoning (Strubell et al., 2019). Hence, this possible limitation should be acknowledged, and ChatGPT should be applied responsibly.

Finally, future research should seek to validate the proposed framework across a broader range of industries and SME contexts and to assess the application of this methodology to organizations other than SMEs.

## Acknowledgments

The authors gratefully acknowledge the financial support from FCT-Fundação para a Ciência e Tecnologia (Portugal), national funding through project UIDB/50022/2020 (LAETA Base Funding).

## References

- Al-Shaikh, M.E., Hanaysha, J.R. (2023). A conceptual review on entrepreneurial marketing and business sustainability in small and medium enterprises. *World Development Sustainability*, 2, 100039. <https://doi.org/10.1016/j.wds.2022.100039>.
- Anvari, S., Turkay, M. (2017). The facility location problem from the perspective of triple bottom line accounting of sustainability. *International Journal Production Research*, 55(21), 6266-6287. <https://doi.org/10.1080/00207543.2017.1341064>.
- Ban, O., Mairescu, I., Bucur, M., Sabou, G.C. and Cohen-Tzedec, B. (2024). AI between Threat and Benefactor for the Competencies of the Human Working Force. *Amfiteatru Economic*, 26(67), pp. 762-782. <https://doi.org/10.24818/EA/2024/67/762>.
- Bansal, P., Clelland, I. (2004). Talking Trash: Legitimacy, Impression Management, and Unsystematic Risk in the Context of the Natural Environment. *The Academy of Management Journal*, 47 (1), 93-103. <https://doi.org/10.2307/20159562>.
- Battisti, M., & Perry, M. (2011). Walking the talk? Environmental responsibility from the perspective of small-business owners. *Corporate Social Responsibility and Environmental Management*, 18(3), 172–185. <https://doi.org/10.1002/csr.266>.
- Bennett, N., Lemoine, G.J. (2014). What a difference a word makes: understanding threats to performance in a VUCA world. *Business Horizons*, 57 (3), 311-317. <https://doi.org/10.1016/j.bushor.2014.01.001>.
- Berns, Maurice & Townend, Andrew & Khayat, Zayna & Balagopal, Balu & Reeves, Martin & Hopkins, H.S. & Kruschwitz, Nina. (2009). The Business of Sustainability: What It Means to Managers Now. *MIT Sloan Management Review*, 51. 20-26.
- Bojan, A. M. (2024). SMEs Representatives' Perceptions of Corporate Governance-Performance Relationship. Evidence from an Emerging Economy. In Proceedings of the International Conference on Economics and Social Sciences. The International Conference on Economics and Social Sciences. Editura ASE. <https://doi.org/10.24818/icess/2024/010>.

