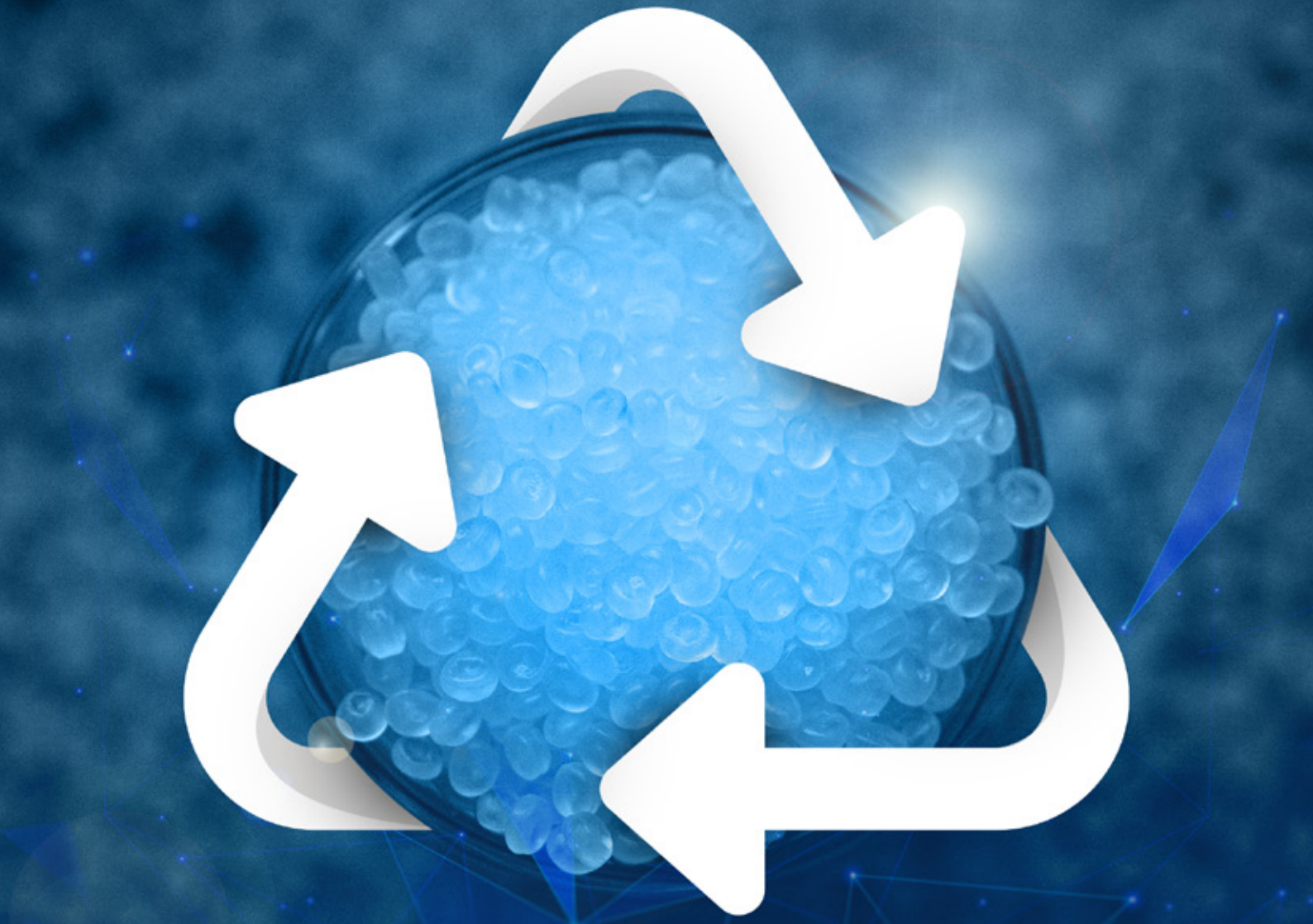
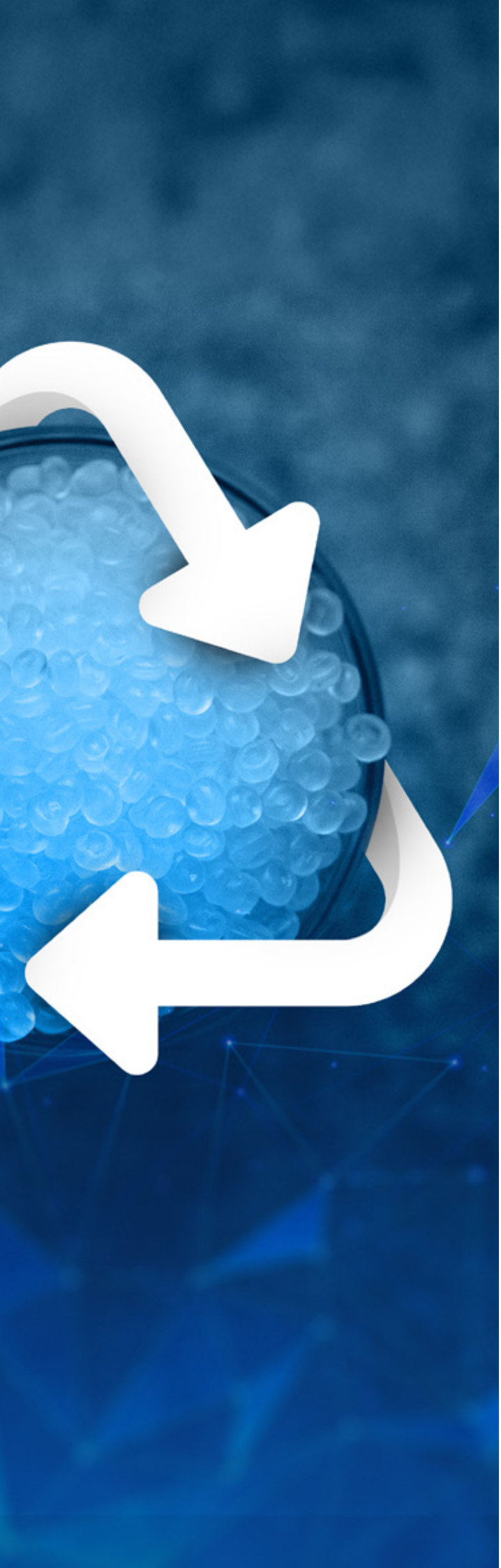
KAPSARC
مركز الملك عبدالله للدراسات والبحوث البترولية
King Abdullah Petroleum Studies and Research Center

gpca
GULF PETROCHEMICALS & CHEMICALS ASSOCIATION
الاتحاد الخليجي للبتروكيماويات والكيماويات

Advancing Plastic Waste Recycling in the GCC: Policies, Technologies, and Economic Opportunities





Contents

1. Introduction

2. State of Plastic Waste: GCC vs. Rest of the World

2.1 The State of Global Plastic Waste

2.2 The State of GCC Plastic Waste

3. Trends in Plastic Recycling Rate: GCC vs. Rest of the World

3.1 Global Recycling Rates: Historical Trends and Outlook

3.2 Plastic Recycling Rates: A Global Benchmark and GCC Performance

3.3 Plastic Recycling in the GCC: Targets vs. Progress

3.4 Market Disconnect in the GCC Plastic Recycling

4. Global and Regional Plastic Waste Regulations

5. Technological Innovations for the GCC Plastic Recycling

5.1 Introduction to Plastic Recycling Technologies

5.2 Plastic Recycling Value Chain

5.3 Mechanical Recycling

5.4 Chemical Recycling

6. Economic Viability of Plastic Recycling in the GCC

6.1 Investment Required and Cost Structure

6.2 Market Potential and Job Creation

7. Conclusion

8. Bibliography

Disclaimer

All rights reserved. No part of this document may be reproduced or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission of Gulf Petrochemicals and Chemicals Association.

This report is confidential to GPCA and its member companies and may not be published or distributed without GPCA permission.

Some of the data and information in this report is provided by third parties.

Information presented is the latest available. Any subsequent revisions or updates of those data will affect the assessment and projections shown.

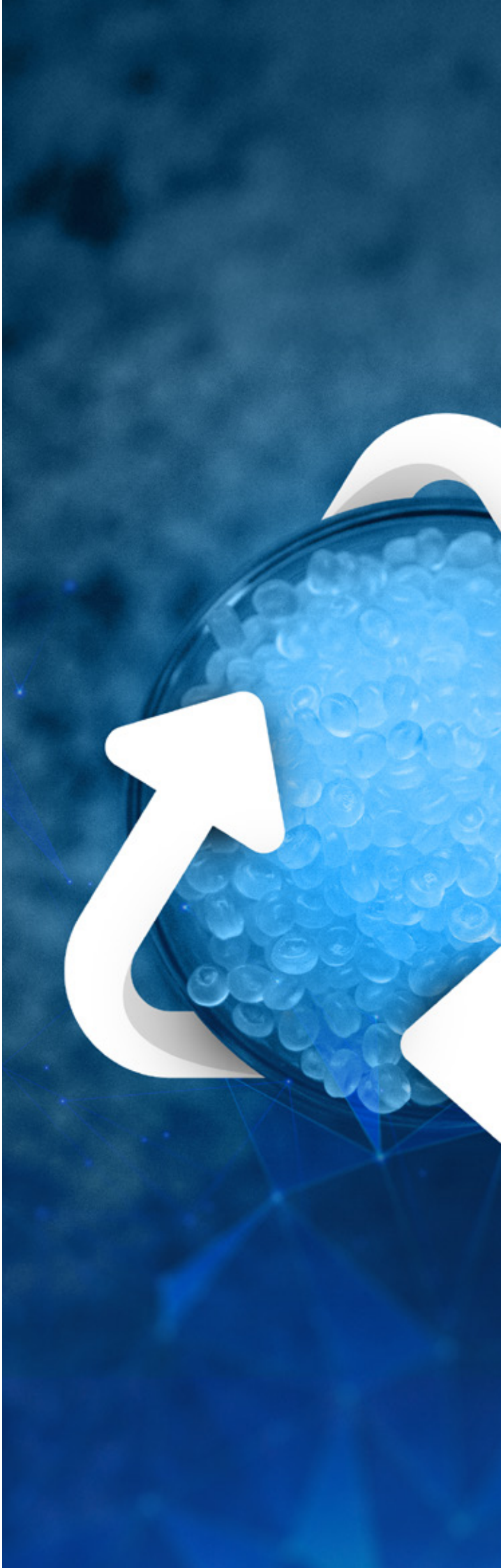
To discuss the report further please contact:

Dr. Sana Ben Kebaier
Head of Economic Research dept (A), **GPCA**
✉ sana.k@gpca.org.ae

Noora Mukhtar
Senior Reseach Specialist, **GPCA**
✉ noora@gpca.org.ae

Julio Arboleda
Senior Fellow- Oil & Gas, **KAPSARC**
✉ julio.arboleda@kapsarc.org

Rami Shabaneh
Senior Fellow- Oil & Gas, **KAPSARC**
✉ rami.shabaneh@kapsarc.org



Executive Summary

Plastics are an integral component of the modern economy due to their cost-effectiveness, durability, and versatility across sectors such as packaging, construction, healthcare, and automotive. However, the environmental costs of plastic mismanagement have become a growing global concern. Worldwide plastic production surged from 2 million tons (MMT) in 1950 to 460 MMT in 2019 and is projected to exceed 1,200 MMT by 2060. Yet only about 9% of plastic waste is currently recycled, with the remainder ending up in landfills, incinerated, or polluting the environment.

The Gulf Cooperation Council (GCC) countries—Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates—are major producers and consumers of plastics due to their robust petrochemical industries. Despite their technological capabilities, recycling rates across the region remain low at approximately 10%, with landfilling still the dominant waste management method. This highlights a significant potential for end-of-life recycling capabilities in the region.

The document presents a comprehensive analysis of the current plastic waste management landscape in the GCC, benchmarking it against global trends. It evaluates the region's recycling infrastructure, outlines regulatory gaps, and explores advanced technological solutions such as mechanical and chemical recycling and high-tech sorting systems. The report underscores that aligning plastic waste management with circular economy principles can yield significant economic, environmental, and social benefits.

Globally, plastic recycling is slowly improving, with projections estimating a 17.3% recycling rate by 2060. In contrast, top-performing regions like the European Union and South Korea already achieve rates above 35–40% through robust policy enforcement, infrastructure investments, and public engagement. The GCC lags due

to weak enforcement of existing policies, limited public awareness, fragmented collection systems, etc.

Technological solutions are critical to closing this gap. Mechanical recycling is viable for clean, homogenous plastics but has limitations in quality and scope. Chemical recycling—including pyrolysis, gasification, and depolymerization—can process complex and contaminated plastics, enabling greater material recovery. The GCC's access to low-cost energy and existing industrial expertise provides a competitive advantage in scaling up these technologies.

Economically, the transition to a circular plastics economy presents an opportunity worth over USD 6 billion annually, with the potential to create 50,000 jobs and avoid 10 – 12 million tons of CO_2 emissions per year. Realizing this potential will require USD 12 – USD 25 billion in infrastructure investments by 2045, focusing on sorting systems, recycling plants, and market development for recycled products.

Policy-wise, most GCC countries have enacted policies to reduce plastic waste but lack cohesive strategies for comprehensive plastic recycling. The report recommends harmonizing regulations across the region, implementing collection and sorting schemes, and developing regional standards for recycling practices and product design.

