Circular Business Models: A New Blueprint for Advancing Industrial Sustainability in Pakistan

Introduction

The concept of Circular Economy (CE) is an interesting phenomenon that has gained global recognition as an alternative to the environmental destruction caused by the linear "take-make-dispose" industrial model. Countries around the world are adopting this model as both an environmental necessity and a means of economic innovation and sustainable competitiveness. However, in Pakistan, the circular economy is little understood and remains largely an unexplored frontier, despite its potential to help the country overcome the growing environmental, economic, and industrial crises. Industry and academia are increasingly turning towards the CE approach as a pathway to bring the much-discussed concept of sustainability to life. Several stakeholders are applying the concept of CE in various operational units across multiple industries.[1]

Figure 1: Circular Economy

The rapidly growing population of over 240 million people and industrial expansion in Pakistan are facing critical challenges in terms of waste management, resource scarcity, and environmental degradation. The industrial sector—which includes textiles, plastics, cement, chemicals, and electronic products — produces enormous quantities of waste, most of which ends up in uncontrolled landfills, rivers, or informal recycling pathways.

The nation generates more than 3.9 million tons of plastic waste annually, recycles less than 10 percent of industrial waste, and lacks consistency in integrating recovered materials into new production cycles. Pakistan produces more than two million tonnes of plastic waste each year, which translates to more than 8 kg per capita annually. Alarmingly, 86 percent of this waste is neither recycled nor managed in an organized manner. It often ends up as litter, pollutes urban areas, clogs waterways, and contaminates food chains, soil, and oceans.

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Indeed, this crisis has reached a stage where Pakistan has joined nine other countries as one of the world's largest plastic polluters. The World-Wide Fund for Nature–Pakistan (WWF-P) highlighted these distressing facts on World Environment Day, commemorated on June 5.[2] This situation indicates a dire need to shift from a linear to a circular economy. However, progress in this direction remains minimal.

Due to the escalation of population, urbanization, increasing reliance on processed materials, and industrialization, waste disposal is becoming increasingly difficult. Recently, many developed nations have transitioned to a Circular Economy (CE) model to achieve Sustainable Waste Management (SWM)[3]. This paradigm shift requires the involvement of individuals, local organizations, environmental institutions, and industries, all of whom must adopt responsible practices such as reducing, recycling, and reusing waste.

Nevertheless, this transition represents a mammoth task for developing nations. The challenges of moving towards a circular economy are rooted in the lack of technological infrastructure, insufficient human resource capacity, and institutional and financial limitations. [4]

Understanding of Circular Economy

The linear and circular economies fundamentally differ in terms of resource management and sustainability. A conventional linear economy operates on the principle of "take, make, use, and dump," in which natural resources are extracted, products are manufactured and used, and waste is discarded—often with minimal recovery or repurposing.

In contrast, the circular economy is regenerative and restorative by design. It focuses on eliminating waste and pollution, keeping products and materials in use through restoration, reuse, and recycling, and regenerating natural systems.[5] While the linear model emphasizes immediate consumption and short-term profitability, the circular model promotes long-term value conservation and resource efficiency.

Research conducted by the Ellen MacArthur Foundation and the World Economic Forum highlights that circular practices can significantly reduce operational costs, optimize supply chains, and create new business models—such as product-as-a-service and resource recovery.[6] For instance, global brands like Philips and IKEA have adopted circular principles by reducing raw material usage and enhancing customer loyalty.

Figure 2: Circular Vs. Linear

Integration of Circular Business Models (CBMs) in Pakistan's Industrial Context

Circular Business Models (CBMs) are sustainable models that aim to minimize waste and maximize the reuse, repair, recycling, and regeneration of products and materials throughout the value chain.[7] Among the practices used in the Pakistani industrial environment, the implementation of CBMs is becoming increasingly relevant for achieving sustainable economic development while addressing resource limitations.

