E-WASTE MANAGEMENT

IN THE GCC: DRIVING SUSTAINABILITY IN THE DIGITAL ECONOMY

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Foreword

As the Gulf Cooperation Council (GCC) strives ahead in technological adoption and economic transformation, a less visible yet equally urgent challenge is looming: electronic waste (e-waste). E-waste generation is rising at an unprecedented pace, yet fewer than one in four devices are properly recycled, leaving an estimated US $62 billion in recoverable materials untapped. At the same time, 2.6 billion people remain offline and the cost of mobile Internet in the least-connected regions can be twelve times higher than in areas of high connectivity, highlighting how affordability continues to restrain the digital economy.

With the GCC's rapid rise as a global hub for innovation, artificial-intelligence deployment, and strategic digital-infrastructure projects, our appetite for consumer electronics is soaring, and so is the volume of discarded smartphones, laptops, home appliances, and industrial hardware. These retired devices carry both precious resources and hazardous substances; unmanaged, they threaten public health, undermine environmental sustainability, and jeopardise the region's economic ambitions.

This report by the Digital Cooperation Organization (DCO) arrives at a pivotal moment, offering the GCC a timely, research-driven roadmap to embed sustainability into its digital-growth story and secure truly inclusive prosperity for decades to come. Grounded in the DCO E-Cycle in Action for Governments framework and informed by the Digital Space Accelerator (DSA) round-tables, it delivers practical, evidence-based recommendations for tackling the e-waste surge, serving simultaneously as an eye-opener and a blueprint for coordinated action.

The analysis underscores the need for comprehensive national strategies anchored in four pillars: (1) robust regulation and enforcement; (2) effective economic incentives such as take-back schemes and green levies; (3) targeted investment in recycling infrastructure and clean technologies; and (4) long-term public-awareness campaigns and capacity-building programmes.

By contextualising global best practice for the GCC's distinctive economic and cultural landscape, the report shows how the region can lead the way in circular, climate-smart e-waste management, just as it has led in energy, logistics, and smart-city innovation.

Equally important is regional coordination. No single Member State can master the complexities of e-waste alone. Harmonised regulations, shared infrastructure investments, and aligned policy frameworks will magnify our collective impact, reduce duplication of effort, and unlock cross-border synergies essential to building an efficient, inclusive, and sustainable e-waste ecosystem.

The GCC has always redefined what is possible, from reshaping global energy markets to building world-class cities. Stewarding a thriving, digitally driven circular economy is our ambition. By weaving sustainability into the very fabric of the digital economy, we do more than mitigate harm; we create fresh value chains, and a whole ecosystem of new industries and future-proof jobs.

On behalf of the GCC, I thank the DCO and every stakeholder who contributed to this landmark study. Let us convert these insights into bold policy, innovative partnerships and a shared commitment to a sustainable , more resilient digital future for all.

H.E. Jasem Mohamed AlBudaiwi

Secretary-General
Gulf Cooperation Council

Foreword

Rapid technological advancement and increased consumption of electronic devices in the Gulf Cooperation Council (GCC) region have brought significant economic opportunities and improvements in quality of life. However, they have also generated increased levels of e-waste, raising environmental and public health concerns. Each discarded device, from smartphones to large household appliances, represents both a challenge and an opportunity.

Improperly managed, these items release hazardous substances, contaminating ecosystems and harming human health. Yet, when effectively managed, e-waste presents immense economic potential through the recovery of valuable materials critical to modern technologies.

At the heart of our mission in the Digital Cooperation Organization (DCO) is the commitment to fostering inclusive, sustainable, and resilient digital economies that empower societies and protect our planet. One critical area requiring immediate and sustained attention is electronic waste management. As digital transformation accelerates globally, particularly within the GCC, addressing the rising challenge of e-waste has become paramount not only for environmental protection but also for economic growth and social equity.

This report, "E-Waste Management in the GCC: Driving Sustainability in the Digital Economy," provides comprehensive insights into the current state, challenges, and opportunities related to e-waste management across GCC Member States. It emphasizes the strategic importance of developing robust, harmonized policies and investing in modern recycling infrastructure.

Through detailed analysis and benchmarking best practices from countries such as Finland, Australia, and the United States, the report outlines clear pathways for GCC Member States to enhance their e-waste management frameworks.

At the DCO, we understand that effective e-waste management is foundational to sustainable digital transformation. Our proprietary "E-Cycle in Action for Governments" framework, developed through extensive stakeholder consultations facilitated by our Digital Space Accelerator, offers a practical roadmap for governments. It highlights essential mechanisms including regulatory reforms, economic incentives, capacity-building initiatives, and infrastructure advancements necessary for creating efficient and sustainable e-waste management systems.

Moreover, managing e-waste sustainably aligns with the broader objectives of economic diversification and digital equity. By promoting recycling and recovery practices, Member States can transform e-waste from an environmental liability into a valuable economic resource, stimulating new industries, creating jobs, and supporting technological innovation. Equally important, enhancing the reuse and redistribution of electronic devices can play a crucial role in bridging the digital divide, improving access to technology for underserved communities, and fostering greater digital inclusion.

I invite policymakers, business leaders, and stakeholders across the GCC region and beyond to leverage the insights provided in this report. Together, we can drive sustainable digital growth, protect our environment, and ensure that the digital economy benefits everyone, everywhere.

Deemah AlYahya

Secretary-General
The Digital Cooperation Organization

EXECUTIVE SUMMARY

The issue of electronic waste (e-waste) management is increasingly significant in the Gulf Cooperation Council (GCC) due to rapid technological growth and high consumer electronics uptake.

This report outlines the challenges, economic and social implications, current practices, and strategic recommendations for effective e-waste management within the six GCC Member States (the United Arab Emirates, the Kingdom of Bahrain, the Kingdom of Saudi Arabia, the Sultanate of Oman, the State of Qatar, and the State of Kuwait).

Additionally, it highlights key government mechanisms, leveraging the DCO's proprietary E-Cycle in Action for Governments framework to improve e-waste governance and develop effective national and cross-border e-waste management systems. It serves to inform and guide regional policymakers in crafting and implementing comprehensive environmental strategies that also harness economic benefits and bridge the digital divide.

The initiative's output was tested through the DCO Digital Space Accelerator (DSA), which organized roundtables across the globe and engaged with experts and Member States to collect their feedback.

Comprehensive Overview of E-Waste:

E-waste includes a broad range of discarded electrical and electronic equipment that is either at end-of-life or obsolete. From large household appliances to small personal devices, e-waste encompasses items such as refrigerators, air conditioners, smartphones, and computers.

These devices often contain hazardous substances like lead, mercury, and cadmium, as well as valuable materials such as gold, silver, and rare earth metals, necessitating proper management to avoid environmental harm and recover valuable resources.

Properly managed e-waste has the potential to offer substantial economic returns through the recovery of precious and rare metals used in high-tech industries.

Efficient recycling can help mitigate the costs of raw material extraction and promote economic sustainability by fostering new industries and job opportunities in the recycling sector.

Furthermore, effective e-waste management can contribute to social equity by reducing health risks associated with hazardous waste and improving the overall quality of life.

Current State Assessment of E-Waste in the GCC Member States:

The GCC's e-waste challenge is exacerbated by an increasing rate of electronic consumption and insufficient recycling infrastructure. Currently, the recycling systems in place can only process a fraction of the e-waste volume generated, indicating a significant gap in e-waste management capacity that threatens environmental sustainability and public health.

Across the GCC, e-waste management practices vary significantly, with many countries at different stages of policy development and implementation.

The lack of comprehensive Extended Producer Responsibility (EPR) schemes and advanced recycling facilities are notable deficiencies that need to be addressed, and a cohesive regional strategy is also lacking.

Benchmark Analysis of Three Countries:

Finland, Australia, and the United States represent best-in-class examples of e-waste management, showcasing innovative strategies and practices that can offer valuable lessons for countries worldwide, including the GCC Member States.

Their approaches highlight common elements—such as robust regulatory frameworks, strategic infrastructure development, and multi-stakeholder collaboration. While their successes provide models for extracting best practices in e-waste management, understanding their challenges can also guide considerations for developing effective systems. By adapting these strategies and learning from their experiences, GCC Member States can advance scalable and sustainable e-waste management solutions.

New E-Waste Management Framework:

Building on the findings of this research and drawing on established frameworks for e-waste management and circularity, the DCO has developed a comprehensive framework to address pressing e-waste management challenges.

The E-Cycle in Action for Governments focuses on key mechanisms where government intervention and leadership are essential for building sustainable and efficient national and cross-border e-waste management systems. It has three components: the e-waste value chain, four steps of implementation (Understand, Plan, Implement, and Monitor), and the following four categories of governmental mechanisms

01 **Regulations, Policies, and Strategies:** Establishing robust regulations that enforce the responsible disposal, recycling, and management of e-waste; developing clear policies that encourage the adoption of sustainable practices across the life cycle of electronic products; and formulating strategic plans that align with global environmental standards and promote the integration of advanced technological solutions for e-waste management.

02 **Economic Instruments:** Introducing financial incentives for companies and consumers to encourage the repair, upcycling, and recycling of electronic devices; implementing penalty systems for non-compliance with e-waste regulations to ensure adherence to environmental laws; and supporting investment in e-waste management infrastructure through subsidies and tax incentives to foster a circular economy.

03 **Human Capital and Awareness:** Enhancing capacity-building of all stakeholders involved in e-waste management through training programs focused on sustainable practices; conducting public awareness campaigns to educate the population on the importance of e-waste recycling and its benefits for the environment and economy; and promoting research and development in e-waste management to innovate and improve recycling processes and technologies.

04 **Infrastructure and Technology:** Developing state-of-the-art recycling facilities equipped to handle the specific needs of e-waste processing and material recovery; investing in technology that automates the sorting and processing of e-waste, increasing efficiency and reducing human exposure to hazardous materials; and establishing a national e-waste registry and tracking system to monitor the flow and disposal of e-waste accurately.

Recommendations:

To address the growing e-waste challenge, the following multifaceted strategic initiatives are recommended:

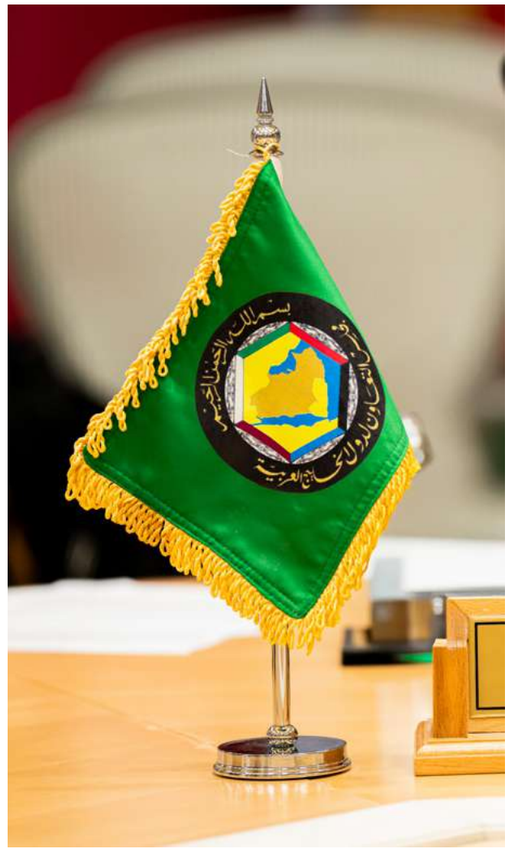
Robust Regulatory Frameworks: There is a need for stringent and harmonized e-waste legislation across the GCC. This should include clear definitions, producer responsibility obligations, and strict enforcement mechanisms to ensure compliance.

Investment in Recycling Infrastructure: Significant investments are required to develop modern e-waste recycling facilities capable of handling the diverse types of e-waste generated. This includes enhancing mechanical and chemical processing capabilities to improve the recovery rates of valuable materials.

Public Awareness and Engagement Programs: Implementing widespread educational campaigns to raise awareness about the benefits of e-waste recycling and proper disposal methods can significantly increase public participation in state-sponsored recycling programs.

Encouraging Public-Private Partnerships: Public-private partnerships should be promoted to leverage private sector expertise, efficiency, and funding in the establishment and operation of e-waste management facilities. These collaborations can also help drive innovation in new recycling technologies and business models.

Regional and International Collaboration: Active participation in regional and global e-waste management networks can help GCC Member States adopt and implement international best practices and standards. This includes cooperation under international treaties such as the Basel Convention and partnerships with global organizations dedicated to improving e-waste management.



Conclusion

The management of e-waste in the GCC presents both significant challenges and opportunities.

By adopting a strategic approach that includes strengthening policy frameworks, investing in technology, engaging the public, and fostering collaborations, GCC Member States can transform e-waste from an environmental burden into an economic asset.

This will not only enhance environmental protection efforts but also support the region's economic diversification and sustainable development goal

INTRODUCTION

INTRODUCTION

E-waste management presents a critical challenge in the GCC, with profound implications for environmental sustainability, public health, economic development, and social equity. Addressing this issue effectively requires a comprehensive and holistic approach that engages diverse stakeholders, establishes clear processes and mechanisms, and ensures the necessary funding and infrastructure to manage e-waste sustainably across the value chain.

We also leveraged the DCO Digital Space Accelerator (DSA), an innovative cooperation mechanism that the DCO General Secretariat created to bring together thought leaders, subject matter experts, and decision-makers from diverse sectors, including governments, the private sector, international organizations, academia, and civil society.

The primary aim of the DSA is to foster multi-stakeholder collaboration to design and propose actionable solutions that address key barriers to a thriving, sustainable, and inclusive digital economy.

This report aims to empower governments to advance sustainable e-waste strategies that mitigate environmental and health risks, maximize economic value recovery, and reduce digital inequities

What is E-Waste?

According to a globally accepted classification, e-waste can be divided into six main categories:

temperature-exchange equipment, such as refrigerators and air conditioners; screens and monitors, including televisions and laptops; lamps, such as fluorescent and LED bulbs; large equipment, like washing machines and solar panels; small equipment, including microwaves and e-cigarettes; and small IT and telecommunication equipment, such as mobile phones and routers.

While these categories cover a broad range of products, certain items, like standalone batteries, built-in automotive electronics, and military-grade devices, are typically excluded from e-waste classifications due to their unique waste management requirements or regulatory exemptions.

Understanding these distinctions is crucial for effective e-waste management and regulation. (Source: Global E-Waste Monitor 2024)

E-waste refers to all discarded stand-alone products with circuitry or electrical components and a power or battery supply

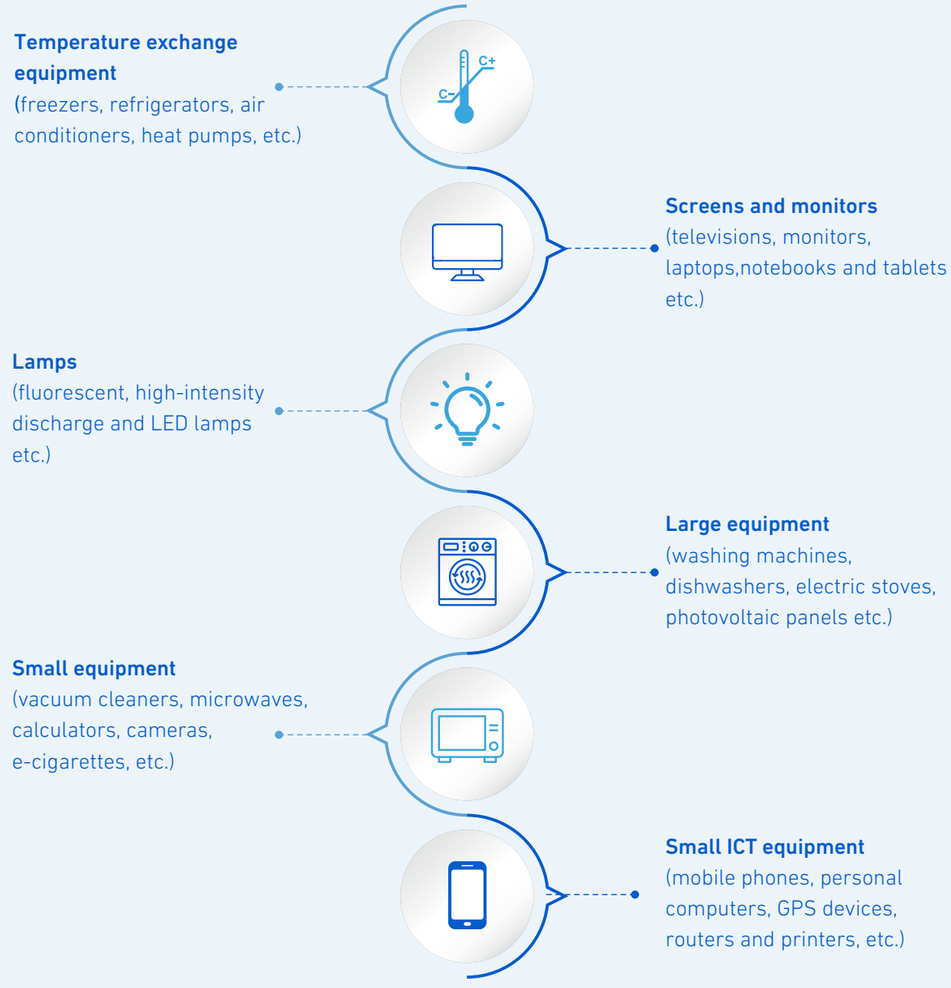


Figure 1: Definition of E-Waste

THE STATE OF GLOBAL E-WASTE MANAGEMENT

As the world becomes increasingly digitally connected, and more and more people own and use electronic devices, the amount of electronics produced and, therefore, discarded is increasing.

