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POLICY OPTIONS IN ACCELERATING CIRCULAR ECONOMY ADOPTION IN THE GULF COUNTRIES

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Abstract. The transition to a circular economy is a pivotal step for the Gulf Cooperation Council (GCC) countries, given the growing environmental challenges, scarce resources, and the urgent need to diversify economies away from hydrocarbon dependence. This paper presents a comprehensive analysis of policies to accelerate the adoption of the circular economy in the Gulf countries based on a multi-dimensional analytical framework encompassing Social, Technological, Economic, Environmental, and Political (STEEP) aspects. Drawing on consultations with regional experts and specialized researchers, numerous case studies, and global best practices. The study reviews a set of proposed policies to accelerate investment in the circular economy in the Gulf countries. These include various tools such as investment in clean technology, strong political support, and the establishment of circular funds. It also reviews the challenges and outcomes of recycling, stimulates legislation, and reduces traditional consumption patterns. The study also presents a "causal loop diagram" (CLD) highlighting the dynamic interactions and feedback influencing the transition to a circular economy. The findings emphasize the importance of aligning regulatory policies, providing financial incentives, developing circular infrastructure, and enhancing community awareness. The study concludes by proposing six actionable policy options constituting a roadmap tailored specifically to the Gulf context, contributing to integrating circular economy principles into national development strategies. It contributes to the sustainable development literature by proposing realistic and effective policies that enable Gulf countries to lead in circular innovation and low-carbon growth. It further contributes to the growing discourse on sustainable development by offering actionable, context-sensitive policy recommendations for fostering a resilient and circular Gulf economy.

Keywords: Circular Economy; Gulf Cooperation Council (GCC); Policy Options; STEEP; Sustainability

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1. Introduction

The Gulf Cooperation Council (GCC) countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates) face numerous challenges in their economic and environmental development due to their long-

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standing reliance on fossil fuel revenues. This reliance has positioned them as global energy suppliers (Nassar, 2024; Ijaz et al., 2025). However, the finite nature of fossil fuels, coupled with increasing environmental pressures, necessitates reconfiguring their economic models (Abid et al., 2024; Balushi & Yusoff, 2025). As a result of these pressures, these countries have started moving toward a circular economy, although they are still in the early stages, facing structural, cultural, and political barriers (Binsuwadan et al., 2023). The circular economy has become a new and inspiring approach to sustainable development. Rather than sticking to the old linear economic model of "take, make, dispose" that has ruled industrial societies for ages, the circular economy seeks to create a regenerative system where the resources are reused, recycled, and repurposed to cut down on waste, boost efficiency, and preserve economic value over time (Corona et al., 2019; Hartley et al., 2023).

The circular economy concept attracts the increasing attention of governments, scholars, companies, and citizens as a necessary step to achieve sustainable development (Ghisellini et al., 2015; Rezk et al., 2024). With the rapid economic growth of GCC, rising populations, and increasing environmental concerns, there has been a noticeable shift towards more sustainable practices, including the embrace of the circular economy (Al-Saidi et al., 2021; Shiva, 2024). The circular economy has emerged as a new approach geared toward achieving sustainable development, serving as an alternative to the old linear economic model of "take, make, dispose" that dominated industrial societies for ages (Stahel, 2016). This involves extracting raw materials, using them to manufacture products, and selling them to consumers, who discard them as waste after a single use. This is a polluting system that leads to the degradation of natural ecosystems and resource scarcity, and it is a driving force behind global challenges such as climate change and the loss of biodiversity (Torcătoru et al., 2022; Abdirahman et al., 2025)

The circular economy differs from linear economic systems by adhering to three core principles: eliminating waste and pollution, extending the use of materials, and regenerating natural ecosystems. Practical applications of these principles include extending product lifecycles, remanufacturing, and promoting sharing economies (Komyshev et al., 2024; Imtihan et al., 2025) This model focuses on retaining resources in the economy for as long as possible and minimizing waste generation by designing long-lasting, durable, repairable, and upgradeable products. It also involves remanufacturing using secondary raw materials and waste extracted from existing products, recycling them into new products, disassembling worn-out items, repairing them, and reintroducing them to the market, ultimately extending their lifecycle, preserving raw materials, and creating added value (Raksha, 2025). This added value benefits producers by reducing the cost of purchasing raw materials for new products, even if more materials are used to make the products more durable. For consumers, the benefit lies in accessing goods at lower prices. Environmental and societal benefits include reduced greenhouse gas emissions, decreased waste, and the restoration of ecosystems. Recently, the concept of the circular economy has gained growing attention from governments, scientists, businesses, countries, and citizens as a necessary step toward achieving sustainable development (Rezk et al., 2024; Wang et al., 2024).

Many countries have adopted specific circular economy strategies and have developed numerous plans and programs to encourage participation in the circular economy and move away from the linear model (De Lange, 2024; Wang et al., 2024). Amid rapid economic growth, population increase, and rising environmental concerns, a noticeable shift has emerged in the Gulf countries toward more sustainable practices, including adopting the circular economy (Andersson et al., 2023). According to the 2019 World Government Summit report, the GCC countries can achieve savings of $138 billion by 2030 if they adopt circular economy models, roughly equivalent to 1% of the cumulative GDP of the GCC countries from 2020 to 2030. The report also confirmed that under the current traditional economic model followed by Gulf countries, there would be an accelerated depletion of resources and the generation of unprecedented levels of waste and emissions, resulting in social, economic, and environmental damage (Anouti et al., 2019).

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The Gulf Cooperation Council (GCC) countries face many challenges that could hinder their transition to a circular economy. The rapid urbanization in Gulf cities, with an 85% increase in the urban population (Arif & Aldosary, 2023), is leading to a significant rise in waste generation rates. In some Gulf countries, such as Qatar and Kuwait, waste rates exceed 1.5 kg per capita per day, burdening waste management systems heavily (Mariyam et al., 2024). Additionally, the Gulf countries suffer from water scarcity, increasing reliance on desalination, an energy-intensive process that pressures natural resources (Saif et al., 2014). One of the factors complicating the adoption of a circular economy is the heavy reliance on migrant labour in these countries, which requires energy subsidies averaging $140 billion annually in the Gulf (Sanfilippo et al., 2024), along with the lack of investment in necessary recycling infrastructure, as less than 10% of municipal waste is recovered (Ibrahim et al., 2022).

Despite many challenges, the GCC countries have several opportunities that could contribute to accelerating the adoption of a circular economy. One such opportunity is the significant investments made by the Gulf countries in clean technologies, such as renewable energy and advanced recycling, with investments in this sector expected to reach $250 billion by 2025 (Alnaser & Alnaser, 2011). Moreover, the youth population in the GCC, which constitutes 70% of the population under the age of 30, represents a major source of innovation and expresses growing demands for sustainability, indicating significant potential for developing circular economy practices (Binsuwadan et al., 2023). Various studies, such as those analyzed by Ateba and Enwereji (2024), Doshi (2023), and Mason (2023), emphasize the continuing role of hydrocarbons in the economies of GCC countries despite increasing efforts toward economic diversification. Many studies highlight how oil and gas revenues continue to shape the region's political economy, creating a delicate balance between global decarbonization pressures and domestic economic demands. Oil and gas, more or less still being the main factors shaping economic policies, call for adaptive strategies to join renewable energy policies with geopolitical and economic contexts unique to the Gulf regions.