As energy costs continue to rise, environmental degradation worsens, and raw materials become scarcer, CBMs such as Product Life Extension, Resource Recovery, and Circular Supply Chains can help industries reduce their dependence on imports, minimize waste, and streamline operations.[8,9,10] For example, textile and manufacturing industries can benefit from recycling and remanufacturing, while agriculture and food processing industries can adopt waste-to-resource strategies by generating bioenergy or compost.

Additionally, improved resource availability for small and medium enterprises (SMEs) through shared solutions and optimized reverse logistics systems can enhance their competitiveness. Furthermore, adopting a design approach focused on circularity can foster innovation and attract green-oriented foreign investors.

Overall, CBMs offer Pakistani industries a pathway to reduce environmental impact, meet global sustainability standards, and improve economic resilience in the face of climate and market pressures.

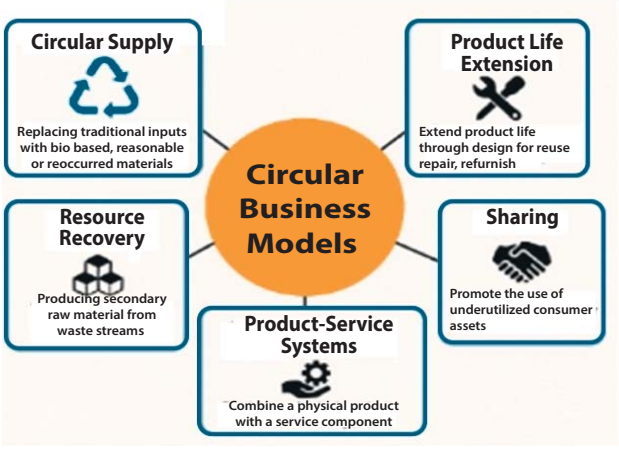

Figure 3: Circular Business Models

Global Relevance and Industrial Applicability of CBMs

A circular economic model provides a feasible and valuable concept for how industries can decouple economic growth from environmental degradation. The major circular strategies that industries can adopt include remanufacturing, recycling of industrial by-products, reverse logistics, product-as-a-service models, and industrial symbiosis—where the waste or by-products of one industry are used in another sector.

At the international level, notable examples include Germany, the Netherlands, and South Korea, which have successfully implemented such models and integrated support measures, policies, and stakeholder engagement to improve sustainability in manufacturing and industrial processes.

In Pakistan, however, the circular economy debate is still in its early stages. Although informal practices such as the recycling and repair of electronic goods and auto parts are common, they are not governed by a formal industrial policy. These practices also lack adequate infrastructure, financing, and regulatory support.

Globally, the shift towards circularity is being driven by the design and development of products and systems that prioritize reuse, repair, and recycling. Policy measures (such as recycling laws in Japan and anti-food waste regulations in France) and private-sector innovations (like Fairphone and Loop) often complement best practices.

In Pakistan, formal policy frameworks, standards, and training programs could significantly improve existing informal circular practices, such as clothing reuse, electronics repair, and auto parts salvage.