E-waste, or electronic waste, refers to discarded products containing electrical or electronic components powered by electricity or batteries. E-waste is the world's fastest-growing waste stream, fueled by the rapid expansion of electronics consumption across the globe.

This growth stems from several key factors: the widespread adoption of consumer electronics like mobile phones, high-consumption culture in high-income nations, and the increasing integration of technology into homes and industries worldwide, such as solar panels and advanced manufacturing systems.

Since 2010, global e-waste generation has risen at an alarming rate, increasing by an average of 2.3 billion kilograms per year. This surge has significantly outpaced the growth in the capacity of formal recycling systems.[1]

In 2010, global e-waste generated annually was estimated to be approximately 34 billion kilograms, but this figure has increased exponentially over time. In 2022, the world generated 62 billion kilograms of e-waste, and by 2030, it is projected to exceed 80 billion kilograms. Yet, formal recycling efforts are expected to manage only around 16 billion kilograms.[1]

This disparity underscores a critical and widening gap between the volume of e-waste generated and our ability to manage and recycle it sustainably. Indeed, the growth in e-waste generation is five times higher than the rise in formal recycling.[1]

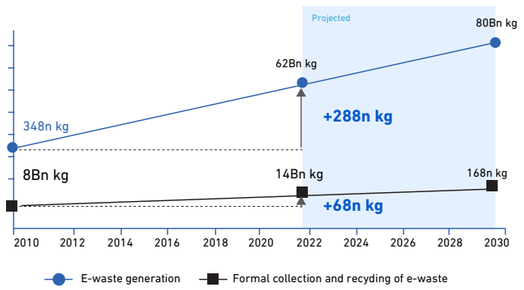


Figure 2: Volume of Global E-Waste Generation, Collection and Recycling

The maturity of countries' e-waste ecosystems varies enormously across the globe, from advanced economies with e-waste-specific regulations, e-waste recycling infrastructure, and high levels of awareness and engagement with environmentally sound management to countries where little to no action being taken, and e-waste is either disposed of with general municipal waste or hoarded by consumers.

According to the Global Transboundary E-Waste Flows Monitor 2022, an estimated 5.1 billion kilograms of e-waste crossed international borders in 2019, accounting for approximately 10% of the total e-waste generated globally. Of this, around 35% (1.8 billion kilograms) was traded in a controlled manner, including hazardous waste shipped under the Basel Convention's control regime, and documented trade of non-hazardous materials like printed circuit boards.[2]

However, the remaining volume was shipped in an uncontrolled manner, often bypassing regulations through various methods. A common tactic involves falsely labeling e-waste as used Electrical and Electronic Equipment (used-EEE) to circumvent Basel Convention restrictions. In other cases, shipments may bypass formal import/export enforcement entirely or be mixed with legal shipments, including legitimate used-EEE, to conceal e-waste.

Addressing the challenges posed by illegal e-waste flows and promoting best practices and legal cross-border trade will be critical for effective e-waste management in the coming decade.

THE CASE FOR E-WASTE MANAGEMENT

E-waste poses a significant challenge with wide-ranging implications for the planet, people, and the economy, underscoring its urgency as a critical issue. The need for effective e-waste management is driven by three primary motivations: mitigating environmental and health risks, unlocking opportunities for economic value recovery, and narrowing the digital divide to promote greater global equity.

Environmental and Health Risks

First and foremost, improper disposal and treatment of e-waste pose severe risks to both the environment and human health. Many electronic devices contain hazardous materials, such as mercury, lead, and other toxic chemicals, which can leach into soil and water, contaminating ecosystems and harming biodiversity.

In 2022, approximately 145 billion kilograms of CO2-equivalent emissions were released due to improper management of refrigerants. Additionally, an estimated 58,000 kilograms of mercury and 45 million kilograms of plastics containing brominated flame retardants were released annually through non-compliant e-waste practices. These pollutants not only degrade ecosystems but also contribute significantly to global environmental crises like climate change.

The human health impacts of improper e-waste management are particularly severe in low- and middle-income countries, where much of the world's e-waste is exported for informal recycling. Over 11 million informal workers in these regions are disproportionately exposed to hazardous pollutants, contributing to respiratory issues, cancers, and developmental problems. Vulnerable populations, including children and pregnant women, face heightened risks, further compounding long-term socio-economic challenges.

The economic costs of improper e-waste management on health and the environment are staggering. According to the Global E-Waste Monitor 2024, the externalized costs of e-waste on human health and the environment amounted to an estimated $78 billion in 2022.[1] This includes $36 billion in long-term socio-economic and environmental costs from greenhouse gas emissions that drive climate change, $22 billion in costs associated with illnesses and reductions in human capital due to mercury exposure, $19 billion from the release of plastic waste into the environment, and close to $1 billion from the effects of lead on wildlife and humans.

These figures underscore the urgent need for comprehensive e-waste management systems to minimize these costs and protect both people and the planet. Addressing these issues requires reducing e-waste generation and supporting environmentally sound management practices to mitigate these adverse outcomes.[1]

Economic Potential

E-waste is an incredibly valuable resource, containing metals and rare earth elements critical for modern technologies. The Global E-Waste Monitor found that in 2022, global e-waste contained a total of 31 billion kilograms of metals, with iron being the most successfully recovered, comprising approximately 24 billion kilograms due to its high recycling rates. Other metals, such as aluminum (3.9 billion kilograms) and copper (2.1 billion kilograms), were present in significant quantities.[1]

Precious metals such as gold, silver, and palladium are present in much smaller quantities, collectively amounting to 1.6 million kilograms, but they hold high economic value due to their critical use in electronics and modern technologies. Critical rare earth elements such as lithium, neodymium, yttrium, and cobalt, and platinum-group metals including palladium, platinum, and rhodium, are also found in smaller quantities, primarily in printed circuit boards, batteries, magnets, and screens.

Effective e-waste recycling not only generates revenue but also reduces reliance on the extraction of finite natural resources, helping to stabilize supply chains dependent on these materials and ensuring the sustainability of industries and countries reliant on them.

Currently, only around 22% of global e-waste is formally recycled, with the current value of recovered materials estimated at $28 billion annually. However, if an aspirational global recycling rate of 60% is achieved by 2040, this value could more than double to $57 billion.[1]

Leveraging this economic potential requires increasing material recovery through improved collection rates and recycling practices. With 12 billion kilograms of metals lost in 2022, enhancing recovery processes could unlock significant material value, reduce reliance on finite resources, and strengthen supply chains. Improved recovery infrastructure also paves the way for sustainable resource use and supports the circular economy principles.[1]

This economic potential can further be realized through strategic investments aimed at making e-waste recycling more cost-effective. Options include outsourcing recycling via cross-border trade or investing in regional e-waste recycling hubs, enabling countries to leverage economies of scale and capitalize on the economic opportunities of e-waste recovery.

Addressing the Digital Divide

Finally, repurposing and reusing second-hand electronics provides a critical opportunity to bridge the digital divide. Many electronics are discarded after short lifespan, creating high levels of wastage, while millions lack access to digital technologies. By redistributing, repairing, and extending the lifespan of devices before they are discarded as waste, we can reduce e-waste generation while improving access to digital tools in underserved communities.

This approach supports environmental sustainability while addressing global inequalities in access to technology. For example, redeploying just 1% of the five billion smartphones discarded in 2022 could have provided affordable devices to 50 million people in the DCO Member States. Leveraging the circular economy and cross-border collaboration can help bridge the digital divide.

The disparity between rising electronics consumption and inadequate regulations, infrastructure, and awareness highlights the urgent need to strengthen global e-waste management systems. Doing so not only mitigates environmental and health risks but also enables the economic and social opportunities inherent in e-waste to be fully realized.

UNDERSTANDING THE E-WASTE VALUE CHAIN

It is crucial to map the value chain of e-waste to ensure a deep understanding of the current challenges and dynamics between stakeholders.

The e-waste value chain can be categorized into three primary stages: e-waste generation, e-waste processing, and e-waste treatment.

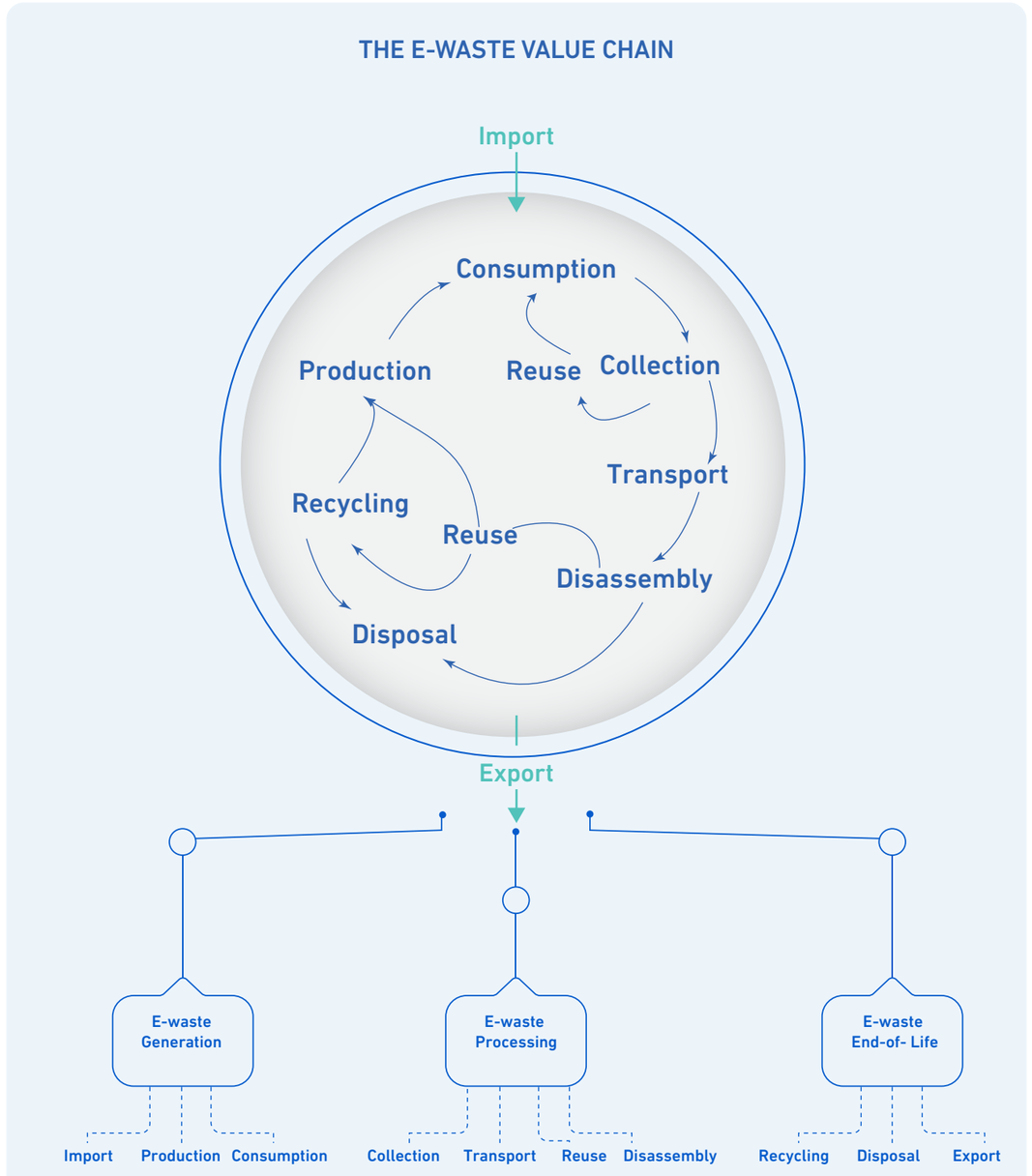


Figure 3: E-Waste Value Chain

E-waste generation encompasses the initial stages of the value chain, where e-waste originates either from the production of new electrical and electronic equipment (EEE) or from subsequent consumption, which involves the purchase and use of EEE by consumers or businesses.

E-waste generation also includes the import of used-EEE or e-waste, necessitating robust regulations to ensure compliance with safety and environmental standards while at the same time representing an attractive trade opportunity for economic growth.

The E-waste processing stage begins with collection, which entails establishing organized systems for the retrieval of discarded or end-of-life EEE. This e-waste must be transported to the necessary facilities and stored until it can be treated or exported.

This step of the value chain is complex and includes sorting the items into different components or materials, dismantling or disassembling the item into subparts, and, if possible, repairing or reusing the item.

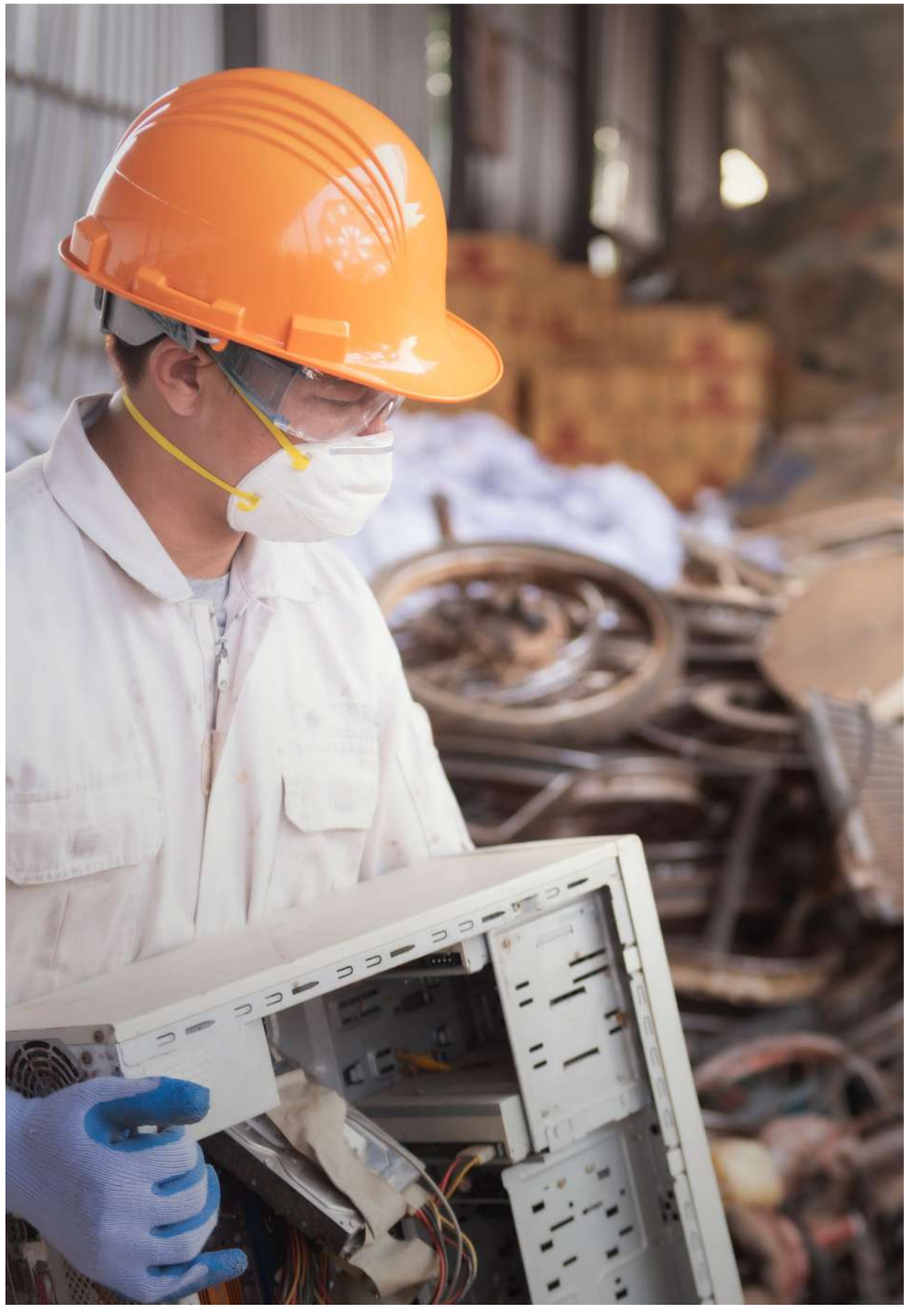
It is crucial to create loops in the value chain to empower different circularity strategies, not only recycling. Redeployment into the consumer or business market through repair and refurbishment further extends the lifespan of products and reduces overall rates of e-waste generation.

The E-waste end-of-life stage focuses on the downstream management of collected e-waste. Hazardous components or substances must be treated and neutralized to ensure safe handling and mitigate environmental risks. Subsequently, the recycling process allows valuable materials to be recovered, reintegrating them into manufacturing processes.

If local recycling capabilities are insufficient or the local secondary market is small, collected e-waste—either in its unprocessed form or after preprocessing—may be exported abroad under regulated cross-border agreements.

Every country has a unique e-waste value chain. These value chains are inherently complex, engaging diverse stakeholders from public, private, and social sectors, each with specific roles. Moreover, different types of e-waste often follow distinct pathways within the value chain, further adding to this complexity.