As one of the great petrochemical players in the Gulf, SABIC, in Saudi Arabia, is set to effectively mirror and map out a government road towards carbon neutrality come 2021, with 2050 as the target date. Energy efficiency, renewable energy, electrification, carbon capture, and green and blue hydrogen are included among the pathways. Like this, Aramco has recently introduced several initiatives to create a framework for a low-carbon circular economy and develop technological capabilities for carbon dioxide capture and geologic storage. Emissions have been converted into added value by capturing carbon dioxide and blending it with hydrocarbon feedstock to create clean, high-value products in the consumer and industrial sectors (Jodai et al., 2024). In Bahrain, several initiatives have been adopted to achieve short-term goals of reducing emissions by 2035 and achieving carbon neutrality by 2023. Bahrain also aims to achieve a circular carbon economy by 2060. Since 2009, Bahrain has established a BHD 52 million carbon dioxide recycling plant to convert it into economic products. This plant recovers 450 tons of carbon dioxide per day from the chimneys of the Gulf Petrochemical Industries Company, which is used to enhance methanol production by 80 tons per day (Sumra et al., 2025).

Meanwhile, the United Arab Emirates has launched the Circular Economy Policy 2021-2031, a comprehensive framework that outlines the country's approach to achieving sustainable management and efficient use of resources by adopting consumption and production methods and technologies. Another important project is the establishment of the UAE Circular Economy Council, which is primarily responsible for developing a mechanism for implementing circular economy policies, adopting performance indicators, encouraging private sector participation, promoting and developing studies and research, and enhancing international cooperation (Yasmin et al., 2023; Lara et al., 2025).

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Qatar also works to guide the circular economy principles in line with Vision 2030. The Integrated Waste Sorting and Recycling Program and the Second National Development Strategy encourage using approximately 20% recycled materials in construction projects and waste as fuel, the first project of its kind in the GCC. The country currently produces about 30 megawatts of electricity at its solid waste treatment centre. Like other GCC countries, Qatar's population is concentrated in cities and is expected to reach about 90% by 2050 (Earthna, 2023). Qatar has invested in building cities and regions that embrace the circular economy concept, such as Lusail and Msheireb Downtown Doha, as part of its sustainability plans. The Supreme Committee for Delivery & Legacy in Qatar estimated that around 2,000 tons of waste removed from the 2022 World Cup stadiums were recycled, 80% of which was recycled. At the same time, 90% of the waste from one stadium was used in constructing the new stadium itself (Invest Qatar, 2022).

The CE initiatives in Oman, under the direction of the Oman Environmental Services Holding Company, offer 12 investment opportunities in waste management and circular economy, amounting to OMR 528 million. These projects will create an electronic waste recycling program, a waste-to-energy facility, and recycling motor oils, glass, copper, and used cooking oils (Oman Observer, 2022). In addition, Kuwait commits to becoming carbon neutral by 2060 and seeking carbon neutrality in the oil and gas sector by 2050. More needs to be done to transition to a circular economy that sustains the environment and economy, with the number of circular economy plans, initiatives, and programs in the GCC (Adebayo et al., 2024). This paper aims to examine the current status of the circular economy in the Gulf countries by analyzing the challenges they face, reviewing global best practices in this field, and presenting a set of policies and measures that can effectively contribute to accelerating the implementation of circular economy practices and achieving environmental and economic sustainability in these countries.

2. Methodology

This research utilizes a qualitative methodological framework to evaluate and design policies that will promote the circular economy in the GCC. The research design uses a literature review, expert interviews, and stakeholder workshops to utilize what is known. The literature review provides the foundation to explore global circular economy practices and their relevance for developing policies in the GCC. To ensure suitability for each policy, various stakeholders, including environmental NGOs, academics, and community representatives, were consulted to gain firsthand information about barriers, opportunities, and actors' roles in catalyzing the transition to a circular economy in the GCC. Data analysis is a two-part, interrelated process: a STEEP analysis and Causal Loop Diagram (CLD) development, which are all systematic ways of analyzing the circular economy situation in the GCC and informing policy. The STEEP (Social, Technological, Economic, Environmental, and Political) analysis framework was employed to analyze qualitative data from interviews, workshops, and the literature review.

The results from this multi-dimensional analytical approach constituted five domains or pillars for reporting purposes: social (i.e., cultural attitudes and societal awareness), technological (i.e., clean technology adoption), economic (i.e., transition costs and large investments), environmental (i.e., waste streams and resource scarcity), and political (i.e., regulatory frameworks and policy momentum). The analysis makes it possible to assess instruments for sustainable energy adoption in the GCC critically. Using the above-outlined documented analysis, a comprehensive causal loop diagram (CLD) was generated that captured balancing and reinforcing feedback loops, including policy momentum and transition costs. The CLD is used to visualize and visualize the dynamic interconnections across the STEEP domains and to demonstrate opportunities for policy intervention at critical anchors about data. Finally, based on this documentary analysis, the research presents specific policy recommendations contextualized for the Gulf and reviewed by key experts.

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3. STEEP analysis of circular economy in Gulf countries

STEEP analysis is a strategic tool used to assess the external factors affecting the circular economy in Gulf countries. It encompasses social, technological, economic, environmental, and political dimensions. This analysis provides an understanding of the opportunities and challenges of adopting a circular economy in the GCC.

3.1. Social factors

The countries in the Gulf region have been growing their populations over time, as shown in Figure 1, with consistent and significant growth in the GCC countries from 2005 to 2023. Based on World Bank data, Saudi Arabia and the UAE have maintained the largest absolute populations, roughly 35.4 million and 9.9 million, respectively, in 2023. Indeed, Qatar and the UAE have also demonstrated the steepest relative increases from the 2005 level; Qatar grew its population from 0.8 million to 2.9 million (over 3 times larger), while the UAE increased its population from 4.1 million to 9.9 million, more than doubling its 2005 figure. The GCC areas grew from around 35.7 million in 2005 to over 58.5 million in 2023, or a 64% increase in just under 20 years. This demographic increase is mainly attributable to labour migration, with expatriates making up over 85% of the UAE's population and 89% in Qatar (WorldBank Data, 2024). Such diverse demographics bring varied consumption patterns and levels of environmental awareness that will affect the adoption of circular economy (CE) actions.

