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The Role of Green Target Costing in Achieving Sustainable Competitive Advantage in Economic Units

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Abstract:

Research aims to determine the role of green target costing in enhancing and supporting sustainable competitive advantage in Iraqi economic units and to define the philosophical concepts of green target costing (GTC) and Sustainable Competitive Advantage (SAC). To achieve this, the research relied on an applied descriptive approach, applying it to an actual production environment, namely the "General Company for Fertilizer Industry - Southern Region in Basra," and relying on data for the year 2024. The research concluded that the application of GTC concepts in the reality of the Iraqi industry is in its early stages. One of the most important objectives of this application is to improve the efficiency of resource use and reduce waste, in addition to designing environmentally friendly products. This contributes to supporting and enhancing the sustainable competitive advantage of the economic unit. The research results show that the full application of the green target costing approach in the research sample created a gap between it and the cost, which amount which can be invested in environmental initiatives or improving competitive profitability. Therefore, the research recommended adopting the integrated GTC methodology in Iraqi national factories to support environmentally friendly national products and create a sustainable competitive advantage for them.

Keywords: Green Target Cost, Sustainable Competitive Advantage, Environmental Costs, Heat Exchanger.

1. Introduction:

The world is witnessing an increasing demand for environmentally friendly products. This has prompted economic units to adopt sustainable strategies that reduce environmental damage and improve efficiency. "Green Target Costing" has emerged as a method and approach that combines cost reduction, environmental dimensions, and quality. This makes it one of the most important sources for creating or enhancing a sustainable competitive advantage. Iraqi economic units suffer from a weak adoption of this method, "Green Target Costing," as well as a lack of field evidence demonstrating its role in reducing environmental and economic costs and enhancing a sustainable competitive advantage. The importance of this research stems from its endeavor to provide quantitative evidence that contributes to supporting decisions to shift towards effective green initiatives. The aim of the research is to analyse the role of "Green Target Costing" in creating a sustainable competitive advantage, through an applied study on the General Company for Fertilizer Industry - Southern Region in Basra Governorate for the year 2024, using the descriptive and applied approach. The research was divided into several sections to achieve its objectives.

2. Literature review and Hypothesis Development:

2.1 The Philosophical Framework of Green Target Costing:

In light of the need to preserve the environment due to environmental changes, as well as the increasing global interest in environmental issues and their protection, it has become imperative for economic units to adopt contemporary production strategies and techniques to strike a balance between their economic and environmental objectives. Among these techniques, the concept of Target Green Costing (T.C.G.) has emerged as one of the contemporary administrative costing techniques, which aims to integrate environmental objectives into the product production process, with the financial performance objectives of economic units, to reduce the negative impact on the environment resulting from product production processes (Berlin et al., 2011). The most important concepts of Target Green Costing and its dimensions will be reviewed.

Green Target Costing (GTC) can be considered a technique that is based on the idea of integrating environmental concerns into the traditional Target Costing (TC) model. This integration is due to the increasing demand from customer stakeholders to find environmentally friendly products (Nishimura, 2014). It is the process by which environmental conservation strategies are integrated with green costing mechanisms, target costing (TC), and its steps are implemented in developing an environmental sustainability strategy. This method leads to a more comprehensive approach and is an important tool for determining the allowable cost of the product (Hendercks, 2015). It also represents the process of including environmental issues in the target costing (TC) method or technique due to environmental legislation (Malone, 2015). Or it is a process of developing the Target Costing (TC) technique that works to meet the desires and goals of customers to obtain environmentally friendly products and takes into account environmental standards, and the method that achieves the economic unit's survival in the market (Al-Jadri, 2018). It can be considered a technique resulting from combining the demands of applying target costing (TC) with the demands of environmental legislation imposed by law, to provide the desires and needs of customers related to environmental conservation at reasonable prices (Saihood, 2023).

The concept of GTC is linked to long-term cost reduction, based on reducing production-related risks while also minimising long-term environmental risks. Green target costing is an extension of target costing, which is considered an important strategic accounting method for the economic unit (Hameed, 2024). Meanwhile, (Wahid, 2023) states that the GTC is one of the techniques that helps provide environmentally friendly products.

As Horngren et al. (2021) pointed out, GTC integrates environmental dimensions into the initial design stages, aiming to achieve products that comply with environmental legislation and reduce environmental impact. Even if the initial cost is high, it creates a sustainable competitive advantage by improving the organisation's image and avoiding future environmental costs (Horngren et al., 2021: 438).

Green Target Costing (GTC) is a technique that seeks to determine the optimal costs for services and products, focusing on the environmental dimensions of production processes in economic units. This technique may include analysing the costs associated with these processes and working to improve production efficiency, and using sustainable resources such as recyclable materials, energy-efficient materials, and low emissions and waste.

2.2 Dimensions of Green Target Costing (GTC):

GTC includes various dimensions that integrate cost management into green practices. This technique focuses not only on economic feasibility, but also on environmental factors. It is based on the fundamentals of traditional target costing, in addition to its reliance on the environmental aspects of the production process and achieves economic goals without harming the environment. The application of GTC relies on certain dimensions and requires careful consideration and maintenance for successful implementation. These dimensions may include consideration of market requirements and customer needs and desires and working to provide them in the economic unit's products, while taking into account the costs incurred by the unit (Berlin et al., 2011). The main dimensions of GTC can be explained as follows:

1. **Economic dimension:** Green target costing contributes to determining the permissible costs of products, which ensures the survival and competitiveness of economic units, in addition to meeting environmental standards. Economic units can benefit from customer insights into pricing green products and services, which helps these units make informed investment decisions in greener alternatives (Chlaihawi, 2023).
2. **Environmental dimension:** Integrating environmental requirements, including green quality, with targeted costing can contribute to reducing costs and improving environmental performance by eliminating activities that do not support environmental requirements and do not add value. This leads to the creation and design of a green product that takes into account the optimal use of scarce resources and works to primarily use environmentally friendly materials or reduce the use of environmentally harmful raw materials (Ridha et al., 2024). The environmental dimension of green TC includes integrating environmental costs into the product design process. This integration improves product functionality, reduces economic and environmental costs, and promotes environmentally friendly practices (Janz et al., 2006).
3. **Social Dimension:** The social aspect of GTC includes an economic unit's understanding of customer requirements and desires for environmentally friendly products, which can drive market differentiation and competitive advantage (Ridha et al., 2024). GTC is derived from a target costing system, where the market price is determined first. The market price is characterised by what customers are willing to pay for a particular product, which reflects the relationship between supply and demand. One of the main factors that determines the market price is the functionality that customers desire to achieve, along with the required quality. Integrating economic, environmental, and social factors can ensure that sustainability goals are pursued collectively, not in isolation from each other. By adding social factors, these factors can also positively impact the sustainable value of economic units (Olender & Rosen, 2023).

Therefore, GTC offers many advantages and is based on the most important dimensions that can support a technology, although the initial costs of its implementation and application may deter economic units from fully committing to this technology. However, its long-term benefits often outweigh the costs of its implementation, and we can explain these dimensions as shown in Figure 1.

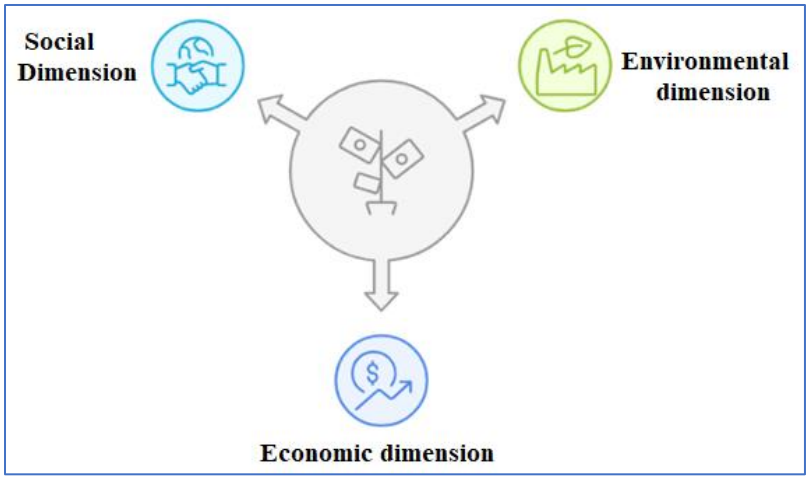

Figure (1): Dimensions of Green Target Costing.

Source: Prepared by researchers

These dimensions represent the essence of GTC, as they combine environmental sustainability goals with profitability and focus on reducing the environmental impact of production processes, while maintaining product quality and achieving efficiency and economy. Therefore, GTC is important when implemented.

2.3 Objectives of the Practical Application of GTC

Given the concept and dimensions of GTC, it seeks to achieve a set of objectives, which can be summarised as follows:

A. Reducing the use of toxic and hazardous materials.
B. Reducing the costs of raw materials used in the production process.
C. Reducing environmentally harmful waste through the application of modern technology to limit environmental pollution.
D. Increasing returns by using waste as raw materials for secondary products, thereby providing job opportunities for community members (Saihood, 2023).

Murad & Al-Kawaz, (2024) argue that GTC seeks to achieve a balance between profitability and environmental sustainability by setting a cost target, implementing improvements, and reducing waste to achieve this goal. The concept of GTC is linked to sustainable green product innovation, which means introducing new or significantly improved products that meet environmental requirements in terms of non-toxic raw materials, green design, energy savings, pollution control, recyclability, low waste volume, and the production of environmentally friendly products that comply with the environmental standards determined by the social environment in which economic units operate (Al-Rubaie, 2022).

We note that one of the most important objectives achieved through the application of GTC is improving the efficiency of resource use and reducing waste and loss, which supports the design of environmentally friendly products. In addition, it can enhance the competitiveness of economic units by reducing environmental costs and achieving long-term sustainability, especially in light of the increasing pressures that direct economic units towards achieving sustainability. GTC can help integrate environmental considerations with cost control objectives.

2.4 Practical Steps for GTC

Researchers have identified some steps to implement GTC, as follows: (Bijan, 2021) (Horváth & Berlin, 2012) (De Melo et al., 2016) (Abdul Abbas & Al-Moussawi, 2024).

Step 1: Identify the distinctive characteristics of the green product.

Step 2: Define the product's target price and green price premium.

Step 3: Determine the "green profit margin" and calculate allowable costs by applying the following equations:

$$Green\ profit\ margin\ =\ Green\ target\ price\ \times\ Green\ profit\ margin\ percentage$$
$$Green\ target\ cost\ =\ Green\ target\ price\ -\ Green\ profit\ margin$$

Step 4: Assign costs to the green target cost drivers.
Step 5: Implement the "green target cost" metrics.
This can be illustrated in the following figure:

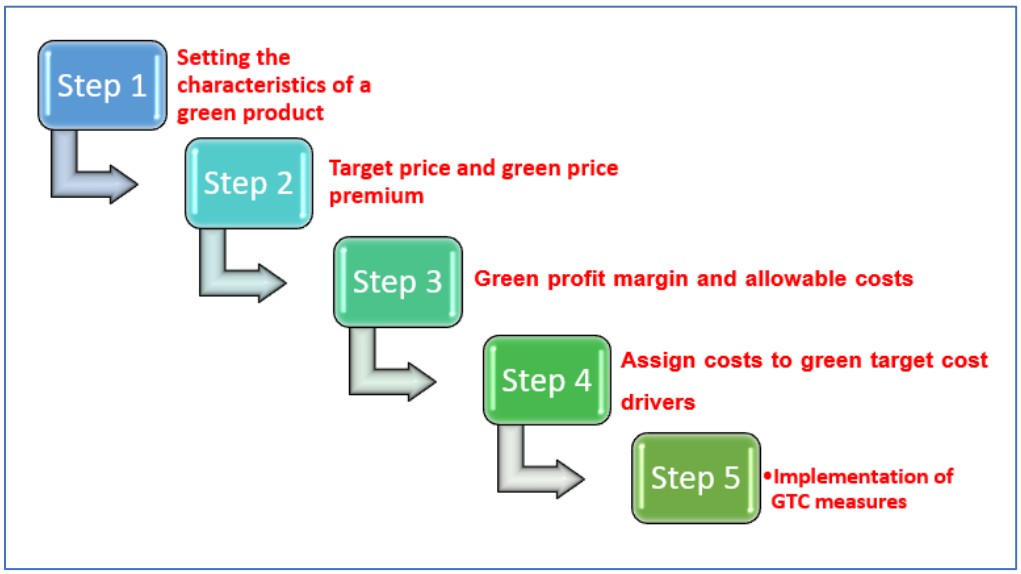

Figure 2: Implementing integrated green target costing steps
Source: Prepared by researchers

From Figure 2, we can see that the practical application of GTC relies on integrating environmental costs with traditional target costing concepts, such as setting a green target price and a green price premium, which represent the core principles of target costing, customer focus, design, teamwork, product lifecycle orientation, and value chain participation.

GTC is not just an accounting technique for cost reduction. It can be considered a comprehensive strategy that contributes to achieving sustainable development by promoting clean production, reducing waste, and achieving a balance between financial performance and environmental responsibility. This strategy comes in response to the increasing pressures facing economic units from a number of relevant parties, who demand a more sustainable product, which makes GTC a key tool in supporting the transformation of economic units towards a more sustainable and environmentally friendly economy.

2.5 The concept of sustainable competitive advantage

Studies that dealt with Sustainable Competitive Advantage (SCA) mention that the first appearance of its concept was in mid 1980s, as this term was developed by Porter et al. on 1985, but he did not provide an official definition for it, as he focused on a variety of competitive strategies such as cost leadership, differentiation, and focus, to achieve a long-term competitive advantage. (Matthews & Shulman, 2005a) showed that the concept of sustainable competitive advantage is determined by the relational structure, reputation, innovation, and strategic assets of economic units(Berlin et al., 2011).

SCA occurs when economic units develop and implement a strategy that competitors cannot replicate (Hanson et al., 2016; Hraiga et al., 2023), and that is consistent with economic units capable of achieving advantages that competitors cannot replicate and that do not lose their characteristics and value due to changes in the environment (Saeed, 2013). The closest definition is the application of strategies to create unique value for economic units, such that competitors cannot imitate or create this value (Hakkak & Ghodsi, 2015; Matthews & Shulman, 2005b).

The concept of sustainability extends to encompass all actions undertaken by economic units that would prevent competitors from imitating the unit's unique strategic strengths and capabilities (Al-Jumaili, 2014). Sustainable competitive advantage is a set of characteristics that distinguish economic units when providing services to customers. This means possessing a set of capabilities, competencies, knowledge, and other skills, through which they provide customers with greater value and satisfaction than competitors. This enables them to achieve superiority over their competitors through the services they provide (Chitheer, 2024; Mohammed, 2023).

Thus, we can define SCA as the ability of economic units to achieve lasting superiority by developing unique strategies that competitors cannot imitate. This superiority results from integrating rare resources and exceptional competencies with elements of innovation and reputation, which leads to the creation of unique added value for customers that is difficult to imitate or replicate even in light of ongoing environmental and competitive changes. This is what drives us to distinguish between SCA and traditional competitive advantage.

2.6 The difference between traditional competitive advantage and sustainable competitive advantage

Porter first mentioned the concept of conventional competitive advantage (CA), linking it to the ability of economic units to offer higher quality or lower cost than competitors over a specific time. He also stated that it relies on factors that can be replicated or imitated (Porter, 2008), while (J. Barney, 1991) believes that the advantages mentioned by Porter are short-term, as others can replicate, imitate, or even surpass them over time. (Hanson et al., 2016) and (J. B. Barney & Hesterly, 2008) indicate that Sustainable Competitive Advantage (SCA) is the ability of economic units to maintain their progress, distinction, and superiority in markets over a long period through the use of their scarce resources, which are not replicable or imitable, and are uniquely suited to the internal and external environment. SCA is based on innovation, reputation, and strategic capabilities that cannot be easily imitated by competitors. Sustainability here is not only related to time, but also to the ability of economic units to resist competitive environmental pressures and internal and external environmental changes without losing their value (Alawaed et al., 2024; Al-Humairi et al., 2024; Matthews & Shulman, 2005a). The traditional advantage will become sustainable when current or potential competitors find it difficult to imitate it or obtain an alternative (Hamadamin & Atan, 2019).

Therefore, the fundamental difference between competitive advantage (CA) and sustainable competitive advantage (SCA) lies in the time factor, i.e., the continuity of this advantage and the difficulty of replicating or imitating it. Traditional competitive advantage (CA) can be considered temporary and can be easily replicated by competitors, while sustainable competitive advantage is difficult to obtain, imitate, or replicate, which makes it more capable of withstanding competition in the markets. There is a link between sustainability and the period in which the state of sustainability is achieved, and the length or shortness of superiority achieved by different economic units.

2.7 The Importance of Achieving Sustainable Competitive Advantage in the Contemporary Competitive Environment

Sustainable competitive advantage refers to a set of characteristics and capabilities that enable an economic unit to meet its customers' needs more effectively than its competitors. These advantages include elements that enable an economic unit to produce goods or provide services at a superior quality or lower cost than others. These advantages help economic units achieve higher sales or profit margins in the market (Dewayana et al., 2025; Larbi, 2019). Sustainability in contemporary competitive environments is one of the most important strategic drivers, and it is necessary to ensure the survival of economic units and enhance their competitiveness in the long term.