- Bratu, A.-M., & Cunea, M.-I. (2024). SDG Reporting in a Romanian Listed Company in Crisis Period. In Proceedings of the International Conference on Economics and Social Sciences. The International Conference on Economics and Social Sciences. Editura ASE. <https://doi.org/10.24818/icess/2024/011>.
- Camilleri, M. A. (2017). The Corporate Social Responsibility Notion. In *Corporate Sustainability, Social Responsibility and Environmental Management*, 3-26. Cham, Switzerland: Springer Nature, Available at SSRN: <https://ssrn.com/abstract=3289530>.
- Cantele, S., Zardini, A. (2018). Is Sustainability a Competitive Advantage for Small Businesses An Empirical Analysis of Possible Mediators in the Sustainability—Financial Performance Relationship. *Journal of Cleaner Production*, 182, 166-176. <https://doi.org/10.1016/j.jclepro.2018.02.016>.
- Cantele S, Zardini A. (2020). What drives small and medium enterprises towards sustainability? Role of interactions between pressures, barriers, and benefits. *Corporate Social Responsibility and Environmental Management*; 27:126-136. <https://doi.org/10.1002/csr.1778>.
- Choi, J., Hwang, M., Kim, G., Seong, J., Ahn, J. (2016). Supporting the measurement of the United Nations' sustainable development goal 11 through the use of national urban information systems and open geospatial technologies: a case study of South Korea. *Open Geospatial Data, Software and Standards*, 1, 4. <https://doi.org/10.1186/s40965-016-0005-0>.
- Chu, M.N. (2023). Assessing the Benefits of ChatGPT for Business: An Empirical Study on Organizational Performance. *IEEE Access*, 11:76427-76436. <https://doi.org/10.1109/ACCESS.2023.3297447>.
- Cosma, A. (2024). The Development of a Quantitative Measurement Scale to Assess Romanian Knowledge and Attitude Towards Sustainability and Sustainable Clothing. In Proceedings of the International Conference on Economics and Social Sciences. The International Conference on Economics and Social Sciences. Editura ASE. <https://doi.org/10.24818/icess/2024/062>.
- Dale, R. (2017). NLP in a post-truth world. *Natural Language Engineering*, 23 (2), 319-324.
- Deloitte. *Introduction to Corporate ESG for SMEs* (<https://www2.deloitte.com/content/dam/Deloitte/sg/Documents/audit/sg-aud-introduction-to-corporate-esg-for-smes-brochure.pdf>, assessed 1 July 2023).
- Dhamija, P., & Bag, S. (2020). Role of artificial intelligence in operations environment: a review and bibliometric analysis. *The TQM Journal*, 32(4), 869-896. <https://doi.org/10.1108/TQM-10-2019-0243>.
- Dwivedi Y.K., Kshetri N., Hughes L., Slade E.L., Jeyaraj A., Kar A.K., et al. (2023). So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy. *International Journal of Information Management*, 71, Article 102642. <https://doi.org/10.1016/j.ijinfomgt.2023.102642>.
- Eriksson, T., Bigi, A., & Bonera, M. (2020). Think with me, or think for me? On the future role of artificial intelligence in marketing strategy formulation. *The TQM Journal*, 32(4), 795-814. <https://doi.org/10.1108/TQM-12-2019-0303>.

- European Commission (2023b). *Corporate sustainability reporting*. [https://finance.ec.europa.eu/capitalmarkets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporatesustainability-reporting\\_en](https://finance.ec.europa.eu/capitalmarkets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporatesustainability-reporting_en), assessed 1 November 2023.
- Fassin, Y., Werner, A., Van Rossem, A., Signori, S., Garriga, E., von Weltzien Hoivik, H., & Schlierer, H. J. (2015). CSR and related terms in SME owner–managers' mental models in six European countries: National context matters. *Journal of Business Ethics*, 128(2), 433–456. <https://doi.org/10.1007/s10551-014-2098-7>.
- Ferro, C., Padin, C., Høgevoid, N., Svensson, G., Varela, J.C.S. (2019). Validating and expanding a framework of a triple bottom line dominant logic for business sustainability through time and across contexts. *Journal of Business & Industrial Marketing*, 34 (1) 95-116. <https://doi.org/10.1108/JBIM-07-2017-0181>.
- Fonseca, L. M. (2015). Strategic drivers for implementing sustainability programs in Portuguese organizations—Let's listen to Aristotle: From triple to quadruple bottom line. *Sustainability: The Journal of Record*, 8(3), 136-142. <https://doi.org/10.1089/SUS.2015.29004>.
- Fonseca, L.M., Domingues, J.P., Pereira, M.T., Martins, F.F. and Zimon, D. (2018). Assessment of circular economy within Portuguese organizations. *Sustainability*, 10(7), 2521. <https://doi.org/10.3390/su10072521>.
- Fonseca, L.M. and Domingues, J.P. (2018). Exploratory Research of ISO 14001:2015 Transition among Portuguese Organizations. *Sustainability*, 10, 781. <https://doi.org/10.3390/su10030781>.
- Fonseca, L., Domingues, J.P., Dima, A.M. (2020). Mapping the Sustainable Development Goals Relationships. *Sustainability*, 12, 3359. <https://doi.org/10.3390/su12083359>.
- Fonseca, L.; Carvalho, F.; Santos, G. (2023). Strategic CSR: Framework for Sustainability through Management Systems Standards—Implementing and Disclosing Sustainable Development Goals and Results. *Sustainability*, 15, 11904. <https://doi.org/10.3390/su151511904>.
- García-Sánchez, I.M., Rodríguez-Ariza, L., Aibar-Guzman, B., Aibar-Guzmán, C. (2020). Do institutional investors drive corporate transparency regarding business contribution to the sustainable development goals? *Business Strategy and the Environment*, 29 (5), 2019–2036. <https://doi.org/10.1002/BSE.2485>.
- Govindan, K.; Khodaverdi, R.; Jafarian, A. (2013). A fuzzy multi criteria approach for measuring sustainability performance of a supplier based on triple bottom line approach. *Journal of Cleaner Production*, 47, 345-354. <https://doi.org/10.1016/j.jclepro.2012.04.014>
- Gürlek, M., Düzgün, E., Uygur, S.M. (2017). How does corporate social responsibility create customer loyalty? The role of corporate image. *Social Responsibility Journal*, 13(3) 409-427. <https://doi.org/10.1108/SRJ-10-2016-0177>.
- Gustafsson, R., Klefsjö, B., Berggren, E. and Granfors, U. (2001). Experiences from implementing ISO 9000 in small enterprises: A study of Swedish organizations. *The TQM Magazine*, 13(4), 232-246. <https://doi.org/10.1108/09544780110366088>.
- Han, L., Benson, A., Chen, J., Zhang, S. (2014). The use and impacts of bank support on UK small and medium-sized enterprises. *International Small Business Journal*, 32(1), 61-80. <https://doi.org/10.1177/0266242612455008>.

