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RESEARCH ARTICLE

Appraising correlation between international organisation for standardisation 50001 and green productivity: A study of workers in Baiji, Iraq

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ABSTRACT

Studies have shown that the progress and success of companies are achieved through their ability to improve energy performance and preserve the environment. It would translate to environmentally friendly products. However, there is a paucity of studies regarding the International Organisation for Standardisation (ISO) 50001 and its role in enhancing environmentally friendly products in developing countries such as Iraq. This study investigates the correlation between ISO 50001 standards and green productivity among Baiji's refinery workers in Iraq. Utilising a structured questionnaire, data from 128 respondents were analysed using descriptive and inferential statistics. Results indicate a significant positive correlation between ISO 50001 and green productivity, underscoring the importance of energy management training in enhancing productivity and environmental protection. As part of the study's implications, it suggests increasing the company's management's attention to training in energy management and green productivity. Its positive impact on improving productivity and protecting the environment through continuous improvement of inputs, processes, outputs, and feedback to the company cannot be overstated.

Keywords: ISO 50001; green productivity; Iraq; productivity improvement; environmental protection

1. Introduction

Over the past years, industrial organisations have achieved a higher value for energy efficiency as a pathway to address costs and climate change. This is because energy is a manageable resource. Its use helps to improve efficiency and optimal use of energy, helping the company reduce costs, reduce environmental impact by reducing emissions and gases, manage energy risks, and increase competitiveness[1]. Barbosa[2]

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recommended the application of ISO 50001 as an international standard, which focuses on optimizing energy, using resources better, and reducing the environmental impact associated with energy consumption. Energy plays an essential role in promoting economic, environmental, and social development through systematic management, and systematic energy management is an appropriate tool that contributes to the continuous improvement of energy efficiency. The information shows that ISO 50001-based firms meet all the conditions of an energy management system[2]. Thus, governments and companies should collaborate to formulate energy management regulations to improve energy efficiency. It will reduce emissions, gases, and global warming and improve the management of limited earth resources.

In Iraq, many companies operate. Whether these companies embrace ISO 50001 to reap the benefits is uncertain. If not, they are certainly worth examining, as well as their relationship. This urgent action is needed in the era of climate change threats to achieving many Sustainable Development Goals (SDGs), especially in developing countries, including Iraq. Hence, there is a need to examine the relationship between ISO 50001 standards and green productivity in Iraq, using Refinery Company in Baiji as a case study. It will enhance green productivity, thus achieving tangible steps in improving productivity and environmental performance and promoting economic growth. The exacerbation of the problem of environmental pollution and the misuse and depletion of available resources are almost one of the most important problems in Refinery Company in Baiji, which affects energy depletion[3]. So, Refinery Company in Baiji must achieve harmony between its productivity and the environment by improving energy self-sufficiency. This is because obtaining energy is more expensive and harmful to the environment. So, implementing new and renewable energy generation programmes to preserve energy use in the production process cannot be overstated. This can lead to the following questions: (1) Do employee's perceptions of ISO 50001 standards? (2) Does Refinery Company in Baiji care about green productivity? (3) What is the relationship between ISO 50001 standards and green productivity in Refinery Company, Baiji, Iraq? (4) Does ISO 50001 contribute to enhancing green productivity in Refinery Company, Baiji?

Companies' progress and success are achieved through their ability to improve energy performance and preserve the environment. It would translate to environmental-friendly products. The importance of this study stems from its variables. The energy management system helps the Refinery Company, Baiji, Iraq, to maximise energy savings and green productivity by identifying the potentials provided by energy efficiency. However, there is a paucity of studies regarding the ISO 50001 and its role in enhancing environmentally friendly products in developing countries such as Iraq. Thus, this study aims to address the following questions: (1) What is the relationship between ISO 50001 standards and green productivity in Baiji's refinery? (2) How does ISO 50001 influence green productivity at both micro and macro levels in Iraq?