Table 1: Global Best Practices by Industries

Sector	Country / Organization	Best Practice / Program	Circular Strategies Used	Relevance for Pakistan
Textiles & Apparel	**Sweden – H&M**	Garment Collecting Program	Take-back schemes, fiber recycling, closed-loop fashion	Pakistan's textile sector can replicate large-scale recycling and resale markets.
	Bangladesh – Reverse Resources	Waste digital mapping and re-user-use platform	Waste traceability, the industrial symbiosis between garment producers and recyclers	It can help Pakistani factories trace and re-use textile waste and support the informal-to-formal transition.
Electronics (E-Waste)	**Japan – Home Appliance Recycling Law**	Legal framework requiring manufacturers to collect and recycle electronics	Product take-back, mandatory producer responsibility	A structured national e-waste framework could formalize Pakistan's large informal recycling sector.
	EU – Fairphone (Netherlands)	Modular smartphone for easy repair and recycling	Design for disassembly, repairability, product longevity	Encourages local electronics businesses to develop long-life, serviceable products.
Automotive	**Germany – BMW & Audi**	Engine and parts remanufacturing programs	Component reuse, remanufacturing, closed-loop supply chains	Pakistan's auto repair sector (Shershah market, etc.) could adopt certified remanufacturing practices.
	EU – ELV Directive	End-of-Life Vehicle policy mandating 95% material recovery	Reverse logistics, recycling of metals, glass, plastic	It could inspire policy for formal vehicle recycling and material recovery in Pakistan.
Plastics & Packaging	**Chile – Plastic Pact**	Industry agreement to reduce virgin plastic and increase reusable packaging	Voluntary producer agreements, re-use models	It can be implemented via a Pakistani Plastics Pact engaging FMCGs and the retail sector.
	Netherlands – Loop by TerraCycle	Refillable packaging systems for household goods and groceries	Refill stations, packaging reuse	Urban retailers in Pakistan can pilot similar programs in supermarkets and shopping malls.
Construction & Demolition	**UK – WRAP (Waste & Resources Action Programme)**	Promotion of recycled aggregates in road and building construction	Reuse of demolition waste, recycled building materials	A large potential market in Pakistan's expanding construction sector reduces urban waste.
	Denmark – Resource Efficient Housing	Modular housing designs using reclaimed materials	Modular construction, material circularity	Ideal for Pakistan's low-cost housing schemes; efficient and sustainable designs.
Food & Agriculture	**France – Food Waste Law**	Supermarkets must donate unsold food or process it into compost	Redistribution networks, food waste prevention	Helpful in reducing food waste in Pakistani urban retail and food services sector.
	South Korea – Pay-as-You-Waste	Users are charged based on the amount of food waste generated	Incentivized composting and biogas production	Municipalities could adapt it to encourage organic waste separation in major cities.
Chemicals / Fertilizer	**Germany – BASF**	Uses by-products from one production line as inputs for another	Industrial symbiosis, waste-to-resource engineering	This can be replicated in Pakistani chemical clusters (e.g., Lahore and Faisalabad industrial zones) for efficiency gains.
	India – IFFCO	Production of bio-fertilizers from organic waste	Bio-circular fertilizers, input substitution	Relevant for reducing dependence on chemical fertilizers and managing agri-waste in Pakistan.

Source: Author's compilation from published sources

Linear Trap of Pakistan's Industrial Sector: Role of CBMs

The industrial sector in Pakistan, which contributes around 19% to GDP and is dominated by textiles, cement, plastics, steel, automotive, and food processing industries[11], follows a linear economic model based on extracting, producing, consuming, and discarding. This system has supported short-term growth but at the cost of long-term sustainability. The sector still relies heavily on virgin raw materials, energy-intensive production processes, and waste disposal methods that lack recovery or reuse mechanisms.

For example, textile mills discharge untreated dye into rivers; construction companies leave large amounts of debris unmanaged; and plastic manufacturers show little regard for recycling or recovery, contributing to rising urban pollution. Although this linear approach was once seen as standard economic practice, it now poses serious threats to resource security, environmental integrity, and industrial competitiveness. System inefficiencies persist due to outdated production technologies, lack of integrated value chains, and the absence of waste valorization systems. Such practices are unsustainable for a nation already grappling with water scarcity, energy shortages, and urban waste crises[12].

The inability of Pakistani industries to innovate will lead to economic marginalization, as international trade increasingly shifts toward circular economy standards. Pakistan remains locked in an outdated model that rewards volume over value, growth over regeneration, and output over meaningful outcomes. It is therefore urgent to realign the industrial base with the principles of the circular economy.

Circular Business Models (CBMs) offer practical solutions to environmental challenges while enhancing resource efficiency and economic resilience. For instance, the circular supply model, which promotes the use of renewable and recovered materials, is especially relevant to the textile and plastic sectors where raw material waste and pollution are significant concerns. Product life extension strategies, such as remanufacturing and refurbishment, can be applied in the electronics, automotive, and machinery industries—many of which already operate through informal repair networks that could be formalized and scaled[13].