To lead in sustainable plastics management, the GCC must adopt a multi-pronged approach:

- Scale advanced recycling infrastructure, including AI sorting and chemical recycling.
- Enforce collection, sorting, and recycling frameworks to hold all stakeholders accountable.
- Promote public-private partnerships and regional coordination.
- Support innovation and circular economy startups.
- Educate consumers to increase participation in recycling programs.

In conclusion, the GCC has the resources, industrial base, and economic incentives to become a global leader in plastic circularity. By transitioning from a disposal-focused model to a value-generating recycling system, the region can meet its sustainability goals, diversify its economy, and position itself as a pioneer in tackling plastic waste pollution.



1. Introduction

Plastic is undoubtedly one of the most remarkable inventions of recent centuries. Its malleability and durability offer unique properties that make its application incredibly versatile, meeting a vast array of human needs across industries and everyday life.

The first plastic was invented in 1860, but it was not until 1970 that the global plastic industry truly began. Industrial development picked up in the 1920s, and the 1940s saw a significant expansion in plastic production (Nayanathara Thathsarani Pilapitiya and Ratnayake 2024).

According to the 'Global Plastics Outlook' presented by the Organization for Economic Co-operation and Development (OECD) in 2022, global plastic production has grown drastically from 2 MMT in 1950 to 460 MMT in 2019, and the use of plastics is forecasted to triple to more than 1200 MMT by 2060. (OECD 2022a). These statistics highlight the significance of plastic in modern life. However, the increasing use of plastics, coupled with irresponsible behavior regarding plastic waste management, has led to several environmental concerns.

The debate over plastic pollution has intensified over the last decade. The increasing presence of microplastics in oceans and water bodies highlights the urgent need for global leaders to address plastic waste pollution. (Scarr and Katakam 2019).

In response to this emerging crisis, the fifth session of the United Nations Environment Assembly (UNEA-5.2) in March 2022 adopted a resolution to establish the Intergovernmental Negotiating Committee (INC).

The INC's goal is to develop an international legally binding instrument on plastic pollution, including in the marine environment (UNEP 2024b).

Finding solutions to plastic waste pollution is not easy. The unique characteristics of plastic make it almost irreplaceable. Transitioning to other materials, such as glass or aluminum, is not always practical, there are weight and cost considerations for manufacturers that make plastics the go-to material.

Aluminum and glass may be too heavy and costly for the product, as well as their production often results in greater environmental pollution than that from plastic.

Additionally, if these materials are not properly recycled, they can pose even higher risks to the environment. A more logical solution involves redesigning plastic products and enhancing efforts in plastic waste management, leading to increased recycling rates (Parker 2020).

Special attention is needed in the packaging sector, which heavily relies on plastics used only once and is a major driver of plastic consumption (OECD 2022a).

Like the rest of the world, the Gulf Cooperation Council (GCC) countries are also concerned about plastic waste management problems. The GCC members are strong producers of virgin plastic feedstock of plastics. Although some might assume this poses a barrier to addressing plastic waste challenges, in reality, the GCC's expertise, infrastructure, and scale position it as a key partner in driving circularity solutions driving reuse (Anouti, Katiyar, and Kumar Mantri 2023).

The GCC counts with a long-term expertise in the petrochemical industry, which is one of the main stakeholders during recycling plastic waste, for the same reason, the region counts with the structure to process the plastic and reuse it, and given the size of the petrochemical industry in the GCC region, the market has the potential to provide a scale advantage.

This report aims to provide a comprehensive analysis of plastic waste disposal, recycling rates and the recycling infrastructure gaps in the GCC countries, along with the encouraging policies to capture the untapped potential of the plastic recycling sector, and transition from current disposal-focused practices to value-creating recycling systems.

It will explore recycling strategies, technological innovations, economic viability, and government policies related to plastic waste management in the GCC region and benchmarks against global players.

By synthesizing existing studies, data, and case studies, this research seeks to identify opportunities and challenges for enhancing plastic recycling efforts in GCC countries.



2. State of Plastic Waste: GCC vs. Rest of the World

2.1 The state of global plastic waste

According to the "OECD Global Plastic Outlook" published in 2022, the amount of global plastic waste more than doubled between 2000 and 2019, reaching 353.3 MMT. However, only 9% of this plastic waste is recycled. Most of that plastic waste ends up in landfills, is incinerated, or leaks into the environment through various pathways, such as streets, rivers, and oceans (OECD 2022b).

Furthermore, annual plastic waste volume could nearly double by 2040, potentially reaching 1,014 MMT by 2060 if no corrective measures are implemented. According to OECD estimates, three countries will account for almost 45% of global plastic waste generated by 2060: China is projected to generate 18%, the U.S. will contribute 14%, and India will account for 12.6%. In contrast, the Middle East and North Africa (MENA) region will be responsible for less than 6% of total plastic waste generation (Figure 2.1).

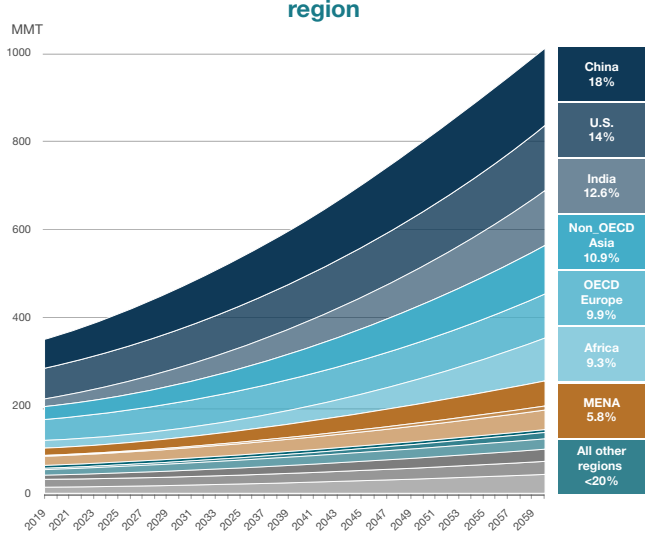
There is increasing recognition of the importance of tracking the generation of plastic waste, but systems for data collection and reporting are still inconsistent between and within regions. This highlights the importance of standardized measurement and reporting mechanisms. However, despite the lack of official numbers, there is broad consensus on the significant rise in mismanaged plastic waste and its harmful impact on both humans and the environment.

Decades of plastic waste pollution from indiscriminate disposal has become a significant environmental concern. Several studies, including Alabi et al. (2019), confirm that in addition to harming aquatic ecosystems, the breakdown of plastic waste also creates contaminated conditions in human occupational and residential environments.

As previously mentioned, plastic waste is projected to nearly triple by 2060, with almost 50% ending up in landfill and 17% being recycled. Addressing this global challenge requires a comprehensive, well-structured approach that spans the entire value chain. Figure 2.2 underscores the urgent need for stronger policies and expanded recycling infrastructure to maximize plastic waste utilization, turn waste into value, and explore its potential benefits.

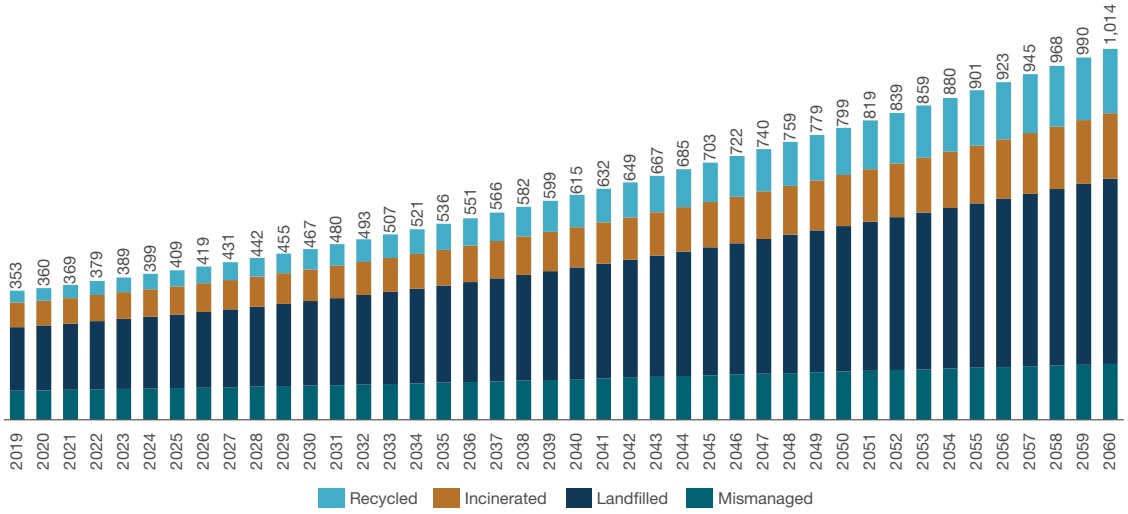


Figure 2.1. Global plastic waste production outlook by region



Source: KAPSARC based on OECD 2022b

Figure 2.2: Global plastic waste by end-of-life fate (Million tons)



Source: GPCA analysis based on OECD 2022b data, 2024 | Note: The scenario used for the projections of Plastic Waste by End-of Life is Baseline



Key drivers of plastic waste growth:

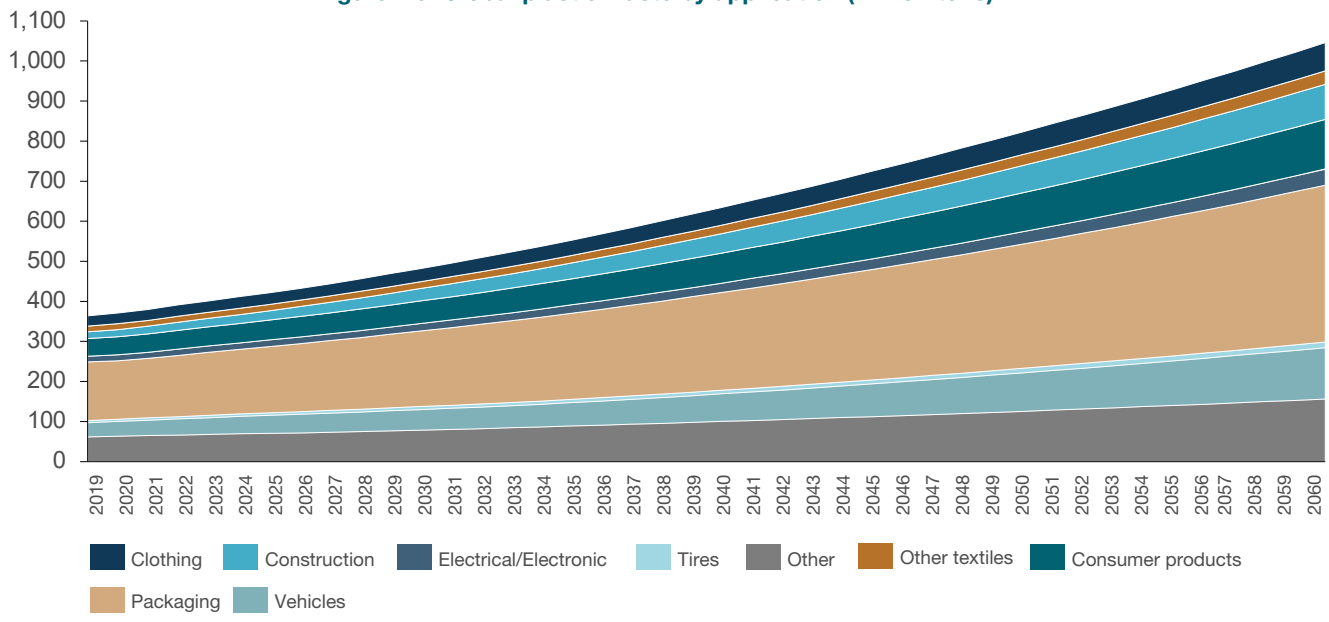
The rapid growth in plastic waste is mainly fueled by the increased demand for packaging, which makes up the biggest portion, almost 40% of all plastic waste created, and is predicted to rise at a Compound Annual Growth Rate (CAGR) of about 2.5%. The construction sector's share is projected to substantially grow as infrastructure development greatly picks up speed from its 2019 level of 5%. The amount of plastic waste from vehicles, currently at about 10%, is expected to grow annually by 2.6%, reflecting the rising adoption of lightweight plastics in the automotive sector. Because of increased consumption patterns, consumer products, which contributed 12% in 2019, will continue to grow as well. These trends point towards an urgent need for improved recycling infrastructure and circular economy initiatives to manage escalating plastic waste volumes effectively. (Figure 2.3)

Looking into the polymer composition of waste streams in the years to come, Polypropylene (PP), Low-Density Polyethylene (LDPE), and High-Density Polyethylene (HDPE) are expected to continue to be the most prevalent polymers, given their widespread usage in consumer products and packaging.

PVC waste is expected to grow significantly due to infrastructure and construction activities. The projections for elastomers, mainly from automotive uses (tires), suggest moderate growth. Synthetic fibers that come from textile waste represent another major category in the predicted waste matrix. Emerging categories such as bioplastics and marine coatings are also slated to feature in a much smaller share.

Global initiatives are underway to address the issue of plastic waste mismanagement. In March 2022, during the resumed fifth session of the UN Environment Assembly, the UNEA 5/14 resolution was adopted, paving the way for the development of an international legally binding agreement on plastic pollution. Following this, the UN Environment Programme (UNEP) established an Intergovernmental Negotiating Committee (INC) to draft the agreement, which will take a comprehensive approach by addressing the full life cycle of plastics, including production, design, and disposal (UNEP 2024a). In December 2024, UNEP concluded its fifth INC session, during which member countries agreed only on a 'Chair's Text' as a starting point for negotiations at a resumed session in 2025, which had not yet been scheduled at the time of writing this report (UNEP 2024c).