2. Literature review

2.1. ISO 50001 energy management system

Most things that assist in raising the quality of human life depend on energy. Thus, as energy consumption continues to increase, natural resources are depleted, and environmental pollution and exposure to hazards may increase if they are not managed[4]. This is because energy production majorly relies on natural resources. ISO 50001[5] was published in 2011 by ISO. The ISO 50001 system on energy management is the fastest-growing ISO management standard[6]. The ISO defines the requirements for an energy management system[7]. It is based on many national and regional energy management standards, specifications, and regulations. ISO 50001's goal is to enhance the systems and processes necessary to improve energy performance in firms. Petnji Yaya et al. [8] affirmed that organisations and companies face challenges in establishing energy types, prices, and sources. This standard sets out the requirements for an

energy management system, including a structured approach to continuously improving energy efficiency and performance[9]. Various firms can employ ISO 50001 in the public and private sectors. It is designed in such a way that it integrates with other management systems[10].

ISO 50001 Energy Management System can be defined as *"a set of interconnected or interacting elements to establish energy policy, objectives, processes, and procedures to achieve those objectives*[11]. It provides a roadmap and pathway to improve energy performance continuously. Gopalakrishnan et al. [12] expressed it as a documented structure that defines the goals, policies, procedures, and processes through which energy is conserved and optimised. Apriyanti et al. [13] referred to it as an integrated energy consumption control activity to achieve efficient energy use to maximise production through structured technical and economic actions. Also, it encourages employees at all firm levels to manage energy use continuously[14]. Energy management implements regulatory, technical, and behavioural actions in an economically sound manner to improve energy performance in the field under discussion[15]. In the USA, about $500 billion yearly is spent on energy. Globally, the industry consumes 51% of the total energy produced, representing about 30% of companies' operating expenses[11]. An energy management system assists in improving energy efficiency. Studies revealed that even improved systems lose their initial efficiency gains over time. This is because of changes in production and employees, especially if there is a lax energy efficiency[16].

The application of ISO 50001 helps organisations save energy to reduce energy costs, reduce the negative impact on the environment, and improve worker comfort[10]. Also, it enhances the company's positive image, increases productivity and competitiveness, and promotes clean and environmentally friendly energy[2]. The outcomes assist in improving energy consumption through the role of senior management by placing energy in its regulatory policies[17]. Thus, energy management assists firms maximise their profits by mitigating fears arising from environmental issues. Skills are required to mitigate this issue. Yucel and Halis[4] identified engineering, management, and finance skills. ISO 50001 can assist firms in implementing processes necessary to understand the baseline of energy use, including energy performance indicators to reduce consumption[2,9]. Using ISO 50001 standards as a guide to implementing the company's programme helps obtain management support and the commitment of all employees through understanding roles and responsibilities[11]. ISO 50001 standards provide an incentive framework for developing national standards, policies, laws, and regulations[18,19].

2.2. Energy management standards

The energy management standard offers a regulatory framework for facilities to integrate energy efficiency into their management practices. This includes controlling production processes and refining energy efficiency. The energy department applies the same culture to improve quality and safety practices[17]. Also, it can create an environment that enables the adoption of capital-intensive technologies in energy efficiency[18]. According to ISO 50001[5], an energy management system is formulating an energy policy for the organisation. The energy policy outlines energy-related guidelines, operating principles, and the company's overall long-term goals. It is used over time as a measure of energy management effectiveness. According to ISO 50001, a statement expressing a company's energy policy must contain several points[12,17]. Management commitment and engagement is an important part of meeting standards and requirements. Setting an implementation plan and verifying the results is necessary and explained below the main items and requirements of the international standard ISO 50001[5,11]: Item 1: General requirements; Item 2: Management responsibility; Item 3: Energy policy; Item 4: Energy planning; Item 5: Implementation and operation; Item 6: Audit; and Item 7: Management review.

2.3. Green productivity

The growing interest in environmental protection creates some consensus, regulations, policies, and strategies that oblige companies to consider their impacts on the environment by improving their environmental performance. This goal seems impossible since companies consider it an onerous cost with no gain[20]. In this situation, in 1996, the Asian Productivity Organisation introduced the concept of green productivity, which offers simultaneous gains to the economy and the environment[21]. The goal of the Asian Production Organization's Green Productivity Programme is to enhance productivity[22]. Green productivity and environmental management systems are complementary systems. They assist in improving the organisation's environmental performance. Green productivity is an analytical methodology highlighting prospects to mitigate pollution and improve productivity[23]. Environmental impacts can be measured in terms of minimal resource use and reduction of environmental impacts[19].

