



The path toward the 2030 Agenda: the implementation status of sustainable development goals in the large industrial sector of Bahrain

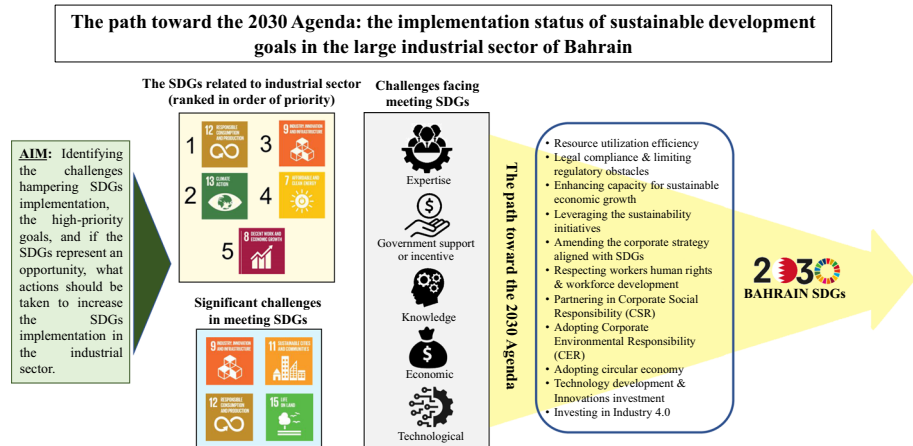
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Abstract

The 2030 Agenda is ushering in a new era of sustainability. However, adopting the SDGs in the industrial sector face difficulty because its various activities and the novelty of SDGs. This study aimed to investigate the sustainability status in the entire large industrial sector (170 companies) by identifying the challenges hampering SDGs implementation, the high-priority goals, and if the SDGs represent an opportunity, what actions will increase the SDGs implementation. Therefore, the structured interview method was employed to attain the study objectives from May to December 2020. The results showed that the industrial sector has several initiatives, sustainable future projects, and sustainable practices, which are the basis for sustainability governance, so there is a need to orient these efforts in the context of SDGs and integrate them into their business plans and strategies. Also, this study revealed; presently, Bahrain's industrial sector is facing challenges to adopt the SDGs, such as a lack of expertise, and knowledge. Furthermore, study results indicate that the most priority SDGs for the industrial sector are 12, 13, 9, 7, and 8, and Bahrain faces major challenges in achieving SDGs 9, 11, 12, and 15. The study has made some recommendations to improve SDGs implementation.

Graphical abstract



Keywords Industry 4.0 · Industrialization · SDGs · Corporate environmental responsibility (CER) · Sustainable industrial development

1 Introduction

The 2030 Agenda acknowledges the significance of industrialization in achieving the Sustainable Development Goals (SDGs), specifically SDG-8 “decent work and economic growth,” and SDG-9 “industry, innovation, and infrastructure” (UN, 2015). Both goals contribute to sustainable and have an impact on the other 15 goals (Mendoza-del Villar et al., 2019). Industrialization contributes to economic growth, capacity-building, and directly and indirectly supports—the accomplishment of social, economic, and environmental goals embedded in the SDGs by creating job opportunities, improving working conditions, innovating, and developing novel and eco-production technologies (UNIDO, 2022). The progress of the industrial sector implies the growth of the entire economy; therefore, the capabilities and expertise of this sector are essential for economic resilience.

Industrialization is a strategic path to achieving sustainability and a viable option for tackling major global issues (Mendoza-del Villar et al., 2019); thus, when developing of the industrial sector policies, it is essential to consider a broader scope of sustainable development (SD), such as actions, practices, and measures beyond economic growth (UNIDO, 2020), and environmental sustainability must be deemed an integral part of industrial policies and strategies for achieving effective development results in the context of the 2030 Agenda (Haraguchi & Kitaoka, 2015). Therefore, to protect the environment, it is necessary to strictly enforce existing environmental policies and devise new effective policies (Opoku & Boachie, 2020). Despite all the efforts, policies, and strategies aimed at achieving the SDGs at the national level, there are still challenges to their implementation, which are often economic or technological. Therefore, the government plays a critical role in achieving the SDGs, which includes setting targets, developing a concrete national plan, establishing an appropriate legal framework, defining norms and standards, coordinating efforts, and monitoring implementation progress (Ulbrich, 2020; Van Zanten & Van

Tulder, 2020). Furthermore, it is important to integrate SD into institutional policies to foster cooperation and coordination at the national and international levels (Berawi, 2019). Consequently, an efficient environmental policy and cohesive regulatory structure are the wherewithal for enhancing a sustainable industrialization path.

The industrial sector is one of the main sectors involved in implementing the SDGs, and the key to sustainable industrial development is enhancing sustainable performance, which can be attained through technological progress and industrial innovations (Beier et al., 2018; Dantas et al., 2021; Silvestre & Țircă, 2019). The concept of Industry 4.0 is not merely a technological development; it is an integral part of multiple social, environmental, and technical interdependencies (Beier et al., 2021). Therefore, Industry 4.0 plays a vital role in driving industrial development towards achieving the SDGs 7–13, particularly in the industrial sector. It encompasses new technologies that aim to promote the circular economy, optimize resource efficiency, improve energy efficiency, control air emissions, manage waste effectively, and promote sustainable products, services, and practices. (Berawi, 2019; Hidayatno et al., 2019; Machado et al., 2020; Modgil et al., 2020; Oláh et al., 2020; Patyal et al., 2022; Schroeder et al., 2019). This topic is still novel and open to further research investigating how the potential of Industry 4.0 technologies could assist in accelerating the achievement of the 17 SDGs (Table 1).

It has been recently observed that industrialization is the primary energy consumer, and there is an increasing concern about the degradation of the environment, particularly due to the greenhouse gas (GHGs) emissions from this sector and their impact on climate change. In the pursuit of sustainable development and combating climate change, industrial emissions mitigation plays a critical role (Arbolino et al., 2017, 2018; Opoku & Boachie, 2020). Globally, the oil and gas industry is one of the essential biggest industries. It accounts for over 57% of the world's total fuel consumption and has beneficial and adverse effects on the areas targeted by the SDGs, and its extensive global footprint presents valuable opportunities for creating a significant and sustainable effect on the SDGs achievement. Consequently, it might contribute to tackling challenges SDGs undertake, such as air pollution, environmental decline, economic issues, and increased wellness hazards (IPIECA, 2017).

Furthermore, it was found that 80% of the available literature discusses the businesses roles in SDGs accomplishment (Garrido-Ruso et al., 2022), and still shortage of researches on SDGs employment in industrial sector. Recent literature suggests that this topic is a recent and emerging research issue in the academic world, with a few researchers taking an interest in examining the role and actions of companies in implementing SDGs (Calabrese et al., 2021; Hummel & Szekely, 2022; van Zanten & van Tulder, 2021). Despite their efforts, there has been little success so far because the SDGs were approved in 2015 and initiated in 2016, and this sector has only recently—in 2019—gained attention in the academic literature, where several researchers have given an interest in examining the roles that should the companies act to implement the SDGs, and still, their efforts have yet to bear fruit, and this underscores that this topic is a recent and emerging research issue in the scientific community (Garrido-Ruso et al., 2022). In addition, the SDGs become an urgent need to adopt in this sector to achieve sustainable industrial development (SID) approach, which is essential to establish a long-term strategy for fulfilling economic and environmental global transformations on the scale required for sustainable development.

Bahrain is an island located in the Middle East. It includes a small archipelago of 44 natural islands and 51 artificial centres around the main island, with a total land area of 765 square kilometers. An idea of its size, Luxembourg is 3.38 times larger than Bahrain, Rhode Island (USA) is 4.10 times larger, Delaware (USA) is 6.71 times larger, and Bali

Table 1 The role of Industry 4.0 in achieving the SDGs

SDGs	The role of Industry 4.0	References
SDG 7 "Affordable and clean energy"	The new technologies will provide sustainable energy efficiency to promote improved quality and save costs to consumers	Bai et al., (2020), Xu et al., (2018)
SDG 8 "Decent work and economic growth"	The new technologies are aimed at protecting the environment, which will lead to economic growth and provide more decent jobs The new technologies will provide companies with profitable business opportunities and high work efficiency and quality The new technologies will reduce labor and material costs	Rüßmann et al., (2015), Gabriel & Pessl, (2016), Xu et al., (2018) Hofmann & Rüsçh, 2017; Erol et al., 2016 Dalenogare et al., 2018; Li, 2018
SDG 9 "Industry, innovation, and infrastructure"	The new technologies will support employee's health and safety and improved workplace conditions The new technologies will enhance sustainable industries, invest more in scientific research and innovations, and improve infrastructure	Müller et al., 2018; Hofmann & Rütisch, 2017 Bauer et al., 2015; Bag et al., 2021
SDG 12 "Responsible consumption and production"	The new technologies will upgrade the efficiency of industries and improve production and consumption patterns Adopting circular economy Products can be dismantled into their elements for re-use, re-cycling, and re-manufacturing The new technologies will improve and raise productivity, sustainable production, and increase production flexibility	Mishra & Mahteshwari, (2020), Beier et al., (2021) Bai et al., (2020), Bag et al., (2021), Lee et al., (2017) Luthra & Mangla, (2018), Dalenogare et al., (2018), Witkowski, (2017) Rüßmann et al., (2015), Beier et al., (2021)
SDG 13 "Climate action"	The new technologies will reduce CO ₂ emissions via data-centric and traceable carbon footprint analysis The new technologies will accelerate adopting net-zero emissions	Gabriel & Pessl, (2016), Sarkis & Zhu, (2018), Modgil et al., (2020) Lee et al., (2017); Okorie et al., (2018)

Island (Indonesia) is 7.56 times larger than Bahrain.¹ Bahrain was among the first Middle Eastern countries to discover oil and establish a refinery and its economy has mainly depend on refine the crude oil of Gulf countries. Lately, the sectors of finance, commercial services and communications were grown-up significantly. This was led to a diversification of the economy into other sectors of finance, banking, and tourism (BEDB, 2021).

This study aimed to investigate the status of sustainability in the industrial sector in Bahrain by identifying the challenges that hamper SDGs implementation, the high-priority goals, and if the SDGs present an opportunity, what actions should be taken to increase the implementation of the SDGs. This article is organized as follows: First, relationship between industry and the environment is highlighted. Second, the importance of corporate environmental responsibility and its relationship with SDGs is discussed. Third, an overview of SDGs interlinkage is given from an industrial perspective. Next, the methodology employed in this study is described, and the results are discussed. Finally, our conclusions and future research scopes are mentioned.

2 Literature review

In September 2015, a 2030 agenda for sustainable development was approved globally, it comprises of 17 SDGs with 169 targets, and aims at address major global challenges such as environmental issues and the poverty (UNGA, 2015). Therefore, it calls all stakeholders including governments, private sectors, and various civil societies to take urgent actions towards sustainable development (Hajer et al., 2015; Le Blanc, 2015). Whereas, the role private sector is pivotal in accomplishing common sustainability issues, thus, a significant change is needed in the patterns of societies and economies due to those goals represent a new phase and require shared global responsibility to attain all the SDGs (Bexell & Jönsson, 2017; D'Amato et al., 2019).