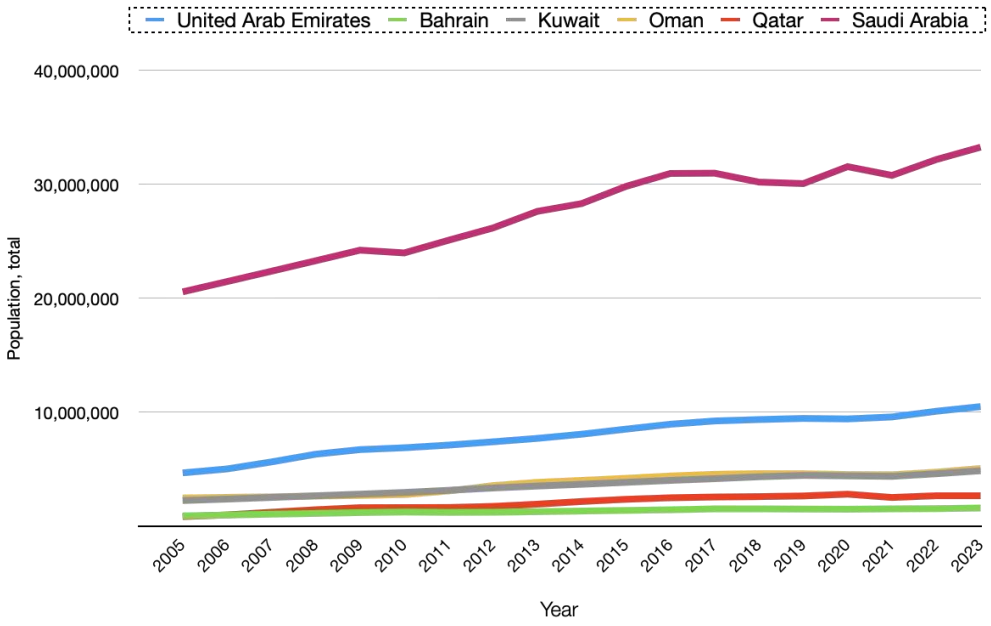

Figure 1. Population Growth of Gulf Countries
Source: GCC-Stat, 2022

Population growth will continue to place increasing demands on resource consumption and waste systems. In 2022, household waste was a significant proportion of municipal solid waste in the GCC. Based on official data (GCC-Stat, 2024), it was estimated that the residential sector generated approximately 31.4 million tons of non-hazardous waste, approximately 75% of the total non-hazardous waste generated in the region. As shown in Table 1, GCC countries' per capita household waste generation rate varied considerably, with an average estimated

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generation rate of 1.0 kg and 1.8 kg per capita per day in 2022. Oman had the steepest per capita contribution from households at around 1.5 kg per capita per day, which reflects high consumption behaviour and a strong opportunity for circular effects interventions. Saudi Arabia and the UAE had reductions in per capita household waste generation from 2017 of 16.9% and 17.5%, respectively, indicating that national household waste generation reduction campaigns and efforts to shift the awareness of consumer behaviour are starting to show results.

In comparison, Bahrain and Oman saw the per capita household waste generation increase by 20% or more. These trends emphasize the need to shift towards a circular economy, which targets household behaviour, enhances waste separation at source, and nurtures a culture of reuse and repair. The data is also encouraging by demonstrating that some countries are making the right strides, showing that the right interventions can bring about real and quick change in implementing circular economy principles at the societal level.

Table 1. Per Capita Household Waste Generation in GCC Countries (kg/day)

Country	2017 (kg/day)	2022 (kg/day)	Change (%)	Trend
Kuwait	1.1	1	-0.052	Decrease
Bahrain	1	1.1	0.21	Increase
Oman	1	1.2	0.204	Increase
UAE	1.6	1.3	-0.175	Decrease
Qatar	1.2	1.4	0.072	Increase
Saudi Arabia	2.1	1.8	-0.169	Decrease

Source: GCC-Stat, 2024

3.2. Technological factors

Waste-to-Energy (WtE) technology development is critical to circular economy strategies in the GCC. Table 2 shows that the UAE, Saudi Arabia, Kuwait and Oman have committed a sizeable amount of funds to convert municipal waste into clean energy through WtE projects. For example, the Al Warsan plant in Dubai, one of the largest operational WtE plants across the region, can process municipal waste at a capacity of 1,825 kt/year and is equipped with 185 MW of installed power. Sharjah, Abu Dhabi and Kuwait also have WtE projects which range in power levels from 30 – 100 MW, demonstrating the ongoing capability of the respective technologies. There is also the demonstration of continuing momentum within Oman, whose 50 MW WtE facility opened in 2023, and Saudi Arabia has set an overall national objective of 3000 MW of WtE by 2030, which indicates a longer-term objective regarding technological advancement with the efforts of the Vision 2030 and Circular Carbon Economy regulations. These projects also highlight the advancement of technology readiness and a shift away from landfills into energy recovery. Advancement that can positively impact waste management objectives and emissions reduction initiatives.

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Table 2. Waste-to-energy projects in Gulf Cooperation Council (GCC) countries

Country	Project	Capacity (kt/year)	Installed Power Capacity (MW)	Cost (Million USD)	Operational Year
UAE	Sharjah	300	30	220	2020
	Sharjah (Sajja area)	400	80	–	–
	Ras Al Khaimah	–	2	32	–
	Dubai (Al Warsan)	1825	185	545	2020
	Abu Dhabi	–	100	850	–
Bahrain	Askar	390	25	480	–
Kuwait	Kabd	1195	100	756	–
Oman	–	803	50	750	2023
Saudi Arabia	National Target (2030)	–	3000	–	2030 (target)

Source: Alsabbagh (2019)

3.3. Economic factors

The Gulf Cooperation Council (GCC) economies actively diversify to minimize their dependence on oil revenue, reinforcing their circular economy ambitions. In 2023, the growth rate of the non-oil sector of the economy grew by 3.3%, while the oil sector declined by -4.8% due to OPEC production cuts. This change reflects a growing concentration on developing sectors such as manufacturing, tourism, and services, which are all relevant for embedding circular economy practices. As depicted in Figure 2, the GCC has showcased a lot of volatility in GDP growth from 2014 to 2022, especially during the pandemic period in 2020, when the GCC faced a severe contraction of -4.8%. However, the economic resilience and recovery of the region are exemplified by the robust GDP rebounds of 3.5% in 2021 and 7.0% in 2022 (GCC-Stat, 2024).

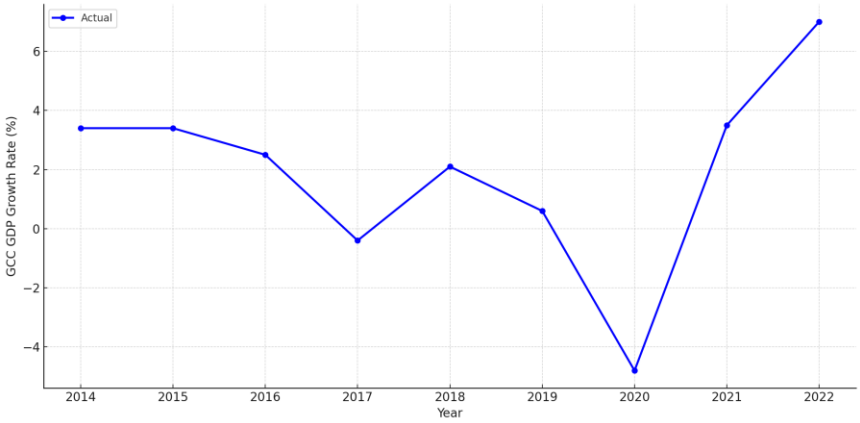

Figure 2. GCC GDP Growth Rate at Constant Prices (2014–2022)
Source: GCC-Stat, 2024

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As shown in Figure 3, Gulf countries such as Saudi Arabia, UAE, Kuwait, and Qatar provide energy subsidies—primarily for oil, gas, and electricity. For example, Saudi Arabia allocates almost 90 billion USD of funding, with most subsidies on gas and electricity. Although Kuwait has a much smaller economy relative to Saudi Arabia, it is a meaningful contributor to the theme of energy subsidies, demonstrating that energy subsidies, when reviewed from a national economic perspective, represent around 9% of Kuwait's GDP, which is meaningfully high under the context of its economy (IEA, 2023), These subsidies are a cost to the national budget, and they are a barrier to efficiency and moving toward sustainability. Energy subsidies not only hide the actual comparative cost of energy in the economy; they suppress research and development of innovations and the private sector's interest in investigating alternative and circular economy options or solutions. Reducing energy subsidies from the national budget and re-investing this funding into circular economy interventions like renewable energy, waste-to-energy projects, water reuse, and sustainable manufacturing can cultivate long-term economic resiliency.