The importance of achieving sustainability revolves around the fact that strategic resource management practices are an important and positive precedent for sustainable competitive advantage (Nasifoglu Elidemir et al., 2020), and sustainability is one of the most important features that put economic units on the path to competitive advantage (CA) when they implement strategies that are not similar to other competitors in the market (Hamadamin & Atan, 2019).

Nafei et al., (2025) indicate that (SCA) is the advanced model of competitive advantage targeted by economic units in the market, because it contains the elements that guarantee continuity and maintain its advantages for the longest possible period, while (Mahdi et al., 2019) linked sustainable competitive advantage and obtaining an economic profit rate higher than the typical rate of its competitors, as well as the ability of the economic unit to generate an economic value higher than the economic value of its competitors, and also considers the success of the economic unit in using its organisational resources (Mahdi et al., 2019). (Albander & Matrood, 2023) pointed out that the importance of achieving a sustainable competitive advantage stems from its role as a weapon to confront market challenges by developing the economic unit's competitive knowledge. It is also a criterion for identifying successful economic units in the market, as they are distinguished by creating new and available models that are difficult to imitate. It is also a fundamental and necessary goal sought by all economic units that aim to excel and distinguish themselves by exploiting resources and capabilities, satisfying customers, and identifying their needs and desires in a way that is difficult for others to imitate. It also determines the availability of the basic elements of success compared to competitors by adopting strategies that leverage the organisation's strengths. (Albander & Matrood, 2023)

We note that the importance of achieving a sustainable competitive advantage in the contemporary competitive environment revolves around two aspects. The first is in the short term, which is represented by achieving higher returns or a higher contribution margin than other competitors, or a higher profit rate through increased sales and market share. The second is in the long term, in addition to the continuity of achieving this return, which is implementing competitive strategies that other competitors in the market cannot achieve.

2.8 Criteria for Achieving Sustainable Competitive Advantage

Sustainable competitive advantage requires economic entities to possess advantages and characteristics that are difficult for others to imitate, with an emphasis on the fact that achieving profits is not limited to the short term. This requires specific capabilities and resources that create or add real value and place barriers to competitors. It also requires that these capabilities and resources have sufficient flexibility to reconfigure and transform in response to opportunities and threats in the business environment. (Al-Humairi et al., 2024; Satar et al., 2023) indicated that the main condition for achieving a sustainable competitive advantage (SCA) is to acquire and control valuable, rare, unique, and non-substitutable assets and competencies, and to have an organizational structure and market objectives that enable the economic unit to win a larger market share or higher profit margins when competing with other economic units in the same customer category (Satar et al., 2023). Meanwhile, Asa et al. (2024) concluded that open innovation and unique capabilities are vital for the effective use of resources to achieve a sustainable competitive advantage for the economic unit. They indicated that the integrated approach to sustainable competitive advantage focuses on the resources, capabilities, and open innovation of the economic unit to improve decisions that lead to a lasting competitive advantage (Asa et al., 2024).

While other recent studies indicate that available resources alone can be considered sufficient to consider an economic unit to have a sustainable advantage, the possession and achievement of SCA also depend on the economic unit’s ability to continuously innovate and continuously learn organizationally, as (Zhang et al., 2023) indicated that with the intensification of competition and the increase in reliance on external partners, open innovation has become an inevitable and common strategy to achieve a sustainable competitive advantage and that there is a fundamental role for organisational learning in achieving a sustainable competitive advantage.

He added that open innovation contributes to a sustainable competitive advantage by enhancing organisational learning (Zhang et al., 2023)

Based on the above, the economic unit possesses (SCA) through some financial and non-financial indicators that are related to long-term performance. The above criteria showed that achieving SCA does not only require the economic unit to possess scarce resources but also requires a solid organisational structure and the ability to innovate. The judgment of its possession of SCA is based on a set of criteria extending from the availability of rare and valuable resources, which are difficult for others to imitate, effective organisation, continuous innovation, financial performance from achieving higher returns than competitors or production at lower costs than them, in addition to integration with the dimensions of environmental and social sustainability.

2.9 Sustainable Competitive Advantage and Green Target Costing

A set of techniques, methods, and tools is used and applied in accounting to achieve a competitive advantage, even if it is simple and temporary, and does not have a long-term characteristic. We find that most of the contemporary literature facilitates the intellectual adoption of techniques in order to achieve a competitive advantage and focuses on techniques that enhance the ability of economic units to achieve a competitive advantage. (Murad & Al-Kawaz, 2024) Indicates that one of the most prominent contemporary accounting methods and approaches that support achieving a competitive advantage is the "green target costing technique," which represents a development of "target costing," as it takes into account the environmental impacts of the product (Murad & Al-Kawaz, 2024). A study conducted by Ridha et al. (2024) indicated that there is a strong positive relationship between the adaptation of green target costing and improvements of competitive indicators of economic units in developing markets, especially in the areas of reducing waste, improving quality, and enhancing customer loyalty. On the other hand, innovation, according to the principles of green target costing, is one of the most prominent determinants for achieving an advantage that is difficult for competitors to imitate. Economic units that adopt green target costing focus on reducing costs, in addition to working on innovating and producing environmentally friendly products. This makes them more capable of gaining the loyalty of customers who are concerned with cost, quality, and sustainability as well (Chlaihawi, 2023). In contrast, it has been found that the environmental legislation has become more stringent worldwide, which motivates economic units to adopt and apply cost-effective technologies that work to achieve sustainability in all aspects, from financial to competitive advantage. Among these cost-effective technologies is green target costing. In terms of objectives, reducing costs in the long term, which depends on reducing risks associated with production, while reducing environmental risks in the long term, is one of the most important objectives of green target costing (Hameed, 2024). It is considered one of the effective methods and ways to reduce product costs, which revolve around key dimensions represented by reducing energy consumption, reducing the depletion of natural resources, reducing pollution, and using renewable (alternative) energy, while maintaining product quality and customer satisfaction, thus achieving a competitive advantage. It is one of the technologies that helps provide environmentally friendly products and achieve a competitive advantage (Wahid, 2023).

