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INNOVATIVE PATHWAYS TO A CIRCULAR ECONOMY IN SAUDI ARABIA AND ITS SPILLOVER EFFECTS ON THE ARAB REGION*

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Abstract. This paper examines the transition towards a Circular Economy (CE) in Saudi Arabia and its potential spillover effects on the Arab region. The concept of a Circular Economy is based on stimulating production that reduces waste and pollution, keeping revenues and consumption expenditures within a closed circle. The paper will follow the numerous pathways of innovation that Saudi Arabia is taking to develop sustainability in the light of technological advancements, policy innovations, and new business models. SWOT analysis of the identification of strengths, weaknesses, opportunities, and threats in implementing CE practices in the Kingdom; the advanced waste management, recycling initiatives, water conservation efforts, and closing with the importance of research and development. The paper highlights how Saudi Vision 2030 underlines those initiatives directed toward economic diversification, environmental sustainability, and reducing the Kingdom's reliance on oil revenues. This paper also attempts to identify how the CE efforts of Saudi Arabia are likely to impact regional collaboration and policy harmonisation, promoting economic and environmental benefits related to the Arab region. The findings underscore that the strategic investments and policy commitments will render the Kingdom a sustainable and resilient economy. The paper also discusses how public-private partnerships and international collaborations may drive the CE agenda. In a nutshell, the Kingdom of Saudi Arabia is best positioned to lead the Arab region in the practice of CE, thereby contributing to regional economic integration, promoting environmental sustainability in the Arab region, and tying the region to global sustainability efforts.

Keywords: circular economy; Saudi Arabia Vision 2030; sustainability; spillover

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JEL Classifications: Q1, Q32

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1. Introduction

A Circular Economy (CE) is a model designed to minimise waste and pollution while optimising the value of products and materials through practices like sharing, leasing, reusing, repairing, refurbishing, and recycling (Rezk et al., 2023). As it is, the model of the world economy is linear. This refers to extracting and processing natural resources to make products that frequently harm the environment and massive waste of natural resources that deplete biodiversity (Sariatli, 2017). Out of reaction to these risks and their associated high costs, governments and civil society have explored and promoted the transition to a Circular Economy. One can define a Circular Economy as a global socioeconomic model centring on improving resource efficiency and reducing an interacting environmental impact, closing material and energy loops, fostering innovation and all means toward sustainable prosperity (Smol & Marcinek, 2023). The model of the Circular Economy acts as the mainstay in modern economies; therefore, this becomes a container for a good deal of the green economy, sustainable economy, biological economy, and purposeful economy. Most, if not all, of the hypothesised models lead to harmony and an outstanding balance between pursuing economic goals and preserving the environment (Abrosimova et al., 2020).

The CE model accentuates a shift to a more sustainable economic system with efficient use of resources, long life of products, recycling, waste reduction, and other modalities that help allay risks of climate change and support the achievement of Sustainable Development Goals (Odia, 2021). Moreover, the circular economy reduces waste from production processes and promotes an environmentally conscious image for businesses, which increases ecological added value, lowers emissions, and increases wealth (Nowicki et al., 2023). The circular economy has received increasing attention from international organisations such as the United Nations and policymakers in developed countries (European Commission, 2015). However, in many low- and middle-income countries, the practical contributions of the circular economy approach have received little attention (Halog & Anieke, 2021).

One of the recent indicators in measuring countries' performances is the 2023 Circular Carbon Economy (CCE) Index (Figure 1), which gives a comparative overview of countries' position on the path to net carbon and the extent of preparedness to get there. The CCE Index rolls up quantitative data points from 38 robust sources on a composite index that covers countries representing about 90% of the global economy and carbon dioxide emissions. Saudi Arabia ranks 20 globally, with some other Arab countries, like the United Arab Emirates, Qatar, and Egypt, ranking in the top 30 countries worldwide (KAPSARC, 2024).

Developed countries like Japan, Netherlands, and Germany have implemented comprehensive CE policies. These include modern waste management systems, large recycling initiatives, and considerable incineration, pyrolysis, and anaerobic digestion expenditures. For instance, the Japanese approach to the circular economy is structured and harmonised. Its root is the "Basic Act for Establishing a Sound Material-Cycle Society," emphasising recycling, using effectively available resources, and reducing waste generation. The effect of this system would be a host of policies, including the Home Appliance Recycling Law, calling for the compulsory recycling of household appliances (Arai et al., 2023). In addition, the European Union has implemented the Circular Economy Action Plan to enhance the circularity of products, reduce waste, and retain resources within the EU economy for as long as possible. Two crucial actions in this sense are the Waste Framework Directive and the Eco-design Directive, which have laid stringent standards in waste management and product design (Mazur-Wierzbicka, 2021).

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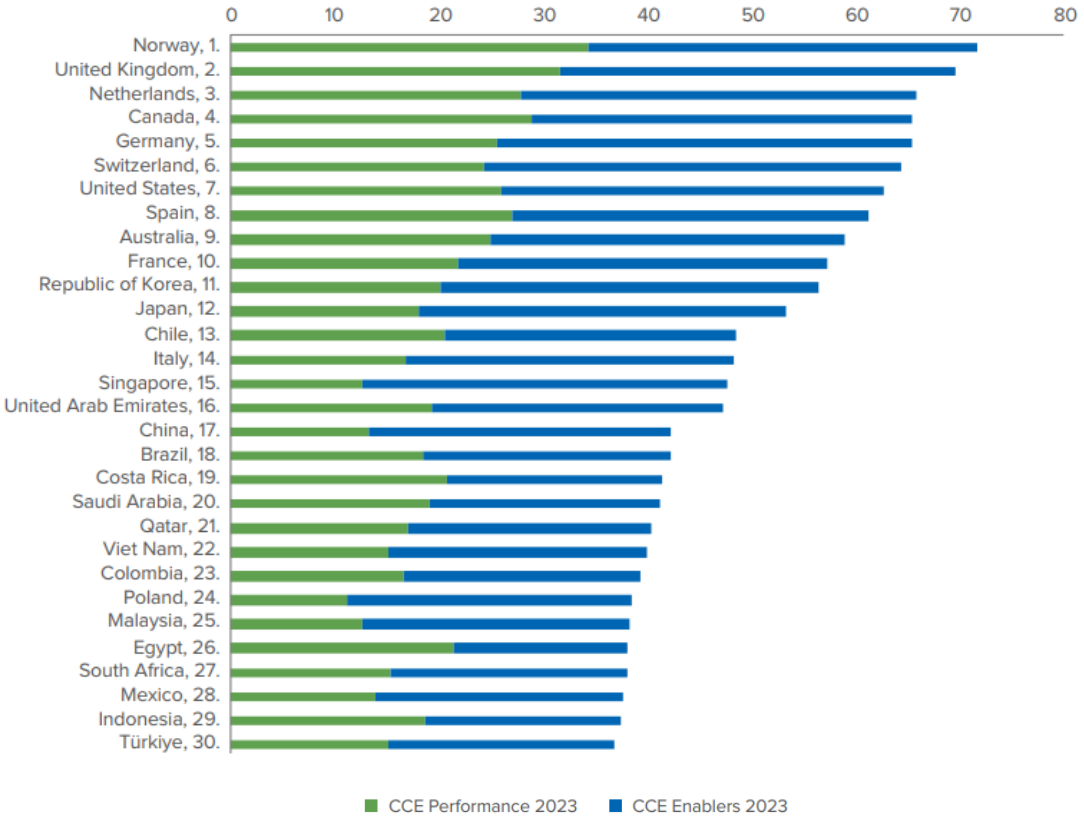

Figure 1. Top 30 countries on CCE Index 2023
Source: KAPSARC, 2024

The Netherlands is the forerunner of circular economy principles. It established ambitious goals for using at least 50% fewer primary raw materials by 2030 and a fully circular economy by 2050. This includes the Amsterdam Circular initiative on sustainable urban planning and waste management and the Green Deals establishing public-private cooperation for promoting circular projects (Verrips et al., 2019). Germany has a robust recycling culture and a well-developed framework for a circular economy; therefore, it has implemented the Packaging Act to promote recycling and the reutilization of packaging material. It also developed the Resource Efficiency Program to enhance resource efficiency in all sectors. Good waste collection and processing infrastructure, coupled with strict regulation, makes Germany one of the leading countries in implementing a circular economy (Ogunmakinde, 2019).

On the other hand, the situation is different in Arab countries, all at varied levels of implementation. Some countries, such as Jordan, Morocco, and the UAE, launched a national strategy promoting CE. Most of these countries have their agenda focused, in this regard, on reducing landfill use by increasing their respective recycling rates. Egypt is still in its CE initiative, which has done a lot, especially regarding improvements in waste management and efficient use of resources (Rezk et al., 2023). As such, transitioning into a circular economy presents challenges but simultaneously creates opportunities for the Kingdom of Saudi Arabia. There is a sizable volume of literature on various aspects of the circular economy in Saudi Arabia that provides insight into the potential benefits that may be available for enjoyment and obstacles to be overcome in the transition. (Almadhi et al., 2023; Yusuf & Lytras, 2023; Ali et al., 2022).