Table 2: Circular Business Models (CBMs) and Their Applications in Pakistani Industries

CBM Type	Applicable Industries	Application	Key Benefits
1. Circular Supply Model	- Textile - Plastics - Paper & Packaging - Leather	Use of renewable, biodegradable, or recycled materials as inputs	Reduces environmental footprint, lowers import dependency, and minimizes landfill contribution
2. Product Life Extension	- Electronics - Automotive - Machinery & Equipment - Mobile Phones - Home Appliances	Remanufacturing, repairing, refurbishing, or re-using components/products	Reduces waste, creates jobs, formalizes the repair economy, lowers consumer cost
3. Resource Recovery	- Construction - Steel & Cement - Food Processing - FMCG	Recovering raw materials, recycling waste (e.g., cement, steel, packaging waste, food waste)	Cuts waste management costs, recycles materials into inputs, enhances eco-compliance
4. Product-Service Systems (PSS)	- Agricultural Machinery - Heavy Equipment - Home Appliances - Office Equipment	Shift from product ownership to leasing/shared services	Lowers CAPEX for users, extends asset lifetime, creates service-based revenue streams
5. Sharing/Exchanging Models	- Transport & Logistics - Hospitality - Co-working & Manufacturing SMEs - Warehousing	Shared mobility, co-utilization of industrial assets (factories, warehouses and tools)	Improves resource utilization, fosters collaboration, reduces idle capacity
6. Circular Design	- Furniture & Handicrafts - Footwear - Fashion & Apparel	Designing products for re-use, modularity, disassembly, and recycling	Enhances brand image, supports eco-design standards, extends market reach to green consumers
7. Industrial Symbiosis	- Chemical - Energy - Agro-based industries - Pulp & Paper	Waste or by-products of one industry become the input of another	Reduces production cost, promotes regional industrial ecosystems, enhances sustainability practices

Source: Author's compilation

The resource recovery model applies well to the construction and packaging industries, which generate large volumes of waste—including cement, steel, and polymers—that can be reused as industrial inputs. While less common, Product-Service Systems (PSS) present valuable opportunities for the heavy equipment and appliance sectors, allowing for leasing or usage-based services that reduce production demands and extend product lifespans.

Finally, exchange models—commonly seen in global transport and hospitality sectors—could inspire innovations in industrial logistics or the shared use of manufacturing facilities in SME-equipped regions of Pakistan. By adopting and operationalizing these CBMs, Pakistan's industrial sector can advance toward greater economic competitiveness and environmental sustainability, in alignment with its Sustainable Development Goals (SDGs) and broader ambitions within the circular economy. [13,14]

Implications for SDGs

The shift to a circular economy offers a transformative opportunity for Pakistan's industrial sector, aligning it more closely with the broader objectives of the United Nations Sustainable Development Goals (SDGs). Key industries—particularly textiles, plastics, construction, and agriculture—are simultaneously contributing to economic growth and environmental degradation. By implementing circular business models, these sectors can strategically address environmental concerns, improve resource efficiency, and enhance global competitiveness.

From an economic perspective, adopting circular strategies such as reuse, recycling, and product life extension helps industries reduce dependency on costly raw materials. These practices lower production and waste treatment costs while opening new revenue streams through refurbished products, leasing systems, and the reuse of by-products as raw materials. Such measures directly contribute to **SDG 8 (Decent Work and Economic Growth)** by promoting green entrepreneurship and creating employment opportunities in repair, remanufacturing, and recycling sectors.

Furthermore, circular models significantly reduce pollution, carbon emissions, and waste, contributing to **SDG 13 (Climate Action)** and **SDG 12 (Responsible Consumption and Production)**. Integrating eco-design, digital traceability, and sustainable materials into innovation efforts supports **SDG 9 (Industry, Innovation, and Infrastructure)**. By embracing circular economy principles, Pakistani industries can better comply with emerging international sustainability standards and become proactive contributors to both national development and the global 2030 Agenda. Ultimately, the circular economy offers a pathway toward industrial resilience, inclusive growth, and long-term sustainability[15].