Mapping these value chains is a vital and valuable investment, as it reveals the intricate dynamics, key stakeholders, and critical points in the process, enabling the development of more effective e-waste management strategies.



GLOBAL E-WASTE MANAGEMENT ECOSYSTEMS

GLOBAL E-WASTE MANAGEMENT ECOSYSTEMS

E-waste management systems are inherently complex, involving numerous interconnected components, spanning regulatory systems, stakeholder coordination, and infrastructure development. Effective management requires addressing these elements holistically to develop sustainable systems that meet both national and international needs.

There are five key components that must be identified across the e-waste value chain to foster a comprehensive understanding of national and cross-border e-waste ecosystems.

First, drivers (WHY) shaping these systems include laws, policies, and voluntary initiatives that provide strategic direction.

Next, the stakeholders (WHO) involved, including public, private, and social sector actors, play pivotal roles in implementing, supporting, and advancing e-waste management initiatives.

Third, enablers (HOW), such as infrastructure, technology, and knowledge, support operational and logistical aspects of e-waste management. Understanding how e-waste types and volumes (WHAT) as they flow throughout the value chain, from generation to collection, recycling, and disposal, is important for understanding system efficacy and potential bottlenecks.

Finally, cross-border flows (WHERE) focus on collaboration and e-waste trade beyond national boundaries.

Together, these components form a framework for conducting a diagnostic assessment of the current state of e-waste management systems and for understanding the challenges and opportunities faced by different stakeholders.

Figure 4: Five Areas of the E-Waste Management Ecosystem

This report provides a comprehensive exploration of the state of e-waste management systems, delving into the challenges and identifying best practices to inform opportunities and effective approaches for the GCC Member States and countries worldwide.

First, it examines the current state of e-waste management across the six GCC Member States and 16 DCO Member States, highlighting key trends, challenges, and best practices to guide sustainable management strategies.

Additionally, the report draws on benchmarking insights from three high-performing countries in e-waste management — Finland, Australia, and the United States — selected to represent best-in-class practices from Europe, the Asia-Pacific region, and the Americas. By analyzing their approaches, challenges, and opportunities, the report identifies actionable lessons to strengthen e-waste management efforts globally.

Together, these insights aim to provide a foundation for advancing sustainable, efficient, and inclusive e-waste ecosystems. The research methodology can be found in Appendix B.

THE CURRENT STATE OF E-WASTE MANAGEMENT IN THE GCC MEMBER STATES

While there is some variation in the state and maturity of e-waste management systems across the GCC Member States, certain trends and common characteristics emerge, highlighting key challenges and opportunities for improving e-waste management.

Drivers

E-waste management policies across the GCC Member States reveal a spectrum of regulatory approaches. While progress is evident, there are gaps in the adoption, implementation, and enforcement of regulations for e-waste management in the GCC Member States, highlighting opportunities for improvement and collaboration.

The absence of broader Extended Producer Responsibility (EPR) scheme adoption across the region leaves governments with the financial and administrative burden of managing e-waste, delaying the development of sustainable systems.

Formal collection and recycling targets remain absent across GCC Member States. Technical standards for e-waste management are under development in the State of Qatar and the Kingdom of Saudi Arabia, while the United Arab Emirates (UAE) has already established one.

These standards promote environmentally sound practices & facilitate cross-border collaboration by establishing consistent guidelines.

To further regulate the sector, countries mandate licensing for e-waste management actors, including collectors and recyclers, to ensure proper oversight and compliance with national regulations and increase transparency over the value chain, and potentially initiate data collection on the flow of products across the value chain.

Despite having limited enforceable legislation, all GCC Member States have developed strategies and plans focused on circularity more generally, with some emphasizing waste management specifically.

These initiatives aim to promote sustainable consumption, waste reduction, and improved oversight of waste management processes, from collection to recycling and proper disposal.

To regulate cross-border trade in hazardous waste, all GCC Member States are signatories to the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and Their Disposal.

This ensures ethical and environmentally sound e-waste management, particularly in cross-border contexts, by mandating prior informed consent for waste shipments and compliance from importers.

Once legislation is better defined, it is essential to establish strong enforcement mechanisms for effective e-waste management.

While the GCC Member States have made strides in e-waste management, gaps remain in adopting specific regulations, setting formal targets, and implementing Extended Producer Responsibility (EPR) schemes. Strengthening these areas, along with robust enforcement & regional collaboration, will be critical for advancing sustainable e-waste management across the region.

It is also important to link e-waste regulations to critical raw materials, which are economically and strategically important for nations but have a high risk associated with their supply.

For example, the European Union includes rare earth elements, lithium, cobalt, and other materials essential for technologies like batteries, wind turbines, semiconductors, and advanced electronics on its list of critical raw materials.

The GCC Member States should look at e-waste not only from the compliance perspective but also as a source of economic value, ecosystem sustainability, strategic autonomy, supply chain resilience, and economic development.

Finally, during the roundtable, it was emphasized that regulations should consider legacy technologies and new technologies separately.

Lamps and some home appliances haven't evolved much compared to 10 years ago, while other new devices, such as disposable vapes, are evolving very fast and creating different issues in the market.

Legislation should be able to address the latest trends—not continually changing policies for legacy technologies but instead adding or modifying them for new items.

E-Waste-Related Drivers

The Kingdom of Bahrain

• Currently, the only GCC Member State with national e-waste-specific legislation, outlined in **Decision No. 5 of 2021 regarding the Management of Electronic and Electrical waste**. This legislation specifically focuses on the regulation of e-waste to ensure sound, safe, and sustainable processing.

The legislation requires all e-waste value chain actors to be licensed, with treatment facilities subject to an environmental impact assessment.

The legislation also mandates the creation of designated collection points and facilities to ensure efficient and safe collection of e-waste.[10]

• **Environment Law No. 7 of 2022**[11]**:** The law classifies electronic waste as hazardous waste. It also prohibits the export of e-waste by unlicensed organizations. Producers must submit an Environmental Impact Assessment (EIA) Data Form to the Supreme Council for Environment (SCE) to gain a license.

• Bahrain mandates licensing for e-waste management actors, including collectors and recyclers, to ensure proper oversight and compliance with national regulations. Under the Environment Law No. 7, all entities are required to comply with the following obligations to enable the SCE to accurately monitor the performance of project owners and waste management strategies:

Conduct periodic analysis of the project's waste.

Monitor the discharge and pollutants resulting from the project.

Record data and submit reports to the SCE.

• **Bahrain's Government Plan 2023-2026**[12]**:** The plan focuses on driving sustainable development, improving public services, and promoting economic diversification in line with the country's Economic Vision 2030. The plan sets out priorities across various sectors, aligned with the Sustainable Development Goals (SDGs), to address the needs of citizens, strengthen the economy, and enhance the quality of life. It commits to strengthening waste management systems and promoting recycling initiatives to create a more sustainable environment.

• **National Waste Management Strategy** [13]**:** Bahrain's National Waste Management Strategy consists of five main pillars that are currently under review:

Backfilling waste by engineering methods.
Recycling demolition and construction waste.
Recycling and conversion waste into energy.
Recycling household and commercial waste and 5. Recycling of green waste.

• **National Environmental Strategy:** Developed in 2006, this strategy supports the Kingdom in identifying and measuring waste generation, understanding environmental and public health impacts, effectively and proactively managing waste disposal, and raising awareness of the need to reduce and recycle waste.

The State of Kuwait

• E-waste regulations are inferred from broader hazardous waste or environmental policies, which vary in their comprehensiveness and scope. **Article 34 of the Environmental Protection Law No. 42 of 2014** (amended in 2015): This law includes provisions for the management of hazardous waste, including e-waste. It strictly regulates the collection, transportation, and safe disposal of hazardous waste.

All actors involved in the collection, transportation, and disposal of hazardous waste must be licensed by the competent authorities.

E-Waste-Related Drivers

The law also enables the development of standards for materials to support their further use. Additionally, it required the Environment Public Authority (EPA) to coordinate with other competent authorities to prepare a National Program for Integrated Waste Management, which has since been completed. [21,25] .

• **The Environmental Protection Law** dictates that entities generating hazardous waste must provide detailed reports to the Environment Public Authority (EPA) and maintain a special register of such waste. It also specifies severe penalties for violations related to mismanagement of hazardous materials and waste.

This includes life imprisonment and fines ranging from 250,000 KD to 1,000,000 KD ($815,825 – $3,263,300) for individuals or entities that cause serious environmental harm through improper handling, disposal, or management of hazardous waste.

The law is enforced by the Kuwait Environment Public Authority (KEPA), which coordinates waste management efforts across the country. [21]

• **Kuwait National Waste Management Strategy 2040**[22]**:** Over a period of five years, the Kuwait National Waste Management Strategy (KNWMS) 2040 was developed in partnership with the German Fraunhofer Institute for Environmental, Safety, and Energy Technology (UMSICHT).

The project was commissioned by the Environment Public Authority (EPA) of Kuwait in 2024 (is it 2014, or 2024?) and is the first comprehensive nationwide waste strategy to be developed in the Gulf region.

• **Funding:** The Kuwaiti National Fund for Small and Medium Enterprises Development funded Tadwire, an e-waste recycling company, to construct a facility for recycling electronic and specialized waste in 2018, the first of its kind in Kuwait.

The e-waste recycler Enviroserve expanded into Kuwait with support from the fund.[23]

• **Economic Incentives:** Companies like Tadwire and MRC offer e-waste services, sometimes providing incentives such as discounts or vouchers for customers who recycle electronics. These incentives encourage individuals and businesses to engage in proper disposal practices. [23,24]

The Sultanate of Oman

• **Environmental Protection and Pollution Control Law, Royal Decree 10/82 (1982) – updated by Decree 114/2001:** Establishes a commitment to the preservation of the environment. It provides basic specifications restricting the discharge of pollutants into the environment.[28]

• **Regulations for the Management of Hazardous Waste, Ministerial Decision No. 18/93 (1993):** Requires reporting on actions taken to minimize the generation of hazardous waste and the application of recycling procedures; a license from the Ministry of Environment for the generation, collection, transportation, storage, pre-treatment, disposal, import and export of hazardous waste; and proper labeling and documentation (through consignment notes) for all movements of hazardous waste.

It was amended in Ministerial Resolution No 10/20173 to define fees for obtaining licenses (50–400 Omani riyals) and for violations of laws (500 Omani riyals, doubled for repeat violations). [29,30]

• **Basel Convention, ratified by Royal Decree 119/94 (1994):** Places restrictions on the transboundary movement of hazardous materials, including e-waste, and requires reporting on import and export volumes. [4,31]

E-Waste-Related Drivers

• **Rotterdam Convention, accession confirmed by Royal Decree 81/99 (1999):** Promotes informed decision-making and regulation in the international trade of hazardous chemicals, some of which are commonly found in electronic waste (e.g. polybrominated biphenyls, polychlorinated biphenyls).[32]

• **Law on Conservation of the Environment and Prevention of Pollution, Royal Decree 114/2001 (2001):** Established the legal framework for managing hazardous waste, a category that includes most e-waste, and outlines pollution control measures. It also requires licensing for the generation of hazardous waste through manufacturing or business processes, as well as for those collecting, storing, or treating e-waste.

It regulates the transport, treatment, and storage of hazardous waste and prohibits the import and export of hazardous waste without ministerial approval. It is overseen by the Ministry of Regional Municipalities, Environment and Water Resources.[33]

• **Royal Decree 46/2009 (2009):** Assigns responsibility for waste management, including e-waste, to Oman Environmental Services Holding Company (Be'ah). A budget was assigned to Be'ah in 2012.[34]

• **Minamata Convention on Mercury, accession confirmed by Royal Decree 58/2020**: Restricts mercury in products like batteries and lighting, reducing mercury in e-waste by encouraging manufacturers to phase it also controls the transboundary movement of mercury, reducing the risk of the import/export of harmful e-waste.

It mandates safe recycling and disposal of mercury-containing e-waste, ensuring it is managed without releasing mercury into the environment.[35] (The remaining sections moved to the next box.)

• **Established Circular Economy Strategy, developed as part of Oman Vision 2040 (2021)** [36,37]**:** Focuses on waste diversion and resource recovery, aiming to divert 80% of municipal solid waste from landfills by 2030 by encouraging recycling, reuse, and recovery. It aims to reduce per capita municipal waste generation from 1.2 kg/day to less than 1 kg/day by 2040.

It launches education initiatives to raise awareness in schools and communities. It promotes the production and consumption of recyclable products. It focuses on the integration of technology, such as potential use of AI and IoT to improve the efficiency of waste management systems, including waste collection and processing, and encourages public-private partnerships to drive innovation and investment.

It is expected to assess the socioeconomic impacts of the transition toward circularity and the cost and returns of this transition in terms of GDP and job creation. The Ministry of Commerce, Industry and Investment Promotion, in cooperation with Oman Environmental Services Holding Co. (Be'ah), is promoting circular economy and waste management opportunities valued at around OMR 528 million to the private sector and SMEs.

• **Be'ah Strategy for Waste Management [2012]:** It establishes the national approach to waste management, including e-waste, focusing on reducing landfill use and promoting recycling. It signed commercial collection agreements with major stakeholders such as Omantel, Ooredoo, and other waste producers.[42]

• **Potential Development of an E-Platform for Waste Trading and Collection** [37]**:** Be'ah has announced plans to develop an e-platform for waste trading and collection, with the goal of increasing recycling rates and maximizing the value recovered from waste through live auctions. Initially scheduled for rollout in Q1 2024 (but not yet launched), it will require all waste generators,

E-Waste-Related Drivers

collectors, transporters, and recyclers to use the platform for transactions related to recyclable materials. Waste collection services will be provided, ensuring the efficient transport of waste to designated facilities.

The platform will feature live pricing for waste, linked to a local pricing index. Full-cycle tracking will be available, covering waste generation, transportation, and processing. It aims to "maximize value creation" by commercializing the waste sector, with the potential to stimulate the growth of SMEs. The platform's revenue model will be based on a combination of subscription and transaction fees.

• **The lack of an integrated regional market and incentives reduces the economic feasibility of e-waste recycling:** The small quantities of waste generated in individual markets discourage large-scale investments in recycling infrastructure, making it less economically feasible to develop such facilities. There are no subsidies or investment opportunities to make the e-waste business viable.[38]

• **The economic benefits** of waste recycling are well-regarded and emphasized and are used to justify and motivate investment in e-waste management, but volume remains a barrier.

The State of Qatar

• **Executive By-Law of the Environment Protection Act, issued via Decree-Law No. 30:** This law, issued in 2002, covers the treatment and disposal of hazardous waste but does not explicitly mention e-waste. It prohibits treating and disposing of such waste in facilities not adequately designed for that purpose.

Under this law, generators of hazardous waste must be licensed and must maintain records on the following: the terms and conditions imposed by the Council regarding operating the facility/ installation; the types and quantities of hazardous waste the facility generates; and the hazardous waste disposal mode used by the facility; the hazardous waste contractors who collect the hazardous waste for disposal.[49]

• **Draft resolution of the Minister** of Municipality and Environment on the recycling and treatment of electrical and electronic waste, 2019: This resolution focuses on establishing clear guidelines for adequately handling, recycling, and treating e-waste to mitigate its environmental impact. It was presented alongside a new draft law on the types of waste and materials that may be recycled, the controls on their circulation, management, processing, recycling, and disposal, and the conditions that must be met at waste treatment sites and facilities.[50]

• **Qatar's National Vision 2030:** One of the four pillars of Qatar's National Vision 2030 is "Environmental Development", confirming Qatar's sustainability commitment.[51]

• **Qatar National Master Plan,** adopted in 2016, commits to developing a National Waste Management Strategy that provides sustainable waste reduction, recycling, and disposal solutions for all, and supports the adoption of ambitious targets for waste minimization, recycling, and energy recovery. [52]

• **Public-Private Partnerships (PPP):** The government encourages partnerships between private companies and public entities to facilitate the development of e-waste treatment and recycling. Through PPP models, the government co-finances recycling plants and e-waste centers. Companies benefit from revenue-sharing models where profits from recycled materials are divided between private companies and the government.

E-Waste-Related Drivers

• **Awareness Initiatives:** The Ministry of Communications and Information Technology is planning to initiate a strategic program to manage e-waste, including recycling and awareness campaigns. This program will target businesses and households to ensure the responsible disposal of electronic products. Other education and awareness initiatives are organized by social-sector organizations such as the Qatar Foundation.

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E-Waste-Related Drivers

The Kingdom of Saudi Arabia

• **Royal Decree No. M/165 of 2020 issuing the Environmental Law:** This law governs the overall protection of the environment in Saudi Arabia, including provisions for waste management. It mandates the proper disposal and treatment of hazardous waste, such as e-waste, to prevent environmental contamination.[59]

• **Royal Decree No. M/3 of 2021 issuing the Waste Management System:** This decree establishes a legal framework for the proper handling, collection, transportation, treatment, recycling, and disposal of all types of waste, including hazardous waste and e-waste.

It encourages the adoption of circular economy principles, promoting waste reduction, recycling, and resource recovery, establishes producer responsibility, and sets a target to recycle 40% of municipal waste and 85% of industrial waste by 2035. It also encourages private sector participation in waste management, sets penalties for non-compliance, and promotes the development of recycling facilities and treatment plants.[60]

• **SASO's Technical Regulation for Limiting Hazardous Substances in Electrical and Electronic Appliances and Equipment:** It aims to protect the health and safety of consumers as well as the environment by regulating the content of cadmium, hexavalent chromium, lead, mercury, and polybrominated diphenyl ethers. The regulation also outlines mandatory conformity assessment procedures.