The concept of green productivity derives from integrating two important development strategies: improving productivity and protecting the environment. Environmental protection offers a platform for sustainable development[24]. Thus, green productivity is a plan to enhance overall socio-economic development's productivity and environmental performance. This is germane to environmental sustainability. Green productivity is the application of suitable management systems and technologies to yield environmentally compatible outcomes[25]. In addition, it would ensure continuous improvement in productivity and environmental protection by applying ISO 14001 and ISO 50001[5,9,15,26].

3. The study's hypothetical development

Figure 1 shows the systematic treatment of the research problem and was designed to express the assumed relationship between the research variables, as illustrated in the hypothetical research scheme (**Figure 1**). The researchers derived the basics of its hypotheses from the issues and the fundamental questions that resulted from the study, in line with Fakhry et al. [27]. The hypotheses are:

H_1: There is a significant correlation between ISO 50001 standards and green productivity at the total level in the surveyed company.

H_2: There is a significant correlation between the ISO 50001 standards and green productivity at the micro level in the surveyed company.

H_3: There is a significant impact of ISO 50001 standards on green productivity at the total level in the company surveyed.

H_4: There is a significant effect of each ISO 50001 standard on green productivity at the micro level in the surveyed company.

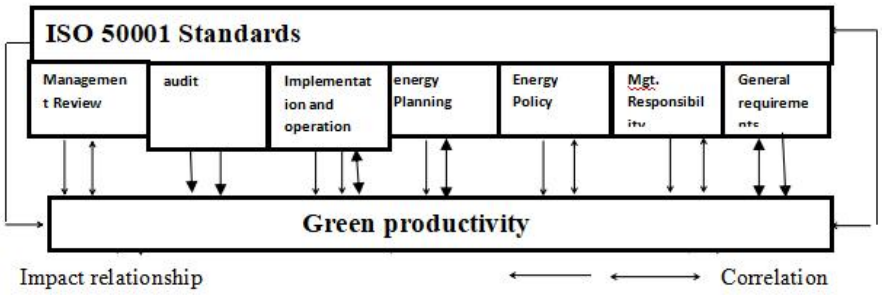

Figure 1. Hypothetical research scheme.

Source: *Authors work*

4. Research Method

The researchers adopted a quantitative research design. It adopted a survey data collection method using a closed-ended structured questionnaire[28]. This method describes patterns in a larger group[28,29]. The study population was workers in the Sumud, Baiji, Iraq refinery. The company is one of the top companies in Iraq that is interested in refining and processing oil. The researchers engaged respondents from different departments/sections (administrative, financial, legal, quality, public relations, control and audit, training and development, and medical) that indicated interest and were administered questionnaires. The total for the research population was 545, and the study arrived at a 135 sample size using a formula approach. From the 135 questionnaires administered by hand across the departments/sections, 128 questionnaires were retrieved and were certified suitable for the analysis. This represents a 94.81% response rate. The researchers adopted Version 28 of the Statistical Package for the Social Sciences (SPSS) to conduct the study[28,30,31]. The Cronbach's alpha coefficient was adopted to test the reliability via a 3-point Likert scale (agree–3, neutral–2, and disagree – 1). The alpha coefficient was 0.922. This is considered acceptable and higher than the suitable reliability in the range of 0.50–0.60, as recommended by Nunnally[32] and corroborated by Ebekozien et al.[33] and Ebekozien et al.[34]. Also, the researchers tested the correlation coefficient via the Pearson correlation coefficient to determine the strength of the relationship between the research variables[35].

5. Findings and discussion

In line with the extant literature, the researchers adopted energy management, energy policy, energy planning, implementation and operation, audit, and energy review as the measuring variables for ISO 50001 standards and to identify the level of awareness of the respondents using 36 items through the triple Likert scale as described. **Table 1** reveals the mean, standard deviations, and response rate to ISO 50001 variables. **Table 1** reveals that among the six standards, energy policy was ranked with the highest response rate at 70.20%, and the lowest was audit, with 66.4%. This validates the assumption that the variables adopted as standards are suitable for the study based on the response rate within the 66.4% and 70.20% range. It implies agreement between the respondents' opinions regarding ISO 50001 standards, as the arithmetic mean rate was 2.48, and the standard deviation was 0.78. Also, the average response rate was 69.65%. This indicates that the Baiji, Iraq refinery is interested in applying ISO 50001 standards. Findings agree with ISO 50001[5], which affirms that energy planning should lead to tasks and enhance energy performance. They also understand the roles and responsibilities in energy management and implement them in a way that contributes to reducing energy costs and their impact on the environment, as well as reviewing any failure in some respects. This is pertinent to promoting sustainability and efficiency in production. The study used the