Policy-Level and Structural Challenges for Industries

1) **Policy-Level:** The environmental laws in Pakistan are still disjointed and place more emphasis on controlling pollution and its consequences than resource effectiveness and circular design. Subsequently, despite establishing the National Resource Efficiency and Circular Economy Policy (2021), there is still a low level of implementation, and the range of measurable goals and enforcement strategies is minimal. More importantly, there is a lack of the Extended Producer Responsibility (EPR) law; the producers are not responsible regarding the post-consumer cycle of their goods. In contrast with numerous OECD nations, little financial or fiscal stimulus exists on the part of the state to enhance circular practices to be adopted in Pakistan. Most industrial policies do not have green tax reliefs, low-interest loans, or subsidies to produce sustainably. As a result, businesses have little incentive to develop refined products, take-back sites, and include recovered materials in supply chains. Waste pickers, scrap dealers, and small-scale processors in Pakistan's informal recycling sector are critical for material recovery [16,17].

   Nevertheless, the sector is unlawful and unofficially backed. The formal industries are usually slow in moving toward collaboration, a factor attributed to the issues of quality assurance and traceability. Due to this breakdown, the potential is lost, and wasted effort is repeated between formal and informal economies.

2) **Structural-Level:** The industrial zones of Pakistan are usually supported by old infrastructure, which is not recommended to aid the use of circular operations like recovery of materials, segregation of waste, or production in a chain. The lack of centralized recycling facilities, reverse logistics systems, or eco-industrial parks, essential to effectively cycling resources, can also be noted. Due to this, industrial waste (particularly textile, plastics, and construction) is usually dumped in landfills or dealt with informally. A large pool of companies, including small and medium enterprises (SMEs), remain ignorant of the circular economy concept. In a 2023 survey by the Sustainable Development Policy Institute (SDPI), 60% of manufacturing companies did not know circular models' economic or environmental rewards.

In addition, most industrial workforces have a logistics shortage regarding technical abilities concerning remanufacture, product redesign, and waste valorization. Technological innovations are usually needed to facilitate the implementation of circular processes in most industries, which include fiber-to-fiber recycling equipment in the textile industry and plastic pelletizing equipment in the packaging industry. Most firms, especially SMEs, cannot incur such investments without outside assistance. There are also no local sources of circular technologies because of the poor research-industry connection and minimal community investment in green research and development[16,17].

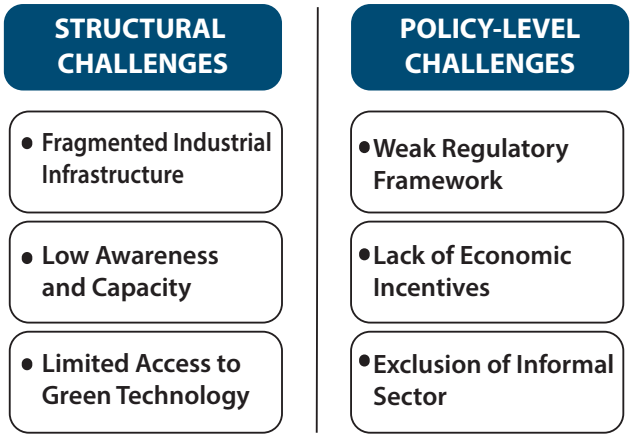

Figure 4: Implementation Challenges for industries

Conclusion and Way Forward

Pakistan's industrial sector stands at a critical juncture. As global and national pressures intensify to achieve sustainable operations, transitioning toward circular economy (CE) business models is not only an environmental necessity but also a valuable business opportunity with significant economic potential. However, this transition is currently hindered by weak policy frameworks, inadequate industry planning, limited access to technology, and a fragmented stakeholder ecosystem.

To move toward a viable solution, Pakistan needs an integrated national strategy that includes enforceable policies such as Extended Producer Responsibility (EPR), investment in circular infrastructure, support for innovation, capacity-building for SMEs, and the formal inclusion of informal waste sector stakeholders. Government authorities must also align industrial development plans with CE principles by incorporating sustainability indicators into trade and investment policies. This kind of systemic change will pave the way for a sustainable, inclusive, and green industrial future—one that aligns with global sustainability commitments while ensuring long-term economic competitiveness.

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