• **Saudi Vision 2030:** Saudi Vision 2030 was officially launched on April 25, 2016. A key aspect of this initiative is improving environmental sustainability through waste management by enhancing efficiency and establishing comprehensive recycling projects, with proposed investments of 100 billion Saudi Riyals in the recycling industry by 2035. [61]

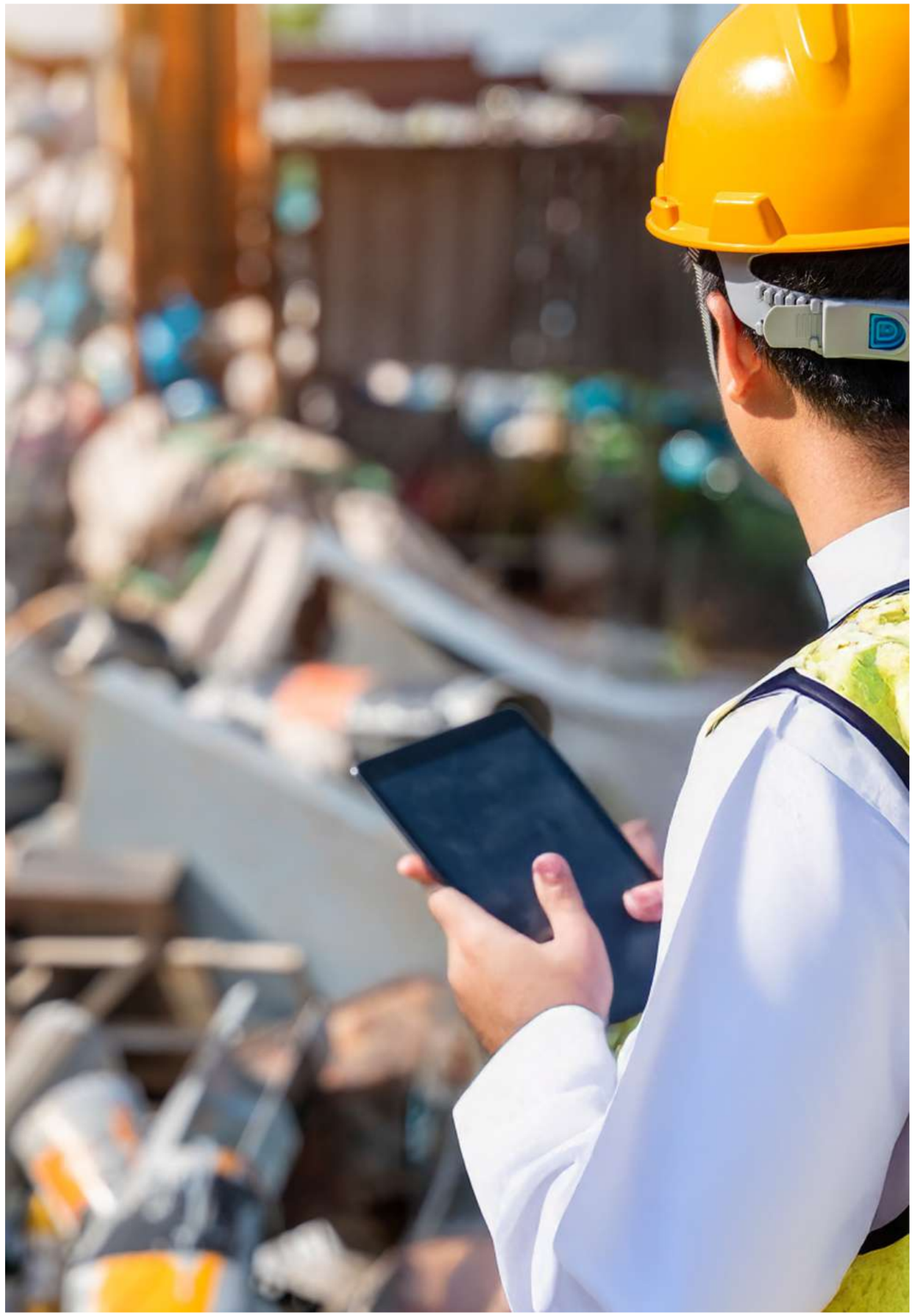
• **The National Centre for Waste Management (MWAN):** MWAN was established by the government in 2019 to regulate and supervise waste management activities and encourage investment. The Center is currently in the process of designing and implementing a master plan—an integrated technical and economic strategy to divert 90% of waste from landfills by 2040 and effectively implement the principles of circular economy—for every region in the Kingdom.

It sets the national strategy for waste management, assesses the existing conditions of waste in each region of the Kingdom to create a national baseline database and ultimately produces a comprehensive and nationally integrated plan for each region or "Cluster". However, e-waste is not identified as a key waste stream and is instead considered as part of broader considerations on municipal solid waste (MSW).[62]

• **Recycling Infrastructure Development:** Saudi Arabia is investing heavily in recycling infrastructure through its Waste Management System, established under Royal Decree No. M/3 of 2021. This includes financial support for the development of e-waste recycling plants, creating an enabling environment for businesses to participate in e-waste collection and treatment.[63]

• **Targets:** To shift from a linear to a circular economy in waste management in Saudi Arabia, strategic targets were set for 2035: a landfill diversion target for municipal solid waste and overall landfill diversion rates of 94% and 82%, respectively.

• **International Conferences:** In 2023, Saudi Arabia hosted the "Investment Forum in the Waste Management Sector" with the participation of over 300 investors from 25 countries, aiming to stimulate investment.



E-Waste-Related Drivers

• **Consumer Awareness Campaigns:** The government, along with private sector companies, runs public awareness campaigns to educate consumers about the importance of e-waste recycling. Private sector campaigns often include incentives for consumers, such as discounts or vouchers for trading in old electronics at designated collection points.

• **Global Collaboration:** Saudi Arabia's Communications, Space, and Technology Commission's (CST) 2 partnership with the International Telecommunication Union (ITU) led to the launch of a new initiative to develop global e-waste management regulations. It explores innovative solutions for mitigating electronic waste, encouraging citizens and local firms to adopt best practices and engage in responsible recycling.[64]

The United Arab Emirates

• **Federal Law No. 12 of 2018 on Integrated Waste Management:** This law provides the framework for the management of all types of waste, including e-waste. It aims to reduce waste generation, encourage recycling, and ensure the safe disposal of hazardous waste, like e-waste. The law also emphasizes the importance of sustainable waste management practices across the country.[76]

• **Cabinet Decree No. (39) of 2021:** The decree introduces an Extended Producer Responsibility Framework for the UAE, and holds manufacturers, importers, and distributors ("producers") responsible for financing the management of the e-waste generated by the products and packaging they place on the market. Producers' responsibilities include [77]: - Bearing the costs resulting from their products proper treatment and disposal. - Submitting regular reports on volumes collected and how waste is managed. -Providing collection boxes at retail locations. Collection must be provided free of charge to consumers. Targets: There are no targets for collection or recycling.

• **Enforcement:** The decree requires producers of e-waste to register and regularly provide reports to enable regulations to be effectively monitored. Administrative penalties can be imposed for violating the legislation, including the temporary or permanent closure of the offending facility and suspension or withdrawal of licenses.

• **UAE Circular Economy Policy:** The policy is a comprehensive framework designed to transition the UAE from a linear to a circular economy, emphasizing the sustainable use of resources. The policy aims to reduce waste, extend the lifespan of products, and promote the recycling and reuse of materials across key sectors such as manufacturing, infrastructure, transportation, and food production.

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E-Waste-Related Drivers

• **UAE Vision 2021:** Launched in 2010, it is a strategic plan aimed at transforming the UAE into one of the world's most sustainable and innovative nations by the 50th anniversary of its founding. The vision is built on four pillars, with sustainability being a core focus.[79]

• **UAE Green Agenda 2030:** Launched in 2015, it is a national framework designed to promote sustainable development by balancing economic growth with environmental preservation. It focuses on enhancing green economic growth, resource efficiency, clean energy adoption, and sustainable city planning, while also addressing climate change mitigation and biodiversity protection.[80]

• **Dubai Integrated Waste Management Plan 2012:** The Dubai Integrated Waste Management Plan 2012 aims to reduce the amount of waste sent to landfills by focusing on recycling, waste-to-energy solutions, and innovative waste management technologies. The plan's long-term goal is to achieve zero waste-to-landfill by 2030, primarily by promoting waste reduction, segregation, and enhanced recycling efforts. It also encourages public and private sector collaboration to develop infrastructure and strategies that improve the efficiency and sustainability of Dubai's waste management systems.[81]

•**Public-Private Partnerships:** The UAE government collaborates with private companies like Enviroserve and Bee'ah to establish large-scale e-waste recycling facilities. These partnerships create incentives to invest in recycling infrastructure by providing business opportunities in the growing sustainability sector. [82,83]

•**Government-backed collection points:** Municipalities, such as Dubai Municipality and Abu Dhabi Waste Management Center (Tadweer), offer dedicated e-waste collection points and services for residents and businesses. These initiatives make it more convenient for individuals and organizations to recycle e-waste responsibly by offering drop-off locations.

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STAKEHOLDER

E-waste management across DCO Member States involves a diverse set of stakeholders, predominantly form the public and private sectors, with some support from social sector entities, each contributing to different aspects of the value chain.

Stakeholders in E-Waste Management Across GCC Member States

The Kingdom of Bahrain

• **Supreme Council for the Environment (SCE):** The SCE oversees environmental regulations and policies, including e-waste management. While not directly involved in e-waste collection, the council sets guidelines and collaborates with other organizations to ensure proper disposal and recycling practices.[17]

The State of Kuwait

• **Kuwait's Environment Public Authority (KEPA):** KEPA serves as the primary regulatory body overseeing environmental policies, including waste management.

• **Ministry of Public Works:** This ministry participates in infrastructure development and waste management projects, including recycling initiatives.

• **Ministry of Communications:** It collaborates with public and private entities to promote e-waste recycling within the telecommunications sector.

The Sultanate of Oman

• **Ministry of Environment and Climate Affairs:** Responsible for drafting and implementing environmental and waste management laws and policies.

• **Authority for Public Services Regulation:** Acts as a regulatory body for public services.

• **Oman Environmental Services Holding Company (Be'ah):** A government-owned entity established by Royal Decree in 2009 to manage various waste streams, including industrial, municipal, and healthcare waste. Be'ah aims to minimize the environmental and health impacts of waste while supporting economic growth and the circular economy.

• **Ministry of Commerce, Industry, and Investment Promotion:** In cooperation with Be'ah, this ministry promotes circular economy and waste management opportunities valued at approximately OMR 528 million to attract private sector and SME investments.

The State of Qatar

• **Ministry of Municipality and Environment (MME):** Oversees waste management policies and regulations in Qatar and plays a vital role in implementing national strategies for sustainable waste management, including e-waste.

• **Ministry of Communications and Information Technology:** Plans to initiate a strategic program for e-waste management. The ministry also launched the Green Computer Club initiative, which promotes recycling, provides ICT tools and internet access to migrant workers, and raises e-waste awareness among students.

Stakeholders in E-Waste Management Across GCC Member States

The Kingdom of Saudi Arabia

• **Ministry of Environment, Water, and Agriculture (MEWA):** Responsible for regulating and implementing environmental policies. MEWA conducts regular inspections and audits of businesses and facilities handling e-waste.

• **National Center for Waste Management (NCWM):** Oversees waste management across all sectors, including e-waste, by establishing guidelines, policies, and standards to ensure compliance with environmental regulations and to promote recycling.

• **National Center for Environmental Compliance (NCEC):** Manages licensing and accreditation of companies offering environmental services and issues renewals for service facilities.

• **Communications, Space, and Technology Commission (CST):**
Regulates the telecommunications sector and plays a key role in managing e-waste from electronics and telecom industries.

• **Saudi Standards, Metrology, and Quality Organization (SASO):** Develops quality and safety standards for electronic devices and their disposal.

• **National Center for Privatization & PPP (NCP):** Identifies waste management as a priority sector for privatization and PPPs. NCP actively works to attract private investment and expertise into the waste management sector, including e-waste recycling. It also serves as a platform for businesses to explore investment opportunities.

The United Arab Emirates

•**Ministry of Climate Change and Environment (MOCCAE):** Responsible for developing regulations and promoting e-waste recycling and hazardous waste management initiatives.

• **Environment Agency – Abu Dhabi (EAD):** Enforces environmental policies and supports sustainability programs.

• **Dubai Municipality:** Plays an active role in e-waste management within Dubai, establishing dedicated collection points and recycling centers. The municipality collaborates with private entities like Enviroserve for proper e-waste disposal and conducts awareness campaigns to educate residents about e-waste recycling.

• **Abu Dhabi Waste Management Center (Tadweer):** Oversees e-waste collection, treatment, and recycling in Abu Dhabi. Tadweer conducts public education campaigns about the dangers of improper e-waste disposal and provides facilities for safe handling and recycling.

In countries where formal efforts to manage e-waste are being made, the public sector is central to establishing and enforcing e-waste regulations, standards, and policies – primarily overseen by ministries of the environment or equivalent authorities.

In some cases, governments provide municipal-level collection and drop-off services to support e-waste processing (e.g., the Kingdom of Bahrain, the State of Kuwait, and the UAE).

The limited adoption of Extended Producer Responsibility (EPR) schemes in many Member States also places significant administrative and financial burdens on the public sector, which is often left to oversee and fund proper e-waste management.

It is also crucial to clearly map out the responsibilities across the different ministries and authorities, establishing strong collaborations to ensure that efforts to improve e-waste management are reinforced rather than slowed down by a lack of clarity and accountability.

The **private sector** plays a critical role in supporting e-waste infrastructure and service delivery across the GCC Member States. This involvement occurs through independent investment and administration of e-waste infrastructure, as well as through producer-driven

initiatives for collection, awareness-raising, and administration. The latter are often implemented under Extended Producer Responsibility (EPR) mandates or as part of Corporate Social Investment or Responsibility (CSI or CSR) programs.

Private ownership of e-waste infrastructure is widespread in the region. Companies such as Tadweer in the State of Kuwait and Enviroserve in the UAE and the Kingdom of Saudi Arabia operate significant recycling facilities.

Other prominent players include Bee'ah and Dulsco in the UAE, ERF Qatar, and the Seashore Group of Companies in the State of Qatar.

In the Kingdom of Bahrain, numerous private entities are actively involved in e-waste collection, treatment, and disposal. In the Sultanate of Oman, the Evergreen Gulf Recycling Hub (EGRH) benefits from technical support provided by the Canadian-based Sparta Group, which supplies expertise and equipment to enhance its operations.

The private sector is also heavily engaged in e-waste collection and awareness-raising initiatives. In the State of Kuwait, private companies, particularly in the telecommunications industry, such as STC Kuwait, Zain Kuwait, Ooredoo Kuwait, and Boubyan Bank, lead campaigns encouraging consumers to properly dispose of old electronic devices.These firms often collaborate with specialized recycling entities to manage the collected waste.

In the State of Qatar, Ooredoo and Vodafone run e-waste collection programs as part of their CSR initiatives, while Saudi STC has partnered with Ericsson to implement a Product Take-Back Program in the Kingdom.

Similarly, telecom operators in the Kingdom of Bahrain, including Batelco and Zain Bahrain, conduct regular programs to collect end-of-life telecom devices from customers.

The **social sector** also plays a vital role in enhancing e-waste awareness and collection systems.

For example, in the Kingdom of Bahrain, Recycling for Charity (RFC) collaborates with Universe Environment Bahrain to place recycling containers strategically across the Kingdom, with plans to install 75 recycling banks in easily accessible locations such as supermarkets, cinemas, and leisure destinations.

In the State of Kuwait, organizations like the Kuwait Society for the Protection of the Environment and the Environmental Voluntary Foundation raise awareness about the environmental and health impacts of improper e-waste management.

In the State of Qatar, the Qatar Foundation, through its sustainability arm Earthna, organizes initiatives like the E-Waste Action Initiative, which conducts e-waste collection campaigns and supports community recycling drives.

In the Kingdom of Saudi Arabia, organizations such as SENS, Al-Nabta, and the Sustainable Development Society focus on education and awareness-building related to e-waste. Similarly, in the UAE, entities like the Emirates Environmental Group and Dubai Cares actively promote awareness and recycling efforts.

Additionally, social sector organizations often support the repair and redeployment of e-waste to under-resourced communities, promoting social equity while reducing waste. For example, in the Kingdom of Saudi Arabia, the nonprofit organization Ertiqa partners with Zain KSA to refurbish and redistribute electronic devices to educational and social institutions.

During the roundtables, the private and social sectors expressed multiple times the willingness to participate in building a stronger e-waste ecosystem. They believe it is crucial that policymakers do not write policies and regulations alone but rather collaborate with various stakeholders in the value chain who will then implement and follow the regulations.

The **informal sector** remains an active participant in e-waste management in several GCC Member States. While informal actors often handle e-waste efficiently, their unregulated practices pose significant risks to both human health and the environment. Efforts are being made to integrate and improve informal sector practices through social sector partnerships.