2.1 The industry and environment

The industrial sector is the largest significant part of the business sector, and it has a tangible impact on achieving sustainability due to its negative effects on the environment, which presents one of the top priority concerns towards achieving sustainable industrial development. That required developing industrial strategies that can enhance the implementation performance of the sustainable sharing economy (Gilli et al., 2017; Govindan et al., 2020; Jiang et al., 2018). A debate has arisen about the balance between the economic benefits of industrialization and the harmful impacts of consuming natural resources, causing severe pollution and environmental degradation (Hami et al., 2016; Liu, 2021). In this vein, when economic profits are prioritized over environmental protection, it is self-evident that the focus on economic development will be prior to the environmental concerns, while there is a general agreement that since the environment provides the economy with essential goods (the natural raw resources), then it should be considered economic assets (Barbier, 2016; Koprina, 2016). Likewise, Dahlmann et al. (2020) have urged businesses to avoid considering sustainability as unimportant and instead prioritize sustainability dimensions in their business strategies, rather than focusing solely on profitability.

¹ Map Fight-Bahrain size comparison, <https://mapfight.xyz/map/bh/>, accessed on 5/6/2023.

There is a linkage between industry and the environment, thus, industrial enterprises should improve their environmental performance to facilitate accomplishing industrial sustainable development in the future (Martins et al., 2020; Moktadir et al., 2018; Trianni et al., 2017). Therefore, it is essential to monitor industrial sustainable developments based standpoint of science to ensure the industrial sustainability involves enhancing production operations that employ resource-efficient technologies, reduce waste generation, and regulate air emissions as environmental sustainability parameters (Lesníková & Schmidtová, 2019; Moktadir et al., 2018; Niehoff & Beier, 2018).

In the early 1990s, companies started to focus on the environmental impacts of industrial processes via adopting the end-of-pipe approach and enhance recycling options to proactively manage environmental issues (Oliveira et al., 2016). Sustainability assessment also became a significant new approach to evaluate the impact of various sectors on sustainability, and this approach helped decision-makers and policymakers in different global sectors, and industry one of them, which gave more attention to this sector, especially the industries that have high carbon emissions (Figueres et al., 2017; Sahimi et al., 2018).

The 2030 Agenda has allocated SDG 9 to strengthen 'sustainable industrialization' because it is essential for a vital economic development that generates incomes and profits, provides jobs, ensures efficient use of resources, and is a driver to increase the investments of economy and technologies (UN, 2015; Gilli et al., 2017; Kynclová et al., 2020). The sustainable manufacturing notion is rooted in the SD principle and it is a significant industrial initiative for achieving complete SD (Abdul-Rashid et al., 2017a & b; Bhakar et al., 2018; de Oliveira-Neto et al., 2018). To achieve this, manufacturers can employ the product life cycle concept to minimize the environmental impacts of their production operations, implement environmentally integrated strategies within their manufacturing process management, and adopt a circular economy (Abdul-Rashid et al., 2017a; Lee et al., 2017). These measures are essential to achieve sustainable manufacturing and minimize the negative impact of production on the environment. Therefore, many industries worldwide have adopted sustainable industrial practices due to their substantial economically and environmental gains (Álvarez et al., 2017). To mitigate the adverse environmental impacts of industrialization, such as greenhouse gas emissions (GHGs), natural resource depletion, wastewater and hazardous waste generation, and the need for sustainable and clean energy, a green manufacturing paradigm has been developed (Seth et al., 2018). This paradigm aims to minimize the accumulation negative impacts of industrialization on the entire planet.

Industrial growth and urbanization have led to increased pollution, resource depletion, and environmental degradation, resulting in a significant impact on the quality of life (Alvarado & Toledo, 2017; de Moraes Hoefel et al., 2018, p.73; Liu, 2021). Historically, between 1979 and 1989, there were several environmental disasters that occurred worldwide, such as climate change. Therefore, the private sector has a substantial part in addressing and localization of SD issues (Busco & Sofra, 2021, p.193), and environmental legislation became more potent and binding in the 1970s and 1980s, in which companies had to confirm their adherence, putting their social and environmental effects under control (Siew, 2015). As a result, sustainability compliance concept offers a wide window of future study opportunities (Turan et al., 2017) to explore various industrial sector aspects that impact SDGs' reporting systems, despite a significance of SDGs, the current monitoring practices are not yet optimal (Liu, 2020; Tsalis et al., 2020). For instance, Bakardjieva (2016) most companies fail to achieve the SDGs due to a lack of sustainable practices, such as recovering, re-using and re-cycling. Therefore, sustainability reporting by companies should be taking responsible action to improve, measure, assess, and develop industrial

sustainability performance (Bhanot et al., 2017; Ferrero-Ferrero et al., 2021; Howard et al., 2019; Jiang et al., 2018) for a successful SDGs implementation.

2.2 Corporate environmental responsibility (CER) and SDGs

The Brundtland Report—Our Common Future—confirms that CER is essential to achieve SD and to secure the needs of present and future eras (WCED, 1987). The United Nations Global Compact (UNGC) also emphasizes the environment, urging businesses to adopt a precautionary approach and promote environmental responsibility through eco-friendly technologies (UNGC, 2021).

CER is an integral facet of Corporate Social Responsibility (CSR), both form basic dimensions for corporate sustainability (Cai et al., 2016), where CSR combines both social and environmental responsibilities (Sinkovics et al., 2021). CER and CSR are considered essential factors or components of competitive advantage (Kasych et al., 2020; Lloret, 2016; Myroshnychenko et al., 2019). Additionally, CER is an important aspect of CSR because it assists in achieving cleaner production and pollution prevention. (Wang, 2016). Thus, CER is a firm's capability to incorporate environmental aspects into its environmental plan and daily practices and operations to lessen the adverse effects of its operations on the environment to strengthen compliance with the provisions of environmental law to achieve corporate environmental commitment and SDGs (Kim et al., 2017; Liu et al., 2017; Phiri et al., 2018). With increasing concerns about environmental pollution, CER has become an essential aspect of a company's values and practices (Li et al., 2020).

Since embracing the 2030 Agenda for Sustainable Development, global concern has increasingly leaned towards corporate sustainability and responsibility. In this regard, Kasych et al. (2020) have emphasized the need to adopt a strategic approach based on the principles of sustainable development to improve CER holistically. A recent report "STOCKHOLM+50" also highlighted the business sector part in implementation of SDGs through effective CER practices for enhanced environmental performance (UNDP, 2022). According to Qin et al. (2019), this can accelerate the implementation of SDGs. Therefore, firms have the potential to contribute to SDG implementation through various activities, but the depth of their actions and CER practices will determine the extent of their impact (Sinkovics et al., 2021).

From an environmental perspective, adopting CER confers an important competitive advantage and enhances corporate ethical commitment to self-orientation and incorporation of the environmental goals (i.e., SDGs) into strategic priorities to ensure the dynamism of environmental continuous improvement. Many scholars have highlighted several essential internal and external factors (Fig. 1) that beneficially influence the adoption of CER, which leads to better corporate environmental performance towards achieving the SDGs (Herghiligiu et al., 2019; Kasych et al., 2020; Kim et al., 2017; Qin et al., 2019; Sáez-Martínez et al., 2016). Further, as per current conditions where environmental issues are significantly exacerbated and gaining global character (e.g., climate change), it is crucial to take robust actions in the formation of a comprehensive vision for improving the CER through a legal and SDGs perspective.

2.3 Interlinkages of SDGs through an industrial lens

Incipient discussions on sustainability indicators between 1972 and 1987 reported unanimity that quantitative information would be essential in achieving SD (Eustachio et al.,

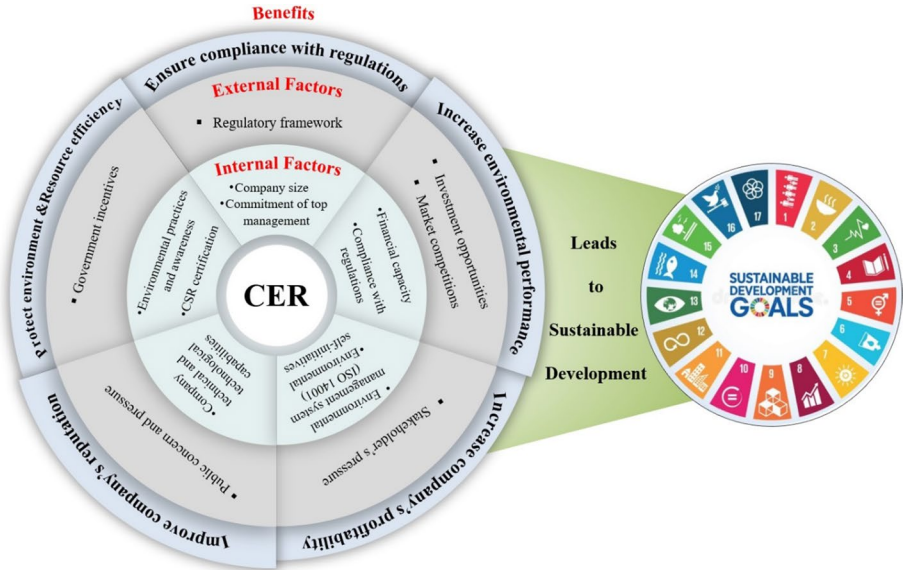


Fig. 1 The external and internal factors and benefits of CER (Author's own depiction)

2019). The 2030 Agenda emphasizes the integrated nature of the SDGs and their interlinkages as fundamental to their successful implementation (UN, 2015). However, since the adoption of the SDGs, there has been controversy surrounding their interlinkages due to the complex relationships between the goals and their targets, the unequal links among them, and the interlinkages described in terms of synergies (positive relationships) and trade-offs (negative relationships), while most of the interlinkages among the SDGs are positive (Fuso Nerini et al., 2019; Nilsson et al., 2022; Pradhan et al., 2017; Weitz et al., 2018).

Figure 2 illustrates that it is essential to implement all 17 SDGs jointly to acquire SDG 13, which is related to climate change and plays a crucial role in attaining SD dimensions. Likewise, without achieving SDG 13, it is nearly impossible to acquire the SDGs. Therefore, we must pursue all SDGs in tandem. If economic growth (SDG8) is not sustainable, it may negatively impact other SDGs that are particularly related to the environment. This could lead to an increase in greenhouse gas (GHGs) emissions (SDG13) and threaten or contaminate environmental ecosystems, such as terrestrial and seas, and vital natural resources (SDGs14 and 15).

Furthermore, sustainable infrastructure is considered the core of the development of sustainable cities (SDG11), where enhanced resilient infrastructure in vulnerable communities may lead to an increased adaptive ability to climate change (SDG13). Industrial projects do not stick to strict and effective environmental performance standards, they could cause severe impacts on climate (SDG 13), aquatic environment (SDG14), and environment on land (SDG15). On the other hand, the promotion of sustainable industrial processes and green products can lead to further efforts to enhance sustainability in goods and services production, which is the objective of Goal 12. However, rapid industrial growth (SDG9) and infrastructure expansion (SDG 11) can have negative impacts on the environment (Goals 14 and 15) if the hazards of those impacts are not controlled strictly.