arithmetic mean, standard deviations (SD), and response rate to measure green productivity and identify the level of respondents' perceptions. **Table 2** reveals that the arithmetic mean was 2.45, the SD was 0.79, and the response rate was 68.17%. It reveals an agreement between respondents' opinions that engaged companies have an interest. Environmental awareness exists when implementing green production processes by improving productivity and protecting the environment[2]. This is key to achieving corporate profit. Findings agree with Egas et al.[36], who suggested an energy-efficient supply chain management technique as an alternative to achieving corporate profit.

Table 1. Arithmetic mean, standard deviations, and the response rate to ISO 50001 variables.

Standards	Arithmetic mean	Standard deviation	Response Rate %
Energy Management	2.47	0.80	69.55%
Energy Policy	2.50	0.74	70.20%
Power Planning	2.45	0.80	69.20%
Implementation and operation	2.46	0.89	% 68.40
audit	2.97	0.89	% 66.4
Energy Review	2.97	0.98	% 67.2
General rate	2.48	0.78	69.65%

Source: *Authors' work*

Table 2. Arithmetic mean, standard deviations, and green productivity response rate.

Green productivity	Arithmetic mean	Standard deviation	Response Rate %
General rate	2.45	0.79	68.17

Source: *Authors work*

Table 3 shows the outcome of the first main hypothesis (H_1: There is a significant correlation between ISO 50001 standards and green productivity at the total level in the surveyed company). It reveals the existence of a significant correlation between the standards of ISO 50001 and the green productivity combined at the level of the company under study. This is evidenced by the value of the total index of the correlation coefficient (0.5) at the significance level of 0.000. It reveals a relationship between the two variables. Also, the result indicates that the management of the company under study is interested in ISO 50001 standards, which contributed positively to increasing green productivity. According to the preceding, accepting the first main hypothesis, the correlation between the standard of energy management and green productivity, as presented in **Table 3**, indicates a significant correlation between the energy management standard as one of the ISO 50001 standards and green productivity (total index of the correlation coefficient reached is 0.5 at a significant level of 0.00). This indicates that the field studied pays special attention to energy management standards to enhance green productivity. The findings agree with Trubetskaya et al.[17], who opined that ISO 51000 energy management system standards could be optimised for efficiency. Also, findings, as revealed in **Table 3**, indicate a significant correlation between the energy policy criterion as one of the ISO 50001 standards and green productivity (total index of the correlation coefficient reached is 0.6 at a significant level of 0.00. Findings agree with Zhao and Irfan[40] and Li et al.[41], who found that green construction growth could strive for economic transformation and environmentally sustainable development. This cannot be achieved without energy policy and green productivity. This indicates that the research field pays special attention to energy management standards to enhance green productivity. Li et al.[41] emphasised the theoretical effects of green finance on agricultural green total factor productivity in the context of "double carbon."

Table 3. Testing the correlation between the two research variables at the macro level.

Green productivity		
ISO 50001	**Correlation coefficient**	**Morale level**
Energy Management	0.50	0.000
Energy Policy	0.60	0.000
Power Planning	0.40	0.000
Implementation and operation	0.70	0.000
audit	0.50	0.000
Energy Review	0.40	0.000
Overall Index	**0.50**	0.000