During its G20 presidency, Saudi Arabia proposed to the Gulf Cooperation Council to implement a circular economy model, partly guided by circular economy models developed within the framework of the EU Circular Economy Action Plan, which represents sustainable competitiveness in a variety of critical sectors such as electronics, energy, vehicles and packaging, water, etc .The ongoing circular economy model is expected to include all pre-existing circular economy initiatives in the GCC region while benefiting from the experiences of other countries and cooperation with the European Union (Yusuf & Lytras, 2023).

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Given its enormous reserves and high production capacity, Saudi Arabia has played a leading role in the global oil and gas industry. It is the world's largest producer and exporter of oil, holding more than 260 billion barrels of proven reserves—equivalent to a quarter of the world's total (Hamieh et al., 2022). Since 2021, tangible improvements in Saudi Arabia's non-oil sectors have accelerated and grown to an average of 4.8% in 2022 due to strong domestic demand. On the other hand, the 2023 prospects maintain an estimated growth of about 5% for non-oil sectors, indicating their prosperity and importance in diversifying the economy from the oil-dependence system. (IMF, 2023).

In 2021, the services sector dominated the economic structure of Saudi Arabia, consisting of 52 per cent of its GDP. Other industrial activities came second, with 33 per cent; manufacturing took 13 per cent of the GDP. Agriculture contributed a minimal proportion, representing only 2% of the economic output (Figure 2). Private consumption contributed the most to GDP at 41% compared to expenditure. Government consumption and fixed investment made a contribution of 24% each to GDP, underlining significant contributions to come from the public sector and capital formation in this economy as well. The net exports component retains 11%, indicating the country's trade balance and export activities. (IMF, 2022).

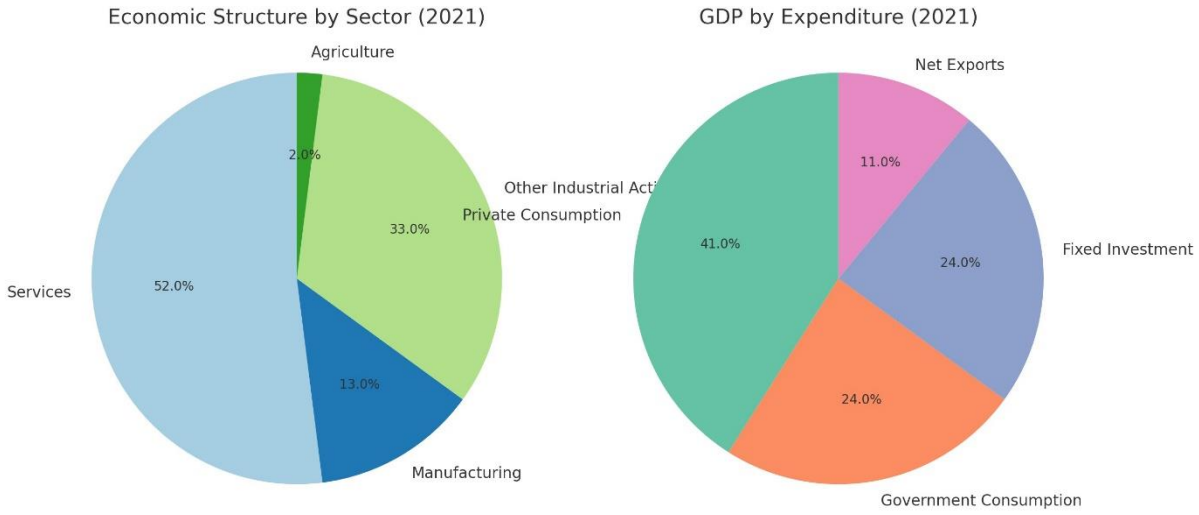

Figure 2. Saudi Arabia's economic structure by sector and GDP by expenditure for the year 2021
Source: IMF, 2022

In Saudi Arabia, industrial growth, rapid urbanisation (83% of the population living in cities as of 2010), and a high-consumption lifestyle has led to many environmental issues, including the degradation of ecosystems, depletion of natural resources, and extensive environmental pollution (Abubakar & Dano, 2019). According to the National Center for Waste Management, in 2021 only, the degradation to the environment from solid waste reached $1.3 billion, which was mainly generated by large urban centres: Riyadh, Jeddah, and Dammam, with corresponding contributions of 21%, 14%, and 8% with landfills all over the country nearing total capacity. The waste generated in Saudi Arabia is shown in Figure 3. The general trend indicates that Municipal Solid Waste (MSW) generation is increasing yearly, highlighting the need for enhanced waste management strategies to cope with growing waste (Almadhi et al., 2023).

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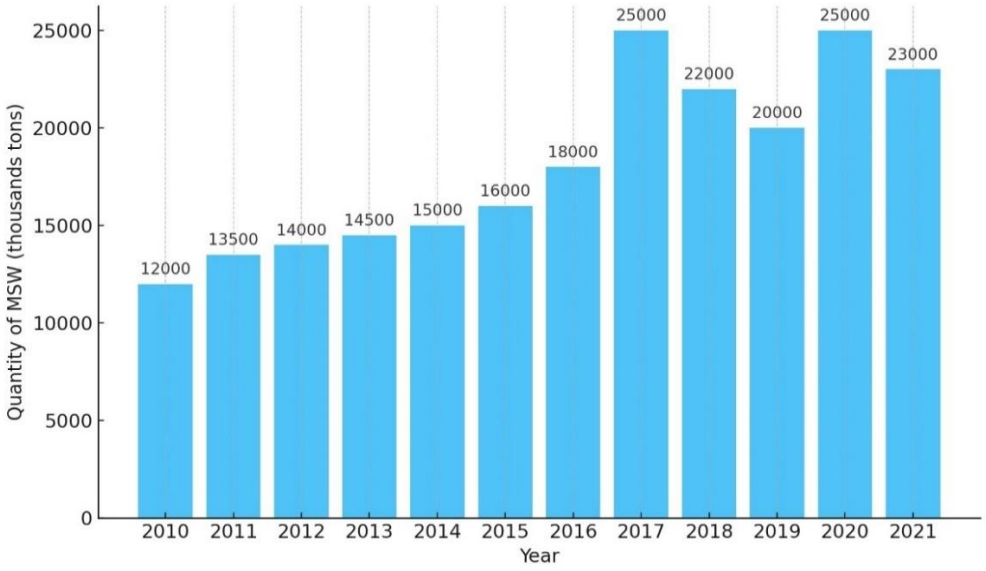

Figure 3. Quantity of MSW in Saudi Arabia
Source: Almadhi et al., 2023

Typical of this is a firm reliance on throwaway items, particularly single-use plastics, pointing out minimal recycling. Much of this waste is either landfilled without treatment or incinerated, with long-term environmental implications, as these locations are lost to any other use once filled. Landfills are generally poorly engineered in Saudi Arabia and mirror continuing problems with waste management (Sulami et al., 2024; ITA, 2024). District-wise, the residential composition of municipal solid wastes in Saudi Arabia significantly differs around urban activities and population density Figure (4), covering food wastes (40–51%), paper (12–28%), cardboard, 7%, plastics, (5–17%), glass, (3–5%), wood, (2–8%), textiles, (2–6%), and metals, (2–8%) (Nizami, 2024).