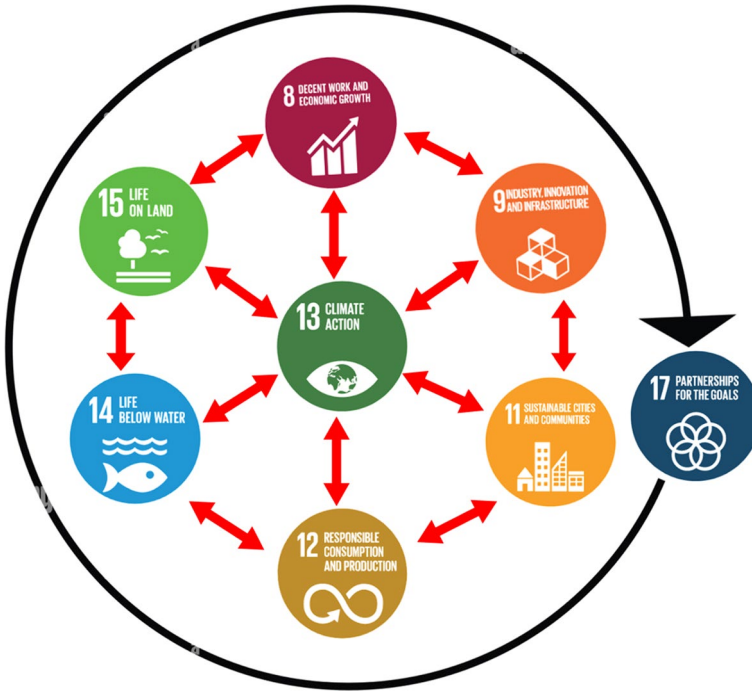


Fig. 2 The interlinkages of the SDGs that are related to the industrial sector (Author's own depiction)

In addition, it is important to increase green areas in the industrial zones (SDG 15), resource efficiency management (SDG 12), and reduce emissions through sustainable infrastructure design and control of pollution sources (SDG 9) that will lead to fulfilling the obligations of climate action (SDG 13). Sustainable production and consideration of environmental impacts (SDG 12) will minimize the pollution of land and water. Consequently, it will reduce deforestation and the loss of biodiversity (SDGs 14 and 15), thus indirectly obstructing climate actions and negative impacts on work conditions (Goal 8). Adopting resource-efficient production (SDG 12) that considers input activity, such as raw material feeding in the manufacturing process, can help enhance the capability to mitigate climate change (SDG 13).

Protecting water bodies like oceans, seas, and rivers from the illegal disposal of industrial solid waste, untreated effluents, and oil spills during the shipment of raw materials and goods can help conserve natural carbon sinks, control climate patterns (Goal 13), and preserve aquatic life (SDG 14). Additionally, safeguarding terrestrial ecosystems (SDG 15) helps conserve natural carbon sinks (SDG 13), also promotes sustainable consumption and production (SDG 12). There is a strong connection between SDGs 14 and 15, as the efforts to preserve land and water ecosystems lead to shared benefits.

As a case in point, the oil and gas industry is often regarded as unsustainable due to its extraction of non-renewable resources (fossil fuels) and the nature of its manufacturing processes. According to current literature, implementing SDGs related to the mining industry, including oil and gas extraction, remains a challenge (Omotehinse & De Tomi,

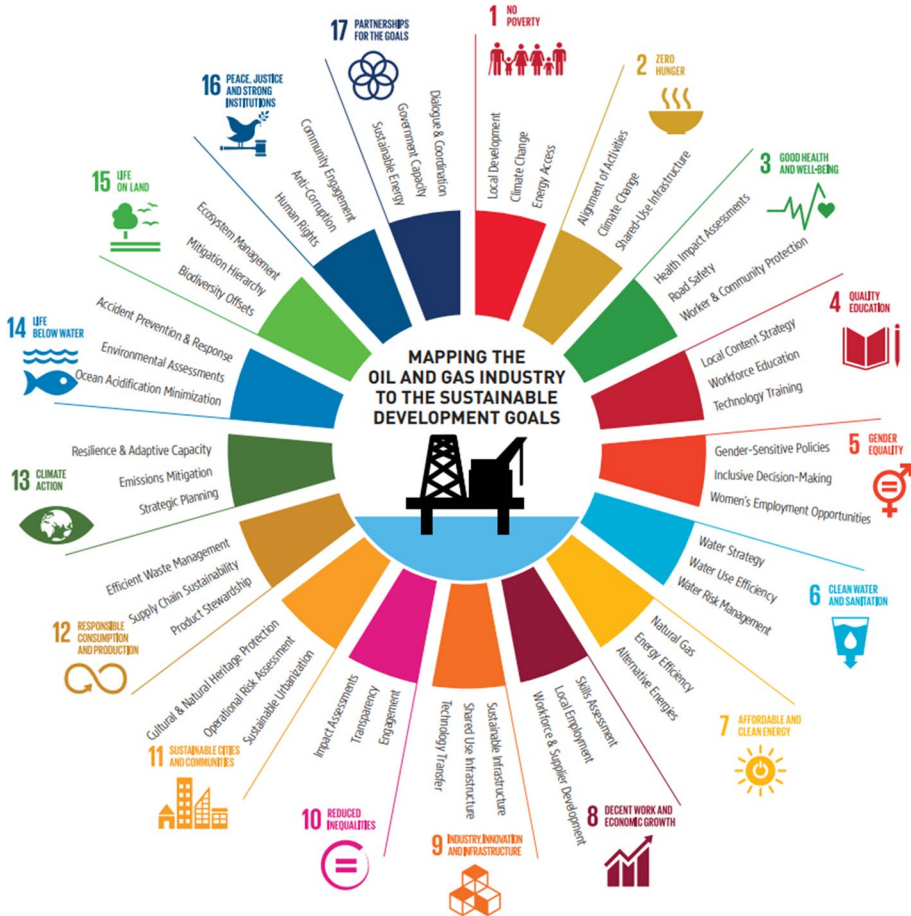


Fig. 3 Key issues in the oil and gas industry mapped to the SDGs (IPIECA, 2017)

2022). For this reason, there is increased pressure on this sector to become more aware and adopt sustainable practices and operations (Silvestre & Gimenes, 2017). In addition, the industrial sector is a crucial contributor to economic growth and social development. It plays a significant role in providing affordable energy and creating decent job opportunities. Therefore, it has the potential to contribute to all SDGs by improving the environment, avoiding negative impacts, and addressing environmental degradation. This sector has an opportunity to conserve the environment and protect the society, and it should strive towards this goal. Figure 3 summarizes the key aspects of oil and gas sector mapped to SDGs (IPIECA, 2017).

This study aims to investigate the sustainability status of the industrial sector in Bahrain, in order to identify the challenges that hinder the implementation of SDGs. Structured interviews were employed to gain a deep understanding of the research subject and achieve the study's objectives.

3 Methods

The structured interview method is an efficient approach that has numerous advantages, such as limiting the researcher's subjectivity and bias, controlling the interview topics, and comparing participants' responses (Doody & Noonan, 2013). Therefore, this method has been employed as it is the appropriate tool for collecting primary data and information to attain the study objectives. The qualitative and quantitative data analysis relies on interpretation and integration, making the structured interview method a suitable technique for gathering data.

The study population included Bahrain's large industrial sector, which encompassed various industries, such as power generation, water, gas and oil, steel, aluminum, chemicals, petrochemicals, plastics, and food, etc. The list was obtained from the official database of the Ministry of Industry and Commerce. Furthermore, the Arabian Business Community Bahrain open database was searched. The study covered all 170 large industrial sector companies. According to Singh and Masuku (2014), studying the entire population as a sample is possible for a small group (e.g., 200 or fewer), which will reduce sampling errors and gather sufficient data on the whole population. Additionally, total population sampling is a technique in which all of the population meets the research criteria and is commonly applied where the number to be studied is small (Etikan et al., 2016). The study focused on large companies since they are the economic base of the country, directly and indirectly impacting a wide range issue (e.g., environment) due to size of production plants. They are more responsive to national policy measures than their small and medium counterparts, and the research subject is novel.

The selected companies were approached through phone or email to obtain their permission to participate in this study. Subsequently, teleconference interviews were scheduled. Due to the COVID-19 pandemic, all the companies were interviewed over the phone, and they were requested to send their responses via email from May 2020 to December 2020.

Interviews provide scholars with valuable qualitative data to understand the interviewees' knowledge and experiences, and this tool used during interviews should pass reliability and validity tests to be considered a reliable source of information (Castillo-Montoya, 2016; Yeong et al., 2018). Additionally, Perneger et al. (2015) stated that the purpose of a pre-test is to ensure that the target audience understands the questions and response options, and can answer them meaningfully. To test the reliability and validity of structured interview questions, a pilot test was conducted on five industry professionals who were not part of the study. They were asked for recommendations and modifications to improve the validity of the questions, and then their feedback and comments were analyzed separately to study their responses.

The next step, the structured interview questions were revised and modified. Two academic professors also reviewed the questions and provided additional feedback. As a result, irrelevant questions were removed, and vague or ambiguous statements were reworded or rewritten to ensure clarity and accuracy. The revised interview was then reviewed again to ensure that the questions were comprehensive, neutral, and consistent, and that the information obtained would be of good quality and unbiased. The interview process was carefully designed to meet the research objectives without any deviation.

The structured interview aimed to collect data and information for qualitative analysis of SDGs implementation in Bahrain's large companies. It sought to answer specific questions, as following:

Q.1 Have you read the Sustainable Development Goals (SDGs)?

Q.2 What are the main obstacles and challenges hampering implementation of the SDGs in your company?

Q.3 Does your company have planned steps to strengthen its commitment to sustainability and prepare towards engaging in the SDGs?

Q.4 Please rank five SDGs on which that you believe your company could have the greatest impact.

Q.5 Please rank five SDGs that may represent a future business opportunity(s) for your company.

Q.6 Do you think that your lack of engagement with the SDGs could become a reputational issue?

Q.7 What are the most urgent actions the private sector should take to increase its resilience and ability to implement the SDGs in the future?

4 Results and discussions

This section reviews the outcomes, feedbacks, and findings of the interviews and discussions of both quantitative and qualitative responses. Out of the 170 companies that were contacted, only 90 agreed to the interview, resulting in an overall response rate of 53% due to the global abnormal situation of COVID-19 restrictions. It was observed that the companies that issued sustainability reports provided a 100% response rate.

Q.1 Have you read the Sustainable Development Goals (SDGs)?

Interesting note that 40 out of 90 interviewees (44.5%) said that they had read about the SDGs and considered their implementation in their companies important. However, not everyone had sufficient knowledge about the SDGs. During the interviews, some respondents admitted to having only basic knowledge, mainly about the number and names of the SDGs. On the other hand, 50 (55.5%) interviewees had weak knowledge of the SDGs because of a lack of competence, capacity building, expertise, time, training, and motivation. They also mentioned that their companies did not include the SDGs in their plans and objectives.

The notion of sustainability is present in the large companies' sector, and companies must understand what sustainability means to them, and how to prioritize it as an objective. It is necessary to find motivation to integrate sustainability into their business practices and identify the most pressing sustainability priorities.

Q.2 What are the main obstacles and challenges hampering implementation of the SDGs in your company?