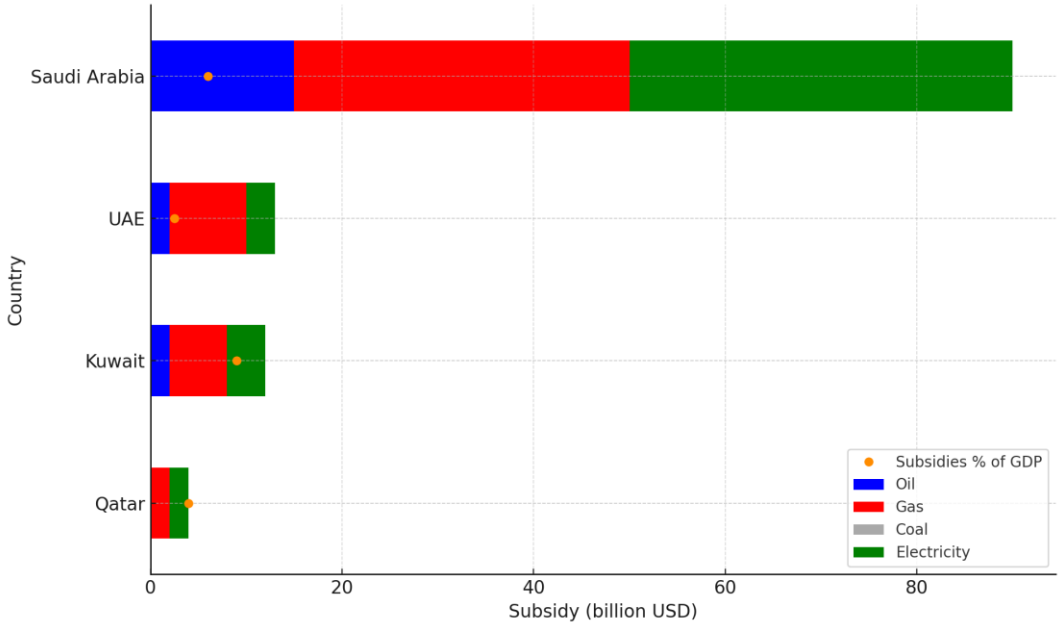

Figure 3. Energy Subsidies in Gulf Countries
Source: IEAm 2023

3.4. Environmental factors

Waste recycling performance is a critical indicator of environmental progress in transitioning to a circular economy. According to the most recent data, GCC countries exhibit substantial disparities in their recycling rates of non-hazardous waste (Figure 4). In 2022, the United Arab Emirates led the region by a wide margin, with 94.5% of treated non-hazardous waste processed through recycling, a significant jump from 83.6% in 2020. This illustrates the considerable investment made by the UAE in terms of infrastructure related to waste treatment operations, as well as policy-based diversion activities. At the same time, other GCC countries either showed a flat line or a steep decrease. For example, Saudi Arabia's recycling rate decreased from 6.7% in 2020 to 1.3% in 2022, and Kuwait from 6.7% to 2.1%. Qatar, Bahrain, and Oman had rates less than 1.5% in 2022 (GCC-STATa), which shows a clear need for improved integrated waste management systems, public-private recycling partnerships, and a national diversion target to recover materials.

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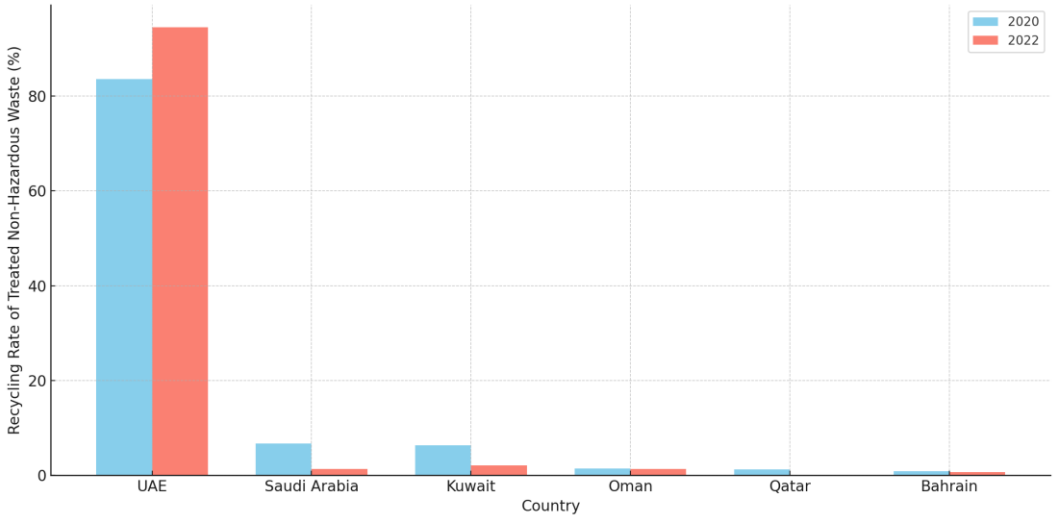

Figure 4. Recycling Rates of Non-Hazardous Waste in GCC Countries (2020 vs 2022)
Source: GCC-Stat, 2024

Despite the high aspirations for sustainability policies, the amount of renewable energy consumed for energy across the GCC is exceedingly low. At best, renewables provide just 1.4% of total final consumption energy across the GCC. This indicates that the region continues to rely on fossil fuels for energy and a pressing need to increase investments in clean energy infrastructure substantially. As displayed in Table 3, the current use of renewables remains low. Bahrain (0.04%), Kuwait (0.2%), Qatar (0.5%), and Saudi Arabia (0.8%) fall into the lowest range of the scale; however, several GCC countries have publicly stated they have strong ambitions for renewables to be part of their total energy portfolio by 2030, such as Saudi Arabia's goal of 50%, and UAE's goal of 30%. Although these broad national goals suggest some will shift towards greener systems, the UAE is the first Gulf state to implement a climate policy direction with a 7.0% renewable share in 2022. The rates of renewable energy consumption and broader climate ambitions are also inconsistent in terms of climate ambitions that link closely to net-zero commitments. Countries, for the most part, begin their net-zero commitments by pledging carbon neutrality levels by 2050 or 2060, with Qatar as the only GCC country that is without a formal net-zero or carbon-neutral timeline, indicating a real gap in space going forward for long-term climate plans.