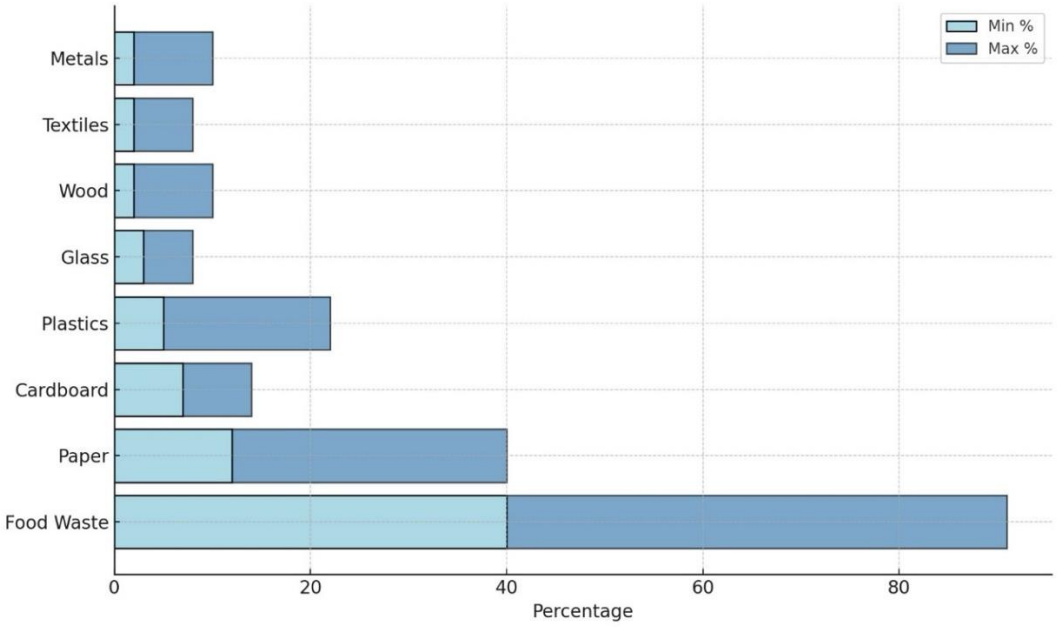

Figure 4. District-Wise Residential Composition of Municipal Solid Waste in Saudi Arabia
Source: Nizami, 2024

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This paper aims to explore and document the innovative pathways Saudi Arabia is adopting to transition towards a circular economy, including technological advancements, policy innovations, and new business models. By performing a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis, the paper aims to understand the current state and potential future of circular economy practices in Saudi Arabia. Additionally, the paper assesses how Saudi Arabia's circular economy initiatives can influence and foster regional collaboration, policy harmonisation, and shared economic and environmental benefits across the Arab region.

2. Methodology

This study uses a set of tools that explore the circular economy in the Kingdom of Saudi Arabia and its regional impacts. It relies on a literature review, detailed case studies, and expert interviews. The literature review includes data from academic journals, publications, and other relevant documents about the circular economy's concepts and how they are used in Saudi Arabia. It also gathers and analyses the success stories of Saudi Arabian that have successfully implemented the circular economy. Additionally, case studies in Saudi Arabia that have adopted the circular economy approach are included in the research, providing specific examples of the challenges and opportunities associated with adopting circular economy concepts in the nation.

Interviews were conducted with experts in the field of circular economy to gather their perspectives on the implementation and impact of circular economy practices in Saudi Arabia. The interviews help put the findings from the literature review and case studies into context and provide a deeper understanding of the strategic and operational considerations associated with the transition to a circular economy. A SWOT analysis is carried out to pinpoint the strengths, weaknesses, opportunities, and threats related to implementing a circular economy in Saudi Arabia, drawing upon literature reviews and discussions with experts. This analysis seeks to offer a detailed insight into the current expertise in Saudi Arabia. In addition, the international publishing database (Scopus) was relied upon to determine the rates of cooperation between the Kingdom and Arab countries in the field of the circular economy, as well as the Kingdom's ability to attract international cooperation in research and development of circular economy technologies.

3. Innovative Pathways to a Circular Economy in KSA

3.1. Saudi Vision 2030 and its Emphasis on CE

Saudi Vision 2030 is a government program launched by the Kingdom of Saudi Arabia to increase diversification economically, socially and culturally. This plan underscores the reduction in Saudi Arabia's high reliance on oil revenues to establish a more sustainable and resilient economy to meet global challenges and uncertainties. The plan that is Vision 2030 puts sustainability across the board, as well as environmental protection and resource use efficiency for sustainable development. This vision sought to protect natural resources, minimise environmental impacts, and enhance sustainable practices in every sector. Aligned with these aspirations for sustainability, Saudi Vision 2030 sets ambitious targets regarding its renewable energy sources, with an aggressive decrease in carbon emissions. It presents the issue of renewable energy, especially solar and wind power, in the world diversification of energy sources, increasing security of supply, and mitigation of global climate change (Shehri et al., 2022; Altouma et al., 2024).

Within the Vision 2030 program "Achieving Environmental Sustainability," Saudi Arabia aims to establish comprehensive recycling facilities and make waste management more efficient by reducing all types of pollution, including soil pollution from non-degradable waste. A set of goals has been set that the Saudi government seeks to achieve (Table 1), in addition to transforming its economy into a sustainable economy as stipulated in Saudi Vision 2030. (Saudi Vision 2030, 2016).

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Table 1. The Saudi Vision 2030 Themes and Targets toward circular economy and sustainability

Theme	Objectives/Targets
A vibrant Society	- To increase KSA's capacity to welcome Umrah visitors (pilgrims) from 8 million to 30 million annually. - To have three Saudi cities recognised as the top-ranked 100 cities in the world. - To raise our position from 26 to 10 in the Social Capital Index.
A thriving Economy	-To lower the rate of unemployment from 11.6% to 7%. -To increase SME contribution to GDP from 20% to 35%. -To move from our position as the 19th largest economy in the world into the top 15. -To rise from our current position of 25 to the top 10 countries on the Global Competitiveness Index. -To increase foreign direct investment from 3.8% to the international level of 5.7% of GDP. -To increase the private sector's contribution from 40% to 65% of GDP. -To raise the share of non-oil exports in non-oil GDP from 16% to 50%.
An ambitious Nation	-To increase non-oil government revenue from SAR 163 billion to SAR 1 trillion. -To raise our ranking in the Government Effectiveness Index from 80 to 20. -To raise the non-profit sector's contribution to GDP from less than 1% to 5%.

Source: Alshuwaikhat and Mohammed, 2017

The Saudi Vision 2030 goals and objectives are entwined with the circular economy in encouraging sustainability and resource efficiency in different areas. For instance, increasing the capacity for Umrah visitors is in line with encouraging sustainable tourism practices, including waste reduction and efficient resource use. Making Saudi cities featured among the top 100 in the world under smart city initiatives for sustainability and circular economy remains pegged to issues like waste management and recycling. This transfer to enrich social capital by moving up the country's rankings in the Social Capital Index shall require community engagement in sustainability, entrenching a recycling and waste reduction culture.

On the economic theme: The circular economy creates jobs in recycling, repair, and remanufacturing, which reduces unemployment. SMEs remain at the core of developing innovative solutions for sustainable production processes. These circular economy practices improve resource efficiency, thereby reducing costs and increasing the promotion of innovation that helps Saudi Arabia move up the Global Competitiveness Index, which will finally attract FDI. Incentivising private sector involvement, circular economies help industries diversify and reduce dependence on exports related to oil while increasing non-oil GDP. The circular economy generates new revenue streams and allows effective governance and the non-profit sector to participate in economic growth through sustainability projects.

3.2 Recycling and Waste Management Programs

In recent years, the Kingdom of Saudi Arabia (KSA) has shown a growing interest in promoting circular economy practices through various initiatives and projects in the recycling and Waste Management sectors. The Saudi Arabian government has recognised the need to encourage recycling and waste management in transitioning towards a more circular economy. Compared to other countries (Figure 5), Saudi Arabia, according to the 2016 Gulf Cooperation Council (GCC) Plastics Industry Indicators, has a meagre recycling rate. Among the GCC countries, the UAE, Oman, and Kuwait have more promising rates, although much is yet to be accomplished in these countries. Under this category, Qatar is the last. This disparity indicates that many better recycling initiatives and waste management infrastructure are required in Saudi Arabia, as well as in other GCC countries, to achieve what has already been done in European countries (The Economist Intelligence Unit, 2022)

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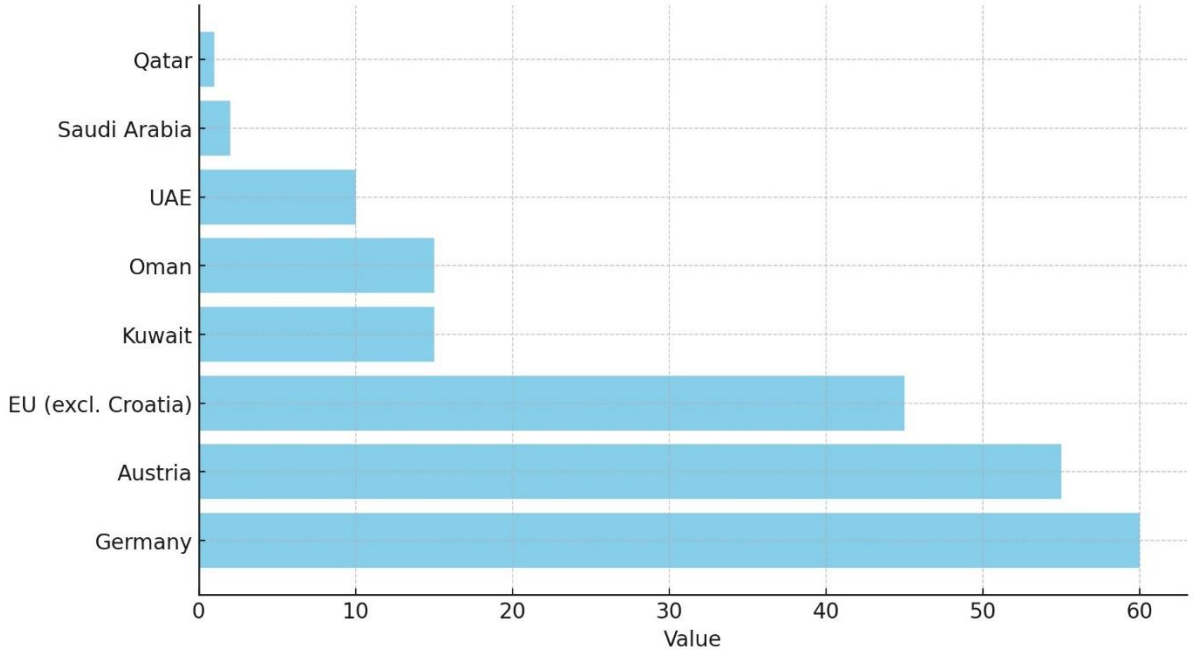