Only 90 companies out of 170 agreed to participate in this study. From Fig. 4, it is evident that "lack of expertise" is the significant challenge, whereas "financial" is the third challenge which faces SDG implementation. Majority of companies (52) considered the major obstacle and challenge in the SDGs implementation was a lack of expertise (57.8%), whereas 39 companies believed that both a lack of knowledge and a lack of government support or incentive (43.3%) were a second challenge. Despite the fanfare about financial challenges (41.1%), it becomes the third-ranked challenge. Furthermore, three companies said that there were no current challenges. The other obstacles and challenges mentioned by interviewees were as follows:

1. Lack of a clear vision and structured coordination on goals and targets between the government and large companies.

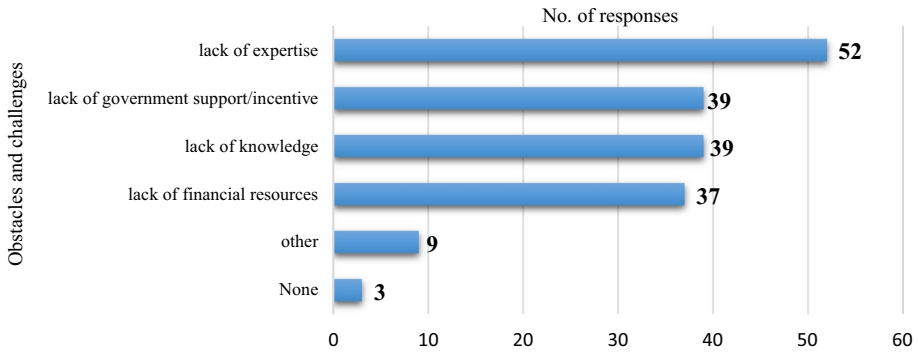


Fig. 4 The number of responses to question 2

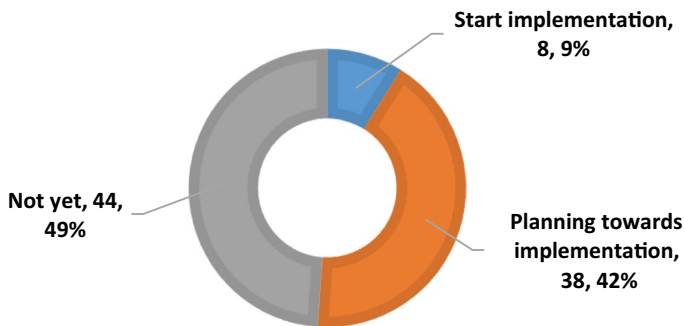


Fig. 5 The number of responses to question 3

2. Lack of coordination among business sectors.
3. Lack of opportunities for investment and improvements.
4. Lack of capacity to engage in the SDGs.
5. Difficulties in changing the behaviors and consumption patterns.

Q.3 Does your company have planned steps to strengthen its commitment to sustainability and prepare towards engaging in the SDGs?

Regarding companies' preparation to engagement in the adoption of SDGs, Fig. 5 showed that only 9% of companies had started implementation; while 42% of companies planning towards adoption, whereas 49% of companies are not yet planned towards adoption the SDGs. Based on the results obtained from this question, it can be considered that the highest percentage (51% started and planned) may constitute a good starting point towards sustainability adoption and a positive sign of corporate awareness and commitment. Also, it indicates that companies seen sustainability as a key environmental issue that should be included in their plans.

Consequently, the view on SDGs is changing. Therefore, companies should confront and adapt to a range of challenges in the new industrial revolution which is creating new business models in the context of the SDGs. As a result, sustainability will become a part of the corporate scope based on accountability and responsibility.

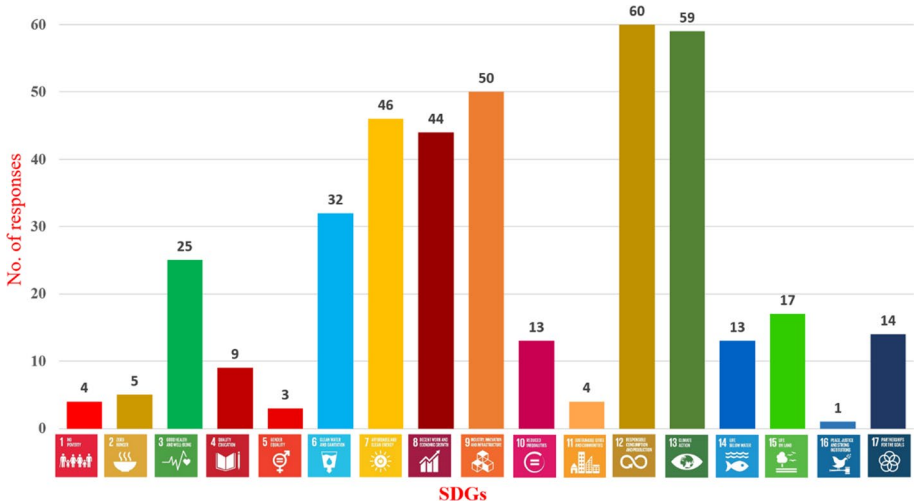


Fig. 6 The number of responses to question 4

Q.4 Please rank five SDGs on which you believe your company could have the greatest impact.

The interviewees were asked to rank five SDGs on which they believed their companies could have a significant impact. The results (Fig. 6) differed as per their points of view and revealed that SDG12 “Responsible Consumption and Production” and SDG13 “Climate Action” were top-ranked (66.7% and 65.5%), these results consistent with the global perspective (see Table 2). In second place were SDG-9 “Industry, Innovation, and Infrastructure” (56%), SDG7 “Affordable and Clean Energy” (51%), and SDG8 “Decent Work and Economic Growth” (49%); these three goals vary in small proportions in the ranking. It is somewhat surprising that our findings showed that, SDG6 “Clean Water and Sanitation” (35.5%) scored place six. While SDG3 “Good Health and Well-being” was ranked in place seven (27%). The other SDGs received less ranking with SDG16 ranking the lowest (only one response). Interestingly, all the SDGs were ranked, and none of them was neglected.

Q.5 Please rank five SDGs that may represent a future business opportunity(s) for your company.

Again, the interviewees were asked to rank five SDGs they believed could represent a future business opportunity(s) for their companies, and again, the results (Fig. 7) differed as per their points of view. The results were similar to those for question 4: SDG-12 and SDG-13 were top-ranked (74.5% and 65.5%), while both SDG-7 and SDG-9 had same ranking (59%) with increases of 8% and 10% respectively and scored second place. While, SDG-8 (46.7%) ranked third. It is somewhat surprising that our findings showed again that, the rating for SDG-6 decreased from 35.5% to 30% compared to the previous question (Q.4). Similarly, the findings showed SDG-3 ranked less by 3.7% (23.3%) here than in question 4. The other SDGs received less ranking, with SDG 16 receiving the least ranking (increased to two responses compared with Q.4). Interestingly, all the SDGs were ranked, and none of them was neglected.

Based on the results obtained from Figs. 6 and 7, the respondents attested to the fact that the industrial sector can implement all the SDGs. Furthermore, based on this result, there

Table 2 The prioritized SDGs in the private sector at the national and global levels

SDGs	Globally*	This Study	Voluntary National Review (VNR) Report	Government Action Plan 2019-2022	Bahrain Economic Vision 2030
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					

*Source of information: SDG Reporting Challenge 2019. Creating a strategy for a better world: How the Sustainable Development Goals can provide the framework for business to deliver progress on our global challenges. PwC network, www.pwc.com/sdgreportingchallenge.

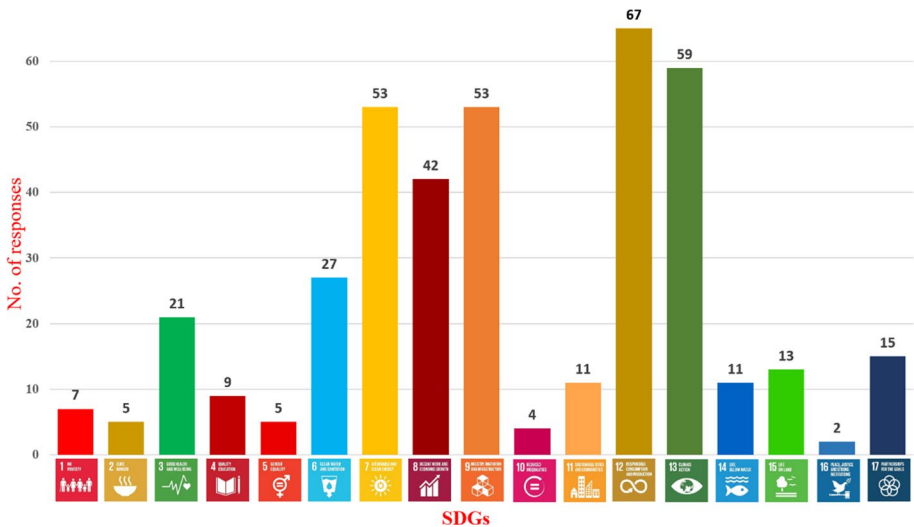


Fig. 7 The number of responses to question 5

is a need to create cooperation and coordination mechanisms among key stakeholders to drive the successful implementation of the SDGs.

Regardless of whether the SDGs are high or low-rated; the less ranking goals—SDG1 “no poverty” (8%), both SDG2 “zero hunger” and SDG5 “gender equality” (5.6%), SDG4 “quality education” (10%), SDG10 “reduced inequality” (4.5%), SDG-11 “sustainable cities and communities” (12%), SDG14 “life below water” (12%), SDG15 “life on land” (14.5%), SDG16 “peace, justice, and strong institutions” (2%), and SDG17 “partnerships for the goals” (17%)—seem to be the most related to company’s core activity. The findings showed the effect of sustainability based on the type of activity, for instance, SDG 2 was mostly mentioned by food sector companies and SDG 14 by companies producing industrial wastewater or effluents that directly affect the environment. However, these goals are significant because they are directly or indirectly interlinked with high-ranking goals.

Table 2 compares the SDGs ranked in order of priority according to global survey 2018, this study’s interview results, Voluntary National Review (VNR) report, Government Action Plan, and Bahrain Economic Vision. Regarding VNR, the government conducted three preparatory workshops aimed at prioritizing the SDGs in Bahrain; one of them was for the private sector, which affirmed that the priority SDGs were SDGs 1, 3, 4, and 8. However, Bahrain’s (2019–2022) Action Plan in priority number 3 stated that “Supporting and Enabling Environment for Sustainable Development,” placed a priority on all the SDGs except SDG 2. The Bahrain Economic Vision embodies the SDGs at its core and is linked with the Government Action Plan. This study’s results concur with the findings obtained by the global ranking survey in the five top SDGs -3, 8, 9, 12 and 13- prioritized in the industrial sector. It is clear that much consideration was given to the SDGs in both Government Action Plan and Bahrain Economic Vision, and both comprise the priority SDGs as per the industrial sector vision. Thus, focusing on sustainability in the industrial sector is crucial to start with adopting the SDGs that make sustainable industrial development a reality.

Table 3 is the synopsis of the analysis presented in Figs. 6 and 7; and the discussion of Table 2. To identify the ranking priority, Table 3 shows that the SDGs ranked differently on national and global levels. At the global level, SDG 8 ranked first; however, it ranked last in this current study and ranked second in the VNR report. Only the SDG 13 ranked the same (second place) at the global level and in this current study. While SDGs 4 and 1 were a priority in the VNR report but not at the global level and in this study. Considering the results in its entirety, ranking the priority SDGs will unite the government and business perspectives. Further, it will lead to cohesive efforts of both the government and companies and assist in embedding the SDGs into national strategies and company plans.