Source: *Authors work* *P≤ 0.05, N =128*

The correlation between the energy planning standard and green productivity, as presented in **Table 3**, indicates a significant correlation between the energy planning standard as one of the ISO 50001 standards and green productivity (the total index of the correlation coefficient reached is 0.4 at a significant level of 0.00. This indicates that the research field pays special attention to energy management standards to enhance green productivity. The correlation between the standard of implementation, operation, and green productivity, as presented in **Table 3**, indicates a significant correlation between the standard of implementation and operation as one of the standards of ISO 50001 and green productivity (total index of the correlation coefficient is 0.7 at a significant level of 0.00. This indicates that the research field pays special attention to the energy management standard that enhances green productivity. The correlation between the audit standard and green productivity, as presented in **Table 3**, indicates a positive significant correlation between the audit standard and green productivity as one of the ISO 50001 standards (total index of the correlation coefficient is 0.5 at a significance level of 0.00). This indicates that the research field pays special attention to energy management standards to enhance green productivity. The correlation between the standard of energy review and green productivity, as presented in **Table 3**, indicates a significant correlation between the energy review standard as one of the ISO 50001 standards and green productivity (total index of the correlation coefficient is 0.4 at a significant level of 0.00. This indicates that the research field pays special attention to the energy management standard to enhance green productivity[2]. Thus, in line with the above, accept the second hypothesis, which established a significant correlation between the ISO 50001 standards and green productivity at the level of the company under study.

Regarding testing the influence relationships between the research variables at the macro and micro levels, first, the researchers presented the results of testing the impact relationship between the two research variables at the macro (**Table 4**). They followed by the micro (**Table 5**) levels. **Table 4** shows the results of the third and fourth hypotheses. **Table 4** shows the regression analysis with a significant effect of ISO 50001 on total green productivity. The calculated value of F was (203.974), which is greater than its tabular value of (3.973) at two degrees of freedom (1.80) and a significant level of (0.05). The value of the coefficient of determination (R2) was (0.719. It means that (71.9%) of the explained differences in green productivity are because of the effect of ISO 50001 combined, and others are because of the random variables that cannot be included or controlled in the regression model. Also, succeeding the value of the coefficient β1 of (0.618) and testing (T) for it, it was discovered that the calculated value of (T) amounted to (14.282). It is greater than its tabular value of (1.993) at a significant level of (0.05) and two degrees of freedom (1.80). This result

indicates that applying ISO 50001 standards enhances green productivity in the surveyed company. Therefore, the third main hypothesis is accepted.

Table 4. The effect of ISO 50001 standards on combined green productivity in the surveyed company.

Green productivity						
	Impact			F		Morale level
ISO 50001 Standards	0β	1β	R^2	Calculated	Tabular	
	15.744	0.618 (14.282)*	0.719	203.974	3.973	0.000

Source: *Authors' work P≤ 0.05, N =128, df = (1, 80), t = (1.993)*

For testing the influence relationship between the two research variables at the micro level, **Table 5** shows the impact relationships of each of the ISO 50001 standards in green productivity at the level of the surveyed company.

a) **Energy Management**: **Table 5** indicates a significant impact of the energy management criterion on green productivity as the value of favouritism (80.805), which is greater than its international value of (3.973) at two degrees of freedom (1.80) and a significant level (0.05), and the value of the determination coefficient R2 (0.503), which shows that (50%) of the explained differences in green productivity are due to the effect of the energy management criterion and the rest is because of the random variables that cannot be included or controlled in the regression model. Through the follow-up of the value of 1B of (3.64) and the test of (T), it was found that the calculated value of (T) amounted to (8.989), which is greater than its tabular value of (1.993) at a significant level of (0.05) and two degrees of freedom (1.80), which indicates that the application of the energy management standard contributes to enhancing green productivity in the company studied. Findings agree with Kanchiralla et al. [37], who discovered that the energy efficiency of a dairy plant can be improved using energy planning guidelines described in ISO 50001 through energy management techniques to enhance operations by measuring and monitoring energy performance. Findings slightly disagree with Testa and Vigolo[38], who affirmed that there is no universal definition of energy management. However, it involves analysis, reporting, and action. These lead to continuous improvement.

b) **Energy Policy: Table 5** shows the existence of a significant impact of the energy policy criterion on green productivity, as the value of (F) favouritism reached (108.041), which is greater than its tabular value of (3.973) at two degrees of freedom (1.80) and a significant level of (0.05) as indicated by the value of the coefficient of determination (R2 (0.575), which shows that (57.5%) of the explained differences in green productivity are due to the impact of the energy policy criterion and the rest is due to other variables that the researcher did not address in his study. When following up the value of (1β) of (1.830) and the test (T), it was found that the calculated value of (T) amounted to (10.394), which is greater than its tabular value of (1.993) at a significant level of (0.05) and two degrees of freedom (1.80), indicating that the company surveyed follows an appropriate energy policy to enhance green productivity. Findings agree with ISO 50001[5], which asserted that energy planning should lead to activities that unceasingly improve energy performance, following the dairy plant's energy policy and providing a conceptual map for energy planning by saving energy and costs.