For instance, in the Kingdom of Bahrain, informal e-waste collection dominates the recycling landscape but is supported by organizations such as Universe Environment Bahrain, which provides training, collaboration opportunities, and capacity-building initiatives to improve safety and sustainability in e-waste handling.

Experts and social sector representatives encourage governments to collaborate more with the informal sector, especially in countries where the informal sector is deeply embedded in society.

E-waste management across the GCC Member States is characterized by a complex interplay of stakeholders. Each sector—public, private, social, and informal—plays a distinct yet complementary role in addressing the challenges and opportunities within the e-waste value chain.

ENABLERS

E-waste enablers, including infrastructure, data availability, and consumer awareness, remain underdeveloped in many GCC Member States, but recent years have seen increased investment and interest in improving these systems, driven primarily by government and private sector organizations that have identified the risks and potential benefits of e-waste management.

Formal **e-waste collection systems** have been established in some GCC Member States, providing structured avenues for proper disposal, though their coverage often remains limited to urban centers.

This service is commonly provided by municipalities and supported by private and social sector efforts. For example, in the State of Kuwait, drop-off points have been strategically placed in public areas such as malls, government buildings, and community hubs, and supported by the Kuwait Municipality.

Alongside this, telecom operators, including STC, Zain, and Ooredoo, have also set up collection points at retail outlets, while recyclers like Tadweer and MRC offer direct e-waste collection services to businesses and individuals.

In the UAE, municipalities such as Dubai Municipality provide dedicated e-waste collection points and services for both residents and businesses. The Kingdom of Bahrain has implemented secure drop-off containers for e-waste managed by municipalities and private firms like Batelco, ensuring citizens have convenient access. Despite these developments, many Member States lack comprehensive collection networks and limited consumer access to formal systems often leads to improper disposal.

Consumer awareness is also a critical enabler for effective e-waste collection but remains limited across the GCC. Recognizing this, several countries have prioritized awareness-raising initiatives to educate the public and encourage sustainable disposal practices, which are collaboratively run by the government, NGOs, and telecommunications companies.

In the Kingdom of Saudi Arabia, public awareness campaigns led by the government and private sector emphasize the importance of e-waste recycling. These campaigns often include incentives, such as discounts or vouchers for trading in old electronics at designated collection points.

In the State of Kuwait, organizations like the Kuwait Environment Public Authority (KEPA) and NGOs run campaigns to inform citizens about the environmental hazards of e-waste and proper disposal methods. Qatar's telecom companies, Ooredoo and Vodafone, integrate e-waste collection into their Corporate Social Responsibility (CSR) initiatives, providing incentives such as discounts on new devices to customers who return old electronics.

Similarly, in the Kingdom of Bahrain, the private sector plays a role in awareness efforts, such as Zain Bahrain's school competitions, which educate students about the need to recycle e-waste. These efforts aim to foster consumer participation, but challenges persist in bridging awareness gaps and promoting sustainable disposal behaviors.

Reuse and redeployment of electronic devices remain low across the GCC Member States, potentially due to limited demand for second-hand devices. This underutilization overlooks significant opportunities to extend the lifespan of electronics, reduce e-waste generation, and address the digital divide by providing affordable technology to under-resourced communities.

In the Kingdom of Saudi Arabia (KSA), the CST launched a successful initiative, "Recycle Your Device", aiming to collect used devices and increase reuse and recycling rates. Indeed, consumers are reassured by the coordination of a public entity that ensures their data is protected and erased properl.

E-waste processing infrastructure in the GCC is generally limited to preprocessing activities. In the Kingdom of Bahrain, processing primarily involves mechanical sorting and disassembly, targeting ferrous and non-ferrous metals through shredding and density separation.

The State of Kuwait and the State of Qatar rely on manual disassembly and basic sorting techniques. While the State of Qatar operates material recovery facilities for metals like copper and aluminum, valuable components are often exported for advanced processing due to a lack of specialized infrastructure.

The Sultanate of Oman is home to the Evergreen Gulf Recycling Hub, which can pre-process 10–20 million kilograms of e-waste annually, making it one of the region's highest-capacity facilities. Progress is being made to expand capabilities.

The Kingdom of Saudi Arabia established the Saudi Investment Recycling Company (SIRC) in 2017, which is the largest industrial waste management company in the GCC. SIRC provides an integrated platform for handling, transporting, treating, and safely disposing of hazardous and metal waste.

Where advanced recycling technologies are unavailable, GCC Member States continue to rely on e-waste exports or informal sector practices, which are often environmentally unsound and unregulated. Addressing these infrastructure gaps through strategic investment and regional collaboration will be essential for improving the efficiency and sustainability of e-waste management across the GCC.

Despite limited collection and recycling infrastructure, GCC Member States are displaying highly innovative approaches to the **adoption of digital platforms** and technologies to improve e-waste management and stimulate economic growth.

For example, Kuwait's Environmental Compliance Platform enhances efficiency in e-waste management and cross-border trade by streamlining administrative processes, reducing documentation cycles, and ensuring alignment with international agreements like the Basel Convention. This initiative modernizes compliance and supports global standards.

To support the market for waste redeployment and recycling, Dubai Municipality launched an e-platform for recyclable and reusable materials in 2021. This system promotes the exchange of materials and related transactions to divert waste from landfills, incentivize recycling, and extend product lifespan.

Finally, in the Sultanate of Oman, Be'ah is in the process of developing an e-platform for waste trading and collection. This innovative system will provide live pricing linked to a local index and full-cycle tracking of waste from generation to processing. It also aims to facilitate live auctions to **maximize value creation** in the waste sector, supporting SME growth and commercialization.

The increasing development of this infrastructure and supporting digital technologies is enabled by substantial investment from GCC governments in e-waste management. With e-waste established as a national priority, whether justified by its environmental or health impacts or the potential for material recovery and economic benefit, there is a strong case for public investment. This commitment and prioritization are embedded in national visions, strategies, and action plans across the region.

The GCC Member States have already established a clear vision for sustainability and waste management. The Kingdom of Bahrain's Vision 2030 highlights environmental sustainability as a key objective, motivating businesses and public institutions to align their practices, including e-waste management, with national goals. Kuwait's National Waste Management Strategy 2040 establishes a policy framework to prioritize recycling and waste management.

Similarly, Qatar's National Master Plan commits to ambitious targets for waste minimization, recycling, and recovery, along with public awareness campaigns and support for recycled material usage. Saudi Arabia's Vision 2030 integrates sustainability into its long-term economic development goals, with plans to invest SAR 100 billion in the recycling industry by 2035.

Meanwhile, the UAE's Vision 2021 and Green Agenda 2030 promote the circular economy principles, focusing on resource efficiency and waste reduction. However, greater specificity regarding e-waste management in these strategies could strengthen their impact.

GCC governments are providing substantial financial support to develop e-waste management infrastructure and encourage innovation. Kuwait's National SME Fund has successfully backed small facilities specializing in e-waste processing, while the Qatar Development Bank (QDB) offers subsidized loans, grants, and incubation programs to businesses focused on sustainability, including e-waste management.

These measures incentivize private-sector participation and foster technological advancements. Under Saudi Vision 2030, investments in the recycling industry are expected to reach SAR 100 billion by 2035, enabling the development of large-scale facilities and infrastructure.

This investment is further supported by the GCC Member States' increased recognition of the socio-economic value of effective e-waste management, framing it as an opportunity for economic growth and job creation.

In the Sultanate of Oman, the Circular Economy Strategy, as part of Oman Vision 2040, is expected to assess the socio-economic impacts of transitioning toward circularity. This includes evaluating the potential returns on GDP growth and job creation, emphasizing the broader economic benefits of sustainable waste management practices.

Similarly, the UAE identifies significant economic potential in recovering valuable materials, such as precious metals, from e-waste. The country's Circular Economy Policy 2021–2031 focuses on reducing resource dependence through enhanced recycling efforts. By doing so, the UAE aims to stimulate economic growth and build a more resilient and sustainable economy. These initiatives highlight the dual benefits of environmental sustainability and economic development, presenting e-waste management as a strategic driver for regional prosperity.

Despite substantial investment in e-waste management, several barriers hinder increased private sector involvement. A key challenge is the absence of mandated frameworks, such as Extended Producer Responsibility (EPR), which hold producers accountable for managing e-waste across its lifespan. Additionally, there is a lack of financial incentives to support the scaling up of recycling businesses, and limited feedstock volumes remain a significant obstacle for private recyclers, reducing the economic feasibility of large-scale operations.

To tackle these challenges, GCC Member States have increasingly turned to **Public-Private Partnerships (PPPs)** to boost innovation and investment in recycling and waste management infrastructure. In the Sultanate of Oman, Be'ah's 2012 strategy for commercial waste collection aimed to attract private sector investment.

Agreements have been signed with key stakeholders like Omantel and Ooredoo, and reports indicate that plans are underway for a new law to further encourage private involvement.

Similarly, the Kingdom of Saudi Arabia's National Center for Privatization and PPP (NCP) prioritizes waste management as a key sector for private investment, focusing on advancing e-waste recycling initiatives.

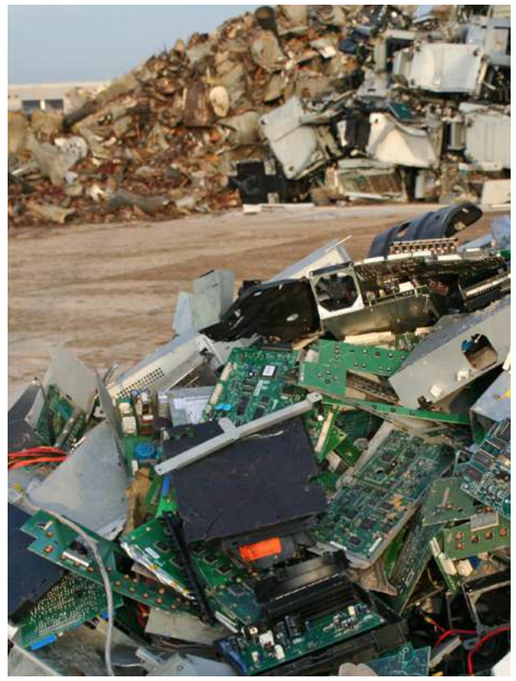
In the State of Qatar, the Ministry of Municipality has privatized waste management facilities across the value chain, and in the UAE, the government has partnered with private waste management companies such as Enviroserve and Bee'ah, leading to the establishment of large-scale e-waste recycling facilities. These efforts highlight how PPPs can address barriers, pool resources, and promote sustainable e-waste management across the region.

Finally, a significant barrier to advancing e-waste management across the GCC Member States is the **lack of reliable data,** particularly regarding collection and recycling rates.

Transparency and effective monitoring of e-waste flows remain limited, with most states only measuring e-waste as a collective category rather than classifying it into specific types. This lack of granular data hinders the ability to evaluate system performance and develop targeted policies.

Some countries are beginning to address these gaps through focused data collection and improved sector oversight. For example, the Kingdom of Saudi Arabia has identified the involvement of e-waste transport actors as a potential means to enhance monitoring and regulatory compliance. Strengthening transparency and data availability is essential for informed decision-making and strategic investments in e-waste management systems. These efforts are crucial for building a more effective and accountable e-waste ecosystem across the region.

The private sector is also asking for unified standards of classification to track and report data and is willing to provide ideas and solutions to digitize the process.



Enablers for Each GCC Member State

The Kingdom of Bahrain

• **Collection Infrastructure:** Designated Collection Points, including secure containers, are available across Bahrain for the drop-off of e-waste. These are managed by municipalities and private firms, such as telecom operator Batelco.

• **Treatment Infrastructure:** In Bahrain, only a few recycling companies exist, and the industry is mainly limited to mechanical sorting and disassembly to separate different materials using conveyor belts, shredders, mechanical separators, and density separators to target ferrous and non-ferrous metals (e.g. Crown Industries, Recycle IT).

• **Public Awareness Campaigns:** Industry campaigns run by organizations like Recycling for Charity and collaborations between private companies and schools help educate the public about the dangers of improper e-waste disposal. These initiatives aim to promote responsible recycling behaviors. In addition, Zain Bahrain [19], a leading telecom provider in the Kingdom, in partnership with the SCE, has run e-waste competitions in schools to raise awareness of the need to recycle e-waste. It has also provided a large drop box at Zain's headquarters for citizens to place any unwanted or expired electronic waste.

• **Green ICT Initiatives:** Bahrain's Supreme Council for the Environment conducted three forums focused on promoting investment in green infrastructure, waste management and sustainable consumption, with the emphasis on the ICT sector.[73]

• **Bahrain Vision 2030** [20]**:** This vision provides a strong policy backdrop that emphasizes environmental sustainability, motivating businesses and public institutions to align their practices, including e-waste management, with national sustainability goals.

• **Partnerships and Collaboration:** Partnerships between the public and private sectors, such as the collaborative e-waste initiative between Crown Industries, Zain Bahrain, and the Supreme Council for Environment, promote shared responsibility in managing e-waste.

The State of Kuwait

• **Collection Infrastructure:** While there is no data readily available on the number of drop off points available to citizens, the Kuwait Municipality supports the placement of e-waste drop-off points in public areas, including malls, government buildings, and other community hubs. Telecom companies like STC, Zain, and Ooredoo have set up e-waste collection points at their retail outlets, and recyclers like Tadweer and MRC offer direct e-waste collection services for businesses and individuals. [23]

• **Treatment Infrastructure:** Until recently, the State of Kuwait had been heavily reliant on landfill disposal of municipal hazardous waste. Dedicated infrastructure for the treatment and management of e-waste is starting to develop, including:

- **Manual Disassembly:** E-waste is manually dismantled to separate components such as circuit boards, cables, and batteries for safe disposal or recycling. (Tadwire & MRC) [23,24]
- **Shredding and Sorting:** Electronic devices are shredded into smaller parts to separate metals, plastics, and other materials. These components are then sorted for recycling or further processing. (Enviroserve Kuwait)
- **Secure Data Destruction:** Tadwire provides secure data destruction services. [23]

Enablers for Each GCC Member State

• **Export Infrastructure:** The Environmental Compliance Platform [27] supports e-waste exports by streamlining the associated administrative processes, reducing documentation cycles, eliminating paper-based procedures, and minimizing direct interactions. In addition, it enhances the efficiency of relevant authorities in monitoring and assessing compliance with international environmental agreements, including the Basel Convention, ensuring national practices align with global standards.

• **National Vision:** The Kuwait National Waste Management Strategy 2040 creates a policy framework that prioritizes waste management and recycling. This national strategy can act as a strong motivator for businesses, public organizations, and individuals to align their practices with the country's environmental goals.[22]

• **Public Education Campaigns:** Organizations, including the Kuwait Environment Public Authority (KEPA), and NGOs, such as the Kuwait Society for the Protection of the Environment (KSPE), play a crucial role in raising awareness about the environmental and health hazards of e-waste. These campaigns inform citizens about proper disposal methods and encourage participation in recycling programs.

• **Online Tools:** The Kuwait Waste Management Atlas is a Geographic Information System (GIS) database that provides an overview of various waste themes, high-level statistics on waste generation, and a map of key operations across Kuwait. However, there is limited e-waste-specific data.[26]

The Sultanate of Oman

• The Evergreen Gulf Recycling Hub (EGRH): A large-scale e-waste recycling facility, has a processing capacity of 10-20 million kg per year. [40,45,48]

- Support Across the Value Chain: Offers complete e-waste management services, from collection to recycling, industry-specific waste management, quality control, and sustainability solutions for businesses and corporations.
- Circular Process: Designed to process and recycle a wide range of electronic and electrical waste while recovering the optimal recyclable value.
- Products: Handles computers, monitors, printers, office equipment, microwaves, televisions, mobile phones, fluorescent bulbs, air conditioners, cables, wires, motors, and more.
- E2MS Management System: Generates Certificates of Destruction, Certificates of Recycling, and Inventory Reports of all e-waste received at the facility after processing. These reports are sent to the customers as proof that their e-waste has been disposed of by an authorized recycler.
- Supported by the Canada-based environmental services specialist Sparta Group, the facility, which is equipped with AI-enabled technology, is one of the most modern in the Gulf region and is suitably equipped to recover the optimal recyclable value from all kinds of electronic waste.
- Partnered with the University of Gothenburg in Sweden to develop and scale an industrial recycling process based on the use of nano-sensor tags.

Enablers for Each GCC Member State

• **Numerous waste management sites** are run by Oman Environmental Services Holding Company (Be'ah) including 10 engineered landfills and 16 transfer stations; however, these are not e-waste focused.[46]

• **Be'ah** has expressed interest in developing an e-platform for waste trading and collection, with the goal of increasing recycling rates and maximizing the value recovered from waste through live auctions.

• **Focus on waste reduction, combined with better waste management:** The target is to reduce per capita municipal waste generation from 1.2 kg/day to less than 1 kg/day by 2040 through raising environmental awareness in society.[47]

• **Awareness-raising** was prioritized before infrastructure development (2019), including campaigns and education within schools.

• The development of e-waste processing facilities coincided with an increased focus on the **economic potential of e-waste recycling.**

The State of Qatar

• **Collection Infrastructure:** E-waste is collected by private sector actors from residential areas in coordination with the competent authorities, such as the Ministry of Municipal and the Environment. In addition, citizens can voluntarily deliver e-waste to designated collection points. The exact number of collection points available to citizens is not publicly available.