Table 3. Renewable Energy Share, Targets, and Net-Zero Commitments in the GCC

country	Renewable Share 2022 (%)	Target for 2030 (%)	Net-Zero Commitment
Saudi Arabia	0.80%	50%	2060 (in policy)
UAE	7.00%	30%	2050 (in policy)
Oman	1.60%	30%	2050 (in policy)
Qatar	0.50%	20%	No target
Kuwait	0.20%	15%	2060 (pledge)
Bahrain	0.04%	10%	2060 (pledge)

Source: Sanfilippo et al., 2024

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Transitioning to renewable energy is critical from a circular economy viewpoint. It represents the foundational energy model necessary for decarbonizing supply chains, energizing low-emission industries, and allowing for circular manufacturing and distribution. The significant gap between the 2022 baseline and the targets set for 2030 reflects the lack of rigorous deployment, policy implementation, and regionally-convened effort needed to translate commitments into tangible outcomes and realize the full benefits of circular systems.

3.5. Political factors

Gulf Cooperation Council (GCC) member countries increasingly align their national development agendas with circular economy principles to improve sustainability and encourage regional economic diversification. National plans, such as Saudi Vision 2030, Qatar National Vision 2030, and Oman Vision 2040, specifically include circular economy objectives to convey a regional pivot away from resource-heavy linear economics and towards a multi-dimensional approach to sustainability.

The United Arab Emirates' Circular Economy Policy 2021–2031 and the Circular Carbon Economy proposition presented by Saudi Arabia when it was president of the G20 group of the world's most economically powerful nations articulate a strong political commitment to develop a foundation for a circular economy as part of long-term development. In the UAE, programs like the National Sustainable Consumption and Production Plan (2019-2030) and the Scale 360 initiative developed in conjunction with the World Economic Forum exist, and some of the GCC programs also mention collaboration and innovation, public-private partnerships, and efficiency in energy, food, and manufacturing systems. Additionally, in Saudi Arabia, which has a clear National Waste Management Strategy, the Vision 2030 reform framework outlines the strategy's goal to divert 82% of waste from landfills to other uses, including composting and circular production, with buy-in from the Saudi Investment Recycling Company (SIRC) and National Center for Waste Management (MWAN). The National Waste Management Strategy was also recently updated in 2020.

Other Gulf countries are also taking steps; Bahrain established a CO_2 recycling plant and set long-term carbon neutrality targets. Kuwait is establishing net-zero commitments by sector. Qatar is integrating circularity into national infrastructure plans. Oman spearheads sustainable industrial change through Vision 2040 (Adebayo *et al*., 2024; Sumra *et al.,* 2025). In addition to OmanVision 2040, planned investments of $250 billion in clean and circular technologies in the GCC are also anticipated by 2025 (Alnaser & Alnaser, 2011). While there has been expansion in these areas, it is essential to note some challenges.

These challenges include the fragmented regulatory enforcement mechanisms, the pushback of institutional inertia, stakeholder reluctance, and the continued expansion of oil-based revenue aspirations (Doshi, 2023; Mason, 2023). Overall, these are positive developments with different sources of policy shifts across the Gulf region toward a more circular, low-carbon future economy. However, the positive effect of these initiatives will depend on sustained investment and cross-border alignment.

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4. Circular economy transitions in the GCC: a causal loop analysis of systemic drivers and barriers

This research reflects the system dynamics associated with the Gulf Cooperation Council (GCC) transition to a circular economy (CE), as presented in Figure 1. This figure aids in capturing the different interrelated factors, feedback loops, and external circumstances that affect the pace and direction of CE in the GCC. Important variables that are incorporated into the system dynamics models include resource efficiency (or maximize output to minimize input), waste (or total waste creation from industrial, commercial, and domestic activities), recycling infrastructure (or facilities to sort and/or process materials), and policy support (or regulations to support CE) Beyond the variables we discussed, we also want you to think about other key factors, such as public awareness, economic diversification, investment in green technology, reliance on oil, transition costs, and market demand in the global marketplace.

The three reinforcing loops (R) frame the acceleration element. R1 (Policies & Infrastructure Growth) shows us how strong policy support leads to greater investments in recycling infrastructure, directly increasing resource efficiency and reducing waste. This further justifies more policy support in the future, particularly under Saudi Vision 2030 or the UAE's Circular Economy Policy 2021-2031. R2 (Awareness and Participation) outlines how public education initiatives increase participation rates in recycling initiatives, improving waste reduction efforts and monitoring efficiency while increasing awareness, for example, Qatar's waste management programs. R3 (Economic Diversification and Green Tech) explains how diversification approaches promote green tech investment, creating efficiencies and revenues that further justify the need for diversification. The Masdar initiative in the UAE and the ambitious green hydrogen strategy in Oman are particularly noteworthy movers in this loop.

Conversely, there are three key balancing loops (B) that function to undermine this phase of sustainability transitions. B1 (Oil Dependency Resistance) illustrates how dependency on fossil fuel exports dampens the appetite for investments in CE, reducing available resources for action and slowing infrastructure development, particularly in Kuwait and Bahrain. B2 (Cost of Transition) highlights the high upfront costs associated with investments in infrastructure and training that inhibit action on policies that attempt to incentivize investment and, thus, on stagnation and waste continuing to occur, particularly in countries with limited budgets. Finally, B3 (Weak Global Market Pull) captures how the weak global demand for sustainable products from the GCC weakens incentives to innovate and develop green infrastructure and ostensibly strengthens economic reliance on oil.

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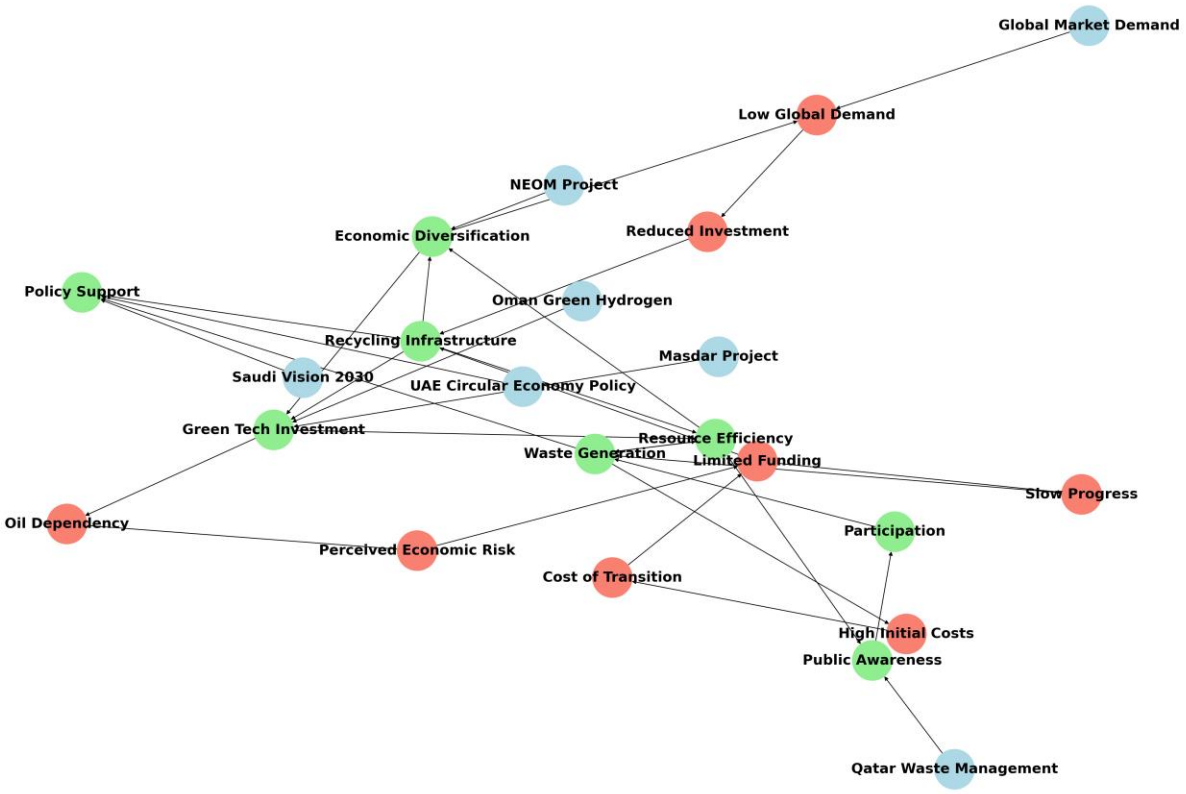