Figure 5. The recycling rate in GCC Plastics Industry Indicators
Source: The Economist Intelligence Unit, 2022

Several initiatives and schemes have been launched to increase recycling rates and waste management and hamper an overflow of landfills. One of the vital recycling initiatives in Saudi Arabia is establishing the National Waste Management Center (NWM), which oversees waste management practices and promotes recycling across Saudi Arabia. The National Center for Waste Management was established in accordance with Council of Ministers order No. 457, date 11/8/1440 AH. They aim to regulate and supervise waste management activities, encourage investment, and expand their quality based on the circular economy principle in waste management to achieve sustainable development goals. The founding pillars of the National Strategy encompass 5 ambitions, 11 strategic objectives, and 19 performance indicators reflected in 65 initiatives setting the foundation for sector transformation (The National Center for Waste Management, 2024).

The Saudi Arabian government has undertaken different regulations and strategies to address waste management challenges, including the management of medical waste (Almubarak et al., 2023), electronic waste (Madkhali et al., 2023), industrial wastewater (Rabeiy et al., 2023), urban air pollution (Alhajj, 2022), and plastic wastes (Almadhi et al., 2023). These initiatives aim to mitigate improper waste disposal practices' adverse environmental and health impacts. These policies all strive to provide an environment that enables the growth of the recycling industry, stimulate investment into its supporting infrastructure, and increase sustainable waste management practices. Furthermore, public-private partnership arrangements have been structured to drive recycling in Saudi Arabia. For example, the Saudi Investment Recycling Company (SIRC) was established to develop and operate recycling facilities, invest in recycling technology, and develop a market for recycled materials. In partnering with the private sector, the government desires to leverage businesses for expertise and access to resources that will help accelerate Saudi Arabia's realisation of a circular economy (SIRC, 2021).

3.3. Water Conservation and Reuse Initiatives in Saudi Arabia

The Kingdom of Saudi Arabia has prioritised the conservation and reuse of water because the region characterises poor water resources and high levels of water scarcity. In establishing initiatives and projects, the country has attempted to avoid avoidable use, develop better management practices, and maximise the reuse of available water resources. These efforts will be most keenly informed by circular economy principles when handling and re-purposing treated wastewater for use in agriculture and industry. Among them, there has been a leading shift towards water recycling and resource recovery from wastewater due to the increasing demand

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for water and mitigation of environmental impacts. The country has set targets that, by 2025, the entire volume of treated wastewater will be utilised and reused, reaching an increase of 800% in reuse capacities (Dawoud et al., 2022). Agricultural irrigation during 2018, followed by landscape irrigation, represented about two-thirds of treated water reuses; the equivalent industrial water would be 13% of the total water reuse (Figure 6).

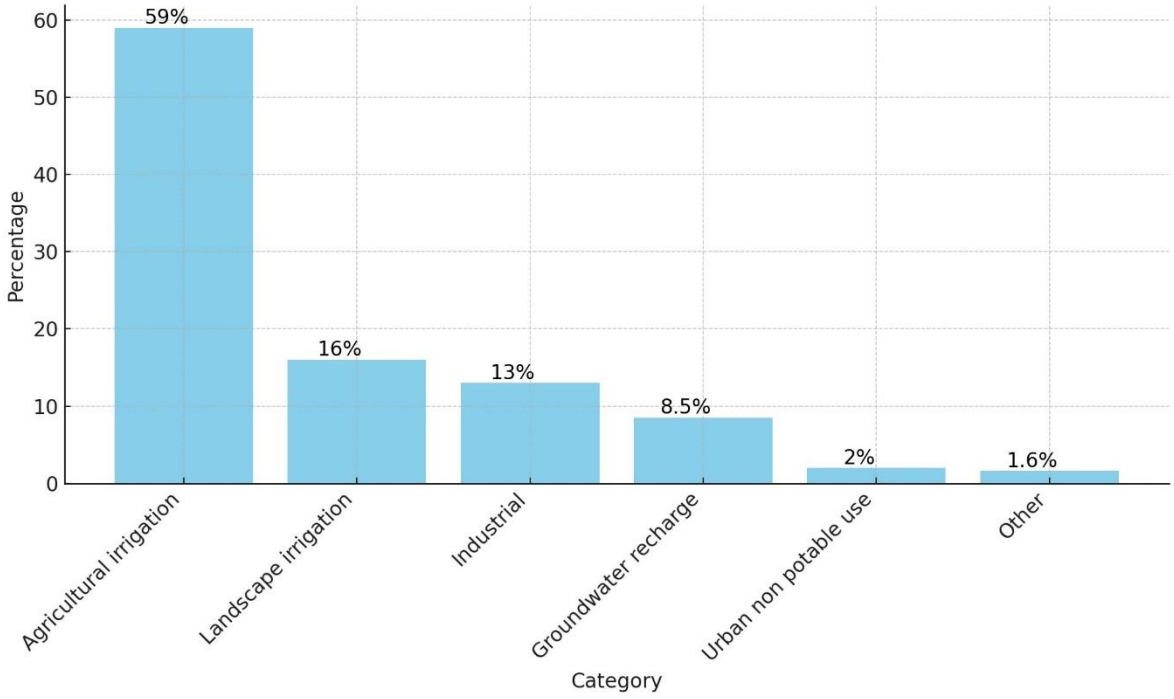

Figure 6. Wastewater Reuse in Saudi Arabia For 2018
Source: Dawoud et al., 2022

Transforming wastewater treatment plants into resource recovery factories is underway; such efforts will support climate neutrality and decarbonisation by way of integrating the production of reusable energy, water, and resources from the same factories (Ali et al., 2022). Besides, produced water from oil operations is being reused to save billions of gallons of groundwater annually and reduce the amount from seawater desalination Ahmed et al. (2022).

One of the critical initiatives regarding water conservation and reuse that Saudi Arabia has focused on is the National Water Strategy. Its purpose is to enhance water security, reduce water wastage, and promote practices that bring about sustainable water management. It comprises programs aimed at improving water efficiency in the agricultural, industrial, and urban sectors, besides initiatives to increase the reuse of treated wastewater for non-potable purposes. In the agricultural sector, water conservation and reuse help ensure the sustainability of farming operations while limiting water use. One major trend adopted in Saudi Arabia has been the use of treated wastewater for irrigation purposes, whereby farmers are less dependent on freshwater resources while reducing the impact of water scarcity on agricultural productivity. The Saudi government has also spent money on infrastructure projects that increase the capacity for wastewater treatment and promote the reuse of treated wastewater. For instance, the King Abdullah Initiative for Saudi Agricultural Investment Abroad coordinates agricultural projects in foreign countries rich in water resources and then exports the products back to Saudi Arabia, thereby reducing pressure on domestic water supplies.

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3.4. Role of Research and Development

Research in CE within the Kingdom of Saudi Arabia is critical to making this implementation of sustainability a success and leading to economic and environmental well-being. Recent research has added much value by pointing out the opportunities and challenges in shifting towards the circular economy model, according to Scopus, the Saudi Arabian expert community published 316 publications on circular economy documents within the last two years. This relatively low number gives one specific focus area within Saudi research; what is extremely interesting is the high collaboration involved in publishing those documents.

Figure 7 shows the country's co-authorship network of circular economy research publications involving Saudi Arabian researchers in the last two years. Saudi Arabia is in the middle, and it shows its contribution to collaborative research. The Saudi Arabia node's big size means most publications are done and collaborations. The most prominent countries associated with Saudi Arabia are the USA, China, the United Kingdom, Malaysia, and Egypt. These connections show that there are solid collaborative relations between these nations. The thickness of the lines between Saudi Arabia and these countries reflects how intense these collaborations are.