• **Treatment Infrastructure**

- Manual dismantling: E-waste items such as computers, televisions, and household electronics are manually dismantled to separate hazardous components (like batteries and circuit boards) from recyclable materials (such as metals and plastics). (ERF and Seashore)
- **Shredding and Sorting:** After dismantling, the remaining e-waste is shredded into smaller pieces and sorted by material type (metals, plastics, etc.). This process allows companies to recover and recycle different materials efficiently. (Tadweer, ERF, and Seashore)
- **Material Recovery:** Valuable metals such as copper and aluminum are extracted from electronic components through specialized processes. This helps reduce the need for virgin material extraction and minimizes environmental impacts. (ERF). Some valuable materials are exported to Singapore and China for further processing.
- **Safe Disposal of Hazardous Waste:** E-waste often contains hazardous materials such as mercury, lead, and cadmium. Safe disposal processes ensure these substances are treated in compliance with environmental standards, minimizing their release into the environment. (ERF and Al Haya Waste Management).
- **Public Awareness and Education Campaigns:** Organizations like the Qatar Foundation conduct educational campaigns to inform citizens about the importance of recycling e-waste and the benefits of extending the lifespan of electronic products.
- **Qatar's National Vision 2030:** This long-term vision encourages companies, government agencies, and individuals to align their practices with national goals, including e-waste recycling.[51]

Enablers for Each GCC Member State

The Kingdom of Saudi Arabia

• **Collection Infrastructure:** In the Kingdom of Saudi Arabia, the exact number of e-waste collection points is not publicly available. However, e-waste recycling is supported by various public and private entities, and several organizations provide accessible drop-off points for citizens. Several municipalities offer designated collection areas, and some recyclers who also offer drop-off points or collection services (Exitcom KSA and Holoul Electronic Recycling Treatment Company). Finally, large electronic retailers (Extra Stores and Jarir Bookstore) and telecom companies (STC and Mobily) often run take-back programs where customers can drop off old devices when purchasing new ones. [65,66,67,68]

• **Future Growth:** Significant future investment has been targeted at the waste and resource sector. By 2040, over 840 treatment and recovery facilities will be built to achieve the national objectives and targets for the waste sector. As part of Saudi's Vision 20301, the government has proposed investments of 100 billion Saudi riyals in the recycling industry.

• **Recycling Infrastructure (Examples):**

- **Manual Dismantling and Material Sorting:** In this initial step of e-waste recycling, workers manually separate hazardous components such as batteries, cables, and circuit boards. After dismantling, materials like metals, plastics, and glass are sorted for further processing. (Holoul Electronic Recycling Treatment Co. and Exitcom KSA) [65,68]
- **Shredding, and Mechanical Separation:** Shredding breaks down larger electronic items into smaller pieces, which are then sorted using mechanical separation technologies. These processes help separate metals, plastics, and other materials for recovery. (SIRC, EnviroServe, and Exitcom KSA). [65,66,70]
- **Advanced Sorting Technologies:** Mechanical and automated processes such as eddy current separation and optical sorting, are used to efficiently segregate materials based on their physical and chemical properties. (SIRC)
- **Metal Recovery and Refining:** After sorting and separating materials, metal recovery techniques extract valuable metals such as copper, gold, silver, and aluminum from electronic components. These metals are then refined and reused in the manufacturing process. (SIRC and Exitcom KSA). [65,70]
- **Thermal Treatment and Incineration:** Hazardous components, especially plastics, may undergo thermal treatment to reduce their volume and neutralize harmful substances. In some cases, incineration is used for non-recyclable waste, but only under controlled conditions to minimize pollution. (Holoul Electronic Recycling Treatment Co.).[68]

• **Government Support and Vision 2030:** The Saudi government's Vision 2030 serves as a significant enabler by embedding sustainability into the country's long-term economic development goals. This national vision places an emphasis on environmental stewardship and limiting waste. This strategic direction motivates public and private sector entities to align their practices with sustainability goals, including e-waste management.

Enablers for Each GCC Member State

The Communications, Space, and Technology Commission has worked toward developing toolkits and frameworks to support sustainable ICT. [74,75]

• **Public Awareness Campaigns:** Educational campaigns play a vital role in raising awareness about the hazards of improper e-waste disposal and the benefits of recycling. Government bodies like the National Center for Waste Management (MWAN), the Communications, Space and Technology Commission, and private sector companies collaborate to run awareness campaigns that inform the public about designated e-waste collection points and encourage responsible behavior.

• **Partnerships and Collaboration:** Partnerships between the public and private sectors, as well as collaborations with international organizations like the International Telecommunication Union (ITU), and the work of the Saudi Investment Recycling Company (SIRC), strengthen the Kingdom of Saudi Arabia's capacity to manage e-waste effectively while helping align local practices with global standards and fostering innovation in e-waste recycling technologies.

• **Technological Innovation:** The use of advanced e-waste recycling technologies, such as those employed by SIRC's e-waste subsidiary, has improved the efficiency and environmental impact of e-waste management. Innovation is a key horizontal theme in the National Center for Waste Management's master plan. Fostering innovation enables the recovery of valuable materials like precious metals, which reduces the need for raw material extraction and supports the circular economy.

• **Cultural Shift Toward Sustainability:** The Kingdom of Saudi Arabia is undergoing a cultural shift, with sustainability becoming more embedded in daily life and business practices. This shift is driven by government policy, corporate leadership, and increasing global awareness about environmental issues, including the risks associated with e-waste.

The United Arab Emirates

• **Collection Infrastructure:** While there is no publicly available data on the number of collection points (waste collection centers) in the UAE, e-waste is collected through a combination of public drop-off points, retail collection points and corporate e-waste collection drives.

• **Treatment Infrastructure:** The key e-waste treatment technologies available in the UAE include:

- **Manual Dismantling and Material Sorting:** This is one of the first steps in the recycling process, where hazardous components such as batteries, cables, and circuit boards are manually separated. Reusable components are segregated and materials like metals, plastics, and glass are sorted for processing.
- **Mechanical Separation and Recovery:** Shredding breaks down larger electronic items into smaller pieces, which are then sorted using mechanical separation technologies. These processes help separate metals, plastics, and other materials for recovery (Enviroserve). [82]
- **Automated Sorting System:** This technology separates the different components of electronic waste, such as metals, plastics, and hazardous materials, helping to maximize the efficiency of recycling processes. (Bee'ah and Tadweer).[83]
- **Thermal Treatment and Incineration (in progress):** Hazardous components, especially plastics, can undergo thermal treatment to reduce their volume and neutralize harmful substances. In some cases, incineration is used for non-recyclable waste, but only under controlled conditions to minimize pollution. (In development by Bee'ah).[83]

Enablers for Each GCC Member State

• **Electronic Platforms:** In August 2021, the Municipality of Dubai launched an electronic platform for the exchange of recyclable and reusable materials. The e-platform aims to reduce the quantities of waste produced and divert more waste from landfills. By facilitating the exchange of materials and related transactions, the platform creates economic incentives for recycling and reuse.

- **Awareness Campaigns:** Government agencies, private organizations, and NGOs frequently launch public awareness campaigns to educate citizens on the hazards of e-waste and the benefits of recycling, such as Dubai Municipality's e-waste collection competition and the annual Abu Dhabi Sustainability Week, which helps shift consumer behavior toward responsible disposal.
- **Corporate Social Responsibility:** Many companies in the UAE are driven by corporate social responsibility (CSR) initiatives, where sustainability and eco-friendly practices are integrated into their business models. Telecommunications companies like Etisalat and du run e-waste recycling programs as part of their CSR strategies, contributing to broader national recycling efforts.
- **Economic Benefits:** The UAE recognizes the potential economic value of recovering precious metals and materials from e-waste. The country's circular economy initiatives, driven by the UAE Circular Economy Policy 2021–2031, aim to capitalize on recycling to reduce resource dependence and stimulate economic growth. [78]
- **Thermal Treatment and Incineration (in progress):** Hazardous components, especially plastics, can undergo thermal treatment to reduce their volume and neutralize harmful substances. In some cases, incineration is used for non-recyclable waste, but only under controlled conditions to minimize pollution. (In development by Bee'ah).[83]

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E-WASTE TYPES AND VOLUMES

E-waste generation across the GCC Member States has grown significantly, from an average of 107 million kilograms generated in 2014 to 168 million kilograms in 2022—a substantial 49% growth over eight years. This increase reflects the accelerating consumption and subsequent disposal of electronic products across the region.

While most Member States experienced growth close to the regional average, the United Arab Emirates saw the highest increase in e-waste generation at 78.2%, whereas the State of Kuwait reported minimal growth of just 2.9% during the same period.

When assessed globally, GCC Member States show moderate levels of e-waste generation. Per capita e-waste generation in the GCC averaged 15 kilograms in 2014 and increased to 17 kilograms in 2022, substantially lower than the 20–24 kilograms per capita reported in some high-income countries, such as the UK (24.5 kg), the United States (21.3 kg), Norway (26.8 kg), and Australia (22.4 kg). However, the GCC rates remain significantly higher than the 9 kilograms per capita average observed across the DCO Member States in 2022.

The Kingdom of Saudi Arabia stands out as the largest contributor to e-waste generation in the GCC, driven by its high population and substantial per capita consumption rates (17.1 kg). The UAE, meanwhile, recorded the highest per capita rate of e-waste generation in the GCC at 18.9 kilograms in 2022, alongside the highest growth rate (76.2%) over the same period.

Volume of E-Waste

The Kingdom of Bahrain

• **Waste Categorization:** The Environment Law No. 7 of 2022 classifies electronic waste as hazardous waste but does not distinguish between types of electrical and electronic waste.

• **EEE Placed on the Market:** In 2019, 22 kg per capita of new electronics were placed on the market, totaling 33 million kilograms.[6] In the survey conducted by the DCO in September 2024, the volume of new electronics placed on the market was further broken down into the following categories:

01 **Temperature Exchange Equipment: 8.1 million kilograms (23%)**

02 **Screens and Monitors: 2.4 million kilograms (7%)**

03 **Lamps: 0.9 million kilograms (3%)**

04 **Large Equipment (any external dimension greater than 50 cm): 4.9 million kilograms (14%)**

05 **Small Equipment (no external dimension greater than 50 cm): 14.5 million kilograms (41%)**

06 **Small ICT Equipment (no dimensions greater than 50 cm): 4.4 million kilograms (12%)**

• **E-Waste Generated:** In 2014, 12.9 kg of e-waste was generated per capita, increasing to 17.8 kg in 2022. In total, e-waste generation increased from 16 million kilograms in 2014 to 26 million kilograms in 2022 (a 62.5% increase), which is the highest rate of increase in the region.

• **E-Waste Collected:** Public data relating to the volume of e-waste recycled in the Kingdom of Bahrain is not readily available. According to the DCO survey, 0.87 million kilograms of e-waste were collected in 2021.

• **Recycling Rates:** Data relating to the volume of e-waste recycled in the Kingdom of Bahrain is not readily available. According to the DCO survey, the single pre-treatment company present in the Kingdom of Bahrain collects and manages 0.87 million kilograms of the 26 million kilograms of e-waste generated in 2022. This equates to 3.3% of the total e-waste.

Volume of E-Waste

The State of Kuwait

• **Waste Categorization:** E-waste is classified under the Environmental Protection Law No. 42 of 2014 (amended in 2015)1 and falls under the broader category of hazardous or non-hazardous waste, with classification based on its chemical content and potential hazards.

• **Placed on the Market:** The amount of new electronics "placed on the market," according to the United Nations Institute for Training and Research's Regional E-Waste Monitor, is 21.7 kilograms per inhabitant. This equates to 100 million kilograms of electrical and electronic equipment being placed on the market in 2019.

• **E-Waste Generated:** The reported volume of e-waste generated has remained steady, with only a 3% increase from 2014 (69 million kilograms) to 2022 (71 million kilograms).

E-waste generated per capita decreased slightly from 17.2 kg in 2014 to 16.7 kg in 2022.

• **E-waste Collected and Recycling Rates:** Not publicly available

The Sultanate of Oman

• **E-Waste Generation:** Annually, 25.0 kilograms of electronics per capita is placed in the market, totaling 110 million kilograms. In 2023, 15.7kg of e-waste was generated per capita, totaling 71 million kilograms, an increase from 14 kg per capita, totaling 46 million kilograms in 2013

• **E-Waste Trade:** In 2022, Oman imported $580,000 of e-waste and exported $95,000 of e-waste.

• **E-Waste Collection:** Estimated at less than 1% of e-waste collected in 2021.

The State of Qatar

• **Placed on the Market:** The amount of new electronics 'placed on the market,' according to the United Nations Institute for Training and Research's Regional E-Waste Monitor, is 24.9 kg per inhabitant.

This totaled 68.4 million kilograms of electronic and electrical devices being placed on the market in 2019. [1,5]

Volume of E-Waste

• **Waste Generation:** In 2022, 16.2 kg per capita of e-waste was generated. E-waste generation per capita has remained steady since 2014, when it was **16.3 kg**.

There has been a 33% increase in overall e-waste production from 2014 (33 million kilograms) to 2022 (44 million kilograms), attributable to population growth. [1,5]

• **Waste Collected:** According to the Regional E-Waste Monitor for 2021, **0.07 kg** of e-waste was collected per inhabitant. This amounts to **0.5%** of Qatar's total e-waste being collected.[5]

• **Recycling Rates:** Data relating to the volume of e-waste recycled in Qatar is not readily available.

The Kingdom of Saudi Arabia

• **Placed on the Market**: According to the Regional E-Waste Monitor Report for the Arab States, the amount of new electronics 'placed on the market' according to the United Nations Institute for Training and Research's Regional E-Waste Monitor is **22,4 kg** per inhabitant in 2019, totaling **758 million** kilograms being placed on the market.

This is a marked increase (200%) from the 378 million kilograms generated in 2015.

• **Waste Collected:** According to the Regional E-Waste Monitor Report for the Arab States [5], it is estimated that less than **1%** of e-waste was collected in 2019.

• **Recycling Rates:** Data relating to the volume of e-waste recycled in the Kingdom of Saudi Arabia is not readily available.

The United Arab Emirates

• **Waste Categorization:** In the UAE, a wide range of e-waste is collected for recycling and disposal as the legislation does not distinguish between different types. E-waste is defined as "goods or damaged electrical and electronic equipment and devices that are or are intended to be disposed of, or any part of their components, by the consumer."

• **Placed on the Market: 24.0 kg** per inhabitant of new electronics was placed on the market in 2019, totaling to **257,855 tons**. Revenue from the consumer electronics market in the UAE amounts to **$0.91billion** in 2024, having grown from **$0.71 billion** in 2019.[5]

• **Waste Collected:** UAE's total volume of e-waste collected in 2020 was **3.24 million** kilograms, or 0.35 kilograms per inhabitant.[5]

• **Waste Recycled:** In 2022, **5.4 kg** per inhabitant was reported as formally collected and recycled in 2022 through the official e-waste system.

This equates to 5.4 million kilograms collected overall, which is 3% of the UAE's total estimated e-waste.

Due to a lack of support programs and the recent introduction of EPR, the UN estimates that approximately **20%** of e-waste continues to be routed through the informal sector or disposal in landfills.[5]

Despite these rising volumes, recycling and collection rates across the GCC Member States remain alarmingly low. The UAE reported a formal collection rate of 5.4% and a recycling rate of 3%, while other Member States are estimated to have collection and recycling rates below 1%, although data availability remains limited. This highlights a critical need for enhanced data collection systems, formalized recycling initiatives, and increased public awareness to address the growing e-waste challenge effectively.

CROSS-BORDER E-WASTE FLOWS

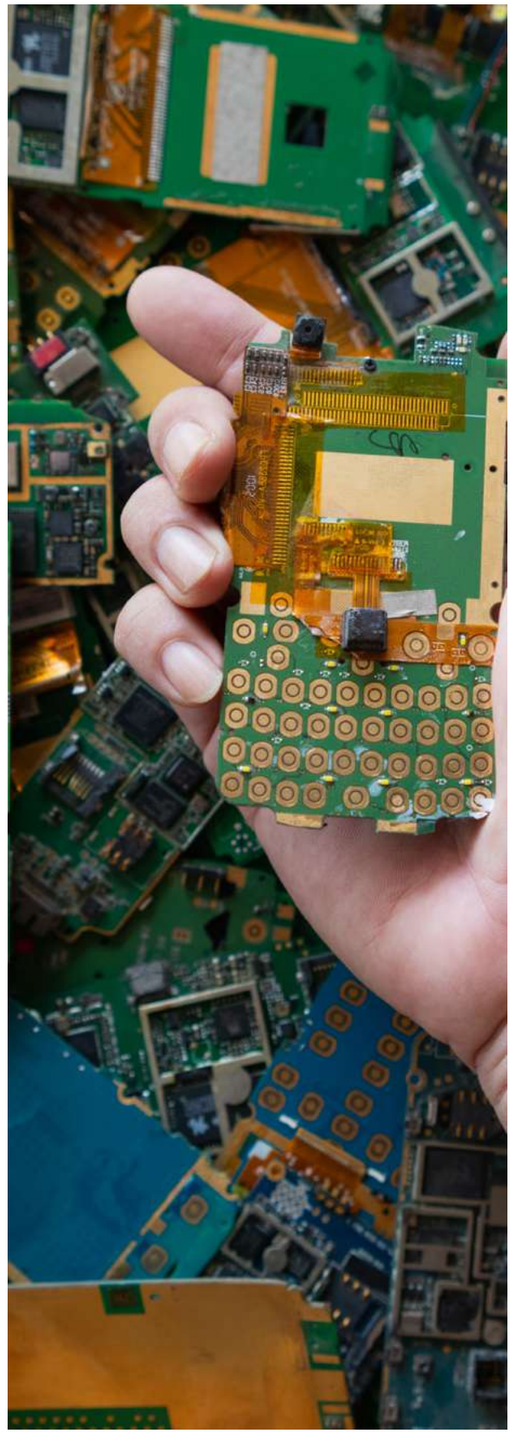
Cross-border e-waste flows are a vital mechanism for managing e-waste, especially in countries with insufficient infrastructure or technical capabilities. This approach enables nations to outsource e-waste management to countries equipped with advanced recycling technologies, ensuring environmentally sound processing.