Figure 2.3: Global plastic waste by application (Million tons)



Source: GPCA analysis based on OECD 2022b

2.2 The state of GCC plastic waste

In the GCC countries, plastic waste is estimated to account for 13-14% of total municipal solid waste (MSW) (Alagha et al. 2022). KAPSARC estimations based on data sources from GCC Statistical Center (GCC Stat 2024) and World Bank (World Bank 2024), show that while some GCC countries experienced an increase in plastic waste production, others witnessed minimum change or a slight decrease, mostly due to policies and programs controlling plastic consumption.

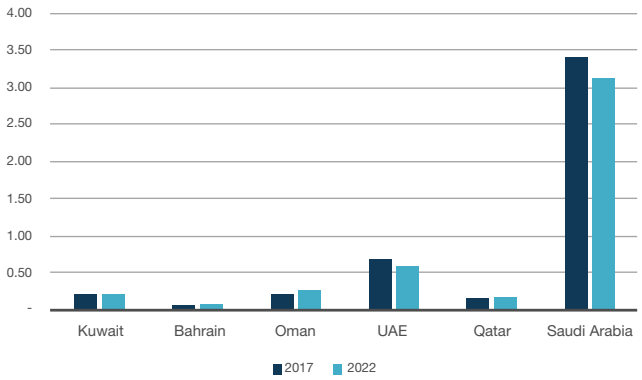
This suggests that plastic consumption and waste accumulation patterns vary across the region, influenced by policy measures, population growth, and economic activity (Figure 2.4).

Comparing total plastic waste by country can be misleading due to significant differences in populations. Plastic waste per capita provides a better reflection of individual plastic waste generation, offering a fairer metric to assess individual contributions to plastic waste, as presented in Figure 2.5.

Although plastic waste management remains a growing challenge for the GCC countries, the current level of plastic recycling in this region remains relatively small, despite the ambitious plans and reliance upon innovative technologies to promote diversified economic growth.

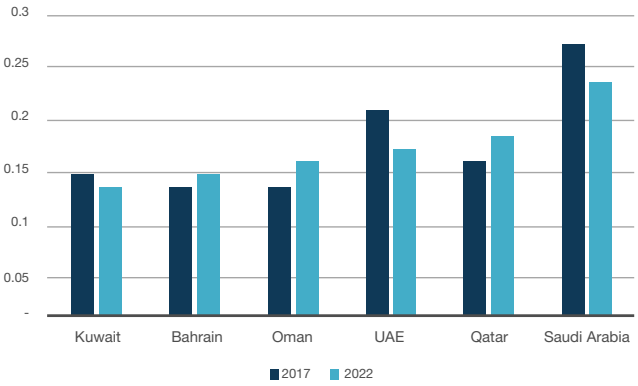
As plastic waste is a versatile resource that can be used to create high-quality, cost-efficient, and environmentally beneficial material, more consideration can be devoted to plastic recycling.

Figure 2.4 Plastic waste produced in GCC countries in million tons per year (MMT/Y)



Source: KAPSARC Assessment based on (GCC Stat 2024) and (World Bank 2024)

Figure 2.5. Per capita plastic waste produced in GCC countries (Kg/day)







3. Trends in Plastic Recycling Rate: GCC vs. Rest of the World

3.1. Global recycling rates: Historical trends and outlook

Historical trends (2000-2019)

According to OECD estimates, the global plastic recycling rate has shown a slow but steady increase, rising from 3.7% in 2000 to 9.3% in 2019. The early 2000s saw minimal recycling efforts, with most plastic waste being landfilled, incinerated, or mismanaged. However, recently, as global awareness of plastic pollution grew, waste management policies, technological advancements, and circular economy initiatives led to gradual improvements in recycling rates.

The most notable acceleration occurred lately when stricter regulations, corporate commitments, and international agreements (such as the Basel Convention Plastic Waste amendments) began influencing waste management systems. Despite this progress, the global recycling rate remains low, indicating that a vast majority of plastic waste has still not been recovered for reuse.policies and expanded recycling infrastructure to maximize plastic waste utilization, turn waste into value, and explore its potential benefits.

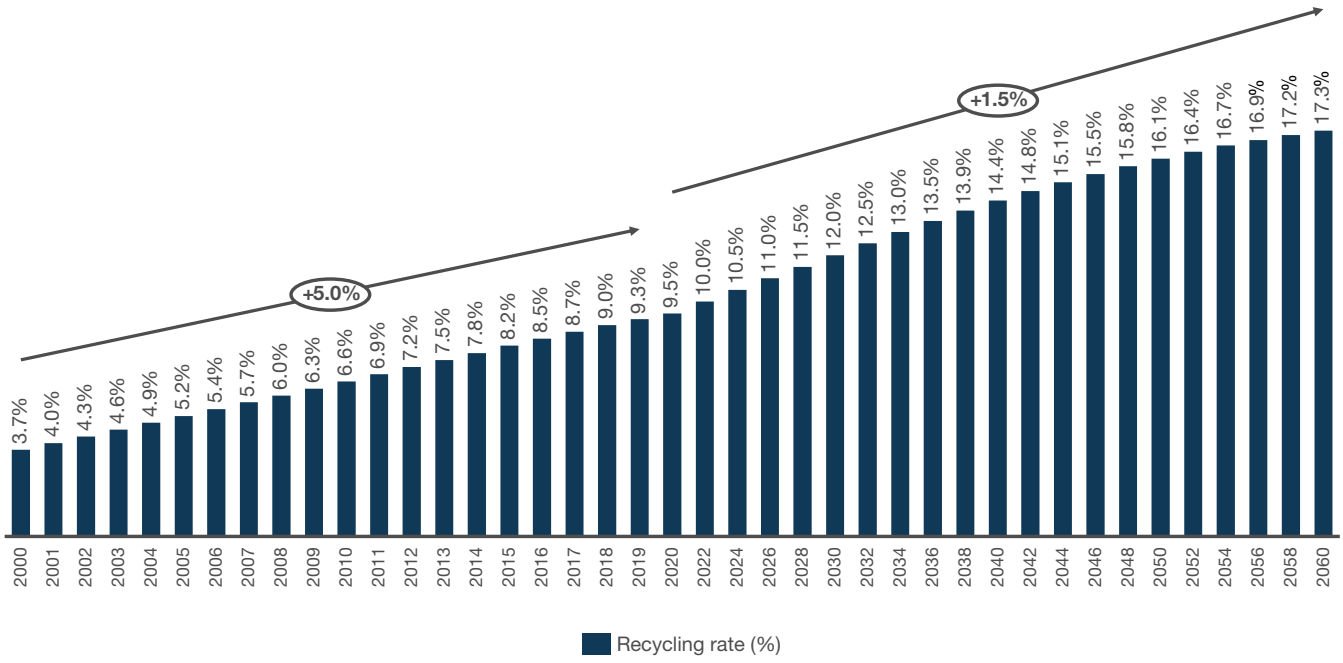
Projected trends (2020–2060)

Looking forward, the global plastic recycling rate is expected to double, reaching 17.3% by 2060 nearly.

The increase, however, remains slow (1.5% CAGR), suggesting persistent challenges in plastic collection, sorting, and reprocessing. The most significant improvements are projected between 2024 and 2040, with the recycling rate growing from 10.5% to 14.4%, driven by potential policy interventions, planned infrastructure investments, and advancements in chemical recycling. However, after 2040, the growth rate slows down, with only a 2.9% increase over two decades (2040–2060). This indicates that without breakthrough innovations and systemic policy changes, the global recycling rate will plateau, leaving over 80% of plastic waste still unprocessed.

It is also necessary to notice that plastic waste generation is increasing exponentially (Figure 2.1.), while the recycling rate is also increasing during the period under analysis (Figure 3.1.), resulting in a faster acceleration in recycling if we compare by volume and not by percentage.

Figure 3.1. Global plastic recycling rate (2000-2060)



Source: GPCA analysis based on OECD, 2022b

3.2. Plastic recycling rates: A global benchmark and GCC performance

The GCC countries are increasingly focusing on plastic waste management to transition towards a circular economy. Collectively, the GCC generates over 90 million tons of solid waste annually, with plastic waste accounting for approximately 10 million tons (PricewaterhouseCoopers 2020). However, only about ~10% of this plastic waste is recycled, highlighting the need for enhanced waste management strategies.

Plastic recycling rates vary significantly worldwide, with developed economies demonstrating more robust recycling systems compared to emerging markets. While countries in the European Union (EU), Japan, and South Korea have implemented stringent regulatory frameworks and circular economy strategies, other regions, including the United States and the GCC, continue to face challenges in scaling up plastic recycling (Table 3.1).

Developed markets have made notable progress in increasing recycling rates through a combination of policy enforcement, infrastructure investments, and extended producer responsibility (EPR) schemes.

Plastic recycling rates in the GCC countries remain low: They collectively recycle only about 10% of their total plastic waste, lower rate compared to the leading countries, with significant opportunities for improvement. The region faces several barriers that hinder the development of an efficient recycling ecosystem, including high plastic consumption, weak regulatory enforcement, and reliance on landfilling as the primary waste disposal method.

Table 3.1: Plastic recycling performance: A global benchmark (2022)

Region/ country	Plastic Recycling Rates	Key drivers of recycling performance
EU – 27 countries	39.7%	Strong regulations (EU Waste Framework Directive, Single Use Plastics Directive), EPR schemes, advanced recycling infrastructure
Japan	27%	Advanced chemical and mechanical recycling, strict waste separation laws and public participation.
South Korea	40%	Nationwide EPR, automated collection, high public compliance.
US	9%	Weak federal regulation, reliance on landfill, slow adoption of the principles of the circular economy.
GCC	~10%	High consumption of plastics, weak enforcement, reliance on landfill, lack of structured EPR schemes.

Source: GPCA research, 2025



3.3. Plastic recycling in the GCC: Targets vs progress

Low recycling rates emphasize the necessity for more stringent enforcement, the development of infrastructure, and the active involvement of consumers. Table 3.2 provides an overview of the plastic recycling targets set by GCC countries and their current progress in achieving these goals.

The GCC region has substantial potential to increase plastic recycling rates, but significant structural challenges must be addressed. Implementing stronger enforcement of EPR schemes, improving waste segregation at the source, and investing in advanced recycling technologies could help the region transition towards a more circular economy. Given the ambitious waste management goals outlined by various GCC governments, achieving higher recycling rates will require a combination of policy reforms, public-private partnerships, greater consumer awareness to promote sustainable waste management practices, and significant investment in infrastructure. These potential initiatives are summarized in Table 3.3.

Table 3.2: Plastic recycling targets and progress in GCC countries

Country	Plastic Recycling Rate	Recycling Targets	Challenges & Notes	Sources
Saudi Arabia	~10% (3 million tons)	50% waste diversion by 2030, 90% by 2040	Need for advanced waste sorting and recycling facilities.	(Dursun 2023), (PricewaterhouseCoopers 2020)
United Arab Emirates (UAE)	10–15%	75% of municipal waste to be recycled by 2021	High per capita plastic consumption; ongoing expansion of waste management facilities.	PricewaterhouseCoopers 2020)
Qatar	Below 15% (No exact data)	95% recycling rate by 2030 (Qatar National Vision 2030)	13–14% of MSW comprises plastics; all household waste currently goes to landfills; FIFA World Cup 2022 achieved a 100% recycling rate for event waste.	(UNEP 2024a), (Mariyam et al. 2022), (Qatar Ministry of Municipality 2024), (US International Trade Administration 2022), (Qatar Tribune 2024)
Kuwait	No official data, likely low	No official recycling target	19.8% of MSW is plastic; initiatives like Eco Star have recycled over 3.5 tons of plastic but have limited national impact.	(UNEP 2024a), (Kuwait EPA 2024)
Oman	Below 15%	60% waste utilization by 2025	~52% of recyclate is exported due to quality concerns; recyclers lack technical expertise.	(GPCA 2024), (Safa 2023)
Bahrain	No official recycling rate	No official recycling target	Focus on waste reduction rather than structured plastic recycling policies.	(GPCA 2024), (PricewaterhouseCoopers 2020)

Source: GPCA research 2025, based on the sources mentioned in the table



The GCC region has substantial potential to increase plastic recycling rates, but structural challenges must be addressed. Implementing stronger enforcement of EPR schemes, improving waste segregation at the source, and investing in advanced recycling technologies could help the region transition towards a more circular economy. Given the ambitious waste management goals outlined by various GCC governments, achieving higher recycling rates will require a combination of policy reforms, public-private partnerships, greater consumer awareness to promote sustainable waste management practices, and significant investment in infrastructure. These potential initiatives are summarized in Table 3.3.