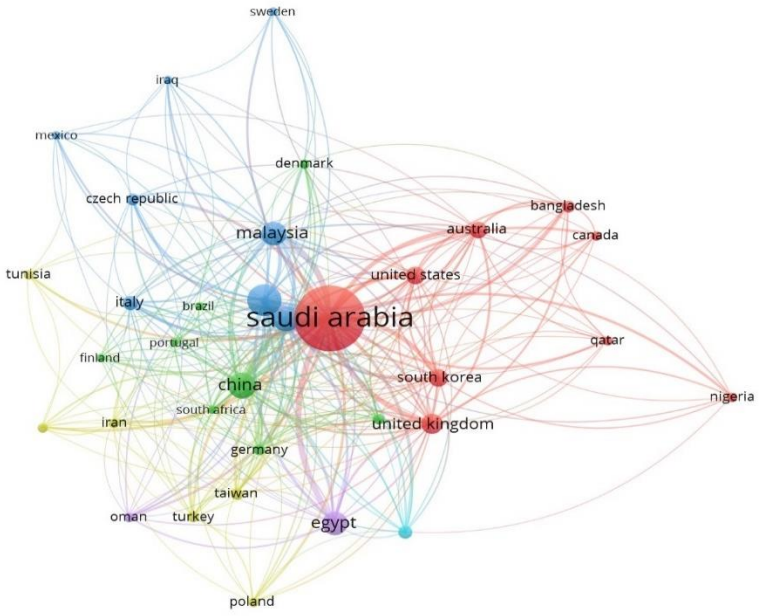

Figure 7. International Co-Authorship Network in Circular Economy Research Involving Saudi Arabian Researchers
Source: Scopus 2024

There is a mix of regional (e.g., Egypt, Iran, Turkey) and global collaboration, such as the United States, the United Kingdom, and Australia, further testifying that a good number of international research collaborations in which Saudi Arabia is actively involved. Other countries, like Malaysia, Italy, and even China, also have sizeable collaborative links with Saudi Arabia, signifying regional initiatives in research or even deeper interests in the circular economy. High rates of international collaboration are often associated with higher-impact research; this could mean anything from contributing ideas to gaining access to different methodologies for spreading the findings further.

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4. Success Stories of Saudi Arabia in the Circular Economy

4.1. Saudi Basic Industries Corporation (SABIC)

SABIC is a major company in the circular economy across Saudi Arabia. It has contributed much towards the circular carbon economy by showcasing new and exciting sustainable ways. It is a founding member of the World Plastics Council, the Alliance to End Plastic Waste, and the World Economic Forum's "Collaborative Innovation for Low-Carbon Technologies in the Chemical Industry" platform. One such notable success was the development of their Trucircle solutions, which include certified circular polymers produced from recycled mixed plastic waste. The project initiative will help reduce the dependency on raw virgin materials. Still, it will also solve the global plastic waste problem by re-processing it into valuable products.

SABIC has implemented a state-of-the-art CO2 capture and utilisation project at their United affiliate in Jubail, Saudi Arabia, and it can capture up to 500,000 metric tons every year. It produces CO2 from its ethylene glycol production. The captured CO2 is further used in the urea and methanol manufacturing process, rather than what otherwise would have been determined as wasted. This project reduces GHG, illustrating a practical application of principles in Circular Carbon (see Figure 8).

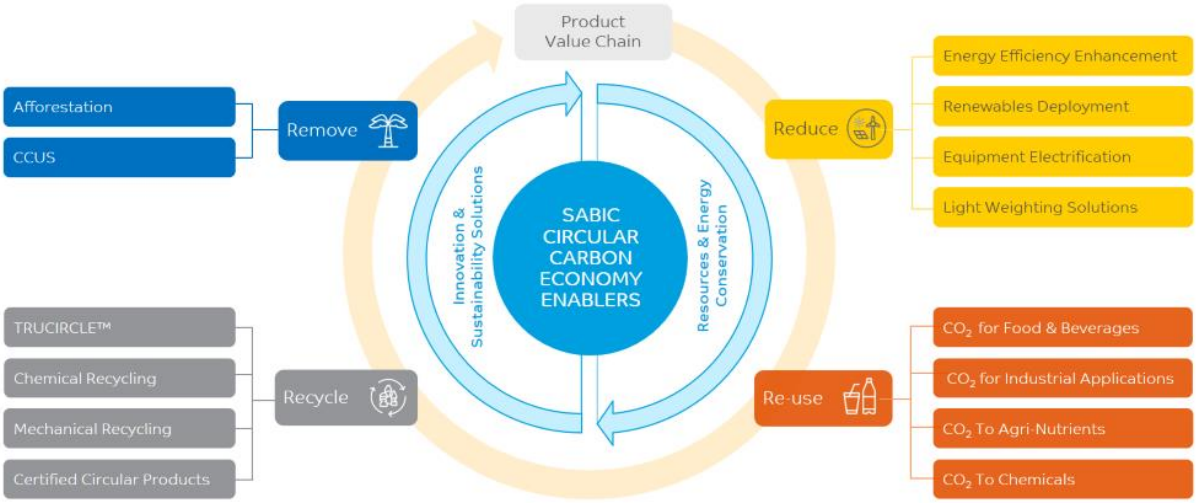

Figure 8. SABIC Circular Carbon Economy Enablers and Strategies
Source: SABIC, 2024

SABIC has invested heavily in advanced recycling technologies, particularly pyrolysis, that can turn hard-to-recycle plastic waste into pyrolysis oil, which will then be turned into feedstock to produce new plastics from waste. The partnership by SABIC with Plastic Energy, a leader in chemical recycling, has been instrumental in scaling this up and making circular solutions more feasible and impactful (SABIC, 2024).

4.2. The Saudi Investment Recycling Company (SIRC)

SIRC is one of the critical drivers for circular economy growth within the Kingdom of Saudi Arabia and aligns with the objectives outlined in Vision 2030. As a Public Investment Fund subsidiary, SIRC aims to transform waste management in the Kingdom. Resource recovery and recycling are encouraged, with a target reduction of landfill waste by 82% over the next 15 years, until 2035. SIRC investments in advanced recycling facilities ensure the processing of several waste streams municipal, industrial, construction, demolition, and electrical/electronic to recover valuable materials and reintroduce them into economic activities. The investments that this company has provided for a capital budget in the execution of its projects amount to 300 million riyals. Modern processing technologies and geographic expansion at new sites in various parts of the Kingdom are involved. This investment is dedicated to improving operational efficiency related to industrial waste treatment processes and creating direct and indirect jobs in diverse fields (SIRC, 2024).

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In this regard, SIRC also runs large-scale public awareness campaigns for citizens' input into the recycling systems. This includes community outreach programs, education partnerships with schools, and media campaigns that raise public awareness about the benefits and benefits associated with recycling. Engaging the public helps SIRC build a culture of sustainability and environment-mindedness necessary for driving circular economy practices toward successful ways. SIRC has many partnerships with local and international organisations to tap into the latest technologies and expertise in the most effective waste management practices. State-of-the-art innovations, such as automated sorting systems, chemical recycling, and waste-to-energy solutions, will also be implemented to ensure efficiency in recycling processes. Such strategic partnerships and technological advancements not only reduce the impact on the environment by conserving resources and reducing pollution but also create economic opportunities in terms of job creation and the stimulation of innovation in green technologies (SIRC, 2024)

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5. SWOT analysis of the Circular Economy in KSA

For Saudi Arabia, the shift to a circular economy presents distinctive opportunities and challenges since its economy has traditionally significantly relied on natural resources while having ambitious Vision 2030 goals in economic diversification and environmental sustainability. Conducting a SWOT analysis projects the strengths, weaknesses, opportunities, and threats associated with transitioning toward a circular economy in Saudi Arabia, all based on the opinions of experts and literature reviews (Table 2).