Figure 8 is built upon the analysis described in the previous Figs. 6 and 7. Figure 8 depicts the future business opportunity(ies) of each goal versus those on which companies have had the greatest impact. This proportion is similar to the sustainability matrix approach to identify and prioritize the most significant SDGs that should the industrial sector start to adopt it. Conspicuously, five of the SDGs fall into the high-rank priority upper right-hand quarter. In particular, the companies ranked SDG 12 as the goal on which the industry can have the most impact to make the highest contribution toward SDG attainment; this was followed by SDG 13. SDGs 3 and 6 fell into the middle ranking. In addition, the position of each SDG in the figure represents the level of significance ranking by the industry. Seven goals form 41% of the total SDGs; companies can effectively enhance their impact to create tangible value. The global timeframe for achievement of the SDGs is 15 years; more than half of this time has passed, and the count down for the second half has begun. Therefore, each company should focus

Table 3 Ranking of priority SDGs in the private sector at the national and global levels

	Globally	Study	Voluntary National Review (VNR) Report
1	8 DECENT WORK AND ECONOMIC GROWTH	12 RESPONSIBLE CONSUMPTION AND PRODUCTION	4 QUALITY EDUCATION
2	13 CLIMATE ACTION	13 CLIMATE ACTION	8 DECENT WORK AND ECONOMIC GROWTH
3	12 RESPONSIBLE CONSUMPTION AND PRODUCTION	9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	3 GOOD HEALTH AND WELL-BEING
4	3 GOOD HEALTH AND WELL-BEING	7 AFFORDABLE AND CLEAN ENERGY	1 NO POVERTY
5	9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	8 DECENT WORK AND ECONOMIC GROWTH	

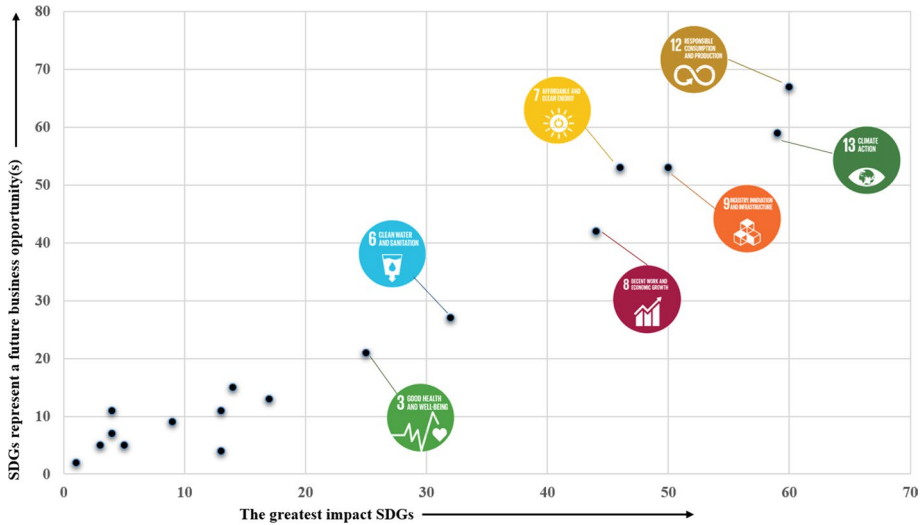
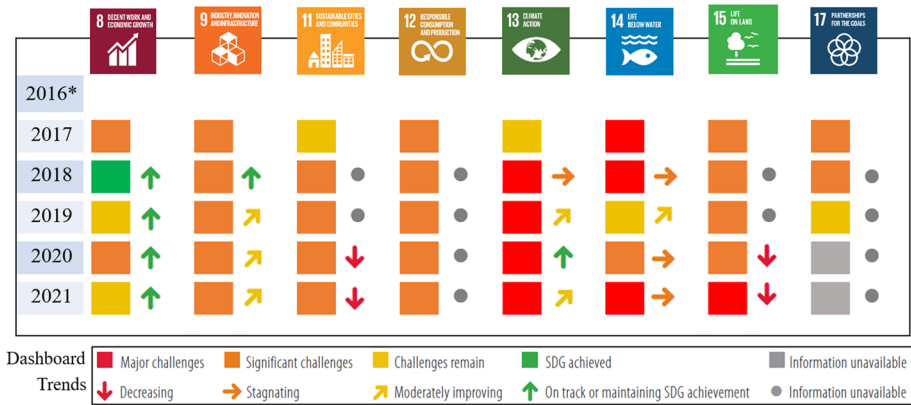


Fig. 8 The SDGs which represent a future business opportunity(s) vs. those on which companies have had the greatest impact (Author's own depiction). * Bahrain is not included in the 2016 SDGs report due to insufficient data



* Bahrain is not included in the 2016 SDGs report due to insufficient data.

Fig. 9 Bahrain’s SDGs dashboard and trends based on UN SDGs reports 2017–2021 (Author’s own depiction; data sources: Sachs et al., 2016, 2017, 2018, 2019, 2020 & 2021)

their attention on the SDGs where they can contribute vitally based on their strengths, capabilities, and experience and have the SDGs as a core part of their business plan to advance their implementation.

Figure 9 shows the SDGs dashboard and trends in Bahrain for the period between 2017 and 2021; it can be observed that Bahrain faces significant challenges in meeting most (57%) of the SDGs (9, 11, 12, and 15). For 20% of the SDGs (13 and 14), major challenges are being faced; for 15% of them, challenges remain, and there is no information (SDGs 15 and 17) regarding 5% of them. Only 2.5% of them are on track to being achieved (SDG 8). The 2021 SDGs report stated that progress on SDG-13 differs among Small Island Developing States, some countries (e.g., Bahrain) has high CO₂ emissions level (Sachs et al., 2021, p. 31). Regarding the trends, both SDGs 12 and 17 have been facing data gaps since 2016. Only SDG 8 is on the achievement track, and SDG 9 is moderately improved.

Based on the results presented above, I suggest that government authorities could benefit from using the SDGs ranking according to companies’ willingness to focus on high-ranking goals as a starting point. This approach could make implementation more efficient and encourage authorities to embrace more SDGs in the future. Additionally, companies could be motivated to work jointly with government authorities to prioritize high-priority SDGs in the national environmental agenda. This may encourage companies to engage in SDG reporting and increase their efforts to localize the SDGs at the national level.

Q.6 Do you think that lack of engagement with the SDGs could become a reputational issue?

According to the interview, this question is the most positive one: majority of firms (70%; n=63) believe that their lack of engagement with SDGs could become a reputational issue. This result makes it clear that the companies are interested in engaging with the SDGs when the opportunity allows.

This highlights the significance of the government’s responsibility in regulating a nationwide plan to actively promote and facilitate the adoption of the SDGs in the industrial sector. The government should enable this sector to plan and execute their contributions towards achieving the SDGs. Additionally, a uniform reporting system should be established to measure their progress towards a sustainable future.

Q.7 What are the most urgent actions the private sector should take to increase its resilience and ability to implement the SDGs in the future?

This open-ended question asked interviewees to freely express and share their opinions on private sector actions that can increase resilience and implement the SDGs in the future. As per the participants, the most pressing step required to implement SDGs in the industrial sector is a government-led initiative and a long-term partnership that could ensure the sustainable integration of sustainability into laws and regulations.

Following the opinions of some of the interviewees discussing the role of the government in implementing SDGs:

I think the starting point would need to come from the government to give clear mandate to the private sector based on consultations and in-depth assessment. Then the private sector will have to implement objectives and targets and allocate the required resources to achieve these mandates. There must be periodic reports on the progress of implementation.

To have a clear information and support from Government agencies to implement SDGs.

Most interviewees focused on the challenges, assistance, capacity building, skills, and expertise. The following quotes are what some of them said:

Create economic opportunities, support the private sector in furthering their skills and connectivity through training and work experience, and encourage industrial innovation.”

“Increase awareness and education, training, sharing expertise and knowledge, sharing best practices, and financial assistance and subsidies.

According to the interviewees, the most important environmental issues that need urgent actions are waste management (waste recycling and minimization and adoption of sustainable consumption); climate change (control air pollution, reduce GHGs, provide renewable energy, and conserve energy); water management and pollution (wastewater treatment and effluent and water consumption reduction); and resource management (reuse, purchase eco-friendly raw materials, and minimize packaging materials). The interviewees said the following:

To conserve natural resources, we can enhance reuse and recycling, purchase recycled materials, and use recyclable packaging.

Produce environmentally friendly products that are safe, energy-efficient, and recyclable or reusable.

Our business is committed to responsible energy use, including conservation, efficient use, and prioritizing renewable sources.

The interviewees have expressed their belief that the COVID-19 pandemic has a valuable lesson learned by the private sector. They have learned the importance of the comprehensive scope of the SDGs and the need for urgent and forceful sustainable practices at global and national levels to conserve the environment and to overcome SDG implementation's challenges. Further, the companies should seriously consider systematically embracing the 2030 Agenda accompanying SDGs as a framework for a more holistic path to structuring sustainability efforts. Therefore, the SDGs are considered an irreplaceable opportunity, and companies should prioritize them, enhancing the collective global effort towards more successful implementation.

The following is what one of the interviewees had to say:

We realize the importance of the environment and the significant damages caused by industries and other activities. To start long term planning to control the impacts of the business on the environment. The first action needed is to accept the SDGs as part of business requirements.

Adopting the SDGs as an integral part of the strategic plans and goals and committing to supporting them. And today should realistically account for a budget towards SDGs implementation.

5 Conclusions

In January 2016, a new era of sustainability began with the adoption of the 17 SDGs on 15 September 2015. However, implementing the SDGs in the industrial sector has proven to be challenging due to the sector's vast range of activities, its size, and the complexity of the SDGs. This study aimed to investigate the sustainability status in the industrial sector by identifying the challenges that hinder SDG implementation, determining high-priority goals, and figuring out what actions can be taken to increase SDG implementation ability, if the SDGs present an opportunity.

The study found that the industrial sector has several sustainable initiatives, projects, and practices that form the basis for sustainability governance. It is necessary to align these efforts with the SDGs and integrate them into the companies' business plans and strategies. The interviewees pointed out that there are barriers to improving current company practices and approaches. Therefore, the government needs to provide attractive incentives and initiatives to encourage companies to embrace sustainability practices and focus on achieving the SDGs. Moreover, the study emphasizes the need for a stronger government presence, environmental accountability, legal liability, and a unified understanding of how companies integrate sustainability issues into their plans. The study also identified the top five SDGs related to Bahrain's industrial sector, which are ranked based on priority: SDGs 12, 13, 9, 7, and 8. The SDGs dashboard showed that Bahrain faces significant challenges in achieving SDGs 9, 11, 12, and 15.

To effect any change in a company's policy, the start-point with the top management, due to their attitude regarding the SDGs is considered a significant primary factor in improving the environmental policy and incorporating it into the company's strategy. Further, the top management plays a paramount role in motivating its employees to participate actively in the development process by providing valuable opportunities to raise the employees' knowledge level, competency, and experience. Moreover, CER in a firm is an environmental realization because it forms a positive signal that is translated into eco actions in the firm's plans; it is considered an essential driving factor for firms to include environmental protection in their values.

5.1 Limitations

Every research is subject to certain limitations which slightly hamper the gaining of optimum results. One of the major limitations of this study was that most interviews were conducted at the peak of the COVID-19 pandemic. As a result, many interviewees were working from home, which led to a reduced response rate and delayed progress. The COVID-19 crisis affected SDGs implementation progress globally at a time when they were gaining momentum and remarkable progress, and it also provides opportunities to reach the 2030

Agenda, especially in the field of planetary health. Therefore, countries must increase their immediate actions to achieve the SDGs.