Table 3.3: Key initiatives and investments required to achieve GCC recycling targets

Requirement	Description	Source
Substantial Capital Investment	An estimated investment of USD 60 – USD 85 billion over the next 20 years is needed across key waste streams, plastic, concrete & cement, metal, and bio-waste to develop sustainable waste management infrastructure in the GCC region.	Waste Recycling Middle East
Government-Industry Collaboration	Establishing strong public-private partnerships to co-develop infrastructure, share risks, and foster innovation in recycling initiatives.	Strategy&
Advancement in Recycling Technologies	Investing in advanced recycling technologies, such as chemical recycling, which, despite being energy-intensive, can process mixed and contaminated plastics. The GCC's low energy costs provide a strategic advantage in this area.	GPCA
Expansion of Waste Collection Systems	Enhancing waste segregation and collection infrastructure to increase access to quality plastic waste feedstock, which is currently limited in the GCC.	Strategy&
Economic and Job Creation Benefits	Achieving a 40% recycling rate could create approximately 50,000 new jobs and generate a market potential of around USD 6 billion per year in the GCC recycling industry.	Consultancy-me.com
Policy and Regulatory Frameworks	Implementing policies such as Extended Producer Responsibility (EPR) to involve producers in waste management, and establishing regulations that encourage recycling and the use of recycled materials.	GPCA
Public Awareness and Education	Raising awareness and educating the public on the importance of recycling and waste segregation to ensure the success of recycling initiatives.	Gulf Research Center
Enhancing Sorting Capabilities	Investments in advanced material recovery facilities (MRFs) and AI-powered sorting tech are seen as key to improving recycling rates. Regional collaboration and a unified policy framework can support scale and infrastructure growth.	Oman Observer

Source: GPCA research 2025, based on the sources mentioned in the table

3.4. Market disconnect in the GCC plastic recycling

Analysis of GCC plastic waste trade data between 2000 and 2023 (Figure 3.2) reveals market trends that collectively point to untapped recycling opportunities in the region. These trends demonstrate the need for strategic realignment to unlock the economic, environmental, and social benefits of a circular plastic economy.

• **Low Value Capture:** Despite handling notable volumes of plastic waste (exports peaked at 200,000 tons /year), the export value per kg remains predominantly low. This indicates GCC countries are exporting low-value segments of the waste trade, missing opportunities for higher returns through advanced recycling and upcycling. This calls for tailored recycling processes suited to regional waste streams and market demands.

• **Consumption vs. Trade Disparity:** The region's high per capita plastic consumption contrasts with modest trade volumes, suggesting much waste is landfilled or managed informally. This gap further showcases substantial untapped resources for value-generating recycling operations.

• **Net Exporter Role:** GCC countries export plastic waste at a value up to three times their import value, functioning as collection and transit points rather than processing hubs. This approach misses opportunities to:

o Build a circular economy.

o Create skilled jobs in advanced recycling.

o Reduce domestic plastic waste pollution.

o Integrate recycled materials with the region's petrochemical industry.

• **Underutilized Potential:** While the GCC has established strong petrochemical production capabilities, the development of complementary recycling infrastructure has yet to keep pace. Addressing this gap presents a valuable opportunity, especially in a global context that increasingly emphasizes resource efficiency and circularity.



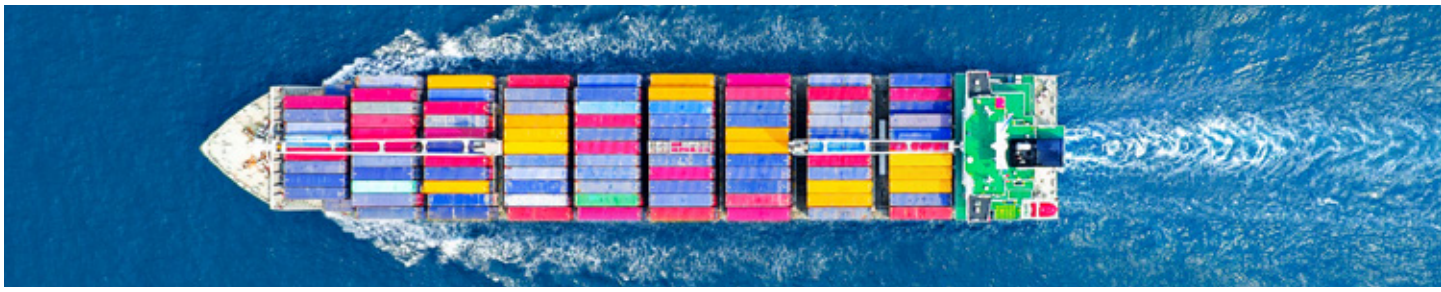
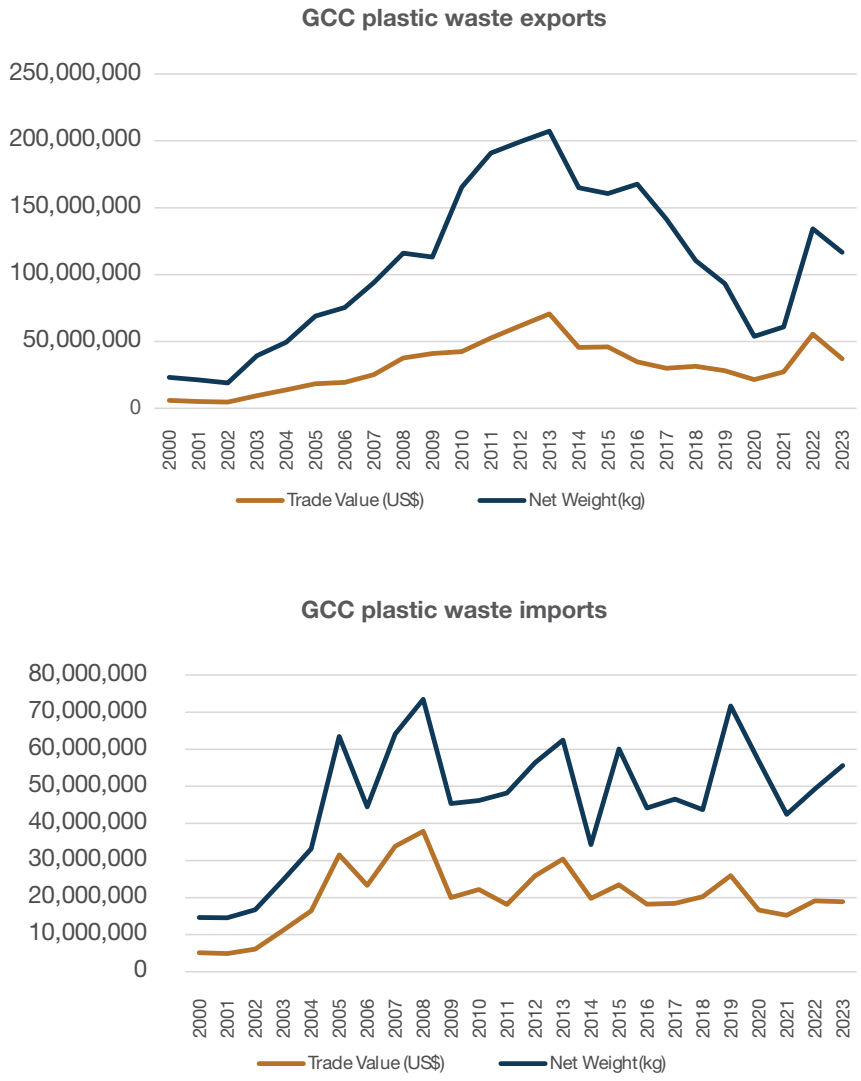


Figure 3.2: The GCC plastic waste trade (2000-2023)



Source: GPCA analysis based on UN COMTRADE database (2025)

The GCC faces a significant supply gap due to inefficiencies in collection, sorting and quality control, despite growing demand for post-consumer recycled plastics driven by corporate sustainability commitments and government mandates.

For example:

- Coca-Cola: Aims to increase recycled plastic use in their primary packaging globally to 30% - 35% by 2035 (Coca Cola 2025).
- Unilever: Committed to reducing virgin plastic use by 30% by 2026, and 40% by 2028, and use 25% recycled plastic in their packaging by 2025 (Unilever 2024).
- Nestlé: Plans to make 100% of its packaging recyclable or reusable by 2025 and to reduce virgin plastic use by one-third (Nestle 2018).

It is anticipated that the demand for recycled plastics in the GCC will experience substantial growth in the forthcoming years, driven by market expansion and heightened consumer awareness of sustainability issues. The GCC recycled plastics market is projected to reach USD 1.6 billion by 2033, with a CAGR of 7.4% between 2025 and 2033. This projected growth is indicative of a broader regional shift towards a circular economy and the increased adoption of recycled materials across various industrial sectors (IMAC 2024).

4. Global and Regional Plastic Waste Regulations

Given the adverse effects of plastic waste, regulations to minimize its impact have been evolving rapidly. On a global level, managing plastic waste is covered in several international fora, including the Basel Convention, a key international treaty aimed at minimizing the negative impact of waste on human health and the environment. When it entered into force in 1992, plastic waste was not the primary focus of the Convention. However, the growing concern about plastic pollution and unmanaged recycling guided the 2019 Plastic Waste Amendments (enforced in 2021), putting more control on the movement of plastic waste across international boundaries and increase domestic processing and recycling. The amendments classify plastic waste into three categories as seen in Table 4.1 which determines the level of control applied.

Table 4.1: Basel convention plastic waste amendments

Category	Basel Annex	Type of Plastic Waste	Control requirements
Non-hazardous clean and sorted plastics	Annex IX	Single polymer streams (e.g. clean PET, PP, etc.) intended for recycling	Not subject to Prior Informed Consent (PIC)[1]
Mixed or contaminated plastic waste	Annex II	Difficult-to-recycle mixtures or contaminated wasted	Subject to PIC
Hazardous plastic waste	Annex VIII	Waste containing additives or residues that are toxic, flammable, corrosive, etc.	Subject to strict control under PIC

[1]The PIC mechanism requires that any party exporting hazardous wastes must properly inform the importing party and seek consent to trade.

Source: Authors based on Basel Conventions

Plastic waste management also intersects with the United Nations Sustainable Development Goal (SDG) 12, which focuses on "Responsible Consumption and Production." SDG 12 targets significantly reducing waste generation through the circular economy framework, adopting sustainable practices, and integrating sustainability reporting.

On a national level, many countries have implemented national-level regulations to control plastic waste, especially since the adoption of the Basel Convention Plastic Waste Amendments. The laws vary in scope, ambition, and enforceability but commonly include bans on single-use plastics, extended producer responsibility schemes, plastic taxes, and recycling targets.

The GCC member countries have recognized that waste management will be an integral part of their societies, given their projected economic and population growth, to enhance the quality of living and meet national environmental targets. Moreover, the ambition toward circularity provides opportunities to achieve greater efficiency, create new jobs, and attract green investments (Hasan 2023). While waste management programs and new entities have been initiated to deal with waste management in the respective countries, dedicated policies on minimizing plastic waste and plastic recycling are needed as supporting measures.

So far, the focus of legislation in GCC member countries has been on the ban on single-use plastic products as Table 4.2 shows. The region continues to develop legal instruments at the national and local levels to combat plastic pollution, focusing on region-specific legislative tools.



Table 4.2: Plastic waste regulations in the GCC

Country	Decision/ Legislation	Title	Policy date/ Effective date	Description	Sources
UAE	Ministerial Resolution No. (380) of 2022	Ministerial Decree regarding regulating the use of single-use products in the UAE markets	January 1, 2024	Prohibition of the import, production, or circulation of single-use plastic shopping bags	التشريعات | وزارة التغير المناخي والبيئة – الامارات العربية المتحدة (moccae.gov.ae)
			January 1, 2026	Prohibition of the import, production, or circulation of other single-use plastic products	
	Executive Council Resolution No. (52) of 2022	Concerning the Reduction of the Use of Single-use Bags in the Emirate of Dubai	July 1, 2022	Mandate to reduce the utilization of single-use bags in the Emirate of Dubai	Executive Council Resolution No. (52) of 2022 Concerning Reduction of the Use of Single-use Bags in the Emirate of Dubai
	Executive Council Resolution Decision No. (124) of 2023	Regulate the Use of Single-use plastics in the Emirate of Dubai	December 31, 2023	Regulate the usage of single-use products in the emirate of Dubai	الدليل التوعوي لتنظيم استخدام المنتجات ذات الستخدام الواحد في إمارة دبي (dm.gov.ae)
	Law No. (4) of 2023	On Prohibiting Single-use Plastic Items in the Emirate of Ras Al Khaimah	March 13, 2023	Prohibits to bring, hold, trade, sell or use single-use plastic items in Ras Al Khaimah	Legislation Search (rak.ae)
Saudi Arabia	Technical Regulation M.A-156-16-03-03	Technical Regulation for Degradable Plastic Products	October 14, 2016	Obligate products manufactured from polypropylene and polyethylene plastics are OXO degradable then bio-degradable	SASO-Technical-Regulations-English.pdf
Qatar	Ministry of Municipality Decree No. (143) of 2022	Regulating the Use of Plastic Bags	July 3, 2022	Prohibitions to institutions, companies, and shopping centers from using single-use plastic bags in packaging, serving, trading, and carrying products and goods of all kinds.	الميزان | البوابة القانونية القطرية | التشريعات | قرار وزير البلدية رقم (١٤٣) لسنة ٢٠٢٢ بضوابط إستعمال الأكياس البلاستيكية (almeezan.qa)
Oman	Ministerial Decree No. 23/2020	Regarding Banning the Use of Single-Consumption Plastic Shopping Bags	-	Companies and institutions are prohibited from using single-use plastic shopping bags	وزارة البيئة والشؤون المناخية: قرار وزاري رقم ٢٣ / ٢٠٢٠ بشأن حظر استخدام أكياس التسوق البلاستيكية – أحادية الاستهلاك Qanoon.om
Bahrain	Ministry of Industry, Commerce and Tourism -Ministerial Order No. (14) of 2022	Regarding the use of single-use plastic bags	September 18, 2022	Prohibits manufacturing, importing, and circulation of single-use plastic bags with a thickness below 35 microns	Ministry of Industry and Commerce (moic.gov.bh)
Kuwait	Circular No.8/2019	Plastic Substance and Waste (onboard ships)	January 1, 2020	Prohibition of Single-use Plastics to be used on board Kuwaiti ships and foreign ships when such ships are at a port or place in Kuwait	https://www.classnk.or.jp/hp/pdf/activities/statutory/ism/flag/kuwait/ism_kuwait_circ-08-2019.pdf

Source: KAPSARC research 2025

Consumer awareness and providing avenues for ease of recycling within households and commercial entities are needed to encourage higher recycling rates. Financial incentives may be required in the early stages of implementation while putting in place a regulatory framework for extended producer responsibility schemes could ensure long-term circularity of the plastics life cycle.