- Hummel, K.; Szekely, M. (2022). Disclosure on the sustainable development goals—Evidence from Europe. *Accounting in Europe*, 19, 152-189. <https://doi.org/10.1080/17449480.2021.1894347>.
- Iamandi, I.E., Constantin, L.G., Munteanu, S.M. and Cernat-Gruici, B. (2024). Insights on the Relationship Between Artificial Intelligence Skills and National Culture. *Amfiteatru Economic*, 26(67), pp. 741-761. <https://doi.org/10.24818/EA/2024/67/741>.
- Ismyrlis, V. and Moschidis, O. (2015). The use of quality management systems, tools, and techniques in ISO 9001: 2008 certified companies with multidimensional statistics: The Greek case. *Total Quality Management and Business Excellence*, 26(5-6), pp.497-514. <http://dx.doi.org/10.1080/14783363.2013.856543>.
- Imamguluyev, R. (2023). The Rise of GPT-3: Implications for Natural Language Processing and Beyond. *International Journal of Research Publication and Reviews*, 4(3), 4893-4903. <https://doi.org/10.55248/gengpi.2023.4.33987>.
- Istudor, N., Socol, A.G., Marinaş, M.C. and Socol, C. (2024). Analysis of the Adequacy of Employees' Skills for the Adoption of Artificial Intelligence in Central and Eastern European Countries. *Amfiteatru Economic*, 26(67), pp. 703-720. <https://doi.org/10.24818/EA/2024/67/703>.
- Izzo, M.F.; Ciaburri, M.; Tiscini, R. (2020). The challenge of sustainable development goal reporting: The first evidence from Italian listed companies. *Sustainability*, 12, 3494. <https://doi.org/10.3390/su12083494>.
- Johnson, M. P. (2015). Sustainability management and small and medium sized enterprises: Managers' awareness and implementation of innovative tools. *Corporate Social Responsibility and Environmental Management*, 22(5), 271–285. <https://doi.org/10.1002/csr.1343>.
- Küchler, R., Nicolai, B. M., & Herzig, C. (2023). Towards a sustainability management tool for food manufacturing small and medium-sized enterprises—Insights from a Delphi study. *Corporate Social Responsibility and Environmental Management*, 30(2), 589-604. <https://doi.org/10.1002/csr.2376>.
- Kumar, A. H. (2023). Analysis of ChatGPT tool to assess the potential of its utility for academic writing in biomedical domain. *Biology, Engineering, Medicine and Science Reports*, 9(1), 24-30. <https://doi.org/10.5530/bems.9.1.5>.
- Lee, K. H., Herold, D. M., & Yu, A. L. (2016). Small and medium enterprises and corporate social responsibility practice: A Swedish perspective. *Corporate Social Responsibility and Environmental Management*, 23(2),88–99. <https://doi.org/10.1002/csr.1366>.
- Lee P., Bubeck S., Petro, J. (2023). Benefits, limits, and risks of GPT-4 as an AI chatbot for medicine. *New England Journal of Medicine*, 388:1233-9. [10.1056/NEJMSr2214184](https://doi.org/10.1056/NEJMSr2214184).
- Liu, X., Lu, D., Zhang, A., Liu, Q., & Jiang, G. (2022). Data-Driven Machine Learning in Environmental Pollution: Gains and Problems. *Environmental Science & Technology*, 56(4), 2124–2133. <https://doi.org/10.1021/acs.est.1c06157>.
- Lucy, L. and Bamman, D. (2021). Gender and representation bias in GPT-3 generated stories. *Proceedings of the Workshop on Narrative Understanding*, 3, 48-55.
- Malesios, C, Skouloudis, A, Dey, PK, Abdelaziz, FB, Kantartzis, A, Evangelinos, K. (2018). Impact of small- and medium-sized enterprises sustainability practices and performance on economic growth from a managerial perspective: Modeling considerations and empirical analysis results. *Business Strategy and the Environment*, 27: 960–972. <https://doi.org/10.1002/bse.2045>.