In addition, the study scope is confined exclusively to Bahrain's geographic domain to a large industrial sector. In part of the interviews with managers or management personnel (such as human resource managers), the researcher preferred environmental specialists responsible for environmental issues in the company due to their experience. Further, this study focuses on a single sector (industry), and the findings showed that the sustainability issue is emerging in limited reports of companies of this sector, therefore needing more cross-sectoral studies.

These limitations provide scope for future research by extending the reporting period for further investigating environmental disclosures. This study is a first effort towards earning an ample and deep understanding of this novel topic about the relation between SDGs and the industrial sector. Therefore, the authors believe that the study could contribute to theory notions and practice in sundry ways. The study explored novel research subjects about SDGs and the industrial sector at the national level, which may contribute to the practice field and pave the way for the required future steps. Moreover, the study highlighted different outcomes of multidisciplinary literature that explored the subjects of sustainable development and raised a set of recommendations for future research. Furthermore, extending existing research through narrative or explanatory reviews of the literature could assist conducting investigating more deeply the academic discussion on the industry sector role and the SDGs, also, future studies are essential to explore the potential benefits of SDGs on other business sectors.

5.2 Future implications

The industrial sector, the largest part of the private sector, is responsible for adopting a more comprehensive approach to sustaining economic growing while keeping the environment secure and protecting society. This can be achieved through a circular economy. More research is required in this area to develop effective implementation frameworks to assist the industrial sector in adopting the SDGs practically and efficiently. Additionally, in-depth case studies are required to analyze the benefits and challenges of implementing the SDGs and to promote sustainability in this sector.

This study aimed to identify and prioritize significant sustainability issues. This will help companies improve their environmental performance and encourage those that do not have sustainability reports to follow suit. Nevertheless, this study is only one sector and more research is needed to investigate the impact of all SDGs disclosures on various business sectors, covering the three dimensions of sustainability. Additionally, this study opens a new window of further research by studying future trends and continuing commitment to corporate SDGs reporting.

In this regard, the companies' data on their air emissions, wastewater, effluents, hazardous waste production, chemicals and other environmental aspects data are kept exclusively by the companies and environmental authorities. However, these data are rich reference resources that should be provided to researchers (as a neutral party) to conduct studies on evaluating the regulations' effectiveness and the extent of companies' compliance. This provides researchers with results that help them to accurately set their goals toward sustainability. Further, conduct studies on evaluating the regulations' effectiveness and the extent of companies' compliance, for instance, studying the

feasibility of adopting environmental auditing within the services of private consulting offices, by making use of the experiences of countries that have implemented it in the industrial sector.

The study has revealed that the industrial sector is facing financial and technological challenges while trying to mitigate their negative impact on the environment. Therefore, it is crucial to conduct an in-depth analysis of these challenges concerning the best available eco-technology and economic perspectives that can help improve environmental quality. This effort could encourage companies to prioritize addressing environmental concerns and compliance in their plans.

5.3 Recommendations

1. The SDGs global framework plan has a timeframe of 15 years. More than half of this time has already passed. Therefore, every company must identify SDGs where they can significantly contribute their strengths, capabilities, and experience. Furthermore, companies should make SDGs a core part of their business plan to advance SDG implementation.
2. The study results indicate that concerned government authorities can benefit from the SDG ranking which indicates companies' willingness to focus on the high-ranking goals as a starting point; this could make implementation more efficient and encourage them to embrace more SDGs in the future. Therefore, the companies could be motivated to work jointly with the concerned governmental authorities to focus on high-priority SDGs in the national environmental agenda; this may encourage the companies to engage in SDG reporting and increase their efforts toward localizing the SDGs at the national level. Consequently, a unified reporting system could be established to measure the progress toward a sustainable future.
3. The government needs to establish a national plan to promote and facilitate the SDGs implementation in the entire industry sectors. This will enable this sector to effectively plan its contributions towards achieving the SDGs and understand how they can positively impact them.
4. The industrial sector requires immediate and urgent action for the implementation of SDGs. The government should take the initiative and form a long-term partnership to ensure that sustainability is integrated into the laws and regulations of the industrial sector. This will make the implementation of SDGs sustainable in the industrial sector and should be considered a top priority.

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Data availability Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

Declarations

Conflict of interest The authors declare no conflict of interest.

References

- Abdul-Rashid, S. H., Sakundarini, N., Ariffin, R., & Ramayah, T. (2017a). Drivers for the adoption of sustainable manufacturing practices: A Malaysia perspective. *International Journal of Precision Engineering and Manufacturing*, 18(11), 1619–1631. <https://doi.org/10.1007/s12541-017-0191-4>
- Abdul-Rashid, S. H., Sakundarini, N., Ghazilla, R. A. R., & Thurasamy, R. (2017b). The impact of sustainable manufacturing practices on sustainability performance. *International Journal of Operations & Production Management*, 37(2), 182–204. <https://doi.org/10.1108/IJOPM-04-2015-0223>
- Alvarado, R., & Toledo, E. (2017). Environmental degradation and economic growth: Evidence for a developing country. *Environment, Development and Sustainability*, 19(4), 1205–1218. <https://doi.org/10.1007/s10668-016-9790-y>
- Álvarez, M. E. P., Bárcena, M. M., & González, F. A. (2017). On the sustainability of machining processes. Proposal for a unified framework through the triple bottom-line from an understanding review. *Journal of Cleaner Production*, 142, 3890–3904. <https://doi.org/10.1016/j.jclepro.2016.10.071>
- Arbolino, R., Boffardi, R., Lanuzza, F., & Ioppolo, G. (2018). Monitoring and evaluation of regional industrial sustainability: Evidence from Italian regions. *Land Use Policy*, 75, 420–428. <https://doi.org/10.1016/j.landusepol.2018.04.007>
- Arbolino, R., Carlucci, F., Cirà, A., Ioppolo, G., & Yigitcanlar, T. (2017). Efficiency of the EU regulation on greenhouse gas emissions in Italy: The hierarchical cluster analysis approach. *Ecological Indicators*, 81, 115–123. <https://doi.org/10.1016/j.ecolind.2017.05.053>
- Bag, S., Yadav, G., Dhamija, P., & Kataria, K. K. (2021). Key resources for industry 4.0 adoption and its effect on sustainable production and circular economy: An empirical study. *Journal of Cleaner Production*, 281, 125233. <https://doi.org/10.1016/j.jclepro.2020.125233>
- Bahrain economic development board (BEDB) (2021). Manufacturing business opportunities. Access Date: 19/01/2021. Retrieved from <https://www.bahrainedb.com/business-opportunities/manufacturing/>
- Bai, C., Dallasega, P., Orzes, G., & Sarkis, J. (2020). Industry 4.0 technologies assessment: A sustainability perspective. *International journal of production economics*, 229, 107776. <https://doi.org/10.1016/j.ijpe.2020.107776>
- Bakardjieva, R. (2016). Sustainable development and corporate social responsibility: Linking goals to standards. *Journal of Innovations and Sustainability*, 2(4), 23–35. <https://doi.org/10.51599/is.2016.02.04.23>
- Barbier, E. B. (2016). Sustainability and development. *Annual Review of Resource Economics*, 8, 261–280. <https://doi.org/10.1146/annurev-resource-100815-095227>
- Bauer, W., Hämmerle, M., Schlund, S., & Vocke, C. (2015). Transforming to a hyper-connected society and economy—Towards an “Industry 4.0.” *Procedia Manufacturing*, 3, 417–424. <https://doi.org/10.1016/j.promfg.2015.07.200>
- Beier, G., Niehoff, S., & Hoffmann, M. (2021). Industry 4.0: a step towards achieving the SDGs? A critical literature review. *Discover sustainability*, 2(1), 1–21. <https://doi.org/10.1007/s43621-021-00030-1>
- Beier, G., Niehoff, S., & Xue, B. (2018). More sustainability in industry through industrial internet of things? *Applied Sciences*, 8(2), 219. <https://doi.org/10.3390/app8020219>
- Berawi, M. A. (2019). The role of industry 4.0 in achieving sustainable development goals. *International Journal of Technology*, 10(4), 644–647. <https://doi.org/10.14716/ijtech.v10i4.3341>
- Bexell, M., & Jönsson, K. (2017). Responsibility and the United Nations’ sustainable development goals. *Forum for Development Studies*, 44(1), 13–29.
- Bhakar, V., Digalwar, A. K., & Sangwan, K. S. (2018). Sustainability assessment framework for manufacturing sector—a conceptual model. *Procedia CIRP*, 69, 248–253. <https://doi.org/10.1016/j.procir.2017.11.101>
- Bhanot, N., Rao, P. V., & Deshmukh, S. G. (2017). An integrated approach for analysing the enablers and barriers of sustainable manufacturing. *Journal of Cleaner Production*, 142, 4412–4439. <https://doi.org/10.1016/j.jclepro.2016.11.123>
- Busco, C., & Sofra, E. (2021). The evolution of sustainability reporting: Integrated reporting and sustainable development challenges. *Corporate Sustainability in Practice* (pp. 191–206). Cham: Springer.
- Cai, L., Cui, J., & Jo, H. (2016). Corporate environmental responsibility and firm risk. *Journal of Business Ethics*, 139(3), 563–594. <https://doi.org/10.1007/s10551-015-2630-4>
- Calabrese, A., Costa, R., Gastaldi, M., Ghiron, N. L., & Montalvan, R. A. V. (2021). Implications for sustainable development goals: A framework to assess company disclosure in sustainability reporting. *Journal of Cleaner Production*, 319, 128624.
- Castillo-Montoya, M. (2016). Preparing for interview research: The interview protocol refinement framework. *The Qualitative Report*, 21(5), 811–831.