In order to build upon the progress and ambitions set by GCC countries to enhance plastic recycling and reduce plastic waste, it is essential to examine how other regions and nations around the world are tackling this global challenge. A comparison of regional and international policies provides valuable insight into emerging trends, regulatory frameworks, and potential best practices that could inform future initiatives in the GCC and beyond. Table 4.3 offers a concise overview of key global regulations that have been designed to manage plastic waste, including the respective timelines for implementation and the overarching objectives of each policy.

Table 4.3: Overview of global regulations on plastic waste management

Country	Decision/ Legislation	Title	Policy date/ Effective date	Description	Sources
European Union	Directive (EU) 2019/904	Single-Use Plastics Directive	July 3, 2021	Bans certain single-use plastic products, reduces consumption of others, and promotes sustainable alternatives.	European Commission
Canada	Canadian Environmental Protection Act, 1999 (Amendment)	Single-Use Plastics Prohibition Regulations	December 20, 2022	Prohibits manufacture, import, and sale of specific single-use plastics, including straws, cutlery, and foodservice ware made from problematic plastics.	Government of Canada
India	Ministry of Environment, Forest and Climate Change Notification	Plastic Waste Management Amendment Rules, 2021	July 1, 2022	Bans identified single-use plastic items, including cutlery, straws, and certain types of packaging.	India Today
United States (Federal)	Microbead-Free Waters Act of 2015	Microbead-Free Waters Act	July 1, 2017	Bans the manufacture and sale of rinse-off cosmetics containing plastic microbeads.	U.S. Congress
United States (State Level)	Varies by state	Various State-Level Bans on Single-Use Plastics	Varies by state	Multiple states, including California and New York, have enacted bans on single-use plastic bags and other items.	National Conference of State Legislatures
Kenya	National Environment Management Authority Directive	Plastic Carrier Bags Ban	August 28, 2017	Imposes a ban on the use, manufacture, and importation of plastic bags used for commercial and household packaging.	United Nations Environment Programme
China	National Development and Reform Commission & Ministry of Ecology and Environment Policy	Plastic Pollution Control Action Plan	January 1, 2021	Phases out non-degradable plastic bags in major cities and bans single-use straws nationwide.	Reuters
Thailand	Ministry of Natural Resources and Environment Notification	Ban on Plastic Waste Imports	January 1, 2025	Prohibits the import of plastic waste to curb toxic pollution and promote environmental sustainability.	The Guardian
New Zealand	Waste Minimisation (Plastic Shopping Bags) Regulations 2018	Plastic Shopping Bags Ban	July 1, 2019	Bans the provision of single-use plastic shopping bags to customers.	New Zealand Ministry for the Environment

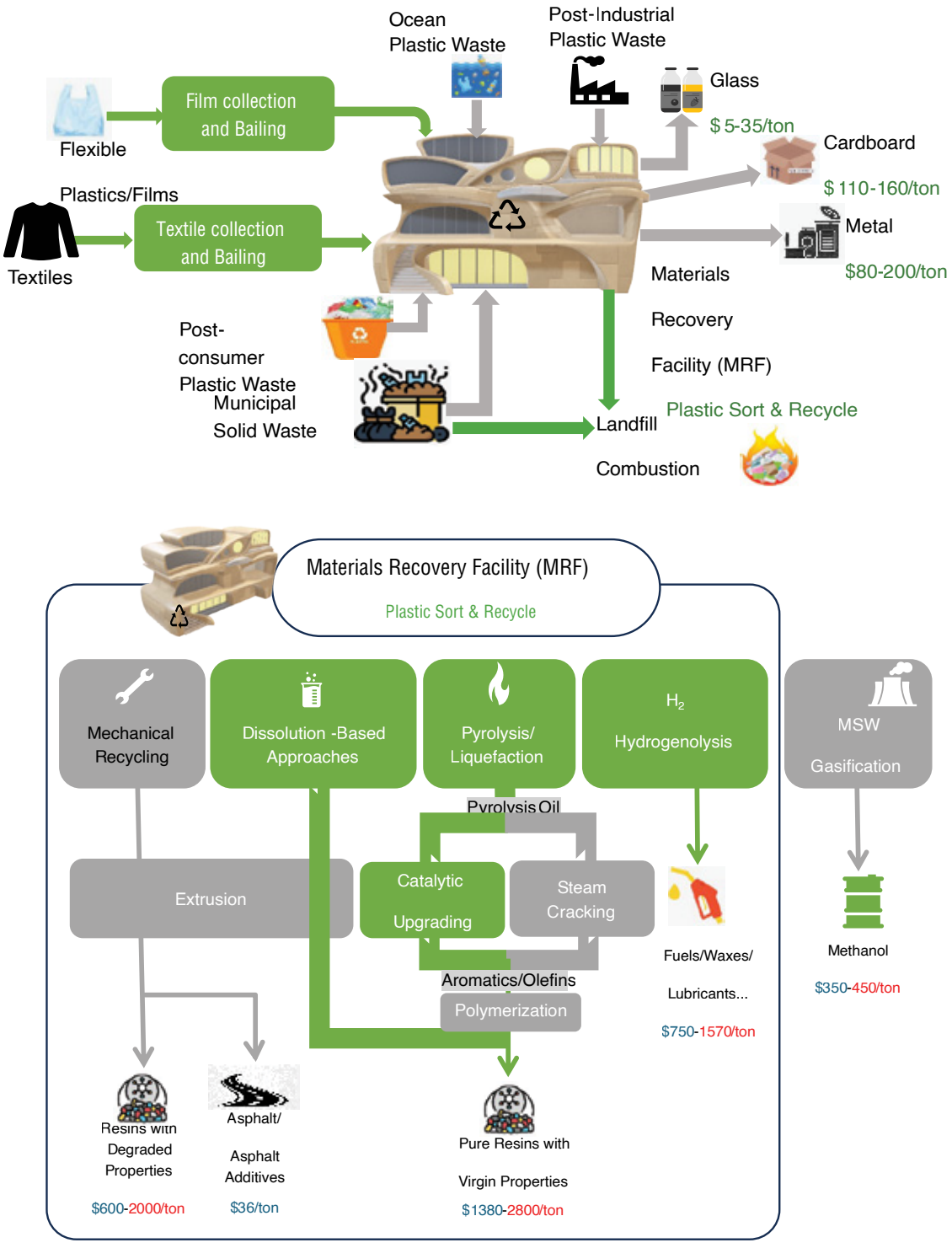
Source: GPCA 2025, based on the sources mentioned in the table

5. Technological Innovations for The GCC Plastic Recycling

5.1. Introduction to plastic recycling technologies

New technologies are being used to recycle plastic waste, either through mechanical recycling for polymer reuse or chemical recycling to produce hydrocarbon feedstock, with energy recovery as a last option (Lange 2021). The recycling process begins with sorting at a material recovery facility (MRF), where waste is separated into categories like post-industrial, post-consumer, municipal, and ocean plastics (Figure 5.1) (Li et al. 2022). Despite sorting, plastic waste remains highly heterogeneous, often containing a mix of polymers, foreign materials, and non-plastic residues. Multilayered films are especially difficult to recycle. Cleaning and washing are crucial steps before recycling to remove contaminants and harmful substances.

Figure 5.1. Summary of the current management system of waste plastics



Source: KAPSARC based on (Li et al. 2022)

This type of plastic significantly impacts its reuse potential due to differences in toxicity and the suitability of available recycling technologies (Table 5.1). Although plastic waste can be recycled into feedstock for new products, the quality of recycled polymers is usually lower than that of virgin materials. Growing concerns over plastic waste have prompted the development of various recycling methods, primarily aimed at producing new polymer or hydrocarbon feedstocks. Recycling is defined as the transformation of discarded solid waste into new, sellable products (Patel 2023). Recycling technologies fall into three main categories: mechanical, chemical, and biological, with specific techniques used depending on the plastic type and recovery goal.

Table 5.1. Plastic recycling methods—Categories, technologies, and resulting feedstock

Category	Technology	Description	Feedstock
Mechanical	Melt, filtration, and extrusion.	Plastic waste is melted to remove impurities and then passed through an extruder to form plastic pellets.	Plastic pellets. Low-quality feedstock.
Mechanical	Flake to preform	Preforms are made by flaking, decontaminating, melting, and filtering the plastic, then directly feeding the molten material into an injection molding machine—bypassing the pelletizing step altogether.	Predesigned final product based on flakes. Low-quality feedstock.
Mechanical	Purification/ Dissolution	Plastic is dissolved in a solvent and purified to separate the polymer from additives and contaminants, after which the polymers are selectively crystallized.	Flake and plastic pellets, medium quality product.
Chemical	Chemolysis	Agents like methanol, glycol, or water are used to break down plastics into their original monomers.	Monomers that form polymers. High-quality product.
Chemical	Non-catalytic thermal pyrolysis	Decomposition of plastic waste through thermal mechanisms in the absence of oxygen to produce plastic oil.	Plastic oil
Chemical	Catalytic pyrolysis	Adding a catalyst to the decomposition of plastic waste in the absence of oxygen to enhance yield, operating window, and other performance metrics.	Plastic oil products
Chemical	Plasma pyrolysis	The combination of traditional pyrolysis with plasma-based thermochemical reactions to rapidly convert plastic waste into synthesis gas.	Plastic gas, hydrogen, methane, ethylene.
Chemical	Hydrothermal recycling	Employs water at high pressure and temperature to break long hydrocarbon chains in plastics, producing oils and chemicals that can be refined into virgin monomers and reused to make new plastics.	Hydro char, plastic oil, plastic gas, hydrogen, methane.
Chemical	Gasification	Involves processing plastic waste in a gasifier under high temperatures or pressures, with limited oxygen or steam, to generate synthesis gas, which can be chemically transformed into monomers.	Synthetic gas
Biological	Enzymatic hydrolysis	A novel biological method combines a plastic-degrading enzyme found in waste-dwelling bacteria with another enzyme, PETase, to accelerate the breakdown of plastic into its basic monomer components.	Polymers and monomers. Emerging technology

Source: Patel 2023

When mechanical recycling is not feasible, chemical recycling can be used to depolymerize plastics back into their original feedstock components. The choice between recycling technologies depends on various factors, including the type of polymer and its intended application.

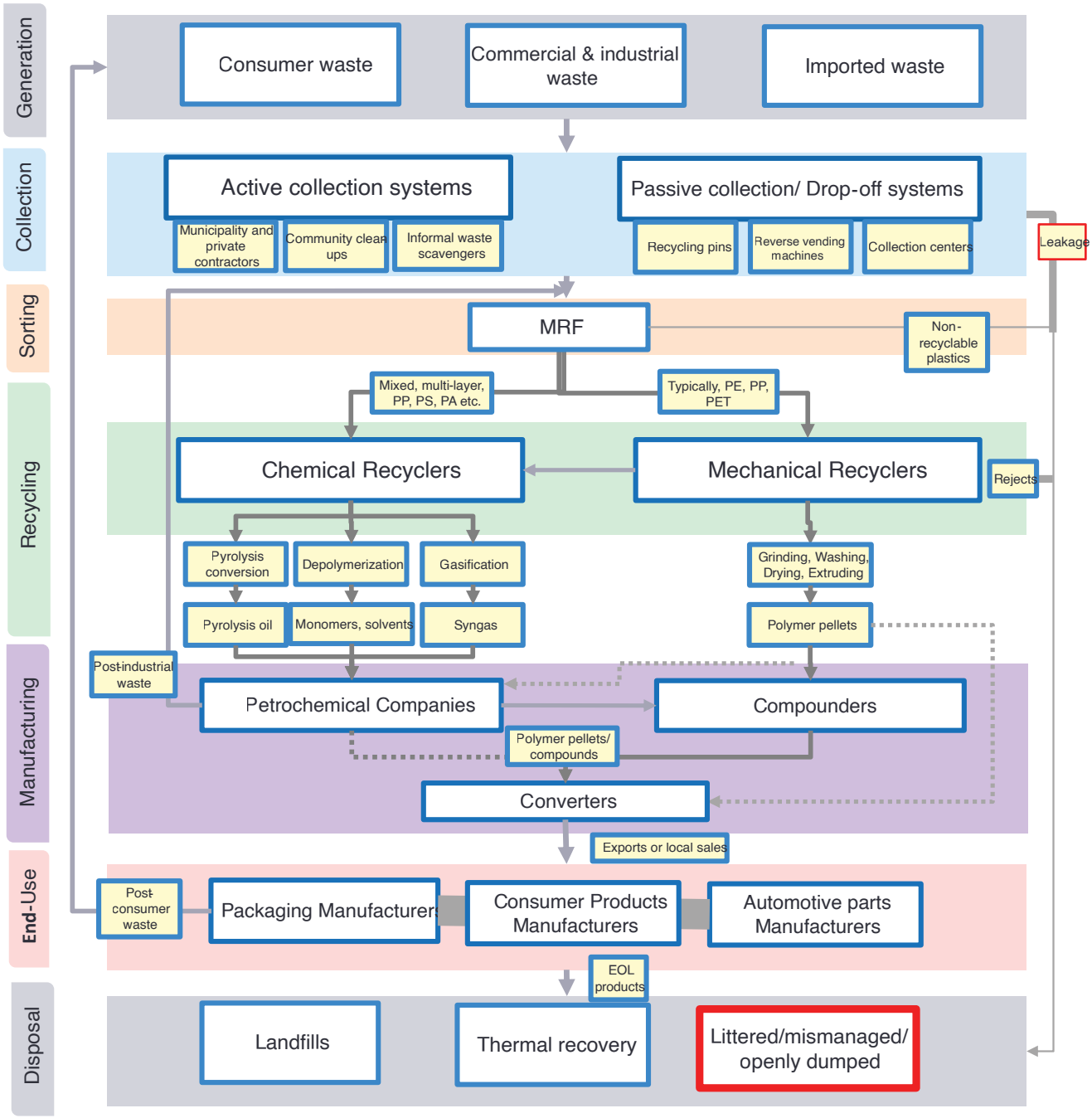
5.2. Plastic recycling value chain

The value chain for plastics recycling in the GCC, like in many other parts of the world, is a complex and dynamic system that needs optimization to maximize material recovery and minimize environmental impact (Figure 5.2). It all starts at the generation phase, where waste products originate from both household and non-household sources.