Table 2. SWOT analysis of Circular Economy in KSA

Strengths:	**Opportunities:**
• The Saudi Vision 2030 initiative's focus on sustainable development creates an appropriate climate for promoting circular economy practices, In addition to initiatives aimed at sustainable development, especially in areas such as water desalination, waste recycling and agricultural water use. (Almulhim & Al-Saidi, 2023). • Saudi Arabia has significant financial resources to invest in the circular economy. • Harnessing advanced technologies and innovation in developing sustainable operations. • A growing population and consumer market can create the necessary demand for circular products and services. • Saudi Arabia has a strong industrial base that can be transformed into a circular economy. • Saudi Arabia is gradually trying to educate and raise awareness among its people regarding sustainability concerns. • The geographical location makes Saudi Arabia a gateway between Europe, Asia and Africa. This represents better opportunities for trade and cooperation. • Availability of sufficient solar and wind energy resources that support sustainable energy in a circular economy. • Multi-stakeholder partnerships exist to propose solutions and encourage sustainable practices, especially in reducing food and recycling waste (Kopnina & Blewitt, 2018). • The possibility of cooperation between the government agency and the private sector in implementing circular economy projects. • Availability of funds necessary for investment, especially those allocated to the sustainability and green technology sectors. • The existence of strong international cooperation between the Kingdom and developed countries allows for the transfer of technology • The presence of many leading and international companies in economics.	• Circular economy practices can thus help diversify the economy away from oil dependency and towards realising the Kingdom's Vision 2030. • New industries and new jobs in recycling, remanufacturing, and the design of sustainable products. • Positioning of the Kingdom of Saudi Arabia as a leader in sustainable development and circular economy practices, particularly in the Middle East. • Research and development opportunities in sustainable technologies and processes. • The possibility of establishing partnerships with international organisations and countries to promote circular economy initiatives. • Great potential to reduce environmental pollution and carbon footprint. • Developing green financing tools and sustainable investment opportunities. • Promote new business models such as the sharing economy and remanufacturing. • Taking advantage of the circular economy to promote the sustainable tourism sector. • Expanding educational programs to build skills and knowledge in sustainability and circular economy principles. • The possibility of developing and exporting circular products and technologies to other regions. • Opportunities to improve resource efficiency and reduce waste in industrial processes. • Possibilities of establishing cooperation between Arab countries and Saudi Arabia

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Weaknesses:	**Threats:**
• Inappropriate waste management infrastructure, recycling systems, and lack of supporting and incentivising policies within the current legal framework. • Traditional consumption patterns and lack of public awareness of the benefits of implementing an economy in a circular flow. • Strong dependence of the economy on oil will act as a barrier to change towards a Circular Economy. • Lack of skilled and experienced professionals within sustainability and circular economy. • Circular economy systems and technologies require huge investments at the beginning. • Lack of data collection and metrics for measuring progress and impacts of circular economy initiatives. • The intensity of waste management practices varies across different regions of the country. • Low citizen involvement in recycling and in participating in sustainable consumption practices. • Businesses, smal- and medium-sized enterprises (SMEs), often need help making the significant investments CE requires, both in the initial launch and the continued financial support for its implementation (Rizos et al., 2016).	• Funding and priorities may change with fluctuations in world oil prices and economic instability. • Other countries embracing the implementation of the theory of a circular economy will very quickly overtake KSA • • The pace of technology changes could be faster than the capacities and resources available. • Willful opposition to new practices 'from industries and consumers • Slow development or adoption of enabling policy and regulatory frameworks • Climate change and environmental degradation could pose problems when implementing a circular economy. • Regional geopolitical tensions that can affect annual economic stability and circular economy initiatives • Over-reliance on imported technologies could open up possible supply chain disruption risks. • Changes in global economic conditions that may hinder funding and investment in circular economy projects • Potential for exacerbating social inequalities if the benefits from the circular economy are not evenly distributed.

Source: Authors

6. Spillover Effects of Saudi Arabia's Circular Economy on the Arab Region

6.1 Economic Spillovers

Economic policies and growth in Saudi Arabia truly influence the GCC. Economic initiatives that flow directly from Saudi Arabia, for instance, as is evident with Vision 2030, have the potential to cascade through and promote further economic integration, making the different countries of the GCC more resilient to any global economic shocks. Some of these initiatives also significantly impact regional market integration, which aims to diversify its economy away from oil. This diversification can reduce the region's collective economic vulnerability to oil price shocks and promote more flexible economic structures (Al-Mawali, 2015).

Economic policies and market conditions in Saudi Arabia directly impact the financial markets in neighbouring countries. Studies have shown significant impacts on returns and volatility from Saudi Arabia to other GCC markets such as Bahrain, Oman, Kuwait, Qatar and the UAE. These indirect effects prove the extent of the entanglement of economies in this zone and how much Saudi economic stability influences regional market performance. (Alotaibi & Mishra, 2015). Saudi Arabia's focus on economic diversification and sustainable practices within the framework of the circular economy model can boost trade and investment among countries in the region. Saudi Arabia can create positive new market opportunities through, for example, sustainable business practices and carbon reduction in sectors—for instance, renewable energy, waste management, and recycling—that attract investments from neighbouring countries. The circular economy in Saudi Arabia would also significantly decrease the country's reliance on oil and foster more sustainable economic practices that can, in turn, influence policy developments that neighbours might consider, thus enhancing the general regional shift towards sustainability and economic diversification. (Bahgat, 2016); see Figure 9 below.

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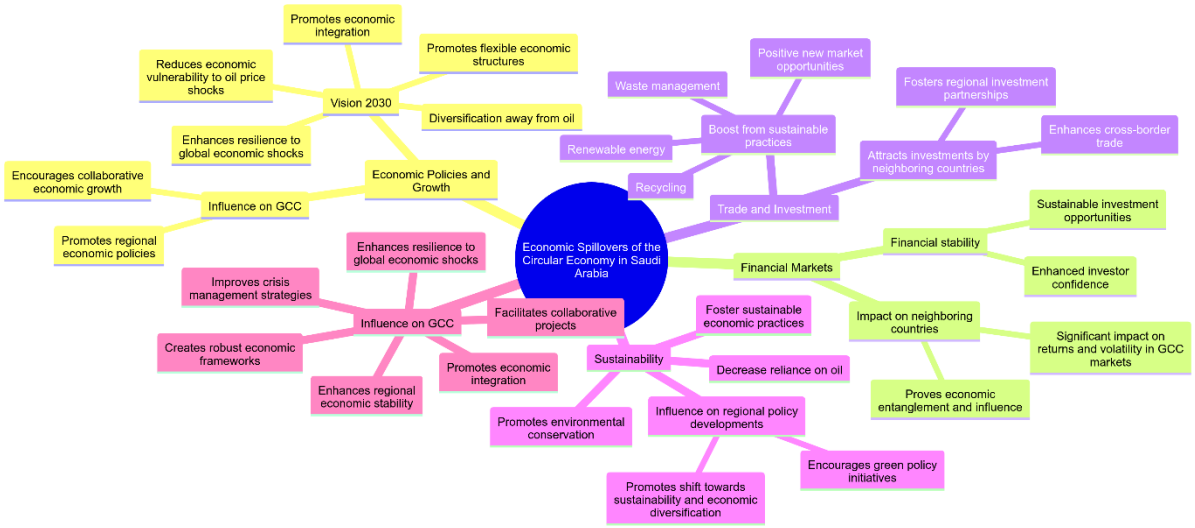

Figure 9. Economic Spillover Effects of Saudi Arabia's Circular Economy on the Arab Region
Source: Authors

6.2. Research and Development Partnerships

R&D partnerships in Saudi Arabia's circular economy are pressing to drive innovation and sustainability. One good example of such a partnership is the cooperation between Saudi Arabia and China in terms of BRI and Saudi Vision 2030. These two initiatives have greatly improved collaboration in trade, investment, power, and the newest technology development, especially by creating pre-conditions that facilitate the execution of the circular carbon economy. (Chen, 2021). Moreover, the Technology Innovation Centers, hosted at King Abdulaziz City for Science and Technology in Saudi Arabia, move toward bridging the unwarranted wide gap between research universities and private industries. It is also an example of a model bringing together academic and industrial resources to solve problems directed at sectors with the view of progressing national technological and economic objectives, moving Agenda 2030 in the circular economy forward. (Khorsheed & Al-Fawzan, 2014).

Further, among the most significant aspects of Saudi Arabia's advancement of the circular carbon economy is its numerous research collaborations. The King Abdullah Petroleum Studies and Research Center signed up to coordinate various events with the King Abdullah University of Science and Technology to track the progress and the implementation plans for the CCE. Additionally, the events will pinpoint the contribution of research in providing ways and means for the development of the public and private sectors and the execution of circular economy initiatives). Furthermore, that reality is crucial for Saudi Arabia's development strategy, as in Vision 2030. This is because the success of PPP projects is predicated on procurement transparency, risk-sharing mechanisms, and knowledge management—all needed for achieving the desired outcomes of the infrastructure and general economic development projects. (Jubair & Singh, 2022).

For Saudi Arabia, most circular economy solutions will be underpinned by new science and technology developments, which can be transferred or replicated across the Arab region. Equally, although some moving-needle solutions have already been identified in key areas, such as circular materials and resource recovery, many of these still need to improve in technological readiness. For instance, biodegradable product packaging could help lessen plastic pollution and support global consumer goods companies in their sustainable pledges. However, significant R&D still needed to be made scalable and cost-efficient. Though many consumer goods companies have excellent in-house research teams, all of them will gain from external collaborations, especially with academia, to complement internal capabilities. This helps translate academic research into applications immediately by developing strategic R&D linkages between private enterprises and leading institutes. Several examples are already in effect: Global consumer goods firms like Procter & Gamble and Nestle are already teaming up with local research institutes like King Abdullah University of Science and Technology. Such

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partnerships help speed up the development and commercialisation of circular innovations. Knowledge and technology transfer can work both ways and for the benefit of neighbouring Arab countries (see Figure 10).