- Dahlmann, F., Stubbs, W., Raven, R., & de Albuquerque, J. P. (2020). The 'purpose ecosystem': Emerging private sector actors in earth system governance. *Earth System Governance*. <https://doi.org/10.1016/j.esg.2020.100053>
- Dalenogare, L. S., Benitez, G. B., Ayala, N. F., & Frank, A. G. (2018). The expected contribution of Industry 4.0 technologies for industrial performance. *International Journal of Production Economics*, 204, 383–394. <https://doi.org/10.1016/j.ijpe.2018.08.019>
- D'Amato, D., Korhonen, J., & Toppinen, A. (2019). Circular, green, and bio economy: How do companies in land-use intensive sectors align with sustainability concepts? *Ecological Economics*, 158, 116–133.
- Dantas, T. E., De-Souza, E. D., Destro, I. R., Hammes, G., Rodriguez, C. M. T., & Soares, S. R. (2021). How the combination of circular economy and industry 4.0 can contribute towards achieving the sustainable development goals. *Sustainable Production and Consumption*, 26, 213–227. <https://doi.org/10.1016/j.spc.2020.10.005>
- de Moraes Hoefel, J. L., da Cal Seixas, S. R., & Machado, M. K. (2018). Corporate sustainable strategies in Dom Pedro I Industrial Road Axis, São Paulo, Brazil. *Handbook of Sustainability Science and Research* (pp. 71–85). Cham: Springer.
- de Oliveira-Neto, G. C., Pinto, L. F. R., Amorim, M. P. C., Giannetti, B. F., & de Almeida, C. M. V. B. (2018). A framework of actions for strong sustainability. *Journal of Cleaner Production*, 196, 1629–1643. <https://doi.org/10.1016/j.jclepro.2018.06.067>
- Doody, O., & Noonan, M. (2013). Preparing and conducting interviews to collect data. *Nurse Researcher*, 20(5), 28–32. <https://doi.org/10.7748/nr2013.05.20.5.28.e327>
- Erol, S., Jäger, A., Hold, P., Ott, K., & Sihn, W. (2016). Tangible Industry 4.0: A scenario-based approach to learning for the future of production. *Procedia Cirp*, 54, 13–18. <https://doi.org/10.1016/j.procir.2016.03.162>
- Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics*, 5(1), 1–4.
- Eustachio, J. H. P. P., Caldana, A. C. F., Liboni, L. B., & Martinelli, D. P. (2019). Systemic indicator of sustainable development: Proposal and application of a framework. *Journal of Cleaner Production*, 241, 118383. <https://doi.org/10.1016/j.jclepro.2019.118383>
- Ferrero-Ferrero, I., León, R., & Muñoz-Torres, M. J. (2021). Sustainability materiality matrices in doubt: May prioritizations of aspects overestimate environmental performance? *Journal of Environmental Planning and Management*, 64(3), 432–463. <https://doi.org/10.1080/09640568.2020.1766427>
- Figueres, C., Schellnhuber, H. J., Whiteman, G., Rockström, J., Hobley, A., & Rahmstorf, S. (2017). Three years to safeguard our climate. *Nature News*, 546(7660), 593. <https://doi.org/10.1038/546593a>
- Fuso Nerini, F., Sovacool, B., Hughes, N., Cozzi, L., Cosgrave, E., Howells, M., & Milligan, B. (2019). Connecting climate action with other sustainable development goals. *Nature Sustainability*, 2(8), 674–680. <https://doi.org/10.1038/s41893-019-0334-y>
- Gabriel, M., & Pessl, E. (2016). Industry 4.0 and sustainability impacts: Critical discussion of sustainability aspects with a special focus on future of work and ecological consequences. *Annals of the Faculty of Engineering Hunedoara*, 14(2), 131.
- Garrido-Ruso, M., Aibar-Guzmán, B., & Monteiro, A. P. (2022). Businesses' role in the fulfillment of the 2030 Agenda: A bibliometric analysis. *Sustainability*, 14(14), 8754.
- Gilli, M., Marin, G., Mazzanti, M., & Nicolli, F. (2017). Sustainable development and industrial development: Manufacturing environmental performance, technology and consumption/production perspectives. *Journal of Environmental Economics and Policy*, 6(2), 183–203. <https://doi.org/10.1080/21606544.2016.1249413>
- Govindan, K., Shankar, K. M., & Kannan, D. (2020). Achieving sustainable development goals through identifying and analyzing barriers to industrial sharing economy: A framework development. *International Journal of Production Economics*, 227, 107575. <https://doi.org/10.1016/j.ijpe.2019.107575>
- Hajer, M., Nilsson, M., Raworth, K., Bakker, P., Berkhout, F., De Boer, Y., Rockström, J., Ludwig, K., & Kok, M. (2015). Beyond cockpit-ism: Four insights to enhance the transformative potential of the sustainable development goals. *Sustainability*, 7(2), 1651–1660.
- Hami, N., Muhamad, M. R., & Ebrahim, Z. (2016). The impact of sustainable manufacturing practices on sustainability. *Jurnal Teknologi*. <https://doi.org/10.11113/jt.v78.3090>
- Haraguchi, N., & Kitaoka, K. (2015). Industrialization in the 2030 agenda for sustainable development. *Development*, 58(4), 452–462. <https://doi.org/10.1057/s41301-016-0052-y>
- Herghiligiu, I. V., Robu, I. B., Pislaru, M., Vilcu, A., Asandului, A. L., Avasilcăi, S., & Balan, C. (2019). Sustainable environmental management system integration and business performance: A balance assessment approach using fuzzy logic. *Sustainability*, 11(19), 5311. <https://doi.org/10.3390/su11195311>

- Hidayatno, A., Destyanto, A. R., & Hulu, C. A. (2019). Industry 4.0 technology implementation impact to industrial sustainable energy in Indonesia: A model conceptualization. *Energy Procedia*, 156, 227–233. <https://doi.org/10.1016/j.egypro.2018.11.133>
- Hofmann, E., & Rüsch, M. (2017). Industry 4.0 and the current status as well as future prospects on logistics. *Computers in Industry*, 89, 23–34. <https://doi.org/10.1016/j.compind.2017.04.002>
- Howard, M., Hopkinson, P., & Miemczyk, J. (2019). The regenerative supply chain: A framework for developing circular economy indicators. *International Journal of Production Research*, 57(23), 7300–7318. <https://doi.org/10.1080/00207543.2018.1524166>
- Hummel, K., & Szekely, M. (2022). Disclosure on the sustainable development goals—Evidence from Europe. *Accounting in Europe*, 19(1), 152–189.
- IPIECA (2017). Mapping the oil and gas industry to the sustainable development goals: An Atlas. UK. Retrieved from http://www.ipieca.org/media/3093/mapping_og_to_sdg_atlas_lr_2017.pdf
- Jiang, Q., Liu, Z., Liu, W., Li, T., Cong, W., Zhang, H., & Shi, J. (2018). A principal component analysis based three-dimensional sustainability assessment model to evaluate corporate sustainable performance. *Journal of Cleaner Production*, 187, 625–637. <https://doi.org/10.1016/j.jclepro.2018.03.255>
- Kasych, A., Suler, P., & Rowland, Z. (2020). Corporate environmental responsibility through the prism of strategic management. *Sustainability*, 12(22), 9589. <https://doi.org/10.3390/su12229589>
- Kim, H., Park, K., & Ryu, D. (2017). Corporate environmental responsibility: A legal origins perspective. *Journal of Business Ethics*, 140(3), 381–402. <https://doi.org/10.1007/s10551-015-2641-1>
- Kopnina, H. (2016). The victims of unsustainability: A challenge to sustainable development goals. *International Journal of Sustainable Development & World Ecology*, 23(2), 113–121. <https://doi.org/10.1080/13504509.2015.1111269>
- Kynčlová, P., Upadhyaya, S., & Nice, T. (2020). Composite index as a measure on achieving sustainable development goal 9 (SDG-9) industry-related targets: The SDG-9 index. *Applied Energy*, 265, 114755. <https://doi.org/10.1016/j.apenergy.2020.114755>
- Le Blanc, D. (2015). Towards integration at last? The sustainable development goals as a network of targets. *Sustainable Development*, 23(3), 176–187. <https://doi.org/10.1002/sd.1582>
- Lee, R. P., Keller, F., & Meyer, B. (2017). A concept to support the transformation from a linear to circular carbon economy: Net zero emissions, resource efficiency and conservation through a coupling of the energy, chemical and waste management sectors. *Clean Energy*, 1(1), 102–113. <https://doi.org/10.1093/ce/zkx004>
- Lesníková, P., & Schmidtová, J. (2019). Environmental management in the context of corporate sustainability concept. *System Safety: Human-Technical Facility-Environment*, 1(1), 352–362. <https://doi.org/10.2478/czoto-2019-0045>
- Li, L. (2018). China's manufacturing locus in 2025: With a comparison of “Made-in-China 2025” and “Industry 4.0.” *Technological Forecasting and Social Change*, 135, 66–74. <https://doi.org/10.1016/j.techfore.2017.05.028>
- Li, Z., Liao, G., & Albitar, K. (2020). Does corporate environmental responsibility engagement affect firm value? The mediating role of corporate innovation. *Business Strategy and the Environment*, 29(3), 1045–1055. <https://doi.org/10.1002/bse.2416>
- Liu, S. (2020). Interlinkages between indicators of sustainable development goals: Evidence from seven low income and lower middle-income countries. *Sustainable Development Research*, 2(1), 58–p58. <https://doi.org/10.30560/sdr.v2n1p58>
- Liu, S. (2021). Interactions between industrial development and environmental protection dimensions of sustainable development goals (SDGs): Evidence from 40 countries with different income levels. *Environmental & Socio-Economic Studies*, 8(3), 60–67. <https://doi.org/10.2478/enviro-2020-0018>
- Liu, W., Wei, Q., Huang, S. Q., & Tsai, S. B. (2017). Doing good again? A multilevel institutional perspective on corporate environmental responsibility and philanthropic strategy. *International Journal of Environmental Research and Public Health*, 14(10), 1283. <https://doi.org/10.3390/ijerph14101283>
- Lloret, A. (2016). Modeling corporate sustainability strategy. *Journal of Business Research*, 69(2), 418–425. <https://doi.org/10.1016/j.jbusres.2015.06.047>
- Luthra, S., & Mangla, S. K. (2018). Evaluating challenges to Industry 4.0 initiatives for supply chain sustainability in emerging economies. *Process Safety and Environmental Protection*, 117, 168–179. <https://doi.org/10.1016/j.psep.2018.04.018>
- Machado, C. G., Winroth, M. P., & Ribeiro da Silva, E. H. D. (2020). Sustainable manufacturing in Industry 4.0: An emerging research agenda. *International Journal of Production Research*, 58(5), 1462–1484. <https://doi.org/10.1080/00207543.2019.1652777>
- Martins, V. W. B., Rampasso, I. S., Siltori, P. F. S., Cazeri, G. T., Anholon, R., Quelhas, O. L. G., & Leal Filho, W. (2020). Contributions from the Brazilian industrial sector to sustainable development. *Journal of Cleaner Production*, 272, 122762. <https://doi.org/10.1016/j.jclepro.2020.122762>