As mentioned before, in the GCC countries, plastic waste is also collected through municipal, private, and community systems and sent to Material Recovery Facilities (MRFs) for sorting. Non-recyclable plastics, often contaminated or made of complex materials, are sent to landfills or incinerated. Recyclable plastics are processed through either mechanical or chemical recycling, depending on the waste type.

Mechanical recycling is suitable for clean, single-type plastics like PET, HDPE, and PP, converting them into polymer pellets for use by compounders or converters. Chemical recycling, including depolymerization, pyrolysis, and gasification, is used for more complex or mixed plastics, producing raw materials like monomers or pyrolysis oil for reprocessing. The choice between using products from petrochemical companies or compounders depends on the final product's needs, formulation complexity, and cost. Recycled plastics are increasingly used in various markets due to sustainability efforts, including packaging, automotive parts, construction materials, and textiles.

Figure 5.2: Plastic recycling value chain



Source: GPCA analysis (2025)

An ideal plastic recycling value chain in the GCC requires efficient sorting and recycling, integration across stakeholders, and strong coordination from waste generation to end use. The region's high plastic consumption and poor source segregation hinder recycling efforts. Collection systems are fragmented, and much recyclable plastic is lost due to leakage or export. Smart collection technologies and formalized systems could improve recovery.

Material Recovery Facilities (MRFs) in the GCC often have limited capacity and struggle with contamination. Advanced sorting tech like AI could improve results. Mechanical recycling is more established but limited by downcycling; integrating chemical recycling (e.g., pyrolysis, gasification, depolymerization) can handle complex plastics and create a circular economy. Recycled plastics can be blended with additives by compounders to enhance quality and broaden applications.

The petrochemical industry in the GCC, currently reliant on virgin plastics, can partly shift to recycling with technological and market developments. "Design for Recyclability" (DfR) and integrated facilities can improve outcomes. Post-industrial waste, being cleaner, can be efficiently reprocessed.

The region still heavily relies on landfilling. Recycling and waste-to-energy systems must replace landfills to minimize environmental impact. Thermal recovery of non-recyclable plastics can support recycling operations by supplying energy.

To realize a circular economy, the GCC needs strategic investments, policies, consumer education, collaboration, and cost-effective transitions. Experts (GPCA 2023) highlight barriers such as low public awareness, informal collection, poor sorting, and limited disposal infrastructure. Despite some progress, especially in acquiring chemical recycling facilities, major improvements are still required.

5.3. Mechanical recycling

Mechanical recycling of plastic waste is the most straightforward recycling technology available. It involves physical separation through mechanical processes such as sorting, shredding, washing, drying, melting, and pelletizing. A key characteristic of this recycling method is that it does not alter the chemical structure of the plastic, allowing multiple reuses of the polymeric material (TWI 2024). The following lines provide a short description of some mechanical recycling methods.

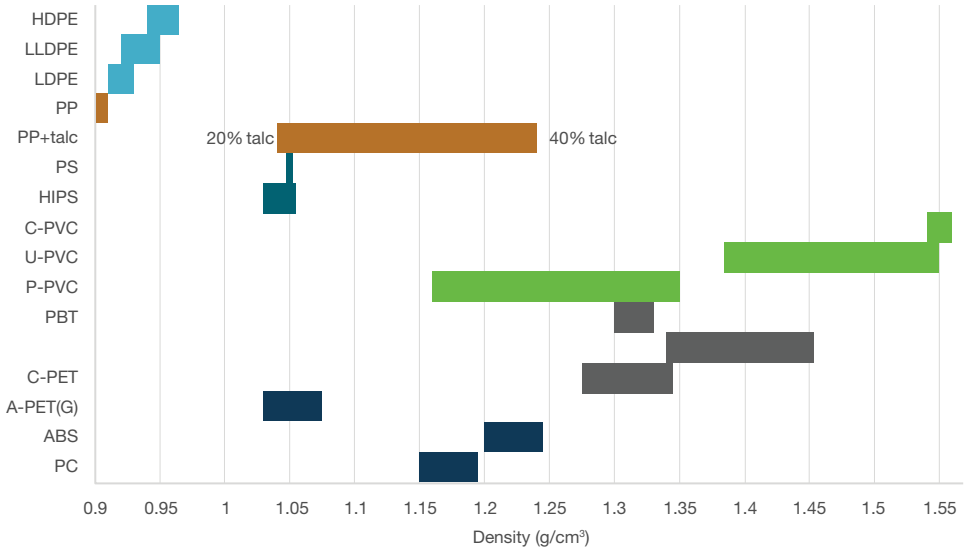
5.3.1. Sorting process

Plastic waste is sorted by resin type (e.g., PET, HDPE, PP) using both manual and automated methods. Advanced technologies like near-infrared (NIR) spectroscopy and flotation techniques improve sorting efficiency and accuracy.

Common sorting methods include:

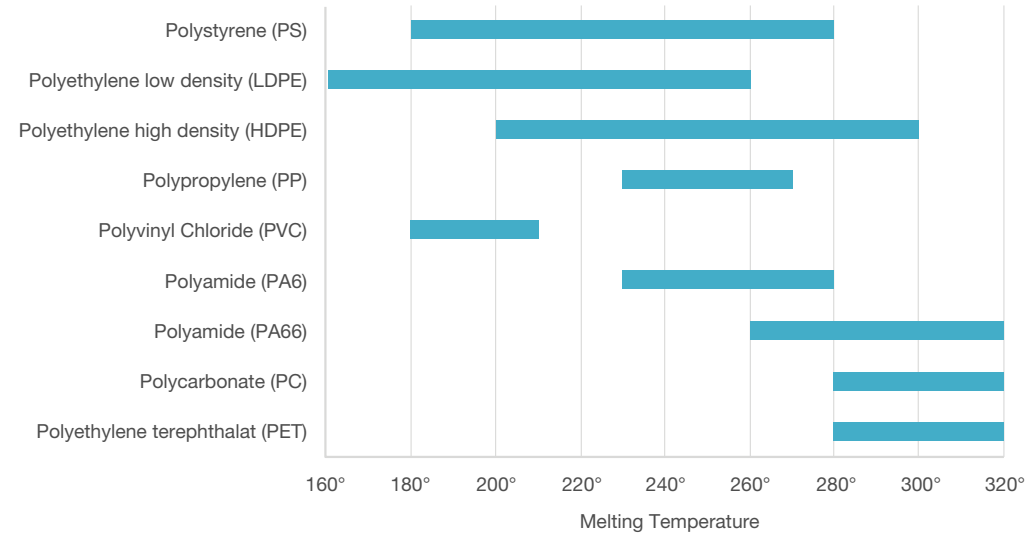
- Manual Sorting: Trained operators manually separate materials.
- Flotation Sorting: Also known as float-sink separation, this method relies on density differences between polymers to achieve separation. In some cases, denser liquids may be used to improve separation efficiency (Ragaert, Delva, and Van Geem 2017). Typical density ranges of common polymers are shown in Figure 5.3.
- Melt filtration: It is an essential technique used to remove non-melting plastic/polymers from molten contaminants during regranulation or subsequent reprocessing. One key challenge is the overlap in melting points and processing temperatures between different polymers in mixed plastic waste (Figure 5.4). This can lead to overheating, causing material degradation.
- Tribo-Electric (Electrostatic) Separation: Polymer flakes are charged by collision in a charging unit, causing one polymer to acquire a positive charge while the other either remains neutral or gains a negative charge (Ragaert, Delva, and Van Geem 2017).
- Froth Flotation: Also known as selective flotation separation, froth flotation is another technique used to separate polymers with similar densities.
- Magnetic Density Separation (MDS): It is an advanced density-based technique adapted from the mineral processing industry. This method utilizes a magnetic liquid containing iron oxide as the separation medium.
- X-ray Detection: It is particularly useful for the separation of PVC containers due to their high chlorine content, which makes them easily distinguishable from other plastics.

Figure 5.3. Density ranges of some of the most common polymers found in plastic waste



Source: Ragaert, Delva, and Van Geem 2017

Figure 5.4. Range of processing temperatures for common plastics



Source: Ragaert, Delva, and Van Geem 2017

5.3.2. Shredding

The sorted plastics are shredded into smaller flakes or granules to facilitate further processing. This step increases the surface area, making subsequent cleaning and melting processes more effective.

5.3.3. Washing and drying

The shredded plastics undergo washing to remove contaminants, such as dirt, labels, and residual chemicals. This step helps maintain the quality of the recycled material. After washing, the plastic is dried to eliminate moisture.

5.3.4. Melting and pelletizing

The clean, dry plastic flakes are melted and extruded into pellets or granules, which serve as raw materials for manufacturing new plastic products. During this process, additives may be introduced to enhance the properties of the recycled plastic.

5.4. Chemical recycling

Chemical recycling refers to a range of technologies that use chemical processes to recycle plastics, especially those unsuitable for mechanical recycling (e.g., films, laminated or mixed plastics). It supports the circular economy by converting hard-to-recycle plastics into feedstocks, sometimes enabling the production of virgin-quality plastic.

Unlike mechanical recycling, which uses physical processes, chemical recycling breaks down plastics chemically into fuels or raw materials for new plastic and industrial chemicals. The three main types are:

- Pyrolysis.
- Gasification.
- Depolymerization

These processes operate under controlled temperature and pressure, often using chemical catalysts to enhance efficiency.

5.4.1. Pyrolysis

Pyrolysis is a thermal process that breaks down plastic polymers into simpler molecules (e.g., pyrolysis oil and gases) at 300–650 °C in an oxygen-free environment. It's mainly used for recycling polyolefins (PE, PP) and polystyrene (PS) from packaging, films, and other mixed plastic waste. If the oil produced contains monomers (especially from PS), it can be reused for plastic production. Otherwise, it may serve as feedstock in steam crackers or refineries.

There are two types of pyrolysis:

- **Pure thermal pyrolysis:** Uses only heat.
- **Catalytic pyrolysis:** Uses catalysts to lower temperature requirements and improve efficiency.

Despite its ability to handle mixed or contaminated waste, pyrolysis has limitations. The output often needs pre-treatment and hydrogen-based upgrading to meet quality standards. Even from clean inputs, pyrolysis produces a mix of hydrocarbons that require further purification for polymer production.

5.4.2. Gasification

Gasification differs from pyrolysis in that it produces a gaseous output (syngas) instead of a liquid product. It involves reacting plastic waste with gasifying agents like steam, oxygen, or air at high temperatures (500–1300 °C), resulting in syngas, a mixture primarily composed of hydrogen (H_2) and carbon monoxide (CO).

The process includes: Drying and depolymerization of plastic in a hot reactor.

Introduction of a gasifying agent, triggering:

- Homogeneous reactions (gas-gas)
- Heterogeneous reactions (gas-solid)

Syngas is a valuable industrial feedstock and can be used in existing chemical production systems.

Gasification operates in two modes:

- Autothermal: Generates heat internally via partial oxidation of feedstock.
- Allothermal: Uses steam as the agent, with heat supplied externally—no oxidation occurs.

Besides H_2 and CO, gasification produces methane, short- and long-chain hydrocarbons, and aromatic compounds. The final gas composition may vary depending on the plastic feedstock and its chemical content (e.g., heteroatoms).

5.4.3. Depolymerization

Depolymerization consists of liquid solvent-specific methods that break specific polymer bonds under controlled temperatures and pressures. In this process, solid plastic dissolves into a liquid-phase solvent, leading to the breakdown of polymer molecules into smaller components—monomers or oligomers. The type of solvent used (e.g., methanol, ethylene glycol, or water) determines the specific monomers or oligomers obtained, as the chemical agent dictates the scission of polymer chains.

The effectiveness of depolymerization depends on the selected chemical agent. Table 5.2 outlines different depolymerization methods for polycondensates such as polyesters (PET) and polyamides.