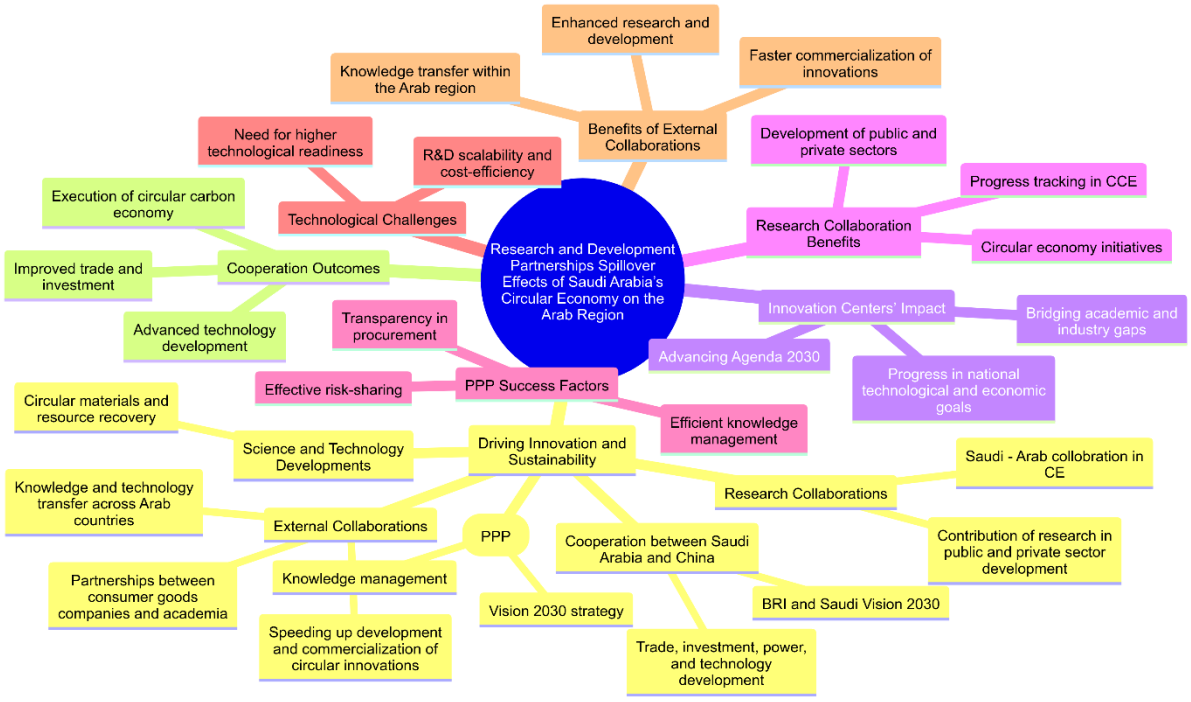

Figure 10. R&D Partnerships Spillover Effects of Saudi Arabia's Circular Economy on the Arab Region
Source: Authors

Conclusion

Therefore, the transition to a circular economy by 2030 shows immense sustainability improvements expected to be brought about by innovative, evident technologies, robust policies, and strategic business models in Saudi Arabia. The country's initiative towards recycling, waste management, and water conservation portrays a severe commitment towards protecting the environment and economic diversification. This transformation offers huge domestic benefits and is believed to have spillover potential across the Arab region, promoting regional collaboration and policy harmonisation. Among these promising drivers should be advanced recycling technologies, waste-to-energy systems, and public-private partnerships—areas in which companies such as SABIC and SIRC have excelled with some of the most successful projects. SWOT analysis reveals strengths in financial resources and technological capabilities and lists challenges such as infrastructure gaps and the need for skilled professionals. Opportunities would include job creation, economic diversification, and regional leadership in sustainability.

The practical value lies in demonstrating how Saudi Arabia can lead CE practices across the Arab region, promoting regional economic integration and environmental sustainability. Specific initiatives, such as waste management improvements, recycling, and water conservation, provide actionable strategies that other countries can adopt. The paper underscores the potential for cross-border trade, attracting investment, and fostering new market opportunities, particularly in the sustainability and renewable energy sectors. By promoting collaborative projects and regional policy harmonisation, Saudi Arabia's CE initiatives are expected to strengthen financial markets, enhance investor confidence, and provide financial stability. The spillover effects include promoting environmental conservation and reducing reliance on oil, thereby encouraging regional green policy initiatives. Technological challenges, the need for higher technological readiness and cost-efficiency in scaling R&D, are highlighted in R&D Spillover. However, benefits like faster commercialisation of innovations and the development of both public and private sectors foster progress in national technological and economic

goals. Saudi Arabia's collaboration with China and regional partners through initiatives like BRI and Vision 2030 significantly contributes to trade, investment, and CE development.

Such efforts from Saudi Arabia could inspire and catalyse similar initiatives across the Arab region for economic resilience and environmental sustainability. Future research should pay attention to detailed case studies, long-term impact assessments, and frameworks for regional cooperation to ensure fruitful implementation of circular economy practices throughout the region. In this way, Saudi Arabia can set an example of the best circular economy practices for other Arab countries to follow in realising regional cooperation toward even more overarching economic resilience and environmental sustainability. Spillovers from Saudi Arabian circular economy leadership will help boost regional integration, stretch the boundaries of sustainable development, and position the Arab region at the helm of global sustainability endeavours. This research offers valuable insights for policymakers, industry stakeholders, and researchers interested in learning more about sustainable development and circular economy strategies in the Arab context. Therefore, there is a need for further research to explore the case studies, additional measures for the long-term impacts of circular economy initiatives, and regionally collaborative frameworks that guarantee the effective uptake and implementation of circular economy practices across the Arab region.

References

Abrosimova, M., Makushev, A., Litvinova, O., Nesterova, N., Gordeeva, L., Semenova, A., & Tolstova, M. (2020). Green economy: preconditions and directions of development in the agricultural sector. IOP Conference Series. *Earth and Environmental Science*, 433(1), 012038. https://doi.org/10.1088/1755-1315/433/1/012038

Abubakar, I. R., & Dano, U. L. (2019). Sustainable urban planning strategies for mitigating climate change in Saudi Arabia. *Environment, Development and Sustainability*, 22(6), 5129-5152. https://doi.org/10.1007/s10668-019-00417-1

Ahmed, S. A., Al-Jeshi, M. A., & Al-Yousef, K. K. (2022). Produced water reuse enabling circularity in oil operations. *Desalination and Water Treatment*, 263, 60-69. https://doi.org/10.5004/dwt.2022.28223

Alhajj, A. T. (2022). Environmental behavior practice in government agencies: Evidence from Kingdom of Saudi Arabia. *Problems & Perspectives in Management*, 20(1), 262-276. https://doi.org/10.21511/ppm.20(1).2022.22

Ali, M., Hong, P. Y., Mishra, H., Vrouwenvelder, J., & Saikaly, P. E. (2022). Adopting the circular model: opportunities and challenges of transforming wastewater treatment plants into resource recovery factories in Saudi Arabia. *Journal of Water Reuse and Desalination*, 12(3), 346-365. https://doi.org/10.2166/wrd.2022.038

Almadhi, A., Abdelhadi, A., & Alyamani, R. (2023). Moving from Linear to Circular Economy in Saudi Arabia: Life-Cycle Assessment on Plastic Waste Management. *Sustainability*, 15(13), 10450. https://doi.org/10.3390/su151310450

Al-Mawali, N. (2015). Intra-Gulf Cooperation Council : Saudi Arabia Effect. *Journal of Economic Integration*, 30(3), 532-552. https://doi.org/10.11130/jei.2015.30.3.532

Almubarak, S. H., Almass, A. A., Dahlawi, S. M., & AlMuhanna, D. S. (2023). Waste management in primary healthcare centers in Saudi Arabia: a policy analysis. *International Journal of Environmental Health Research*, 1-10. https://doi.org/10.1080/09603123.2023.2214508

Almulhim, A. I., & Al-Saidi, M. (2023). Circular economy and the resource nexus: Realignment and progress towards sustainable development in Saudi Arabia. *Environmental Development*, 46, 100851. https://doi.org/10.1016/j.envdev.2023.100851

Alotaibi, A. R., & Mishra, A. V. (2015). Global and regional volatility spillovers to GCC stock markets. *Economic Modelling*, 45, 38-49. https://doi.org/10.1016/j.econmod.2014.10.052

Alshuwaikhat, H. M., & Mohammed, I. (2017). Sustainability Matters in National Development Visions—Evidence from Saudi Arabia's Vision for 2030. *Sustainability*, 9(3), 408. https://doi.org/10.3390/su9030408

Altouma, A., Bashir, B., Ata, B., Ocwa, A., Alsalman, A., Harsányi, E., & Mohammed, S. (2024). An environmental impact assessment of Saudi Arabia's vision 2030 for sustainable urban development: A policy perspective on greenhouse gas emissions. *Environmental and Sustainability Indicators*, 21, 100323. https://doi.org/10.1016/j.indic.2023.100323