- Mendoza-del Villar, L. A., Oliva-López, E., Luis-Pineda, O., & Garza-Reyes, J. A. (2019). Towards sustainable industrial development-A systems thinking-based approach. In *Proceedings 3th EU International Conference on Industrial Engineering and Operations Management* (pp. 1994–2005).
- Mishra, H., & Maheshwari, P. (2020). Achieving sustainable development goals through fourth industrial revolution: An Indian perspective. *Indian Journal of Commerce and Management Studies*, 11(2), 63–75. <https://doi.org/10.18843/ijcms/v11i2/06>
- Modgil, S., Gupta, S., & Bhushan, B. (2020). Building a living economy through modern information decision support systems and UN sustainable development goals. *Production Planning & Control*, 31(11–12), 967–987. <https://doi.org/10.1080/09537287.2019.1695916>
- Moktadir, M. A., Rahman, T., Rahman, M. H., Ali, S. M., & Paul, S. K. (2018). Drivers to sustainable manufacturing practices and circular economy: A perspective of leather industries in Bangladesh. *Journal of Cleaner Production*, 174, 1366–1380. <https://doi.org/10.1016/j.jclepro.2017.11.063>
- Müller, J. M., Kiel, D., & Voigt, K. I. (2018). What drives the implementation of Industry 4.0? The role of opportunities and challenges in the context of sustainability. *Sustainability*, 10(1), 247. <https://doi.org/10.3390/su10010247>
- Myroshnychenko, I., Makarenko, I., Smolennikov, D., & Buriak, A. (2019). The approach to managing corporate social and environmental responsibility in manufacturing. *TEM Journal*, 8(3), 740. <https://doi.org/10.18421/TEM83-07>
- Niehoff, S., & Beier, G. (2018). Industrie 4.0 and a sustainable development: A short study on the perception and expectations of experts in Germany. *International Journal of Innovation and Sustainable Development*, 12(3), 360–374. <https://doi.org/10.1504/IJISD.2018.091543>
- Nilsson, M., Vijge, M. J., Alva, I. L., Bornemann, B., Fernando, K., Hickmann, T., & Weiland, S. (2022). Interlinkages, integration and coherence. In *The political impact of the sustainable development goals: Transforming governance through global goals?* (pp. 92–115). Cambridge University Press.
- Okorie, O., Salontis, K., Charnley, F., Moreno, M., Turner, C., & Tiwari, A. (2018). Digitisation and the circular economy: A review of current research and future trends. *Energies*, 11(11), 3009. <https://doi.org/10.3390/en11113009>
- Oláh, J., Aburumman, N., Popp, J., Khan, M. A., Haddad, H., & Kitukutha, N. (2020). Impact of Industry 4.0 on environmental sustainability. *Sustainability*, 12(11), 4674. <https://doi.org/10.3390/su12114674>
- Oliveira, J. A., Oliveira, O. J., Ometto, A. R., Ferraudo, A. S., & Salgado, M. H. (2016). Environmental management system ISO 14001 factors for promoting the adoption of cleaner production practices. *Journal of Cleaner Production*, 133, 1384–1394. <https://doi.org/10.1016/j.jclepro.2016.06.013>
- Omotehinse, A. O., & De Tomi, G. (2022). Mining and the sustainable development goals: Prioritizing SDG targets for proper environmental governance. *Ambio*. <https://doi.org/10.1007/s13280-022-01775-3>
- Opoku, E. E. O., & Boachie, M. K. (2020). The environmental impact of industrialization and foreign direct investment. *Energy Policy*, 137, 111–178. <https://doi.org/10.1016/j.enpol.2019.111178>
- Patyal, V. S., Sarma, P. R. S., Modgil, S., Nag, T., & Dennehy, D. (2022). Mapping the links between Industry 4.0, circular economy and sustainability: A systematic literature review. *Journal of Enterprise Information Management*, 35(1), 1–35. <https://doi.org/10.1108/JEIM-05-2021-0197>
- Perneger, T. V., Courvoisier, D. S., Hudelson, P. M., & Gayet-Ageron, A. (2015). Sample size for pre-tests of questionnaires. *Quality of Life Research*, 24(1), 147–151. <https://doi.org/10.1007/s11136-014-0752-2>
- Phiri, O., Mantzari, E., & Gleadle, P. (2018). Stakeholder interactions and corporate social responsibility (CSR) practices: Evidence from the Zambian copper mining sector. *Accounting, Auditing & Accountability Journal*. <https://doi.org/10.1108/AAAJ-04-2016-2540>
- Pradhan, P., Costa, L., Rybski, D., Lucht, W., & Kropp, J. P. (2017). A systematic study of sustainable development goal (SDG) interactions. *Earth's Future*, 5(11), 1169–1179. <https://doi.org/10.1002/2017EF000632>
- Qin, Y., Harrison, J., & Chen, L. (2019). A framework for the practice of corporate environmental responsibility in China. *Journal of Cleaner Production*, 235, 426–452. <https://doi.org/10.1016/j.jclepro.2019.06.245>
- Rüßmann, M., Lorenz, M., Gerbert, P., Waldner, M., Justus, J., Engel, P., & Harnisch, M. (2015). Industry 4.0: The future of productivity and growth in manufacturing industries. *Boston Consulting Group*, 9(1), 54–89.
- Sachs, J., Schmidt-Traub, G., Kroll, C., Durand-Delacré, D., & Teksoz, K. (2016). An SDG index and dashboards—Global report. New York: Bertelsmann Stiftung and sustainable development solutions network (SDSN).
- Sachs, J., Schmidt-Traub, G., Kroll, C., Durand-Delacré, D., & Teksoz, K. (2017). SDG index and dashboards report 2017. New York: Bertelsmann Stiftung and Sustainable Development Solutions Network (SDSN).

- Sachs, J., Schmidt-Traub, G., Kroll, C., Lafortune, G. & Fuller, G. (2018). *SDG index and dashboards Report 2018*. New York: Bertelsmann Stiftung and sustainable development solutions network (SDSN).
- Sachs, J., Schmidt-Traub, G., Kroll, C., Lafortune, G. & Fuller, G. (2019). *Sustainable development report 2019*. New York: Bertelsmann Stiftung and sustainable development solutions network (SDSN).
- Sachs, J., Schmidt-Traub, G., Kroll, C., Lafortune, G., Fuller, G. and Woelm, F. (2020). *The sustainable development goals and COVID-19*. Sustainable Development Report 2020. Cambridge: Cambridge University Press.
- Sachs, J., Kroll, C., Lafortune, G., Fuller, G., & Woelm, F. (2021). *The decade of action for the sustainable development Goals: Sustainable development report 2021*. Cambridge University Press.
- Sáez-Martínez, F. J., Díaz-García, C., & González-Moreno, A. (2016). Factors promoting environmental responsibility in European SMEs: The effect on performance. *Sustainability*, 8(9), 898. <https://doi.org/10.3390/su8090898>
- Sahimi, N. S., Turan, F. M., & Johan, K. (2018). Framework of sustainability assessment (FSA) method for manufacturing industry in Malaysia. In *IOP Conference Series: Materials Science and Engineering* (Vol. 342, No. 1, p. 012079). Doi: <https://doi.org/10.1088/1757-899X/342/1/012079>
- Sarkis, J., & Zhu, Q. (2018). Environmental sustainability and production: Taking the road less travelled. *International Journal of Production Research*, 56(1–2), 743–759. <https://doi.org/10.1080/00207543.2017.1365182>
- Schroeder, P., Anggraeni, K., & Weber, U. (2019). The relevance of circular economy practices to the sustainable development goals. *Journal of Industrial Ecology*, 23(1), 77–95. <https://doi.org/10.1111/jiec.12732>
- Seth, D., Rehman, M. A. A., & Shrivastava, R. L. (2018). Green manufacturing drivers and their relationships for small and medium (SME) and large industries. *Journal of Cleaner Production*, 198, 1381–1405. <https://doi.org/10.1016/j.jclepro.2018.07.106>
- Siew, R. Y. (2015). A review of corporate sustainability reporting tools (SRTs). *Journal of Environmental Management*, 164, 180–195. <https://doi.org/10.1016/j.jenvman.2015.09.010>
- Silvestre, B. S., & Gimenes, F. A. P. (2017). A sustainability paradox? Sustainable operations in the offshore oil and gas industry: The case of Petrobras. *Journal of Cleaner Production*, 142, 360–370. <https://doi.org/10.1016/j.jclepro.2016.07.215>
- Silvestre, B. S., & Țircă, D. M. (2019). Innovations for sustainable development: Moving toward a sustainable future. *Journal of Cleaner Production*, 208, 325–332. <https://doi.org/10.1016/j.jclepro.2018.09.244>
- Singh, A. S., & Masuku, M. B. (2014). Sampling techniques & determination of sample size in applied statistics research: An overview. *International Journal of Economics, Commerce and Management*, 2(11), 1–22.
- Sinkovics, N., Sinkovics, R. R., & Archie-Acheampong, J. (2021). The business responsibility matrix: A diagnostic tool to aid the design of better interventions for achieving the SDGs. *Multinational Business Review*, 29(1), 1–20. <https://doi.org/10.1108/MBR-07-2020-0154>
- Trianni, A., Cagno, E., & Neri, A. (2017). Modelling barriers to the adoption of industrial sustainability measures. *Journal of Cleaner Production*, 168, 1482–1504. <https://doi.org/10.1016/j.jclepro.2017.07.244>
- Tsalis, T. A., Malamateniou, K. E., Koulouriotis, D., & Nikolaou, I. E. (2020). New challenges for corporate sustainability reporting: United Nations' 2030 Agenda for sustainable development and the sustainable development goals. *Corporate Social Responsibility and Environmental Management*, 27(4), 1617–1629. <https://doi.org/10.1002/csr.1910>
- Turan, F. M., Johan, K., Lanang, W. W., & Asmanizam, A. (2017). Assessing sustainability in environmental management: A case study in malaysia industry. In *IOP Conference Series: Materials Science and Engineering* (Vol. 226, No. 1). Doi: <https://doi.org/10.1088/1757-899X/226/1/012050>
- Ulbrych, M. (2020). Progress in achieving sustainable industrial development—the case of the Czech Republic and Poland. *Comparative economic research*. *Central and Eastern Europe*, 23(4), 109–128. <https://doi.org/10.18778/1508-2008.23.30>
- UNGA (2015). *Transforming our world: The 2030 Agenda for sustainable development*. Resolution adopted by the general assembly on 25 September 2015, seventieth session Agenda. Available: A/RES/70/1. Retrieved from http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E.
- United Nations (UN) (2015). Resolution 70/1 in 2015: transforming our world: The 2030 agenda for sustainable development. United Nations General Assembly. Retrieved from https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E.
- United Nations Industrial Development Organization (UNIDO) (2020). *Industrialization as the driver of sustained prosperity*. Vienna. Available at <https://www.unido.org> (accessed on Jun. 2022).

- United Nations Global Compact (UNGC) (2021). UN Global compact strategy 2021–2023. New York, USA.
- United Nations Industrial Development Organization (UNIDO) (2022). International yearbook of industrial statistics: Towards inclusive and sustainable development with reliable industrial statistics. Vienna. Available at UNIDO_IndustrialStatistics_Yearbook_2022.pdf (accessed on Nov. 2022)
- United Nations Development Programme (UNDP) (2022). STOCKHOLM+50 A global synthesis report of national consultations: A healthy planet for the prosperity of all –our responsibility, our opportunity.
- Van Zanten, J. A., & Van Tulder, R. (2020). Beyond COVID-19: Applying “SDG logics” for resilient transformations. *Journal of International Business Policy*, 3(4), 451–464. <https://doi.org/10.1057/s42214-020-00076-4>
- Van Zanten, J. A., & van Tulder, R. (2021). Improving companies’ impacts on sustainable development: A nexus approach to the SDGs. *Business Strategy and the Environment*, 30(8), 3703–3720.
- Wang, H. (2016). Systematic analysis of corporate environmental responsibility: Elements, structure, function, and principles. *Chinese Journal of Population Resources and Environment*, 14(2), 96–104. <https://doi.org/10.1080/10042857.2016.1147715>
- Weitz, N., Carlsen, H., Nilsson, M., & Skanberg, K. (2018). Towards systemic and contextual priority setting for implementing the 2030 Agenda. *Sustainability Science*, 13(2), 531–548. <https://doi.org/10.1007/s11625-017-0470-0>
- Witkowski, K. (2017). Internet of things, big data, industry 4.0–Innovative solutions in logistics and supply chains management. *Procedia Engineering*, 182, 763–769. <https://doi.org/10.1016/j.proeng.2017.03.197>
- World Commission on Environment & Development (WCED) (1987). Our Common Future, Transmitted to the general assembly as an annex to document A/42/427–Development and International Co-operation: Environment.
- Xu, L. D., Xu, E. L., & Li, L. (2018). Industry 4.0: State of the art and future trends. *International Journal of Production Research*, 56(8), 2941–2962. <https://doi.org/10.1080/00207543.2018.1444806>
- Yeong, M. L., Ismail, R., Ismail, N. H., & Hamzah, M. (2018). Interview protocol refinement: fine-tuning qualitative research interview questions for multi-racial populations in Malaysia. *Qualitative Report*, 23(11), 2700–2713.

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