Figure 5. A causal loop analysis of systemic drivers and barriers

Figure 5 shows these loops do not exist in a vacuum—they operate within a complicated, dynamic system of interacting forces. Reinforcing loops such as R1 and R3 could offset balancing forces operating against national development visions. Challenges such as B2, however, will remain in place until addressed by upfront market valuation subsidies or international partnerships. A leverage point is public education/engagement (reinforcing loop R2) and global engagement into new green market opportunities to offset B3. Regionally, GCC states like UAE and Saudi Arabia show greater prospects to navigate these dynamics given the momentum around economic diversification than Kuwait or Bahrain, which are navigating more stifling structural constraints. Ultimately, the GCC transition to a circular economy is directed by a non-linear, interacting matrix of forces. Progress can be made through amplifying positive feedback mechanisms for policy, public engagement, and innovation and targeting to limit systemic backlash (tied to economic demand). Plans must be holistic and context-specific to shift the status quo toward systemic sustainability.

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5. Policy options to accelerate the adoption of circular economy in Gulf countries

As Gulf countries grapple with increasing environmental challenges such as diminishing natural resources, waste management problems, and increased carbon emissions, a clear opportunity exists to pursue sustainable economic development via a circular economy approach. A circular economy minimizes the reliance on finite resources and promotes the development of innovation, jobs, and environmental protection. The following six policy options provide a pathway to enhance and speed up the adoption of circular economy policies in the GCC, where each policy option will cover an overview of the policy action, description of policy action, main key players to employ the policy, and best practice for each policy option.

5.1. Policy option # 1: strengthen regulations on waste management and recycling

This policy proposes a comprehensive framework of regulatory and incentive measures. It suggests that Gulf governments set ambitious recycling targets, including a minimum recycling rate of at least 50% by 2030, with higher allocations for priority materials, such as plastics (60%), e-waste (75%), and metals (85%). These targets are coupled with an integrated Extended Producer Responsibility (EPR) system that requires Gulf manufacturers to take full responsibility for the lifecycle of their products, including post-consumer products, with progressive fees imposed on non-recyclable materials and deposit systems for packaging. The policy also includes a timeline for phasing out single-use plastics in the Gulf region, starting with a complete ban on plastic bags by 2030 and ending with a ban on all non-recyclable packaging by 2032.

To incentivize vendors, fines of up to 10% of sales will be imposed on violators, and certifications of excellence and financial incentives will be granted to compliant facilities. The incentive package includes financing up to 30% of the costs of recycling systems, tax exemptions of up to 25%, and preferential treatment for these types of projects in government tenders. The supportive incentive package includes financing up to 30% of recycling systems costs, tax exemptions of up to 25%, and favourable treatment of these projects in government tenders. This policy anticipates a positive impact of 40% reduction in municipal waste volume and 60% reliance on landfills (i.e., disposal) while creating 100,000 new jobs in the circular economy sectors by 2030. Table 4 includes policy measures for the implementation of this option.

Table 4. Main policy actions for strengthening regulations on waste management and recycling policy

Policy Action	Description of policy action	Main Key Players	Best Practice
Enforce Mandatory Extended Producer Responsibility (EPR) Laws	Enforcing Mandatory Extended Producer Responsibility (EPR) laws means requiring producers to take full responsibility for the environmental impact of their products throughout their entire lifecycle.	Governments, Manufacturers, Waste Managers	In the European Union, Extended Producer Responsibility (EPR) is enforced through key laws like the Waste Electrical and Electronic Equipment (WEEE) Directive (2012/19/EU) and the Packaging Waste Directive (2018/852/EU), both aimed at boosting recycling and holding producers accountable for their product's end-of-life impact. (Elisabetta Ceroni, 2024).
Set and Enforce Material-Specific Recycling Targets by 2030	The governments will define clear recycling goals for different waste types—60% for plastics and 75% for e-waste—to be achieved by 2030.	Municipalities, Industry Associations	The European Union has established ambitious recycling targets to advance its circular economy objectives. Under the Waste Framework Directive, member states must recycle or prepare for reuse at least 60% of municipal waste by 2030 and 65% by 2035. Additionally, the Packaging and Packaging Waste Directive sets a target to recycle at least 70% of all packaging waste by 2030. (Domenech & Bahn-Walkowiak, 2017)

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Policy Action	Description of policy action	Main Key Players	Best Practice
Introduce deposit return schemes for bottles/containers	Implement a system where consumers pay a small deposit when purchasing beverage bottles or containers, which is refunded when they return the empty packaging.	Governments, Retailers, Beverage Companies	Norway's bottle deposit scheme has achieved a 97% recycling rate for plastic bottles, setting a global benchmark for effective circular waste management (Rachel Cooper, 2018)
Implement a Ban on Single-Use Plastics (bags by 2025, all non-recyclables by 2032)	Introducing legislation to phase out plastic bags by 2025 and eliminate all non-recyclable single-use plastics by 2032.	Environment Agencies, Retailers	Through a phased ban approach, France reduced plastic bag usage by 85% over five years (2015–2020), showcasing how gradual regulation paired with public education can effectively drive sustainable behaviour change. (Cowan et al., 2021)

5.2. Policy option #2: incentivize circular business models through financial tools

This policy proposes a comprehensive package of financial instruments to address the unique demands faced by the industrial and commercial sectors of the Gulf countries. These include a multi-tier tax exemption structure starting at 15% for companies that implement minimum sustainability requirements, with the exemption level gradually increasing to 30% for top-tier companies that achieve excellence in sustainable design (e.g., using at least 80% recycled material or using design principles that achieve zero waste rates in manufacturing). The policy also proposes to establish a regional circular finance fund to provide necessary cash liquidity for the transition to circular economy business models, with an acceptable initial capitalization of not less than $1 billion. The fund could provide a broad package of financing products (like zero-interest loans for up to five years aimed at project launches that recycle waste into commodities) and possibly government guarantees of up to 60% of the total loan amount in support of the work of commercial banks in the relevant economic sector. The fund would also include a special credit line to support new and existing small and medium-sized enterprises needing circular economy transition financing with reduced guarantees.