Therefore, it can be pointed out that GTC is not merely an accounting tool for pricing products, but rather a strategic framework that helps achieve a sustainable competitive advantage. It is a cost accounting tool that leverages valuable and scarce resources within economic units, helping them achieve a hard-to-imitate advantage by producing environmentally friendly products. It is an important strategic driver for creating a competitive resource that is difficult for competitors to imitate for as long as possible. This will be addressed in the next section, which discusses the practical application of GTC to achieve SCA in the research sample.

3. Research Methodology:

3.1 Research Problem:

Iraqi economic units face challenges represented by rising production costs, including the energy costs used in production and the environmental impacts. Consequently, these units face competitive pressures. At the same time, a notable weakness can be observed in the application of contemporary cost accounting methods, including "green target costing." This is due to the lack of applied studies in the Iraqi context that clearly define its economic and environmental feasibility. The problem of this research is:

"Iraqi economic units suffer from the lack of a comprehensive and systematic approach to implementing green target costing, in addition to the lack of field evidence demonstrating the extent to which this approach contributes to reducing economic and environmental costs, while simultaneously supporting and enhancing a sustainable competitive advantage."

3.2 Importance of Research:

The importance of this research lies in its contribution to supporting the rationalization of energy consumption and the recovery of wasted energy in Iraqi factories, on the one hand, supporting the reduction of environmentally harmful emissions from Iraqi industry, on the other, aligning with global trends toward clean industries. The research seeks to provide a scientific vision for the full application of green target costing to preserve the environment, which can achieve and support a sustainable competitive advantage. The research also provides quantitative evidence that can help managers and decision-makers make decisions based on environmentally friendly green initiatives and specific costs. The research also includes an incentive to develop Iraqi cadres in production plants and qualify them to produce environmentally friendly products that achieve competitive sustainability. It also aims to enrich the Iraqi scientific and accounting library with research that seeks to integrate environmental considerations with cost methodologies.

3.3 Research Objectives:

The research seeks to achieve several objectives:

1. Identify the role of green target costing in enhancing and supporting sustainable competitive advantage in Iraqi industrial economic units.
2. Analyse the philosophical and cognitive dimensions of green target costing and sustainable competitive advantage.
3. Identify the most important differences between traditional competitive advantage and sustainable competitive advantage.
4. Evaluate advanced mechanisms for green initiatives within the framework of green target costing, and rank them according to the savings they achieve and their environmental impacts.
5. The research proposes policies and methods that help economic units implement all steps of green target costing properly and comprehensively to enhance sustainable competitive advantage and ensure the sustainability of its results through holding training workshops for employees and providing them with technical qualifications.

3.4 Research Hypotheses:

There are real and increasing environmental challenges and pressures to reduce costs for economic units. "Green Target Costing" can be considered a proactive technique through which costs are determined that takes into account the environmental impact of production processes, as well as maintaining the required quality and performance. "Sustainable Competitive Advantage" focuses on the ability of economic units to maintain market superiority over the long term by building capabilities that are difficult to imitate or replicate. Based on this, we assume that there is a role between implementing "Green Target Costing" steps and achieving sustainable competitive advantage in economic units. Therefore, the research hypothesis can be formulated as follows:

"Implementing the green target costing methodology contributes to creating or enhancing a sustainable competitive advantage by reducing production costs."

3.5 Methods used in the scientific aspect:

The research relied on a descriptive and applied approach, seeking to analyse the role of implementing green target costing in a real-world production environment, namely the "General Company for Fertilizer Manufacturing - Southern Region in Basra." This was due to the availability of data and information about this company and the responsiveness of its employees. This approach ensures an integration of theoretical aspects through descriptive and applied approaches, making it a reliable basis for making strategic decisions based on quantitative and qualitative evidence.

3.6 Research limits:

The spatial boundaries of the research are the "General Company for Fertilizer Industry - Southern Region" in Basra Governorate, Iraq, represented by the urea fertilizer plant. The accounting departments, the cost division, the production department, and the maintenance division at the urea fertilizer plant have been chosen by the research.

The timeframe of the research covers the year 2024, focusing on actual working days, excluding weekends and public holidays.

4 .Results and Discussion:

4.1 Applying GTC to Achieve SCA in the General Company for Fertilizers Industry - Southern Region – Basra

The location of this company in Basra Governorate/ the Khor Al-Zubair area, 45 km southwest of Basra city, produces chemical fertilizer (urea) with a design capacity of 3,200 tons/day, with an actual production of a thousand tons/day, the General Company for Fertilizer Industry - Southern Region is currently the only source for supplying urea to farms in Iraq after the factories of the General Company for Fertilizer Industry in Northern Baiji went out of operation years ago, and it constitutes 60% of meeting the needs of the local market, and the factories consist of two lines for producing liquid ammonia with a design capacity of 1000 tons/day and two factories for producing granular urea with a design capacity of 1600 tons/day for each of them. In addition to the service units for the factories, which consist of "four steam boilers, a water treatment unit, and a urea fertilizer filling unit, it also includes 14 filling lines and 2 cooling towers, in addition to a gas station to generate electricity with a capacity to meet the factory's needs, and other accessories such as maintenance workshops, warehouse and administration buildings. The company owns a land area of 2000 km^2 dunums, the occupied part of which is about 612 km^2, while the vacant area is used as temporary storage yards and for future expansions. (Ministry of Industry and Minerals, 2024) and the capital of the General Company for Fertilizer Industry - Southern Region is three hundred and twenty million, three hundred and sixty-four thousand dinars (Samer, 2010). According to Article (1/C) of the Internal Regulations of the General Company for Fertilizer Industry / Southern Region No. 27 of 2000