Conversely, imports allow nations with developed infrastructure to secure sufficient feedstock, generate revenue, and build economies of scale. Exports may consist of raw e-waste or pre-processed materials that have been dismantled and sorted into specialized components for further treatment.

Among the GCC Member States, five out of six countries are net exporters of e-waste, with the United Arab Emirates being the sole net importer. This aligns with the UAE's position as having the most advanced e-waste recycling infrastructure in the region, enabling it to manage both domestic and imported waste effectively. Other GCC Member States primarily focus on preprocessing and often have limited capacity, so they prioritize the treatment of domestically generated e-waste.

Some GCC Member Staes, including the State of Kuwait, the State of Qatar, and the Kingdom of Saudi Arabia, have implemented restrictions on e-waste exports, permitting them only when local infrastructure is unable to process the waste. These restrictions help ensure that sufficient feedstock remains within national systems to sustain domestic recycling facilities, preventing dependence on outsourcing to lower-cost countries that could undermine local industries.

Notably, the State of Qatar has also instituted a complete ban on hazardous waste imports, limiting the possibility of importing most e-waste streams and their subcomponents. The Sultanate of Oman has invested in infrastructure for dismantling e-waste, but authorities have highlighted that e-waste recycling is still not as developed as needed, with low visibility into local capacity and feedstock availability.



CHALLENGES IN E-WASTE MANAGEMENT ACROSS GCC MEMBER STATES

The DCO launched an online survey to collect and rate the challenges that the GCC Member States face regarding e-waste management. The representative of each Member State rated the potential national and cross-border challenges from 1 to 10, where 1 was considered *"Not Relevant" for the Member State and 10 "Relevant" for the Member State.*

In parallel, the representatives of the GCC Member States also ranked the main opportunities in e-waste management by relevance for their Member States, highlighting the potential initiatives that would be most impactful in their countries to address the challenges.

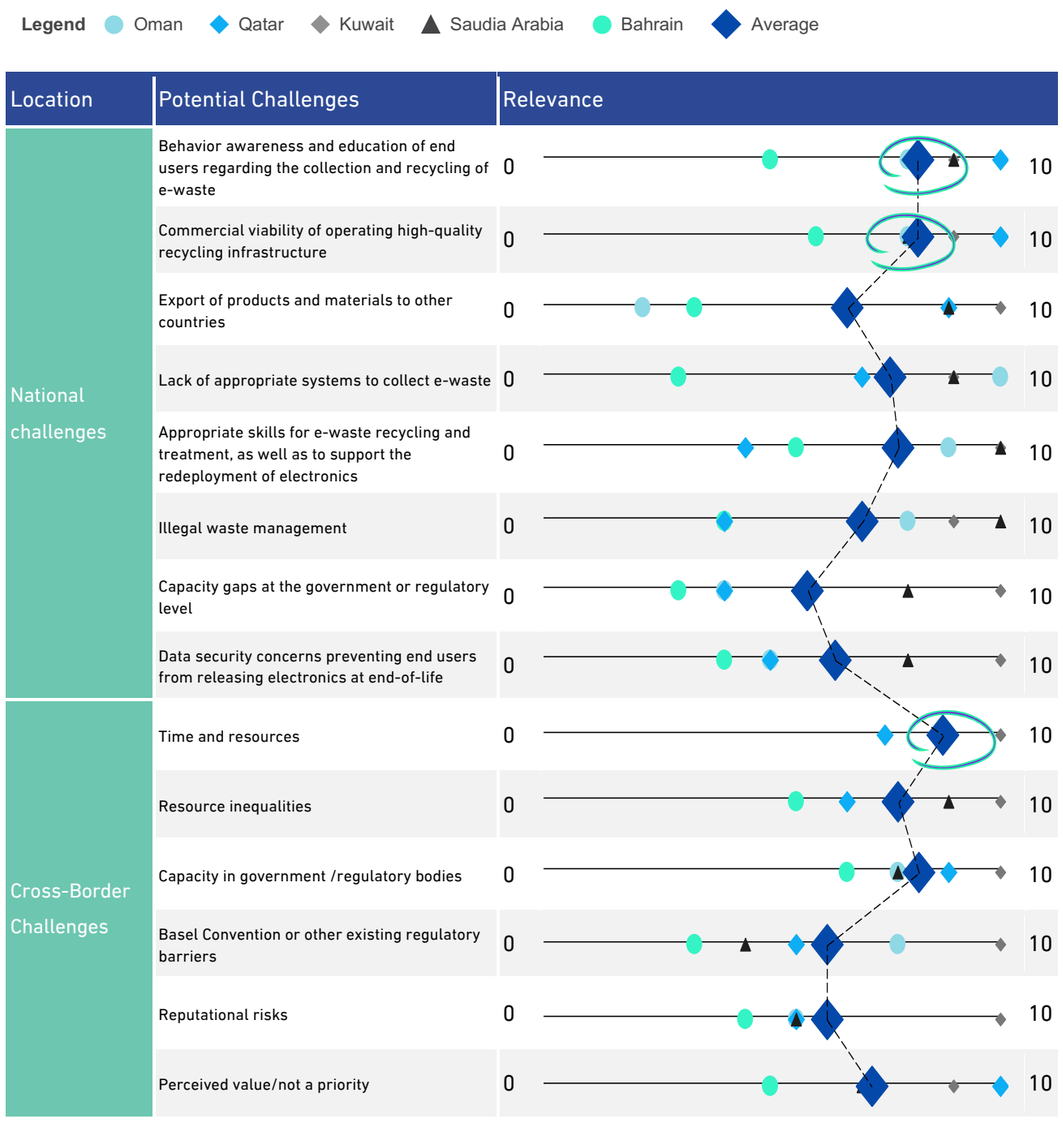


Table 1: Poll Results on the Challenges in E-Waste Management for GCC Member States

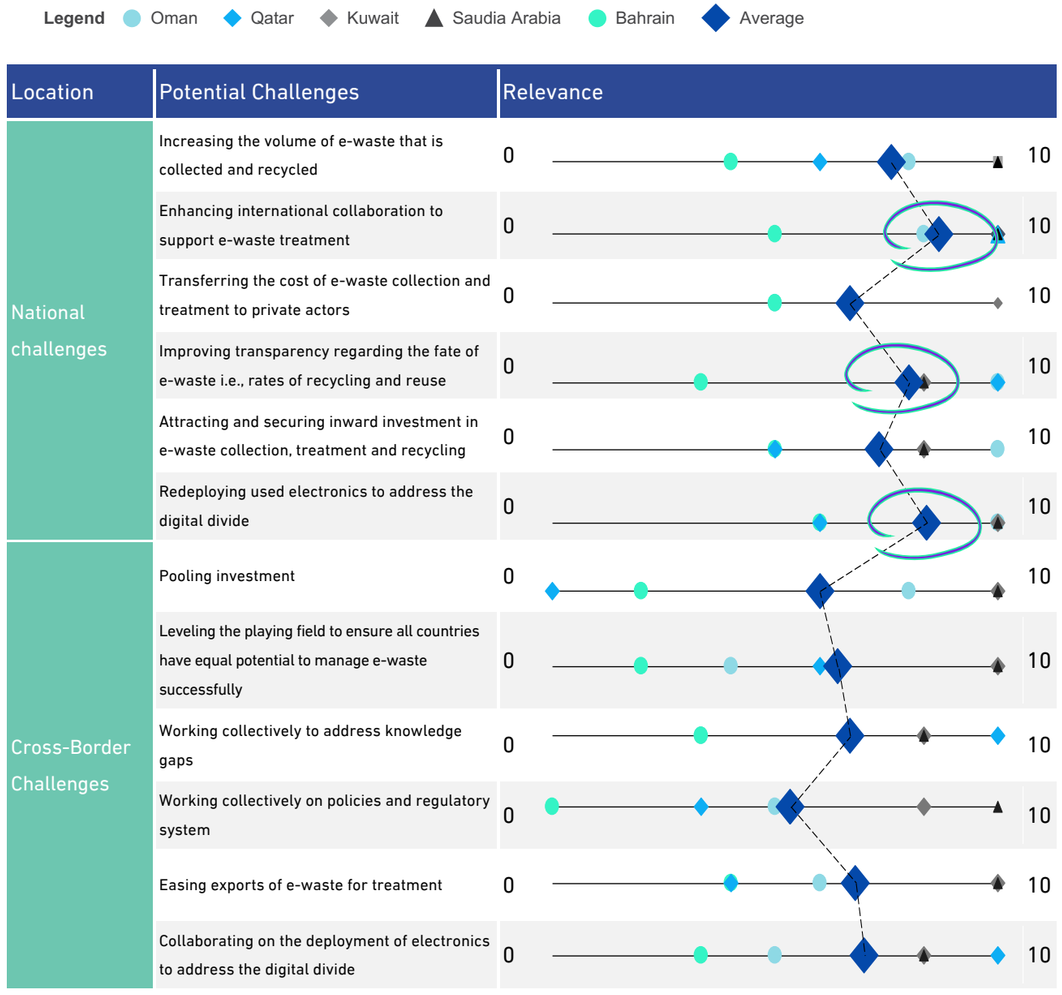


Table 1: Poll Results on the Challenges in E-Waste Management for GCC Member States

Informed by expert interviews and research, we have identified the six main common challenges in e-waste management for the GCC Member States that require targeted interventions to improve regulatory frameworks, infrastructure, and public awareness.

COMMON CHALLENGES IN GCC MEMBER STATES

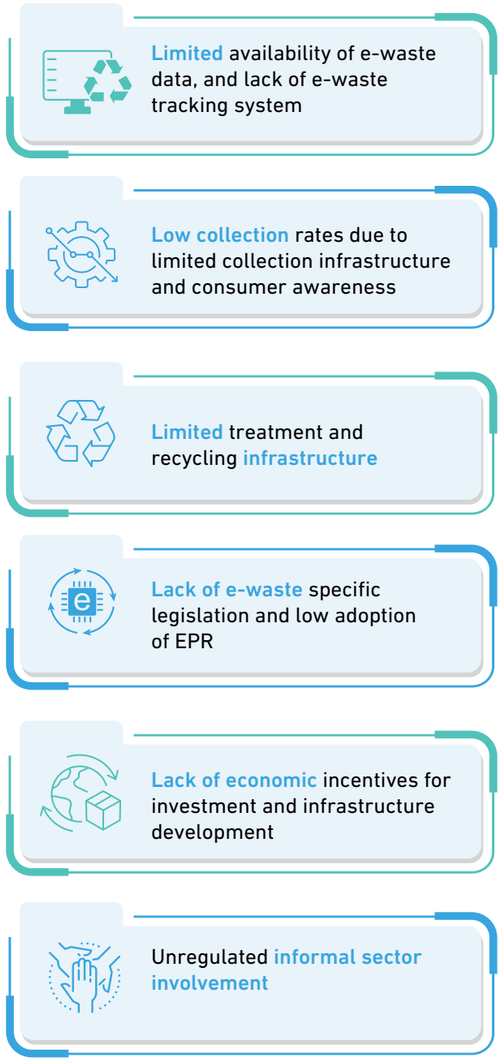


Figure 5: Common Challenges in GCC Member States

1. Data Limitations

The lack of comprehensive e-waste tracking systems significantly impedes the ability of governments and stakeholders to monitor and regulate e-waste flows. Limited data availability, particularly concerning collection and recycling rates, complicates effective planning and the evaluation of policy outcomes, making it challenging to identify gaps and measure progress.

2. Lack of E-Waste-Specific Policies and Low Adoption of Extended Producer Responsibility (EPR)

Few Member States have implemented e-waste-specific policies that clearly define value-chain roles, responsibilities, and enforcement mechanisms. Additionally, the adoption of EPR schemes remains limited. Without EPR, which places the financial and administrative burden of end-of-life product management on producers, governments are left to manage e-waste, hindering the development of sustainable systems.

3. Low Collection Rates Due to Infrastructure Gaps and Low Consumer Awareness

Inadequate e-waste collection infrastructure in many Member States discourages citizens from disposing of e-waste correctly. Limited accessibility, particularly outside urban hubs, exacerbates low collection rates, reducing the overall efficiency of waste management systems. A significant portion of the public also remains unaware of the proper handling of e-waste and its environmental impacts.

This lack of awareness reduces participation in collection systems and hampers efforts to integrate sustainable disposal practices into everyday behavior.

4. Lack of Economic Incentives for Investment and Infrastructure Development

The absence of economic incentives and an integrated regional market reduces the financial feasibility of e-waste recycling. Small individual markets generate insufficient waste to attract large-scale investments in recycling infrastructure.

Without subsidies or financial support, developing economically viable e-waste management systems remains challenging.

5. Recycling Infrastructure Gaps

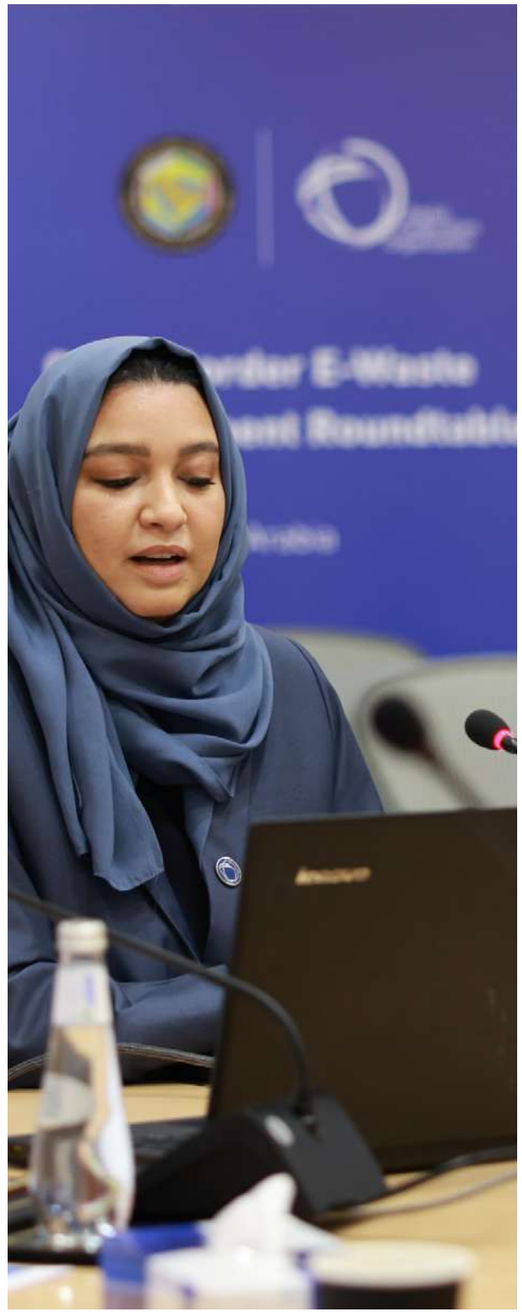
Many Member States lack adequate infrastructure for end-to-end e-waste treatment and recycling, which can lead to reliance on exports for recycling. The lack of specialized facilities for niche components and materials also restricts local processing capabilities.

6. Informal E-Waste Collection and Processing

Informal actors dominate e-waste collection and processing in several Member States. These actors often use unsafe recycling practices that harm both the environment and public health. Furthermore, their lower operational costs create unfair competition for formal systems, undermining efforts to establish regulated e-waste management practices.

Addressing these challenges requires the development of stronger regulatory frameworks, investment in infrastructure, and improved collaboration among public, private, and social sector stakeholders.

By prioritizing these areas, GCC Member States can create more sustainable and effective e-waste management systems that benefit both the environment and their economies.



BEST PRACTICES IN GCC MEMBER STATES

Figure 6: Best Practices in GCC Member States

These best practices demonstrate the significant progress being made by GCC Member States in advancing e-waste management through innovative approaches to domestic processing, regulatory enforcement, data-driven decision-making, and collaboration with private-sector actors.

While challenges remain, these examples showcase the potential for mutual learning and the opportunity for Member States to share expertise and build on one another's successes. By fostering collaboration and leveraging shared insights, GCC Member States can collectively enhance their e-waste management systems and contribute to global sustainability efforts.

1. Place Limits on Hazardous Substances

Implementing regulations to limit hazardous materials in locally manufactured products is a critical step toward reducing environmental and health risks associated with e-waste. By restricting the use of substances like lead, mercury, and cadmium, countries can ensure that manufactured electronics meet safety and environmental standards from the outset.

Example: The Kingdom of Saudi Arabia's SASO Technical Regulations specify permissible levels of hazardous substances in manufactured electronics, contributing to safer production processes and reducing long-term environmental contamination.