Finally, in support of significant investments, the policy would require a "smart green bond" product offering that strictly relies on blockchain technology to ensure total transparency in tracking environmental impact documents.20% of the proceeds will be allocated to establishing regional centres of excellence specializing in developing advanced solutions for recycling complex and composite materials, such as carbon fibre and demolition waste. The policy allocates a package of applied research grants ranging from $500,000 to $1 million for universities, research centres, and startups developing revolutionary business models in the circular economy to stimulate innovation. Continued funding requires knowledge sharing and technology transfer to at least five local companies. Table 5 shows the policy actions needed to apply this policy option.

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Table 5. Policy actions for incentivizing circular business models through financial tools policy

Policy Action	Description of policy action	Main Key Players	Best Practice
Introduce Tiered Tax Exemptions (15-30%) for Circular Economy Initiatives	Providing tax benefits at different levels based on a company's circular performance, such as using recycled materials, designing recyclable products, or reducing waste to incentivize businesses to adopt more sustainable and circular practices.	Governments, Tax Authorities, Corporations	Sweden has successfully implemented a tax deduction scheme for repair services, allowing individuals to claim 50% of labour costs (up to €2,500 annually) as a deduction from taxable income (Orange, 2017)
Establish a Circular Economy Fund	Creating a dedicated financial resource to support circular economy initiatives	Central Banks, Investors	Australia's BG Planet Ark Circular Future Fund is spearheading the nation's transition to a circular economy with an ambitious $1 billion funding target by 2030. (Hollands, 2025)
Launch Blockchain-Tracked Green Bonds	Issuing green bonds (a bond where the funds are used exclusively for environmentally friendly projects) and tracking them using blockchain technology.	Financial Institutions, Tech Firms	By the end of 2022, EU general governments had issued green bonds totalling €266 billion in face value, representing 1.7% of the EU's GDP (Eurostat, 2023).
Allocate a Specific Percentage of Government Procurement to Circular Products	Allocate a fixed percentage of government procurement budgets to circular products to promote sustainable markets and support the circular economy.	Governments, Procurement Agencies, Suppliers	Amsterdam invested €150 million in circular procurement, with 32 municipalities and two regional governments pledging to progressively adopt circular purchasing—targeting 10% by 2022, 50% by 2025, and full implementation in the future (OECD, 2020).

5.3. Policy option # 3. Create Public-Private Partnerships for infrastructure development

This option is based on a strategy to build an integrated circular economy infrastructure through effective public-private partnerships in the Gulf countries. The first step is to create a network of waste-to-energy (WTE) plants utilizing advanced technologies such as thermal gasification and pyrolysis that convert waste into renewable energy with an efficiency of up to 80% while eliminating harmful emissions by up to 95%. It also requires the development of advanced recycling facilities using artificial intelligence and robotics to sort electronic, plastic, and textile waste with an accuracy of up to 95% and creating integrated material recovery facilities (MRFs) to recover and recycle valuable materials.

These initiatives would be funded using new financing options like build-operate-transfer (BOT) contracts with tax and customs incentives for participating companies to build and operate the plants. Performance standards must be established to ensure each new facility/plant meets the operational quality and efficiency standards. Table 6 identifies the policy measures required to develop this policy option.

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Table 6. Policy actions to create Public-Private Partnerships for infrastructure development policy

Policy Action	Description of policy action	Main Key Players	Best Practice
Establish Waste-to-Energy Plants with 80% Efficiency	Convert non-recyclable waste into electricity or heat, reducing landfill use and supporting sustainable energy generation.	Governments, Energy Companies, Municipalities	In Korea, replacing coal with municipal solid waste for electricity generation has led to a notable reduction in carbon dioxide emissions, estimated at around 230,000 tons (Cui et al., 2024).
Develop AI-Powered Recycling Facilities for Enhanced Efficiency	Developing AI-powered recycling facilities means using artificial intelligence to automate the sorting and processing of waste.	Tech Providers, Waste Sector	ZenRobotics, based in Finland, utilizes AI-powered robots to sort industrial and construction waste, significantly enhancing the efficiency and quality of recycled materials. (ZenRobotics, 2025)
Create Industrial Symbiosis Parks for Advancing Circular Economy	Creating industrial symbiosis parks involves clustering businesses together so that the waste or by-products of one company become resources for another.	Industry Clusters, Planners	The eco-industrial park in Kalundborg, Denmark saves the city €24 million annually while reducing 635,000 tons of CO_2, conserving 3.6 million m^3 of water, saving 100 GWh of energy, and eliminating 87,000 tons of solid waste (engieimpact., 2025).
Establish Material Recovery Facilities through BOT Contracts	Establishing material recovery facilities via BOT (Build-Operate-Transfer) contracts involves private companies designing, building, and operating waste recovery facilities for a set period, after which ownership is transferred to the government.	PPP Contractors and Investors	The Xiamen MSW plant in China operates under a Build-Operate-Transfer (BOT) agreement between Alee and the Xiamen Municipal Government. Alee invested RMB 206 million and will operate the facility for 25 years, processing 500 tons of municipal solid waste daily, with payments based on the actual waste handled. (TOMRA, 2016)

5.4. Policy option # 4. Establish circular economy innovation hubs

The policy takes a comprehensive strategy to stimulate innovation and entrepreneurship. Several regional innovation centres are being created to build a circular economy across UAE, Saudi Arabia, and Qatar. These centres aim to develop leading-edge technologies that focus on recovering resources from waste and developing sustainable alternative materials throughout the region, particularly plastic and electronic waste issues. The Gulf Cooperation Council is also asking governments to provide an overall allocation package of funding, including research grants for innovation ideas and partial funding covering 50-75% of the costs to obtain patents. In addition, technology incubators are being formed with leading-edge laboratories, shared office space, and a shared database of contacts of experts/ advisors in sustainable design and materials engineering. The policy also adopts an integrated system to support marketing, including allocating 5% of government procurement to sustainable products. Annual competitions for innovation in the circular economy are also being launched, with significant financial prizes. Table 7 shows the policy actions needed to apply this policy option.

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Table 7. policy actions for Establish Circular Economy Innovation Hubs policy

Policy Action	Description of policy action	Main Key Players	Best Practice
Launch Gulf Circular Economy Centers for Regional Sustainability	Establish dedicated centres in the Gulf region to coordinate, support, and promote circular economy initiatives. These centres enhance cooperation between governments, companies, and academia in the Gulf to accelerate circular transformations.	Universities, Startups	Circular Flanders drives circular economy advancement in Belgium's Flanders region. It combines public institutions, businesses, academia, and civil society to form a strong, coordinated network. This collective approach fosters innovation, scales circular solutions, and steers the region toward a low-waste, sustainable economic model. (Circular Flanders, 2024)
Subsidize 50-70% of Patent Costs for Circular Technology	The government or relevant authority would cover 50-70% of the costs of applying for patents related to circular economy technologies.	IP Offices, Inventors	China has actively supported innovation in circular technologies by offering substantial subsidies for patent applications and encouraging research, development, and commercialization of circular technology. (Dang & Motohashi, 2015)
Create Startup Incubators with Testing Labs for Circular Economy Innovation	Shared workspaces with prototyping equipment	Accelerators, Corporations	In early 2023, European startups developing circular economy solutions secured €867 million in funding across 67 deals, highlighting strong investor confidence in sustainable innovation. (Net Zero Insights, 2023).