- Mammadov, H., Ruiz-Gándara, A., González-Abril, L., and Romero, I. (2024). Adoption of Artificial Intelligence in Small and Medium-Sized Enterprises in Spain: The Role of Competences and Skills. *Amfiteatru Economic*, 26(67), 848-866. <https://doi.org/10.24818/EA/2024/67/848>.
- Manes-Rossi, F.; Nicolo', G. (2022). Exploring sustainable development goals reporting practices: From symbolic to substantive approaches—Evidence from the energy sector. *Corporate Social Responsibility and Environmental Management*, 29, 1799-1815. <https://doi.org/10.1002/csr.2328>.
- Moore, S., Manring, S. (2009). Strategy development in small and medium sized enterprises for sustainability and increased value creation. *Journal of Cleaner Production*, 17 (1), 276–282. <https://doi.org/10.1016/j.jclepro.2008.06.004>.
- Moursellas, A., Malesios, C., Skouloudis, A., Evangelinos, K., Dey, P.K. (2023). Perceived enablers and barriers impacting sustainability of small-and-medium sized enterprises: A quantitative analysis in four European countries. *Environmental Quality Management*, 00, (00) 1–16. <https://doi.org/10.1002/tqem.22128>.
- Neis, A.M. & Tanțău, A. (2023). Exploring the Usefulness of ChatGPT in Understanding and Promoting the Concepts of Sustainability: A Comparative Study. In *Geopolitical perspectives and technological challenges for sustainable growth in the 21<sup>st</sup> century*, 64-71. *Sciendo*. <https://doi.org/10.2478/9788367405546-007>.
- Nvidia. <https://blogs.nvidia.com/blog/2023/01/26/what-are-large-language-models-used-for/> (assessed, 1st July 2023).
- Niessen, L.W., Mohan, D., Akuoku, J.K., Mirelman, A.J., Ahmed, S., Koehlmoos, T.P., Trujillo, A., Khan, J., Peters, D.H. (2018). Tackling socioeconomic inequalities and non-communicable diseases in low-income and middle-income countries under the Sustainable Development agenda. *Lancet*, 391 (10134), 2036-2046. [https://doi:10.1016/S0140-6736\(18\)30482-3](https://doi:10.1016/S0140-6736(18)30482-3).
- Pasca, M.G. and Arcese, G. (2024). ChatGPT between opportunities and challenges: an empirical study in Italy. *The TQM Journal*, Vol. ahead-of-print No. ahead-of-print. <https://doi.org/10.1108/TQM-08-2023-0268>.
- Pelău C. (2024). Artificial Intelligence in Enterprises: How Staff Competencies Requirements of Business Organizations are Evolving through the Integration of Artificial Intelligence. *Amfiteatru Economic*, 26(67), pp. 698-701. <https://doi.org/10.24818/EA/2024/67/698>.
- Pernici, A., & Stancu, S. (2024). The Worldwide Progress of SDGs. Depicting the Yearly Hot Topics, using Language Processing. In *Proceedings of the International Conference on Economics and Social Sciences*. The International Conference on Economics and Social Sciences. Editura ASE. <https://doi.org/10.24818/icess/2024/049>.
- Popescu (Iacobescu), I.M., Zavatin (Chilea), I., Manea, D.I., Pamfilie, R. and Jurconi, A., 2024. Adapting the Competences of the Employed Personnel in the Context of the Integration of Artificial Intelligence in Organisations. *Amfiteatru Economic*, 26(67), 817-831. <https://doi.org/10.24818/EA/2024/67/817>.
- Qasem, F. (2023), ChatGPT in scientific and academic research: future fears and reassurances, *Library Hi Tech News*, 40 (3), 30-32. <https://doi.org/10.1108/LHTN-03-2023-0043>.
- Radford, A., Narasimhan, K., Salimans, T. & Sutskever, I. (2018). Improving language understanding by generative pre-training. <https://www.mikecaptain.com/resources/pdf/GPT-1.pdf> (accessed: 1st July 2023).