The process of manufacturing urea fertilizer is a chemical process related to the petrochemical industries, as it depends on two elements as raw materials, which are: ammonia in gas phase (NH_3) and carbon dioxide (CO_2). Production is carried out according to a technology called the wet process, and the production process goes through the following stages:

1. Reaction Stage: In this stage, ammonia gas and carbon dioxide gas are mixed at a pressure of 140–160 atmospheres and a temperature of 210–180 degrees Celsius. This stage produces an intermediate compound called ammonium carbamate.
2. Decomposition Stage: In this stage, ammonium carbamate is decomposed in special evaporators to produce urea and water.
3. Evaporation and Concentration Stage: In this stage, water is evaporated to increase the concentration of raw urea to approximately 99.7%.
4. Granulation Stage: In this stage, the concentrated urea is converted into solid granules through granulation towers using cold air.

5.Cooling and Packaging Stage: In this stage, the produced granules are cooled to room temperature and then packaged in 50 kg plastic bags.
The company is supplied with raw materials based on a set of government contracts, where ammonia is extracted from natural gas associated with oil from the Rumaitha, North Rumaila, and Al-Faka fields via the Basra Gas Company. The South Gas Company processes the raw gas coming from the Basra Oil Company to convert it into dry gas that is sent via the pipeline company to the factory. Natural gas is then treated in a reactor with steam to produce hydrogen, which is then combined with nitrogen to produce ammonia. Carbon dioxide (CO_2): This is a by-product of the reactor that produces ammonia. The CO_2 produced by the ammonia production unit is recycled to the urea plant as a secondary product, without the need for external purchase. The annual production for the 2023 is 324 thousand tons according to the production department in the company, 75% of the production is supplied to the Ministry of Agriculture through the Agricultural Equipment Directorate and the Agricultural Equipment Directorate in Basra Governorate, the remain is a reserve to ensure continuity of supply in the event of increased demand or emergencies, and when analyzing the market for the urea fertilizer product offered in the local markets, it was as follows in Table (1):

Table (1): Analysis of market prices for urea fertilizer

No.	Product	Price Dinar/ton
1	Iranian Shiraz factories	700,000
2	Iranian Kermanshah factories	800,000
3	Omani	850,000
4	Saudi	900,000
5	Iraqi (Basra) factories	600,000

Source: Prepared by the researcher based on information from local market traders.

It has been noted that the selling price in the local market for the urea fertilizer product of the General Company for Fertilizers Industry, Southern Region, despite its high quality that matches international products and the company's commitment to (ISO9001) standards, is 600,000 ID per ton. This difference in price between the closest competing products to the company's product, the research sample, can achieve a competitive advantage for it, and this advantage cannot be sustained, as well as its commitment to international trends seeking to preserve the environment. Hence, we are required to apply modern technologies that can achieve a sustainable competitive advantage through environmental conservation. The closest of these technologies is the green target cost, and its methodology has been adopted based on the company's data for the year (2024) and related to the factory, as the factory does not have separate accounts.

4.2 Production and Cost Reality:

The actual working days during the year (2024) can be calculated as shown in Table (2), which indicates that weekends (Fridays and Saturdays) (52 Fridays + 52 Saturdays = 104 days) and public holidays falling on working days excluding Fridays and Saturdays were (37 days), bringing the actual number of working days to (225 days).

Table (2): Calculating actual working days.

Details	Number of days
Days of the Year	366
Fridays and Saturdays	104
Public Holidays	37
Actual Working Days	225

Source: Prepared by researchers

The actual production is 1,000 tons/day in 2024, so the actual production volume is 255,000 tons, and the factory's cost records for one ton of urea fertilizer in the research sample factory included the following:

Table (3): Cost per ton

Cost Element	Actual cost (ID/ton)
Commodity Requirements (Raw Materials)	320,000
Service Requirements:	
Salaries and Wages	30,000
Depreciation	20,000
Maintenance	20,000
Fuel and Electricity	121,000
Packaging	14,000
Other Expenses (General)	30,000
Total Actual Cost per Ton	**555,000**

Source: Prepared by researchers based on information from the Production and Accounts Departments, Cost Records Unit.

Thus, the actual production cost for the year (2024) can be calculated to be (255,000 tons), so the total costs will be (141,525,000,000 ID).

$$Actual\ production/ton\ x\ cost\ per\ ton\ (ID/ton)\ =\ total\ production\ cost$$

$$255{,}000\ tons\ x\ 555{,}000\ ID/ton\ =\ 141{,}525{,}000{,}000\ ID$$

4.3 Green Target Costing Methodology:

According to the literature on the application of "green target costing," the application goes through five steps:

First step: Determine the production characteristics of urea fertilizer to turn it into a green product. To convert it, it requires making changes to the characteristics of the production process, to reduce the environmental damage of the production process, and make it compatible with the requirements of green production. According to the researcher's interview with the production workers, the reaction stage produces a temperature ranging between 180-210 degrees, which is a high temperature that affects the environment surrounding the production process on the one hand. On the other hand, it requires fuel and electricity expenses to reduce the ambient temperature, and the thermal energy is not exploited and cannot be used. To benefit from this heat and achieve the goals of the green product, a thermal generator (Shell-and-Tube HRSG) is installed. This converter is symbolized by (HRSG) to convert the heat resulting from the reaction into low-pressure steam, as it works to extract steam from the hot gas instead of discharging it to the environment surrounding the factory, the research sample, and it can be used to produce electrical energy for the factory and obtain clean energy. When searching for this converter, the cost of obtaining and installing it was (660,000,000 ID). The expected benefits are reducing the use of Kerogen as a fuel to generate electricity by 15%, which leads to a reduction in fuel costs by the same percentage, as well as reducing CO_2 emissions resulting from the combustion of kerosene in electric generators by a percentage ranging from 500-700 tons/year. The engineers working in the production department of the factory explained that the implementation of the project to install a heat recovery generator (HRSG) faces some problems and challenges that should be taken into consideration if the implementation and installation of this transformer is initiated, including that it requires periodic and specialized maintenance carried out by experienced specialists, and this is done through maintenance contracts outside the factory or the involvement of engineers in the maintenance department in specialized courses in maintaining this transformer, and that the cost of this maintenance is relatively high. In addition to the time time-consuming, it requires shutting down the transformer for a considerable period of time,