Table 5.2. Characteristics of different depolymerization types & methods

Parameter	Glycolysis	Hydrolysis	Aminolysis	Methanolysis
Temperature [°C]	180–240	Ambient – 300	20–190	180–280
Pressure [bar]	Ambient conditions	Ambient – 40	Ambient – 20	20–40
Chemical agent	Glycols (EG, ...)	Water or steam (neutral hydrolysis)	Ammonia or amines (ethanolamine, allylamine, polyamines)	Methanol
Mechanism	Glycol diffuses in polymer structure, swells up - reaction of glycols with ester bonds	H^+ and CH^- break PET molecules apart in ester groups	Nucleophilic reaction of organic amine with PET ester bonds - polymer chain scission	Trans-esterification by methanol
Process conditions	High specific area beneficial - use of catalysts	Acidic, neutral, or alkaline media are used	PET as powder or fibers for higher specific area	Catalyst (zinc, magnesium) to assist trans-esterification
PROs	Broad field of product applications possible	Lower energy demand than glycolysis and methanolysis	High yield and purity of bis(2-hydroxyethyl) terephthalamide (BHETA)	Products have higher purity than glycolysis products
CONs	Immiscibility of PET with the polyols	Terephthalic acid (TPA): low purity	Amines are often toxic; long reaction times	No broad field of product application; high pressure - batch processing

Source: (Biessey et al. 2023)



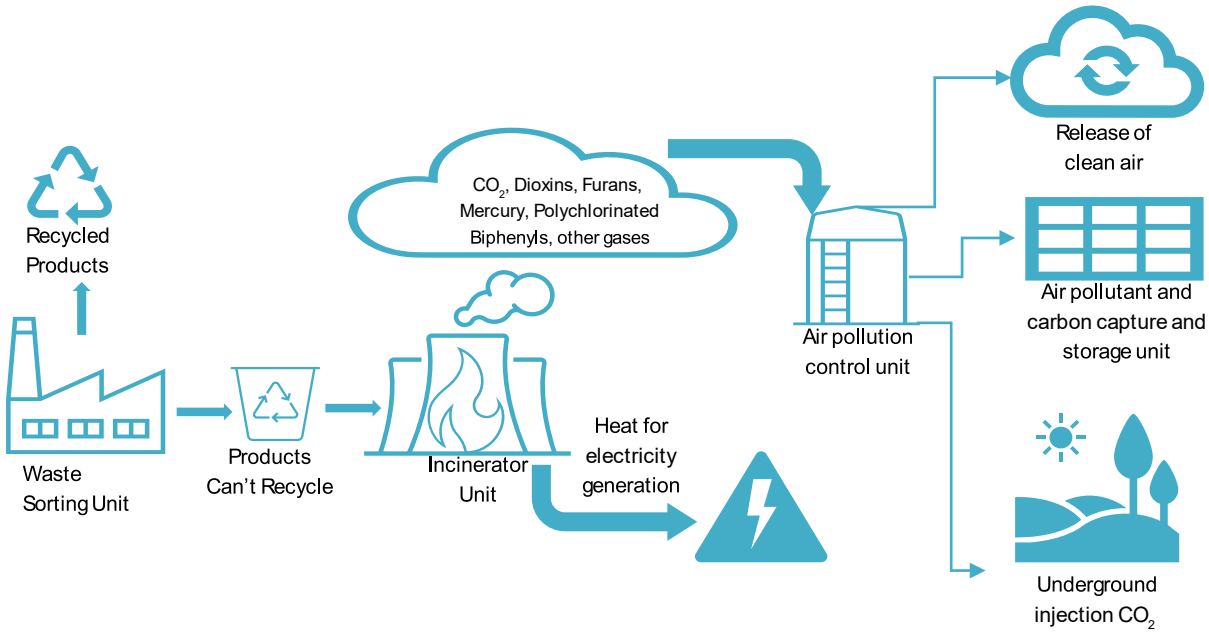
5.4.4. Incineration

The classification of incineration as a chemical recycling method remains a topic of debate due to the lack of clear legislation. This report presents incineration as an alternative for thermally recycling plastic waste, emphasizing that, technically, it follows thermochemical principles.

Incineration is primarily conducted using refuse-derived fuels (RDF) (Verma et al. 2016), commonly utilized in cement plants and RDF power plants. In both cases, incineration and pyrolysis, the process occurs under controlled conditions, allowing regulation of oxygen levels. However, open incineration, which lacks such controls, generates high volumes of toxic gases and is not recommended. Despite this, some conventional waste incineration plants still use open incineration for sorting residues and low-grade waste fractions.

In all incineration scenarios, only the chemical energy in the waste is released and used for industrial energy, heat, or electricity generation. The primary by-products, aside from residual ash, include H_2O and CO_2, along with other undesirable emissions, as shown in figure 5.5. Ideally, incineration should only be applied to non-recyclable plastic waste (Verma et al. 2016).

Figure 5.5. Plastic waste incineration and pollution typical treat



Source: KAPSARC

5.4.5. Chemical recycling challenges and limitations

While chemical recycling offers numerous advantages, its success depends on capital investment and infrastructure development to support advanced technological solutions. These innovations can help address key challenges, including:

Low Recycling Levels. Critics argue that chemical recycling does not yet achieve its full potential. However, this limitation is not due to the technology itself but rather to inadequate collection and sorting infrastructure. The lack of efficient plastic waste collection and sorting systems prevents chemical recycling from reaching higher efficiency levels.

Pollution Concerns. Certain chemical recycling methods produce liquid and gaseous byproducts that require proper treatment before environmental release. The high tolerance for contaminated feedstock has, in some cases, led to negligence in sorting practices, resulting in impurities in the final product or hazardous emissions. However, when best practices in collection, sorting, and recycling are followed, chemical recycling technologies have been proven safe and effective.

Many processes require significant investment and infrastructure development to become commercially viable. Additionally, environmental risks must be carefully managed to ensure true sustainability.

Case studies illustrating business models for plastic recycling in GCC countries

The implementation of effective business models has significantly advanced plastic recycling initiatives in the GCC. These strategies promote environmental sustainability and also unlock significant economic opportunities. The following are notable case studies that illustrate successful approaches by value chain segment across the GCC.

Table 5.3: Plastic recycling initiatives in the GCC: key ongoing projects and progress

Company/ Initiative	Country	Business Model	Revenue Streams	Impact	Year	Status	Value Chain Segment	Exact Recycling Technology
SABIC's TRUCIRCLE	Saudi Arabia	Closed-loop recycling model - SABIC collects mixed plastic waste, processes it via chemical recycling, and reintegrates it into its product portfolio under the TRUCIRCLE initiative.	Sale of recycled plastics and polymers under the TRUCIRCLE, partnerships with companies for sustainable packaging solutions.	Supports circular economy in petrochemicals, reduces dependency on virgin plastics, and promotes sustainability in the industry.	2019	Active	Chemical Recycling (Advanced Processing)	Chemical depolymerization and pyrolysis to convert mixed plastic waste into virgin-quality polymers.
DGrade - Simply Bottles	United Arab Emirates	Circular economy model - DGrade collects PET plastic bottles, converts them into sustainable clothing and accessories, and collaborates with businesses for bottle collection.	Revenue from selling recycled PET textiles, collaboration with corporate partners for bottle collection programs.	Reduces plastic waste in landfills, supports sustainable fashion, and promotes corporate responsibility for plastic waste.	2017	Active	Mechanical Recycling (Collection & Reprocessing)	Mechanical PET recycling - washing, shredding, and reprocessing PET bottles into textile fibers.
Saudi Investment Recycling Company (SIRC)	Saudi Arabia	Integrated waste management model - SIRC manages the full waste value chain, from collection to advanced recycling and waste-to-energy conversion, aiming for high landfill diversion rates.	Government funding, waste processing contracts, and revenue from energy recovery and secondary raw materials.	Aims for 94% landfill diversion by 2035, significantly increasing Saudi Arabia's recycling capacity.	2017	Active	Integrated Waste Management (Sorting & Processing)	Advanced pyrolysis, gasification, and mechanical recycling for mixed plastic waste conversion.
be'ah Plastic Waste Management Program	Oman	Public-private partnership model - be'ah partners with private companies and municipalities to enhance plastic waste collection and processing through mechanical and chemical recycling.	Public funding, partnerships with private waste management firms, and revenue from recycled material sales.	Enhances recycling infrastructure in Oman, reducing reliance on landfilling and promoting sustainable waste management.	2017	Active	Public-Private Partnership (Collection & Sorting)	Hybrid mechanical and chemical recycling for high-value plastic material recovery.
Oman's PET Recycling Plant near Sohar Port	Oman	Industrial-scale recycling model - The upcoming PET recycling plant near Sohar Port is designed to process large quantities of plastic waste, contributing to Oman's circular economy efforts.	Revenue from processing fees, partnerships with businesses using recycled PET, and government incentives.	Expected to process a significant portion of Oman's plastic waste, reducing environmental impact and creating economic opportunities.	Scheduled (2025)	Upcoming	Industrial-Scale PET Recycling (Processing & Reuse)	High-efficiency PET washing, flake processing, and re-extrusion for food-grade applications.

Source: GPCA research 2025

6. Economic Viability of Plastic Recycling in the GCC

6.1. Investment required and cost structure

A transition towards a circular plastic economy in the GCC will necessitate substantial capital investment. According to Strategy& (PwC), the estimated financial requirement across all key waste streams in the GCC over the next 20 years is projected to be in the range of USD 60–USD 85 billion. Plastic waste is projected to account for 20% to 30% of this figure, translating into an investment range of USD 12–USD 25 billion by 2045.

A country-level breakdown of annual investment needs based on population size, plastic waste volume, and existing infrastructure suggests the following:

Table 6.1: GCC country-level breakdown of plastic recycling investment needs (USD million/year)

Country	Share of Total Plastic Waste & Infrastructure Needs	Allocated % of total GCC required Investments	Control requirements
Saudi Arabia	~45–50% of GCC plastic waste (highest population and waste volume)	~55%	$700–900 million/year
United Arab Emirates	~20% share (high per capita waste, strong government-led plans e.g., Tadweer, EPR in Dubai)	~25%	$300–400 million/year
Qatar	~10–12% (moderate total waste, high GDP per capita, FIFA 2022 legacy, 2030 targets)	~7.5%	$100–150 million/year
Oman	~10–12% (moderate waste, improving infrastructure via be'ah and private sector)	~7.5%	$100–150 million/year
Kuwait	~7–8% (moderate population and GDP, weak waste segregation, reliance on landfill)	~3%	$40–60 million/ year
Bahrain	~3–4% (smallest population, limited infrastructure, no formal EPR yet)	~2%	$30–40 million/ year

Source: GPCA analysis 2025, based on World Bank and GCC Stat data

Note: The proportions were applied to the annualized GCC-wide plastic waste investment estimate of $1.2 billion (upper bound of PwC's range). To estimate the annual investment, we used a composite index using four indicators: (1) Total plastic waste generation (weighting 35%) representing the primary driver of infrastructure need, (2) Population size (weighting 25%) representing a proxy for future waste generation and service scale, (3) Infrastructure readiness (weighting 20%), representing a gap analysis to reflect required build-out, and (4) GDP share (weighting 20%) representing the ability to finance and attract investment. These weights are calculated following international best practices by OECD Handbook on Constructing Composite Indicators (2008), the UNDP Human Development Index methodology, and the Environmental Performance Index by Yale and Columbia Universities

As with any product, the economic cycle of plastic includes not only production and distribution but also the collection and treatment of waste generated from plastic use, in order to complete the cycle. Although production processes may be somewhat standardized, the social, environmental, and economic costs of pollution from mismanaged plastic waste vary significantly between countries.

In November 2023, the World Wildlife Fund (WWF) released the report "Who Pays for Plastic Pollution?" which revealed that the true costs of plastic are eight times higher for low- and middle-income countries (LMICs) compared to high-income countries (HICs) (WWF 2023).

According to the report, the stark difference in associated costs arises from the fact that LMICs mismanage 40% of their plastic waste, while HICs only mismanage 6%. This translates into associated costs of USD 17 per kilogram of plastic in HICs, compared to USD 149 in LMICs (Table 6.2).

Table 6.2. Breakdown of the lifecycle costs for a kilogram of plastic in HICs and LMICs

	High-income	Low- and middle-income (average)	Upper middle-income	Lower-middle income	Low-income
Mass of plastic mismanaged (kg)	0.05	0.50	0.25	0.43	0.64
Mass of plastic managed (kg)	0.95	0.50	0.75	0.57	0.36
Market cost (USD)	1.01	1.01	1.01	1.01	1.01
GHG emissions from production (USD)	0.40	0.40	0.40	0.40	0.40
Managed waste cost (USD)	0.49	0.30	0.31	0.29	0.30
Mismanaged waste cost (USD)	16.90	149.00	76.60	131.69	196.10
Total cost (USD)	18.80	150.71	78.32	132.71	198.81
HIC Multiplier	**1.00**	**8.41**	**4.34**	**7.40**	**11.06**

Source: (WWF 2023)

The previous table confirms that investing in plastic waste management technologies is a sound decision, particularly when considering the social and environmental costs of untreated pollution. As discussed in earlier chapters, the plastic industry offers several recycling technologies. Choosing the most suitable technology for a community depends on various factors, including the community's financial situation.

Experts agree that while mechanical recycling limits the types of products that can be processed, the initial investment is significantly lower compared to chemical recycling options. Additionally, chemical recycling and pyrolysis have elevated debates due to the higher greenhouse gas (GHG) emissions they generate (Liu, Barlaz, and Johnson 2024). Table 6.3 provides a cost comparison between mechanical and chemical recycling plants, drawing on experiences from India (Nikiema and Asiedu 2022).

The two previous tables underscore the challenges low-income countries face in combating plastic pollution. Table 6.3 illustrates the high cost of establishing a recycling plant, particularly if the goal is to develop a chemical recycling facility. In contrast, Table 6.2 highlights the significant social and environmental costs of not collecting and managing plastic waste.