- Rizos, V.; Behrens, A.; van der Gaast, W.; Hofman, E.; Ioannou, A.; Kafyeke, T.; Flamos, A.; Rinaldi, R.; Papadelis, S.; Hirschnitz-Garbers, M.; et al. (2016). Implementation of Circular Economy Business Models by Small and Medium-Sized Enterprises (SMEs): Barriers and Enablers. *Sustainability*, 8, 1212. <https://doi.org/10.3390/su8111212>.
- Salimzadeh, P., Courvisanos, J. & Nayak, R. (2015). *Social and environmental practices of SMEs in a regional city of Australia*. Small Enterprise Association of Australian and New Zealand, 1, 1-17.
- Schaltegger, S.; Beckmann, M.; Hansen, E.G. (2013). Transdisciplinarity in corporate sustainability: Mapping the field. *Business Strategy and the Environment*, 22, 219-229. <https://doi.org/10.1002/bse.1772>.
- Seidel, M., Seidel, R., Tedford, D., Cross, R., Wait, L. and Hämmerle, E. (2009), Overcoming barriers to implementing environmentally benign manufacturing practices: Strategic tools for SMEs. *Environmental Quality Management*, 18: 37-55. <https://doi.org/10.1002/tqem.20214>.
- Shields, J., & Shelleman, J. M. (2015). Integrating Sustainability into SME Strategy. *Journal of Small Business Strategy*, 25(2), 59-78. Retrieved from <https://libjournals.mtsu.edu/index.php/jsbs/article/view/561>.
- Soergel, B., Krieglner, E., Weindl, I., Rauner, S., Dirnaichner, A., Ruhe, C., Hofmann, M., Bauer, N., Bertram, C., Bodirsky, B.L., Leimbach, M., Leininger, J., Levesque, A., Luderer, G., Pehl, M., Wogens, C., Baumstark, L., Beier, F., Dietrich, J.P., Humpenoder, F., von Jeetze, P., Klein, D., Koch, J., Pietzcker, R., Strefler, J., Lotze-Campen, H., Popp, A. (2021). A sustainable development pathway for climate action within the UN 2030 Agenda. *Nature Climate Change*, 11, 656–664. <https://doi.org/10.1038/s41558-021-01098-3>.
- Sohail, S. S., Farhat, F., Himeur, Y., Nadeem, M., Madsen, D. Ø., Singh, Y., ... Mansoor, W. (2023). The Future of GPT: A Taxonomy of Existing ChatGPT Research, Current Challenges, and Possible Future Directions. *Current Challenges, and Possible Future Directions. SSRN Electronic Journal*. <https://api.semanticscholar.org/CorpusID:258247415>.
- Siegel, R., Antony, J, Garza-Reyes, J.A., Cherrafi, A., Lameijer, B. (2019). Integrated green lean approach and sustainability for SMEs: from literature review to a conceptual framework. *Journal of Cleaner Production*, 240, 1-14. <https://doi.org/10.1016/j.jclepro.2019.118205>.
- Strubell, E., Ganesh, A. and McCallum, A. 2019. Energy and policy considerations for deep learning in NLP. *Proceedings of the Annual Meeting of the Association for Computational Linguistics*, 57, 3645-3650.
- Sullivan, K., Thomas, S., Rosano, M. (2018). Using industrial ecology and strategic management concepts to pursue the sustainable development goals. *Journal of Cleaner Production*, 174, 237–246. <https://doi.org/10.1016/j.jclepro.2017.10.201>.
- Stafford-Smith, M., Griggs, D., Gaffney, O., Ullah, F., Meyers, B., Kanie, N., Stigson, B., Shrivastava, P., Leach, M., O'Connell, D. (2017). Integration: the key to implementing the sustainable development goals. *Sustainability Science*, 1-9. <https://doi.org/10.1007/s11625-016-0383-3>.
- Sustana. <https://www.triplepundit.com/story/2022/esg-smes-small-business/761816> (assessed, 1st July 2023).