c) **Power Planning: Table 5** shows the existence of a significant impact of the energy planning criterion on green productivity, and it reached (F) favouritism (78.760), which is greater than the tabular (3.973) at two degrees of freedom (1.80) and a significant level (0.05) as indicated by the value of the coefficient of determination (R2) (0.496) to show that (49.6%) of the differences explained in green productivity is due to the impact of the energy planning criterion and the rest is due to other variables not addressed by the researchers in this study. When following up the value of (1β) of (3.165) and the test (T), it was found that the calculated value of (T) amounted to (8.875), which is greater than the tabular value of (1.993) at a significant level of (0.05) and two degrees of freedom (1.80) to reflect the company's great interest in energy planning and this is what achieves green productivity.

d) **Execution of operation: Table 5** indicates the existence of a significant effect of the implementation and operation criterion on green productivity through the calculated value of (F) (95.077), which is greater than the tabular (3.973) at two degrees of freedom (1.80) and the level of significance (0.05), and indicated, the value of the coefficient of determination (R2 (0.543), which is greater than the table (1.993), the level of significance (0.05) and two degrees of freedom (1.80) to show that implementation and operation contribute seriously to achieving green productivity in the company surveyed, and this indicates that (54.3%) of the explained differences in green productivity are due to Implementation and operation. Findings corroborated Imel et al. [39], who found that a significant decrease in energy use within a county where integrated multiple of the norm were operated daily. Thus, operations in line with the ISO standards should be complied with.

e) E-audit: Table 5 indicates a significant effect of the audit criterion on green productivity, where the calculated value of (F) was (46.629), which is greater than the tabular (3.973) at two degrees of freedom (1.80) and a significant level of (0.05). The coefficient of determination (R2 (6.829) indicated that (682%) of the differences explaining green productivity are due to the effect of (auditing) and the rest to other variables not included in the model and when following up the value of (1β) (3.302) and the (T) test of (T). 6.829) indicates that it is greater than the tabular (1.993) and two degrees of freedom (1.80) to indicate that the standard of proper auditing contributes to the achievement of green productivity.

f) **Energy Review: Table 5** shows the existence of a significant effect of the energy review criterion on green productivity, with a calculated value of (F) (92) and greater than the tabular (3.973) and the value of the coefficient of determination (R2) (0.534) indicates that (53%) of the explained differences in green productivity are due to the effect of energy review. The rest is due to other variables not included in the model. When following up the value of (1β) of (3.502), test (T) (9.592), greater than the tabular (1.993), level of significance (0.05) and two degrees of freedom (1.80), this indicates that the energy review has a major role in achieving green productivity. In summary, it indicates the fulfillment of the fourth hypothesis[27], which states the significant effect of each ISO 50001 standard on the combined green productivity in the surveyed company.

Table 5. The effect of each ISO 50001 standard on green productivity combined in the surveyed company.

Green productivity						
ISO 50001	Impact		R^2	F		Morale level
	0β	1β		Calculated	Tabular	
Energy Management	56.513	3.649 (8.989)*	0.503	80.805	3.973	0.000
Energy Policy	34.486	1.830 (10.394)*	0.575	108.041	3.973	0.000
Power Planning	49.338	3.165 (8.875)*	0.496	78.760	3.973	0.000
Implementation and operation	41.764	5.930 (9.751)*	0.543	95.077	3.973	0.000
Audit	28.774	3.302 (6.829)*	0.500	46.629	3.973	0.000
Energy Review	53.345	(3.530) (9.592*)	0.534	92.009	3.973	0.000