which will affect the continuity of the production process. Despite these problems, the expected benefit of installing this transformer, which is represented by reducing fuel consumption and utilising wasted thermal energy, makes adopting and adopting this transformer, which will reduce future environmental costs and improve the reputation of the research sample factory, with the increasing demand for environmentally friendly agricultural products.

This step is essential to transform the factory's product into a green product, and it is a necessary step in achieving a sustainable competitive advantage for the research sample factory.

Step Two: Determine the target price of the product and the green price premium. Refer to Table 1 for the prices of competing products in the local markets to determine the target price for urea fertilizer and the green price premium that can be added based on the willingness to pay for the environmental benefits. Determine the "target price," which is usually the lowest price of the main competitors, and through the prices in Table 1. The price of the Iraqi product is the lowest price (600,000 ID/ton), which gives it a competitive price advantage and thus the possibility of determining the green price premium to make the product competitive in terms of price and environment. The green price premium is calculated based on applied studies in the "green target cost", and the green price premium is often equivalent to 5% of the traditional price to cover environmental costs. Therefore, the green target price is:

$$Green\ Target\ Price\ =\ Conventional\ Price\ x\ 105\%$$

$$Green\ Target\ Price\ =\ (600{,}000\ x\ 105\%)\ =\ 630{,}000\ ID/ton$$

Step three: Determine the "green profit margin" to determine the green target cost and calculate allowable costs, using the following equations:

$$Green\ profit\ margin\ =\ Green\ target\ price\ \times\ Green\ profit\ margin\ percentage$$

$$Green\ target\ cost\ =\ Green\ target\ price\ -\ Green\ profit\ margin$$

Based on profit margins in the fertilizer sector and globally, the profit margin that is consistent with the goal of achieving a sustainable competitive advantage is 8.5% of the green target price. Accordingly, the green target cost is:

$$Green\ Target\ Cost\ =\ Green\ Target\ Price\ -\ (8.5\%)$$

$$Green\ Target\ Cost\ =\ (630{,}000\ -\ 8.5\%)\ =\ 576{,}450\ dinars/ton$$

The profit margin is (53,550 ID/ton), and this profit balances between maintaining existing customers for the longest period and attracting new customers interested in environmentally friendly products.

Step Four: Determine the cost gap and the green target cost. In this step, we compare the actual costs of the research sample factory, where the total cost per ton of urea fertiliser is (555,000 ID/ton) according to Table 3, and the green target cost is (576,450 ID/ton) from the third step. Thus, the difference (gap) between them is (-21,450 ID/ton). The difference indicates that the actual costs are less than the green target costs by an amount of (21,450 ID/ton).

This negative result shows that the targeted green cost is more than the actual cost by an amount of (21,450 ID per ton), and this generates an investment margin to implement green efforts and initiatives without affecting the planned profit margin, and this value resulting from the profit margin is the basis for launching the fifth step, where the required improvement efforts are distributed to green the production process of urea fertilizer in the research sample factory.

Step Five: Implementation of Green Target Costing Measures. To ensure that procedures work to convert the production of green urea fertilizer in the research sample factory, and to implement the green target costing steps, it was suggested to the management of the research sample factory to "install a Shell-and-Tube HRSG heat exchanger (HRSG), which works to recover the heat generated by the chemical reaction between ammonia and carbon dioxide (with a temperature ranging between 180-210°C). This heat is converted into uncompressed steam, which can be used in evaporation or heating processes instead of relying on additional energy. The process of including this converter within the steps or components of the green target cost can be explained as follows:

1. Function of the converter: This converter converts the heat generated by the reaction into low-pressure steam. It extracts steam from the hot gas instead of discharging it into the environment surrounding the research sample plant.
2. Environmental impact of the converter: This converter contributes to reducing heat emissions from the reaction within the research sample plant and discharging the heat generated by the reaction into the environment surrounding the research sample plant.
3. Productive impact of the converter: The productive impact of the converter is represented by the production of environmentally friendly urea fertilizer, as well as utilising the output of this converter to generate electrical power for the plant, thus providing clean energy.
4. The investment cost of the transformer and how it contributes to reducing production: The cost of obtaining and installing the transformer is estimated at (660,000,000ID), and it is expected to contribute to reducing the use of kerosene as fuel to generate electricity by a percentage of 15%, which leads to reducing fuel costs by the same percentage as well. The transformer needs periodic and corrective maintenance during its productive life, which consists of cleaning the pipes from deposits and salts once or twice a year, as well as conducting welding and pipe inspection using ultrasonic technology, and replacing damaged gaskets and valves. The annual cost of these works is estimated per ton, according to the production engineers in the research sample factory, at (38,000 ID/ton).
5. Its role in supporting the achievement of the green target cost: Reducing carbon emissions (CO_2) resulting from the combustion of kerosene in electric generators by an expected percentage ranging from (500-700 tons/year), and adopting and adopting this converter will reduce future environmental costs and improve the reputation of the research sample factory with the increasing demand for environmentally friendly agricultural products. This step is essential for converting the factory's product into a green product, which is a necessary step in achieving a sustainable competitive advantage for the research sample factory.