- Terama, E., Milligan, B., Jimenez-Aybar, R., Mace, G.M., Ekins, P. (2015). Accounting for the environment as an economic asset: global progress and realizing the 2030 Agenda for Sustainable Development. *Sustainability Science*, 1-6. <https://doi.org/10.1007/s11625-015-0350-4>.
- Troise, C., Corvello, V., Ghobadian, A., O'Regan, N. (2022). How can SMEs successfully navigate VUCA environment: the role of agility in the digital transformation era. *Technology Forecast and Social Change*. 174, 121227. <https://doi.org/10.1016/j.techfore.2021.121227>.
- United Nations Brundtland Report (1987). *Report of the world commission on environment and development: our common future*. <http://www.undocuments.net/our-common-future.pdf>. (Accessed 8 June 2020).
- United Nations (2018). *The Sustainable Development Goals Report 2018*. United Nations: New York, NY, USA. Available online: <https://unstats.un.org/sdgs/report/2018> (accessed on 4 February 2020).
- UN (2021). *Sustainable Development Report 2021-The Decade of Action for the Sustainable Development Goals*. <https://www.sustainabledevelopment.report/reports/sustainable-development-report-2021/>.
- UN (2022). *From Crisis to Sustainable Development: the SDGs as Roadmap to 2030 and beyond*. Sustainable Development Report 2022. <https://www.sustainabledevelopment.report/reports/sustainable-development-report-2022/>.
- UN (2023). <https://www.un.org/sustainabledevelopment/climate-action/>. Assessed 30.23.10.01.
- Vesal, M., Siahtiri, V., O'Cass, A. (2020). Strengthening B2B brands by signalling environmental sustainability and managing customer relationships. *Industrial Marketing Management*, 92, 321-331. <https://doi.org/10.1016/j.indmarman.2020.02.024>.
- Xu, Z., Chau, S.N., Chen, X. et al. (2020). Assessing progress towards sustainable development over space and time. *Nature* 577, 74-78. <https://doi.org/10.1038/s41586-019-1846-3>.
- Yin, C., Zhao, W., Fu, B., Meadows, M.E., Pereira, P. (2023). Key axes of global progress towards the Sustainable Development Goals. *Journal of Cleaner Production*, 385, 135767, <https://doi.org/10.1016/j.jclepro.2022.135767>.
- Wang, F. Y., Miao, Q., Li, X., Wang, X., & Lin, Y. (2023). What does ChatGPT say: The DAO from algorithmic intelligence to linguistic intelligence. *IEEE/CAA Journal of Automatica Sinica*, 10(3), 575-579. <https://doi.org/10.1109/JAS.2023.123486>.
- Zhong, S., Zhang, K., Bagheri, M., Burken, J. G., Gu, A., Li, B., Ma, X., Marrone, B. L., Ren, Z. J., Schrier, J., Shi, W., Tan, H., Wang, T., Wang, X., Wong, B. M., Xiao, X., Yu, X., Zhu, J. J., & Zhang, H. (2021). Machine Learning: New Ideas and Tools in Environmental Science and Engineering. *Environmental Science and Technology*, 55(19), 12741-12754. <https://doi.org/10.1021/acs.est.1c01339>.
- Zhou, X., Chen, Z., Jin, X. and Wang, W.Y. (2021). HULK: an energy efficiency benchmark platform for responsible natural language processing. *Proceedings of the Conference of the European Chapter of the Association for Computational Linguistics: System Demonstrations*, 16, 329-336.