Arai, R., Friant, M. C., & Vermeulen, W. J. V. (2023). The Japanese Circular Economy and Sound Material-Cycle Society Policies: Discourse and Policy Analysis. *Circular Economy and Sustainability*, 4(1), 619–650. https://doi.org/10.1007/s43615-023-00298-7

Bahgat, G. (2016). Lower for Longer: Saudi Arabia Adjusts to the New Oil Era. *Middle East Policy*, 23(3), 39-48. https://doi.org/10.1111/mepo.12215

Chen, D. (2021). China's BRI and Saudi Vision 2030. Review to Partnership for Sustainability. https://doi.org/10.30573/ks--2021-dp016

Dawoud, M. A., Ewea, H. A., & Alaswad, S. O. (2022). The future of wastewater treatment and reuse in Kingdom of Saudi Arabia. *Desalination and Water Treatment*, 263, 127-138. https://doi.org/10.5004/dwt.2022.28217

European Commission. (2015). Closing the loop—An EU action plan for the Circular Economy (COM(2015) 614 final). Brussels: European Commission. Retrieved July 4, 2024, from https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52015DC0614

Halog, A., & Anieke, S. (2021). A Review of Circular Economy Studies in Developed Countries and Its Potential Adoption in Developing Countries. *Circular Economy and Sustainability*, 1(1), 209-230. https://doi.org/10.1007/s43615-021-00017-0

Hamieh, A., Rowaihy, F., Al-Juaied, M., Abo-Khatwa, A. N., Afifi, A. M., & Hoteit, H. (2022). Quantification and analysis of CO2 footprint from industrial facilities in Saudi Arabia. *Energy Conversion and Management*, 16, 100299. https://doi.org/10.1016/j.ecmx.2022.100299

International Monetary Fund (IMF). (2022). World Economic Outlook Database. Retrieved June 30, 2024, from https://www.imf.org/en/Countries/SAU

International Monetary Fund (IMF). (2023). Saudi Arabia's Economy Grows as it Diversifies. Retrieved June 30, 2024, from https://www.imf.org/en/News/Articles/2023/09/28/cf-saudi-arabias-economy-grows-as-it-diversifies

International Trade Administration (ITA). (2024). Saudi Arabia - Waste Management| Trade.gov. Retrieved June 30, 2024, from https://www.trade.gov/country-commercial-guides/saudi-arabia-waste-management

Jubair, S. M. B., & Singh, J. S. K. (2022). Critical Success Factors of Public-private Partnership (PPP) Projects in the Kingdom of Saudi Arabia. *Webology*, 19(1), 1521-1540. https://doi.org/10.14704/web/v19i1/web19102

KAPSARC. (2024). The Circular Carbon Economy Index 2023: Results - KAPSARC. Retrieved July 4, 2024, from https://www.kapsarc.org/research/publications/the-circular-carbon-economy-index-2023-results/

Khorsheed, M. S., & Al-Fawzan, M. A. (2014). Fostering university–industry collaboration in Saudi Arabia through technology innovation centers. *Innovation*, 16(2), 224-237. https://doi.org/10.1080/14479338.2014.11081984

Kopnina, H., & Blewitt, J. (2018). Sustainable Business. In Routledge eBooks. https://doi.org/10.4324/9781315110172

Madkhali, H., Duraib, S., Nguyen, L., Prasad, M., Sharma, M., & Joshi, S. (2023a). A Comprehensive Review on E-Waste Management Strategies and Prediction Methods: A Saudi Arabia Perspective. Knowledge, 3(2), 163-179. https://doi.org/10.3390/knowledge3020012

Madkhali, H., Duraib, S., Nguyen, L., Prasad, M., Sharma, M., & Joshi, S. (2023b). A Comprehensive Review on E-Waste Management Strategies and Prediction Methods: A Saudi Arabia Perspective. *Knowledge*, 3(2), 163-179. https://doi.org/10.3390/knowledge3020012

Mazur-Wierzbicka, E. (2021). Circular economy: advancement of European Union countries. *Environmental Sciences Europe*, 33(1). https://doi.org/10.1186/s12302-021-00549-0

Nizami, A. S. (2024, April 23). Recycling Prospects in Saudi Arabia | EcoMENA. EcoMENA. Retrieved June 30, 2024, from https://www.ecomena.org/recycling-in-saudi-arabia/

Nowicki, P., Ćwiklicki, M., Kafel, P., Niezgoda, J., & Wojnarowska, M. (2023). The circular economy and its benefits for pro-environmental companies. *Business Strategy and the Environment*, 32(7), 4584-4599. https://doi.org/10.1002/bse.3382

Odia, J. O. (2021). Circular Economy and Climate Change in Developing Economies. In Advances in business information systems and analytics book series (pp. 225-238). https://doi.org/10.4018/978-1-7998-6788-3.ch011

Ogunmakinde, N. (2019). A Review of Circular Economy Development Models in China, Germany and Japan. *Recycling*, 4(3), 27. https://doi.org/10.3390/recycling4030027

Rabeiy, R., Almutairi, S., Birima, A., Kassem, L., & Nafady, A. (2023). A Cross-Sectional Study of Knowledge, Practice, and Management of Solid Waste Segregation in Higher Educational Institutes: A Case Study in KSA. *Sustainability*, 15(6), 5516. https://doi.org/10.3390/su15065516

Rezk, M. R., Kapiel, T. Y., Piccinetti, L., Salem, N., Khasawneh, A., Santoro, D., Montagnino, F. M., El-Bary, A. A., Sakr, M. M. 2023. Circular economy in Egypt: an overview of the current landscape and potential for growth. *Insights into Regional Development*, 5(3), 45-57. https://doi.org/10.9770/IRD.2023.5.3(3)

Rizos, V., Behrens, A., Van Der Gaast, W., Hofman, E., Ioannou, A., Kafyeke, T., Flamos, A., Rinaldi, R., Papadelis, S., Hirschnitz-Garbers, M., & Topi, C. (2016). Implementation of Circular Economy Business Models by Small and Medium-Sized Enterprises (SMEs): Barriers and Enablers. *Sustainability*, 8(11), 1212. https://doi.org/10.3390/su8111212

SABIC. (2024). Circular Economy. Retrieved July 3, 2024, from https://www.sabic.com/en/sustainability/circular-economy

Sariatli, F. (2017). Linear Economy Versus Circular Economy: A Comparative and Analyzer Study for Optimization of Economy for Sustainability. *Visegrad Journal on Bioeconomy and Sustainable Development*, 6(1), 31–34. https://doi.org/10.1515/vjbsd-2017-0005

Saudi Vision 2030. (2016). Vision 2030 Pillars. Retrieved June 30, 2024, from https://www.vision2030.gov.sa/en/vision-2030/overview/

Shehri, T. A., Braun, J. F., Howarth, N., Lanza, A., & Luomi, M. (2022). Saudi Arabia's Climate Change Policy and the Circular Carbon Economy Approach. *Climate Policy*, 23(2), 151–167. https://doi.org/10.1080/14693062.2022.2070118

SIRC. (2024). Circular Economy. Retrieved July 3, 2024, from https://sirc.sa/about.html

Smol, M., & Marcinek, P. (2023). Circular economy—the new innovation wave. In Elsevier eBooks (pp. 65–77). https://doi.org/10.1016/b978-0-323-95278-1.00024-3

Sulami, S. A., Sulami, M. A., Nasr, J., & Sharawi, H. (2024). Circular Economy Analysis as a Tool to Enhance Sustainability of Supply Chains in Kingdom Saudi Arabia and a Means to Achieve Saudi Vision 2030. *Modern Economy*, 15(05), 566–586. https://doi.org/10.4236/me.2024.155029

The Economist Intelligence Unit. (2022). In Boosting Circularity Across Saudi Arabia. The Economist Intelligence Unit. Retrieved June 30, 2024, from https://impact.economist.com/perspectives/sites/default/files/08112020_eiu_boosting_circularity_across_saudi_arabia_march_2021.pdf

The National Center for Waste Management. (2024). Retrieved June 30, 2024, from https://mwan.gov.sa/en

Verrips, A., Hoogendoorn, S., Jansema-Hoekstra, K., & Romijn, G. (2019). The Circular Economy of Plastics in the Netherlands. In Education for sustainability (pp. 43-56). https://doi.org/10.1007/978-981-13-9173-6_4

Yusuf, N., & Lytras, M. D. (2023). Competitive Sustainability of Saudi Companies through Digitalization and the Circular Carbon Economy Model: A Bold Contribution to the Vision 2030 Agenda in Saudi Arabia. *Sustainability*, 15(3), 2616. https://doi.org/10.3390/su15032616

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