The initial investment cost of the transformer is estimated at (5,200,000,000 ID), and it can be allocated and distributed accounting-wise using the fixed-instalment depreciation method, assuming that the transformer has no value at the end of its productive life and over a period of (8 years), then the increase in the annual depreciation expense will be:

$$Increase\ in\ depreciation\ =\ Transformer\ cost\ \div\ Productive\ life$$
$$=\ 5{,}200{,}00{,}000\ Iraqi\ dinars\ \div\ 8\ years\ =\ 82{,}500{,}000\ ID/year$$

With an annual production of 255,000 tons, the increase in the cost per ton for depreciation expenses is (324 dinars), calculated as follows:

$$82{,}500{,}000\ dinars/year\ \div\ 255{,}000\ tons\ =\ 324\ ID/ton$$

This increase in the depreciation amount is included in the calculation of the cost per ton according to the application of the green target cost, and at the same time, the cost of fuel and energy is reduced by an amount of (30,250), and it was calculated as follows:

$$Fuel\ cost\ reduction\ =\ fuel\ cost\ x\ 25\%$$
$$=\ 121{,}000\ dinars\ x\ 15\%\ =\ 18{,}150\ ID$$

Therefore, fuel and electricity costs per ton will be (121,000 - 18,150 = 102,850 ID), while maintenance costs will increase because the transformer needs corrective and periodic maintenance during its productive life, estimated at (5,000 ID/ton), and therefore maintenance costs per ton will be (25,000 ID/ton), which achieves savings higher than the investment cost of purchasing the transformer and also provides an actual reduction margin that contributes to achieving the targeted green cost of (576,450 ID/ton).

Table (4): Cost per ton after applying the green target cost

Cost Element	Actual cost (ID/ton)
Commodity Requirements (Raw Materials)	320,000
Service Requirements:	
Salaries and Wages	30,000
Depreciation	20,324
Maintenance	25,000
Fuel	102,850
Packaging	14,000
Other Expenses (General)	30,000
Total Actual Cost per Ton	**542,174**

Source: Prepared by the researcher based on the steps for implementing green target costing.

We note that if a thermal recovery generator (HRSG) is installed to utilize the heat generated by the reaction in the urea fertilizer production process, the cost per ton of urea fertilizer, after adding the depreciation of the thermal recovery generator, taking into account the decrease in fuel consumption resulting from the use of this generator, and including the maintenance costs of the generator, The results indicate that the actual cost per ton is (542,174 ID/ton), while the green target cost that was calculated based on the application of its methodology was (576,450 ID/ton). This means that the installation of this converter achieves savings in costs per ton by (34,276 ID/ton), and that these savings indicate the success of the green target cost methodology in reducing costs while maintaining production stability. The financial savings can be used to implement other green initiatives to increase the greenness of the product or enhance and support the competitive advantage of the product, whether it is price or maintaining the same price or increasing the profitability of the product. These results support and reinforce the importance of the green target cost and the necessity of implementing its methodology and converting it to its application as an integrated concept that combines environmental and economic efficiency.

Based on the results of fully implementing the Green Target Costing methodology in the research sample factory, it is clear that installing a heat recovery converter (HRSG) led to an actual reduction in the cost of production per ton from ID 585,000/ton to ID 542,174/ton. This saved ID 42,826/ton, a difference of ID 34,276/ton from the calculated and approved green target cost of ID 576,450/ton. From here, we conclude that fully implementing the Green Target Costing methodology not only enhances and supports the environment and produces environmentally friendly products, but also clearly contributes to reducing production costs and decreasing reliance on other energy sources that are harmful to the environment on the one hand and expensive on the other. This is all within an appropriate and competitive profit margin in the market, creating a sustainable competitive advantage for the economic unit. Accordingly, the research hypothesis is proven, which states that "implementing the Green Target Costing methodology contributes to creating or enhancing a sustainable competitive advantage by reducing production costs." Improving financial and environmental performance.

5. Conclusions:

1. Green Target Costing seeks to determine the optimal costs for services and products and focuses on the environmental dimensions of production processes in economic units. It combines the objectives of environmental sustainability and profitability.
2. One of the most important objectives that the GTC implementation contributes to is improving the efficiency of resource use, reducing waste, and supporting the design of environmentally friendly products. This contributes to supporting and enhancing the competitiveness of economic units.

3. Sustainable competitive advantage is represented by the ability of an economic unit to achieve a lasting superiority that competitors cannot imitate. This distinguishes it from traditional competitive advantage. The main difference between them is the time factor, i.e., the continuity of this advantage, as well as the difficulty of replicating, imitating, or copying it.
4. The actual application of green target costing concepts in the Iraqi industry is in its early stages and requires government support through environmental and economic legislation, as well as cooperation between universities and research centers, and industrial entities to expand the practical application of these concepts.
5. Practical results demonstrate that implementing green target costing achieves real financial savings without compromising product quality and maintaining the technical level of production. This is a sustainable competitive advantage that lasts for long periods and cannot be easily overcome by competitors.
6. The cost gap achieved between the green target cost and the actual cost, amounting to (34,276 ID/ton), represents financial savings that can be invested in environmental initiatives or improving the competitive profitability of the research sample. 7. Installing a heat recovery system (HRSG) is an economically and environmentally effective solution for recovering wasted heat energy, leading to reduced fuel consumption. Its acquisition cost is lower than the annual cost savings resulting from its use.
7. There are operational challenges and problems facing the installation of a heat recovery system (HRSG) in the practical application of urea fertilizer production in the research sample, such as maintenance and installation costs. These can be overcome if managed within a long-term vision.

Authors Declaration:
Conflicts of Interest: None
-We Hereby Confirm That All The Figures and Tables In The Manuscript Are Mine and Ours. Besides, The Figures and Images, which are Not Mine, Have Been Permitted Republication and Attached to The Manuscript.
- Ethical Clearance: The Research Was Approved by The Local Ethical Committee in The University.

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