Source: *Authors work P≤ 0.05 , N =128 , d.f = (1 , 80) , t = (1.993)*

6. Conclusion and recommendations

ISO 50001 energy management is a goal that companies seek to achieve through several tools, and green productivity can be one of those tools. It can provide green products that suit the environment and enhance green productivity. The results of the company surveyed regarding the variable of ISO 50001 standards revealed an agreement towards the application of standards, which contributed to energy management and policies. The findings also showed the positive attitude of the surveyed company towards the concept of energy management ISO 50001 at the general level and, therefore, the keenness of the research field on the optimal use of natural resources and environmental protection to preserve the share of future generations and their fairness. The results of the descriptive analysis at the level of the dimensions of energy management ISO 50001 revealed that there is a high agreement in the field on these dimensions, and as a result, paying attention to energy management ISO 50001 will lead to reaping the fruits at the economic, social and environmental levels. The results of the description and diagnosis of data analysis in the surveyed company were presented that the individuals in the surveyed company are aware and familiar with the entrance to green productivity and thus the ease and speed and adoption of the concept to change the reality of the company's condition from a working system with good productivity and suitable for the environment to high productivity and conformity to environmental standards through the use of natural resources in ideal ways.

However, the responding individuals stated that there is fertile ground for adopting the green productivity approach in the surveyed company to improve productivity and protect the environment and natural resources. At the level of green productivity, it was proven that there is a significant correlation between each dimension of the energy management ISO 50001 and green productivity, where all the values of the correlation coefficients of the dimensions were close in strength. This, in turn, enhances the positive interaction between the research variables in the filter. The correlation coefficient proved a positive relationship between energy management and green productivity, and this indicates a strong role for the entrance to energy management in achieving green productivity in the surveyed company. This relationship is logical and refers to the effective contribution of green productivity in reaching the goals and expected benefits through the entrance to the development of energy management ISO 50001. The existence of

significant impact relationships for ISO 50001 standards in green productivity at the macro level and each ISO 50001 standard in green productivity at the micro level indicates the vital role of ISO 50001 in enhancing green productivity in the research refinery.

The following recommendations are proposed to complement the methodological requirements. The researchers found it appropriate to present a set of proposals that can help the companies surveyed in employing ISO 50001 energy management techniques in achieving green productivity and enhancing the position of those companies in the market, and these proposals are as follows:

a) There is a need to increase the attention of the management of the company surveyed to training in energy management and green productivity, deepening it, improving productivity, and protecting the environment through continuous improvement of inputs, processes, outputs, and feedback. It motivates the management of the company under study to adopt green productivity techniques and dimensions of energy management ISO 50001 through awareness programmes. It strengthens them among managers and working individuals.

b) The company should expand the horizons of employees and management on green productivity techniques and the dimensions of energy management ISO 50001 by providing everything new in these two fields. This would keep pace with their developments and increase the awareness of managers and workers by seeing the leading companies applying green productivity technologies and the dimensions of energy management.

c) The study suggests preparing special programmes for field visits and working to inform managers and workers about the experiences of leading companies in green productivity and energy management through visits or by hosting a group of specialists in this field. Also, increasing attention to the concept of waste prevention and working to apply it in the field to invest energy well, reduce waste, and reduce waste in production to the lowest possible by applying the five steps to ensure the preservation of resources and not depletion.

Author contributions

Conceptualisation, B.K.K; methodology, B.K.K, M.M.S., M.A.H., Z.C.M., S.N.R., and A.E.; software, B.K.K, M.M.S., M.A.H., Z.C.M., S.N.R., and A.E.; validation, B.K.K, M.M.S., M.A.H., Z.C.M., S.N.R., and A.E.; formal analysis, B.K.K, M.M.S., M.A.H., Z.C.M., S.N.R., and A.E.; investigation, B.K.K and M.M.S.; resources, B.K.K, M.M.S., M.A.H., Z.C.M., S.N.R., and A.E.; data curation, B.K.K, M.M.S., and A.E.; writing—original draft preparation, B.K.K, M.M.S., M.A.H., Z.C.M., S.N.R., and A.E.; writing—review and editing, B.K.K, M.M.S., M.A.H., Z.C.M., S.N.R., and A.E.; visualization, B.K.K, M.M.S., M.A.H., Z.C.M., S.N.R., and A.E.; supervision, B.K.K, M.M.S., M.A.H., Z.C.M., S.N.R., and A.E.; project administration, B.K.K, M.M.S., M.A.H., Z.C.M., S.N.R., and A.E.; funding acquisition, B.K.K, M.M.S., and M.A.H.. All authors have read and agreed to the published version of the manuscript.

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Conflict of interest

The authors declare no conflict of interest.

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