Due to these challenges, numerous programs have been developed worldwide to support investment in plastic recycling technologies.

Table 6.3. Costs of plastic waste recycling technologies

Technology	Investment cost to process 1 ton/day capacity	Annual O&M to process 1 ton/day capacity	Typical net CO_2 emissions (ton per ton of plastic)	GCC relevance
Mechanical recycling	180–240	Typically USD 500–1,500 (In India)	-2.3 to -0.27	Cost-effective for PET, HDPE; operational in UAE, Saudi Arabia and Oman
	Lifecycle cost of recycling (capital and O&M) is typically EUR 204/ton*			
Chemical recycling (pyrolysis)	USD 857,000	USD 500–1,000 (in Europe and North America)	-1.5 to -0.1	Suitable for mixed plastic waste; pilot projects in Saudi Arabia (SIRC)
Chemical recycling (gasification)	USD385,000	Labor: USD 4,250 Maintenance: USD 18,100	0.4–1.1	Early-stage adoption in GCC; potential in industrial zones
Incineration	USD 330,000–100,000 in Myanmar	USD 10,800–14,000 in Myanmar	1.8–2.8	Limited use in GCC due to emissions; not aligned with material circularity goals
	USD -489,770,000 516,680 in France	USD 43,060 in France (USD 129 to 140 per ton of waste)		

Source: Nikiema and Asiedu 2022, and GPCA analysis 2025

*Producing ethylene from virgin feedstock may cost over 400-600 $/ton in Saudi Arabia. Adding on the incremental costs to produce polyethylene products, suggests mechanical recycling is a no-brainer.

6.2. Market potential and job creation

The GCC's transition towards a circular plastics economy represents a significant economic opportunity, estimated to be valued at several billion dollars. By augmenting plastic recycling rates from the present ~10% to a pragmatic target of 40%, the region stands to unlock substantial economic, social, and environmental value.

This transition is imperative for the achievement of national sustainability goals (e.g., Saudi Vision 2030, UAE Net Zero 2050), the catalysis of new industries, the generation of skilled employment, and the reduction of the region's reliance on virgin plastics.

Table 6.2: Estimated economic and environmental gains from achieving 40% plastic recycling rate in the GCC

Impact Area	Estimated Benefit
Market Value	~ USD 6 billion per year across the recycling value chain (collection, sorting, reprocessing, resale)
Job Creation	~50,000 new jobs in logistics, waste collection, processing, recycling, and technology deployment
Carbon Emissions	10–12 million tons/year of CO_2 emissions avoided by replacing virgin plastic production
Energy Efficiency	~4% reduction in primary energy consumption through circular material flows
Import Substitution	Reduced dependency on imported virgin polymers by enabling local recycled plastic production

Source: GPCA analysis 2025 and PricewaterhouseCoopers 2020

The development of a robust plastics recycling ecosystem in the GCC is of significant strategic importance to the region's socio-economic transformation. It offers a tangible opportunity to diversify the labour market by creating thousands of semi-skilled and skilled jobs, particularly in Saudi Arabia and the UAE, in line with national employment and Saudization goals (PwC, 2020).

Moreover, as global ESG investors increasingly encourage the expansion of circular plastics value chains provides the GCC with a compelling sustainability narrative, enhancing its ability to attract climate-focused foreign direct investment (UNEP, 2024). Locally produced recycled polymers can also support the growth of downstream manufacturing in key sectors such as packaging, construction, textiles and automotive components, contributing to import substitution and greater supply chain resilience. In addition, the sector provides a strong platform for small and medium-sized enterprises (SMEs) to thrive, particularly in waste collection, sorting and logistics - areas that have historically been SME-led and can benefit from improved access to finance, clearer regulation and public-private collaboration (PricewaterhouseCoopers 2020).

7. Conclusion

Plastics have been vital to modern life and will remain essential in the future due to their inherent characteristics and cost-effectiveness. They are used across critical sectors, including healthcare, food preservation, construction, automotive, and renewable energy technologies, making them a practical and resource-efficient solution in many end-use applications. However, their use comes at an environmental cost. The durability that makes plastics so valuable also makes them persistent in nature, and the mismanagement of plastic waste can adversely affect our ecosystems. Thus, a future with plastics must be one where waste is minimized and environmental harm is avoided. This balancing act involves more innovative design to make products easier to recycle, expanding recycling infrastructure, and shifting to a circular economy.

The GCC member countries are among the world's leading producers of plastics, and their abundant hydrocarbon resources have enabled the region to develop a large and competitive petrochemical industry, which is also a key pillar of their economic diversification strategies. The region has also enjoyed high per-capita consumption of plastics. However, despite the growing awareness of environmental risk, the GCC continues to experience low recycling rates and a heavy reliance on landfilling. While regulatory progress has been made, notably throughpolicies promoting efficient use of plastics and the establishment of waste management entities, enforcement remains limited, and extended producer responsibility mechanisms are still underdeveloped. Aligning strong upstream plastic production capabilities with downstream recycling infrastructure could unlock significant environmental and economic benefits, including job creation, reduced emissions, and new industrial opportunities. The GCC's scale and expertise in plastic production position it well to transition into a circular economy model and present a unique opportunity for the GCC to lead in sustainable plastics solutions. Our main recommendation can be summarized as follows:

1) Scaling up investment in advanced recycling infrastructure: This includes AI-powered sorting and chemical recycling, which will be critical in enhancing performance and achieving its sustainability targets

2) Adopting and harmonizing EPR frameworks across the GCC: Developing a unified GCC-wide legislation mandating producers to manage end-of-life plastics. This should include providing fiscal incentives and mandatory recycled content targets

3) Encourage public-private partnerships: facilitating regional collaborations to attract private sector participation which can generate a competitive advantage while contributing to national sustainability goals.

4) Establish regional standards and guidelines: create harmonized recycling definitions, labeling, and product design guidelines across the GCC member countries to foster economies of scale and investor confidence

5) Support innovation and circular economy startups: facilitate R&D and financing mechanisms for startups developing sustainable packaging, biodegradable alternatives, and digital waste tracking

Finally, a coordinated regional research agenda can help guide evidence-based policymaking and support the GCC transition toward a resilient and circular plastic economy. Further research can focus on many aspects including:

1) Quantifying the lifecycle environmental and economic impacts of various recycling pathways withing the GCC context

2) Assessing the feasibility of scaling EPR systems and other market-based instruments, and

3) Exploring behavioral interventions and consumer awareness strategies that can drive segregation and recycling at the source.



8. Bibliography

Alabi, Okunola A., Kehinde I. Ologbonjaye, Oluwaseun Awosolu, and Olufiropa E. Alalade. 2019. “Public and Environmental Health Effects of Plastic Wastes Disposal: A Review.” Journal of Toxicology and Risk Assessment 5 (1): 13. https://clinmedjournals.org/articles/ijtra/international-journal-of-toxicology-and-risk-assessment-ijtra-5-021.pdf?jid=ijtra.

Alagha, Danah I., John N. Hahladakis, Sami Sayadi, and Mohammad A. Al-Ghouti. 2022. “Material Flow Analysis of Plastic Waste in the Gulf Co-Operation Countries (GCC) and the Arabian Gulf: Focusing on Qatar.” Science of The Total Environment 830 (July):154745. https://doi.org/10.1016/j.scitotenv.2022.154745.

Anouti, Yahya, Devesh Katiyar, and Jayanth Kumar Mantri. 2023. “How GCC Countries Can Win in the Future Plastics Economy.” International Organization. GPCA (blog). May 22, 2023. https://www.gpca.org.ae/2023/05/22/how-gcc-countries-can-win-in-the-future-plastics-economy/.

Basel Convention. 2024. “SGP on Plastic Waste.” NGO. Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (blog). 2024. https://www.basel.int/SGPonplasticwaste/tabid/8402/Default.aspx.

Biessey, Philip, Julia Vogel, Mathias Seitz, and Peter Quicker. 2023. “Plastic Waste Utilization via Chemical Recycling: Approaches, Limitations, and the Challenges Ahead.” Chemie Ingenieur Technik 95 (8): 1199–1214. https://doi.org/10.1002/cite.202300042.

Dursun, Onur. 2023. “Unlocking Saudi Arabia’s Plastic Recycling Potential: A Green Investment Opportunity.” Frost & Sullivan (blog). December 11, 2023. https://www.frost.com/growth-opportunity-news/unlocking-saudi-arabias-plastic-recycling-potential-a-green-investment-opportunity/.

GAIA. 2023. “Smoke and Mirrors: The Realities of Plastic Credits and Offsetting.” Break Free From Plastic and the Global Alliance on Incinerator Alternatives (GAIA). https://www.breakfreefromplastic.org/wp-content/uploads/2023/12/NOV-29-2023_Smoke-and-Mirrors-the-Realities-of-Plastic-Credits-and-Offsetting.pdf.

GCC Stat. 2024. “Waste statistics in the GCC countries 2024.” Waste statistics in the GCC countries. GCC Statistical Center. https://gccstat.org/en/statistic/publications/waste-statistics-in-the-gcc-countries.

Geneva Environment Network. 2024. “Plastics and Finance | Plastics and the Environment Series.” NGO. Geneva Environment Network (blog). October 17, 2024. https://www.genevaenvironmentnetwork.org/resources/updates/plastics-and-finance-plastics-and-the-environment-series/.

Global Plastic Action. 2024. “Global Plastic Action Partnership.” NGO. Global Plastic Action Partnership (blog). 2024. https://www.globalplasticaction.org/home.

GPCA. 2023. “Leveraging the Plastic Waste Recycling Opportunity in the GCC.” Gulf Petrochemical and Chemicals Association (GPCA) (blog). July 10, 2023. https://www.gpca.org.ae/2023/07/10/leveraging-the-plastic-waste-recycling-opportunity-in-the-gcc/.

———. 2024. “Pathways Toward Circular Plastics in the GCC to Meet the ESG Agenda.” Gulf Petroleum and Chemicals Association (GPCA).

Hasan, Azhan. 2023. “Circular Economy in the GCC: Status, Challenges, and Opportunities.” The Gulf Research Center (blog). June 5, 2023. https://www.grc.net/single-commentary/89.

Karz, David. 2019. “Plastic Bank: Launching Social Plastic® Revolution.” The Journal of Field Actions, Reinventing Plastics, Special Issue (19). https://journals.openedition.org/factsreports/pdf/5478.

Kuwait EPA. 2024. “About EPA.” Enivronment Public Authority - Kuwait (blog). 2024. https://epa.gov.kw/en-US/Home#Home.

Lange, Jean-Paul. 2021. “Managing Plastic Waste-Sorting, Recycling, Disposal, and Product Redesign.” ACS Sustainable Chemistry & Engineering 9 (47): 15722–38. https://doi.org/10.1021/acssuschemeng.1c05013.

Li, Houqian, Horacio A. Aguirre-Villegas, Robert D. Allen, Xianglan Bai, Craig H. Benson, Gregg T. Beckham, Sabrina L. Bradshaw, et al. 2022. “Expanding Plastics Recycling Technologies: Chemical Aspects, Technology Status and Challenges.” Green Chemistry 24 (23): 8899–9002. https://doi.org/10.1039/D2GC02588D.

Liu, Lily, Morton A. Barlaz, and Jeremiah X. Johnson. 2024. “Economic and Environmental Comparison of Emerging Plastic Waste Management Technologies.” Resources, Conservation and Recycling 205 (June):107531. https://doi.org/10.1016/j.resconrec.2024.107531.

Mariyam, Sabah, Logan Cochrane, Shifa Zuhara, and Gordon McKay. 2022. “Waste Management in Qatar: A Systematic Literature Review and Recommendations for System Strengthening.” Sustainability 14 (15): 8991. https://doi.org/10.3390/su14158991.

Nayanathara Thathsarani Pilapitiya, P. G. C., and Amila Sandaruwan Ratnayake. 2024. “The World of Plastic Waste: A Review.” Cleaner Materials 11 (March):100220. https://doi.org/10.1016/j.clema.2024.100220.

Nikiema, Josiane, and Zipporah Asiedu. 2022. “A Review of the Cost and Effectiveness of Solutions to Address Plastic Pollution.” Environmental Science and Pollution Research International 29 (17): 24547–73. https://doi.org/10.1007/s11356

The Gulf Petrochemicals and Chemicals Association (GPCA) represents the downstream hydrocarbon industry in the Arabian Gulf. Established in 2006, the association voices the common interests of more than 250 member companies from the chemical and allied industries, accounting for over 95% of chemical output in the Gulf region. The industry makes up the second largest manufacturing sector in the region, producing over USD 108 billion worth of products a year.

The association supports the region's petrochemical and chemical industry through advocacy, networking and thought leadership initiatives that help member companies to connect, to share and advance knowledge, to contribute to international dialogue, and to become prime influencers in shaping the future of the global petrochemicals industry.

Committed to providing a regional platform for stakeholders from across the industry, the GPCA manages six working committees - Plastic, Supply Chain, Fertilizers (now known as Agri-nutrients), International Trade, Research and Innovation, and Responsible Care - and organizes five world-class events each year. The association also publishes an annual report, regular newsletters and reports.

For more information, please visit **www.gpca.org.ae**

Gulf Petrochemicals and Chemicals Association (GPCA)
P.O. Box 123055
1601, 1602
Vision Tower, Business Bay
Dubai, United Arab Emirates
T +971 4 451 0666
F +971 4 451 0777
Email: info@gpca.org.ae