5.5. Policy option #5: implement educational and public awareness campaigns

This policy employs a multi-dimensional strategy to incorporate circular economy principles within community awareness and education. The policy proposes a National Multimedia Campaign with the tagline "Our Circular Gulf," which includes intensive awareness commercials on traditional and digital media and community workshops within shopping complexes and residential neighbourhoods. The policy also embeds circular economy principles into K12, which begins at the elementary school level with applied learning in sustainability labs and the secondary school with vocational training. Universities will offer advanced educational programs and applied learning programs which require the design of circular business models, modelling of sustainable properties, and sustainable materials engineering, as well as education and training programs available to business owners and employees in the private sector on strategies for environmental design, efficiency of resources and waste management with awarded and recognizedrecognized professional badges in these new and emerging fields. To promote the sustainable nature of the impact, the policy establishes a National Observatory of Environmental Awareness Indicators so indicators could be collected as measures of organizational behaviour and a system for schools and companies that implemented circular economy strategies and best practices. Finally, an award at an annual event to recognize the best community efforts was designed within the policy to promote circular skills and competency development further. The policy actions are illustrated in Table 8 for implementing this policy option.

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Table 8. Main policy actions for Implement Educational and Public Awareness Campaigns policy

Policy Action	Description of policy action	Main Key Players	Best Practice
Run the "Our Circular Gulf" Media Campaign to Promote Circular Economy	Running a national "Our Circular Gulf" media campaign involves launching a public awareness initiative to promote the principles of a circular economy across Gulf countries.	Media outlets, Ministries of Information, Environmental NGOs	San Francisco set an ambitious goal of achieving zero waste by 2020, implementing various initiatives and community-driven campaigns to reduce landfill use and promote recycling and composting. (economic donut, 2023)
Integrate circular economy principles into School Curricula	Integrating circular economy into school curricula involves incorporating concepts of sustainability, recycling, waste reduction, and resource efficiency into educational programs.	Ministries of Education, Teachers' Associations, Textbook Publishers	In Singapore, the Ministry of Education has integrated circular economy concepts into the national curriculum, engaging students with sustainability through interactive lessons, activities, and hands-on projects. (economic donut, 2023)
Offer Vocational Training in Circular Economy Skills	Offering vocational training in circular skills involves providing specialized education and hands-on training in recycling, waste management, sustainable design, and resource efficiency.	Technical Colleges, Industry Associations, Labor Ministries	India is embedding circular economy principles into vocational training programs to equip youth and professionals with hands-on skills that support sustainable jobs and green growth. (Circle Economy, 2024)

5.6. Policy option #6: develop regional circular economy cooperation

Table 9. outlines the main policy actions required to achieve the implementation of the regional circular economy cooperation policy option created. The policy is to develop a unified legislative framework establishing recycling and waste management standards and technical specifications for sustainable products in the Arabian Gulf region. This will facilitate companies running operations smoothly and building a competitive market for green products. It also involves the establishment of a Gulf Circular Economy Fund with an initial capital of $2 billion to fund projects across borders, joint green bonds, and the Gulf Federation for Circular Economy Research, comprising centres of excellence in sustainable technologies and programs specialized in innovation. It will also create a higher coordination committee at the level of environment ministers and seek to develop a unified measurement (monitoring) system to assess performance and provide periodic reports.

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Table 9. Policy actions for the Develop Regional Circular Economy Cooperation policy.

Policy Action	Description of policy action	Main Key Players	Best Practice
Harmonize Recycling Standards Across GCC Countries	Involves aligning recycling regulations, guidelines, and practices across Gulf Cooperation Council countries to ensure consistency and efficiency in waste management.	GCC Secretariat, Regulators	The European Union has enacted new rules to improve packaging sustainability, requiring all packaging to be recyclable, limiting hazardous materials, and reducing excessive or unnecessary packaging. (ESG News, 2024)
Establish a $2B GCC Circular Economy Fund	Establishing a Gulf Circular Economy Fund involves creating a financial initiative across the Gulf Cooperation Council (GCC) countries to support investments in circular economy projects.	GCC States, Multilaterals	COMESA and the European Union have launched a €40 million regional circular economy programme to support sustainable development, resource efficiency, and green innovation across member states. (Gakunga, 2024)
Develop a Gulf-wide Circular Economy Monitoring Framework	Create a unified system across Gulf countries to measure and track circular economy performance and support sustainable policy decisions	Energy Ministries, Utilities	The European Union's Circular Economy Monitoring Framework, developed by Eurostat, is a global best practice for evaluating circular economy progress and shaping evidence-based policy enhancements across the EU. (Eurostat, 2024)

The policy options demonstrated a robust strategy for advancing circular economy practices in the GCC. The Gulf region can shift towards a more sustainable future and a circular economy by enhancing regulations, providing incentives for circular business models, promoting collaboration between the public and private sectors, establishing innovation hubs, increasing education, and promoting regional cooperation. All the strategies use global best practices to enable the region to tackle its environmental issues while unlocking economic growth and social well-being.

Conclusion

The move toward a circular economy represents an important opportunity for Gulf Cooperation Council (GCC) members to deal with growing environmental pressures, lessen dependence on non-renewable resources, and work towards sustainable, diversified economic development. This study has presented a multi-dimensional analysis through the STEEP framework and causal loop modelling to explain the systemic enablers and barriers to a circular economy in the region. Our findings show that, while there are still structural barriers—such as reliance on fossil fuel, lack of recycling infrastructure, and lack of cohesive regional and national policies—the GCC countries are making progress through national and strategic visions, investments in clean technology, and beginning to develop regulatory frameworks. The six policy options presented in this paper provide a framework to bolster the transition toward a circular economy in the GCC region. The first is to develop waste regulations that acknowledge circular economy aspirations; second, to create business models that incentivize and incentivize business practices that encourage circularity; third, to create public/private partnerships to develop capital infrastructure that supports circularity. The fourth is to establish innovation hubs based on best practices; the fifth is to make education and public awareness to reinforce circular economies; and the final option is to promote and strengthen partnerships within member states of the GCC and between the GCC and other partners. All policy options reflect a reasonable faith effort to enhance positive reinforcing loops experienced globally while addressing systemic barriers such as the cost of transition and resistance to new markets.

For the GCC, adopting a circular economy is not simply an environmental issue but an economic one. By investing in circularity now, the Gulf states can usher in a resilient, inclusive, and low-carbon future for the region. Successfully implementing these policy choices will require coherent governance, regional cooperation, and ongoing commitment from all players: government, the private sector, and civil society.

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