2. Ban Import of E-Waste When National Capacity is Exceeded

Restricting e-waste imports prevents overwhelming local processing capacities and ensures responsible waste handling. This protects domestic infrastructure while promoting sustainable practices within national boundaries.

Example: The State of Qatar bans hazardous waste imports while allowing exports under the Basel Convention, enabling safe management of domestic waste while only exporting when necessary.

3. Require Licensing for E-Waste Value Chain Actors

Licensing stakeholders such as collectors, transporters, and recyclers ensures monitoring and compliance with regulations. This formalizes the sector, enhances accountability, and reduces unregulated practices.

Example: The Kingdom of Bahrain mandates that all e-waste handlers obtain licenses from the Competent Directorate, ensuring transparency and standardization.

4. Prioritize Data Collection to Inform Decision-Making

Collecting accurate data on e-waste generation, recycling rates, and treatment processes is crucial for strategic planning and effective policymaking.

Example: The Kingdom of Saudi Arabia's National Center for Waste Management (NCWM) conducts comprehensive waste assessments to develop integrated plans aligned with national sustainability goals.

5. Establish Online Platforms for Reuse and Recycling

Developing digital platforms for the exchange of recyclable and reusable materials supports the circular economy principles by extending product lifespans, reducing waste, and providing feedstock to recyclers.

Example: In 2021, Dubai launched an electronic platform to facilitate the exchange of recyclable and reusable materials, extending product lifespan and diverting waste from landfills.

6. Restrict E-Waste Exports

Limiting e-waste exports encourages the development of domestic recycling facilities, keeping valuable materials within the local economy and reducing reliance on potentially unsafe international practices.

Example: The State of Kuwait prohibits hazardous waste exports unless local facilities lack the capacity to handle the materials, supporting domestic recycling industries.

7. Adopt Economic Incentives for Investment in Treatment Infrastructure

Economic incentives attract local and international companies to invest in e-waste management infrastructure, driving innovation and capacity-building.

Example: Qatar Development Bank (QDB) supports sustainability-focused businesses through subsidized loans, grants, and access to incubation programs, stimulating innovation in e-waste management.

8. Enforce Strict Penalties for Hazardous Waste Mismanagement

Severe penalties deter violations and encourage compliance with environmental regulations.

Example: Kuwait's Environmental Protection Law imposes heavy fines and even life imprisonment for entities causing significant environmental harm through improper hazardous waste management.

These best practices highlight the significant progress GCC Member States have made in advancing e-waste management. By learning from each other's successes, challenges, and innovative approaches, Member States can build stronger, more cohesive systems.

Enhanced collaboration and mutual expertise-sharing across the GCC can further elevate their collective contributions to global sustainability efforts.

BEST-IN-CLASS E-WASTE MANAGEMENT: FINLAND, AUSTRALIA, AND THE UNITED STATES

Finland, Australia, and the United States represent best-in-class examples of e-waste management, showcasing innovative strategies and practices that can offer valuable lessons for countries worldwide, including the GCC Member States.

Their approaches highlight common elements—such as robust regulatory frameworks, strategic infrastructure development, and multi-stakeholder collaboration. While their successes provide models for extracting best practices in e-waste management, understanding their challenges can also guide considerations for developing effective systems.

By adapting these strategies and learning from their experiences, countries can advance scalable and sustainable e-waste management solutions.

DRIVERS

All three countries have implemented e-waste-specific legislation that sets a strong foundation for sustainable management. Within these regulations, there are several elements common among these countries, representing best practices. Extended Producer Responsibility (EPR) is a cornerstone in both Finland and the United States, while product stewardship legislation in Australia assigns responsibility for e-waste management to producers, including importers, manufacturers, retailers, and distributors.

These frameworks offset costs and administrative burdens from governments to producers, promoting shared accountability across the value-chain. Landfill bans further drive environmentally sound management and circular practices, preventing e-waste from entering landfills and encouraging reuse and recycling initiatives.

Ambitious collection and recycling targets are clearly defined and integrated into the e-waste management systems in these countries.

Since August 2018, European Union Member States have been required to demonstrate achievement of collection rates ranging from 75% to 85%, and reuse/recycling rates ranging from 55% to 80%, depending on the waste stream.

Standard-setting also enhances standardization and increases regulation of e-waste systems. In Finland, regulations guided by the EU WEEE Directive require compliance with eco-design standards to facilitate reuse and recycling, correct product labeling to promote proper disposal practices, and the use of recycled materials in manufacturing.

In Australia, recyclers can be audited against the national standard for best practices, with companies often requiring proof of responsible recycling from service providers, which incentivizes the adoption of best practices.

National policies and strategies provide overarching guidance and set priorities for e-waste management. Examples include Australia's National Waste Policy and Finland's Strategic Program to Promote a Circular Economy and Circular Economy Roadmap, which outline approaches to enhance circular practices and waste reduction.

These strategic frameworks support the development of legislation and the implementation of targeted initiatives. In contrast, e-waste management in the United States is primarily regulated at the state level, rather than through national legislation or strategies, as seen in Finland and Australia.

Australia's e-waste management system blends national legislation with state-level implementation. While some measures, such as landfill bans, are state-specific, core e-waste regulations are implemented at the national level, ensuring consistency across the country.

In the United States, voluntary drivers play a significant role, particularly through financial incentives.

For example, New Jersey offers tax credits to businesses that invest in recycling technologies, including e-waste processing facilities, while New York provides similar incentives for businesses engaging in e-waste recycling and recovery.

Public-private partnerships are also gaining traction in the United States, enabling businesses to collaborate with state governments. This not only reduces the administrative and financial burden on the public sector but also opens new market opportunities for private enterprises.

These examples demonstrate the diverse approaches to e-waste management, guided by several common principles, with each country tailoring its strategy to fit its legislative and economic context.

STAKEHOLDERS

The successful e-waste management systems in Finland, Australia, and the United States rely on the coordinated efforts of diverse stakeholders, including the public sector, private sector, and social sector, each playing distinct but complementary roles.

The public sector oversees the development and enforcement of e-waste regulations and policies through national or state-level ministries and agencies, such as Finland's Ministry of the Environment.

Municipalities further support e-waste management by providing critical services, including collection systems and drop-off facilities, ensuring accessible and reliable avenues for proper disposal.

In the private sector, electronics manufacturers and retailers also actively participate in e-waste management through retail takeback programs and Corporate Social Investment (CSI) initiatives, which are incentivized by the EPR policies.

For example, some retailers and telecom operators, such as Harvey Norman, Telstra, and Optus in Australia, offer in-store takeback services to facilitate consumer participation in e-waste collection.

Industry-led schemes also contribute significantly; for example, TechCollect is a free program funded by leading technology companies in Australia to collect and recycle unwanted monitors, computers, and accessories, exemplifying private-sector leadership in e-waste management.

Producer Responsibility Organizations (PROs), such as Elker Oy in Finland, provide recycling, information dissemination, registration, and other compliance services for registered producers.

Similarly, Australia's National Television and Computer Recycling Scheme (NTCRS) is a co-regulatory product stewardship program that ensures national collection and recycling services for televisions, computers, printers, and related peripherals, funded by industry to serve households and small businesses.

Although collection efforts are dominantly run by municipalities, producers, and social sector actors, recycling facilities are primarily owned by the private sector.

The social sector plays a role in collection, reuse, and raising awareness, bridging gaps between stakeholders and driving community engagement. Campaigns, collection drives, and educational initiatives help inform the public about proper e-waste disposal.

For example, Kierrätyskeskus is a Finnish nonprofit that encourages the reuse and recycling of electronics in urban areas, and Infoxchange refurbishes old computers and IT equipment in Australia, which are then donated to disadvantaged communities.

Unlike in many developing countries, the informal sector has minimal to no involvement in e-waste management in Finland, Australia, and the United States.

The formalized systems and stringent regulations in these countries limit the scope for unregulated practices, ensuring environmentally sound and compliant e-waste management processes.

ENABLERS

In Finland, Australia, and the United States, significant effort is dedicated to developing extensive and consumer-friendly e-waste collection systems. These countries offer diverse collection options, including free recycling programs, mobile collection systems for rural areas, drop-off points, and retail take-back programs, ensuring accessibility and convenience for all consumers.

Awareness-building initiatives for both individuals and businesses play a crucial role in supporting these systems, using e-waste collection drives, sustainability education, and awareness campaigns to foster responsible disposal practices. Social norms and a culture of environmental consciousness further motivate consumers to adopt sustainable behaviors, reinforcing civic responsibility for e-waste management.

Investment in recycling infrastructure across these countries is bolstered by a predictable feedstock of materials and financial incentives, including grants and research funding.

For example, the Australian government allocated $10 million in grant funding in 2024 to support e-waste collection, storage, and reuse, including processing infrastructure.

In the United States, state-level funding programs incentivize investment and participation in e-waste management efforts.

Another example is New York's Environmental Protection Fund, which encourages innovation in recycling technologies through grants, research funding, and collaborations with universities and research centers. Vermont's Agency of Natural Resources also offers additional funding for waste reduction and recycling programs.

Achieving economies of scale is critical to the financial viability of e-waste facilities in these countries. Initial investments focus on developing infrastructure for basic capabilities, such as preprocessing and common waste streams, to ensure sufficient feedstock.

Once these capabilities are developed, investments extend to advanced or niche processing capabilities, supplemented by both domestic and imported e-waste components. High-value e-waste is initially prioritized to promote economic viability and return on investment. For specialized processing, e-waste components may also be exported to regional hubs in neighboring countries.

Data availability remains a challenge, particularly in tracking downstream exports of dismantled e-waste components. However, efforts are underway to improve transparency. For example, Australia collaborates with nearby countries to prevent illegal e-waste shipments through initiatives like the Asia-Pacific Waste Transfer Information Network.

In Finland, the Finnish Innovation Fund (Sitra) has developed 18 indicators to measure progress toward a circular economy, covering activities such as design, material extraction, production, trade, consumption, and reuse. These efforts aim to enhance monitoring and support informed decision-making across the value chain.

The approaches in Finland, Australia, and the United States highlight the importance of consumer engagement, strategic investment in infrastructure, and improved data transparency. By adopting similar strategies, GCC Member States can develop scalable, efficient, and sustainable e-waste management systems tailored to their unique contexts.

PRODUCT

E-waste generation in Finland, Australia, and the United States is significantly high, reflecting their elevated consumption rates of electronic devices. According to the Global E-Waste Monitor, Finland and the United States both generated 21.3 kilograms of e-waste per capita in 2022, while Australia exceeded this with 22.4 kg per capita. Despite consistently high e-waste generation rates, these countries demonstrate varying levels of progress in recycling and material recovery.

In Finland, there is comprehensive coverage of all e-waste streams within the recycling system, and collection rates have been increasing faster than e-waste generation since 2017.

As a result,Finland achieved an impressive recycling rate of 88.1% of collected e-waste in 2022, showcasing the effectiveness of its structured approach to e-waste management.

In contrast, Australia and the United States prioritize high-value e-waste streams, such as consumer electronics and ICT equipment, due to their less comprehensive recycling systems.

In Australia, of the 500 million kilograms of e-waste generated in 2020–21, 54% was sent to recyclers, recovering 35% of material inputs for reuse.

Similarly, in the United States, 56.4% of generated e-waste was formally collected and recycled, indicating significant progress but room for improvement compared to Finland's advanced systems.

These examples illustrate the importance of tailoring e-waste management systems to local contexts. Countries with less comprehensive recycling systems, like Australia and the United States, emphasize high-value streams, while Finland's mature system effectively manages all e-waste categories. By building robust collection networks and investing in common waste streams, GCC Member States can improve recycling rates and resource efficiency, even in high-generation contexts.

LOCATION

In Finland, 22,697 tons of e-waste scrap were exported in 2023, primarily to Estonia, Sweden, and Latvia, where advanced facilities handle material recovery efficiently.

Imports of e-waste into Finland are minimal and highly targeted, focusing on precious metal-rich components for recovery in domestic recycling facilities.

The United States exports e-waste to various countries in Africa and Asia, including China, Ghana, Nigeria, Pakistan, India, and Vietnam, largely driven by the lower costs of processing in these nations.

This export practice reflects cost considerations but raises concerns about environmental and health impacts in recipient countries with less stringent e-waste management systems.

In Australia, e-waste imports are limited, particularly in cases where national capacity cannot handle domestic volumes. Like Finland, Australia exports certain e-waste components to India, the Republic of Korea, and Japan, utilizing specialized recycling capabilities in these countries to process complex or valuable materials.

These practices underscore the importance of balancing local processing capacity with strategic export policies, taking advantage of economies of scale and reducing costs through cross-border collaboration, while also ensuring sufficient feedstock for national infrastructure.

Cross-border collaboration is essential for optimizing e-waste management and leveraging specialized infrastructure. Finland exemplifies this through its harmonized classification systems and targets, which enable collaboration with other EU countries. Finland also partners with Nordic neighbors like Sweden, Denmark, and Norway on e-waste initiatives.

As signatories of the Basel Convention, Finland and Australia are mandated to follow strict protocols, which ensure ethical and environmentally sound cross-border management of hazardous e-waste.

While the United States has not signed the convention, it has established bilateral agreements with countries such as Malaysia and the Philippines to facilitate cross-border movement of hazardous waste in a controlled and consensual manner.

Regional collaboration within the EU and across states in the United States fosters economies of scale by sending specialized e-waste streams to centralized hubs for processing.

CHALLENGES IN BENCHMARKED COUNTRIES

Even in these high-performing countries, numerous challenges persist, highlighting areas that require attention and providing valuable lessons for GCC Member States. Understanding these challenges can inform the design of e-waste management systems to address these risks proactively.

- **High Rates of E-Waste Generation:** Rapid advancements in technology and growing consumer demand lead to ever-increasing volumes of electronic waste. Managing this surge effectively requires scalable solutions that adapt to these trends.
- **Costly Collection in Remote Areas:** Collecting e-waste from less accessible regions incurs higher operational costs, creating barriers to equitable access to e-waste management services and leaving rural areas underserved.
- **Limited Data Availability:** The absence of comprehensive data on e-waste generation, collection, and recycling rates limits policymakers' ability to make informed decisions, track progress, and identify gaps within the system.
- **Prioritization of Recycling Over Reuse:** E-waste management systems often emphasize recycling at the expense of reuse, missing opportunities to extend the lifespan of devices and reduce waste generation through repair and redeployment initiatives.

COMMON CHALLENGES IN BENCHMARKED COUNTRIES

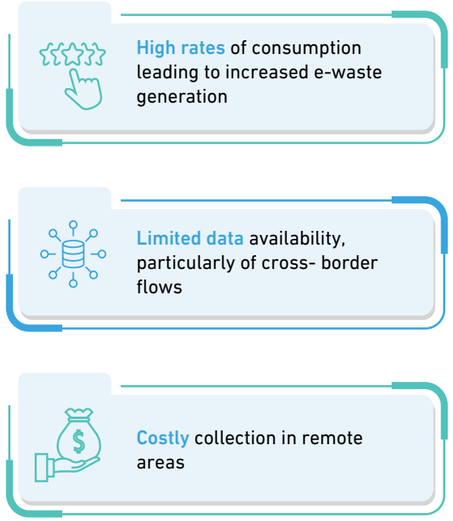


Figure 7: Common Challenges in Benchmarked Countries

BEST PRACTICES IN BENCHMARKED COUNTRIES

These practices highlight the importance of strategic planning, regulation, and collaboration in achieving sustainable e-waste management.

Circular Economy Vision: Establish a strategy prioritizing reuse and the valorization of waste.
Example: Finland introduced the world's first national roadmap for a circular economy (2016–2025), setting specific targets for managing waste, including e-waste.

Extended Producer Responsibility (EPR): Implement EPR legislation targeting manufacturers, importers, and distributors.

Example: Australia's Recycling and Waste Reduction Act of 2020 outlines a framework for mandatory, co-regulated, and voluntary schemes.

Convenient Collection Networks: Establish accessible collection systems via government programs, EPR schemes, or public-private partnerships (PPPs).

Example: Finland operates over 400 municipal, EPR-financed collection points, more than 2,000 retail collection points, and rural mail-back options.

Social Sector Participation: Enable the social sector to collect, repair, and redistribute electronics.

Example: New York's e-waste law supports reuse initiatives via programs like the Lower East Side Ecology Center.

Harmonized Classification and Targets: Align e-waste classification and targets regionally to achieve economies of scale.

Example: Finland aligns targets with EU Member States to create incentives for private-sector investment.

Innovation Funding and Incentives: Provide funding and tax incentives to recyclers for sustainable investments.

Example: New Jersey's $3-per-ton "tax on trash" funds e-waste recycling infrastructure, while tax credits incentivize businesses.

Bilateral Arrangements: Develop agreements to regulate cross-border e-waste flows for recycling.

Example: The United States and Canada negotiated the U.S.-Canada Bilateral Agreement on Hazardous Waste to streamline cross-border recycling with aligned standards.

Awareness and Culture: Develop awareness around e-waste recycling and foster a culture of civic responsibility to motivate sustainable consumption and increase engagement in environmentally sound disposal practices.

Example: In Finland, social norming is achieved and reinforced through community-led initiatives and by promoting recycling as a civic responsibility.

From both their successes and challenges, the state of e-waste management in these high-performing countries can inform principles for approaching e-waste management in countries worldwide.

BEST PRACTICES IN BENCHMARKED COUNTRIES

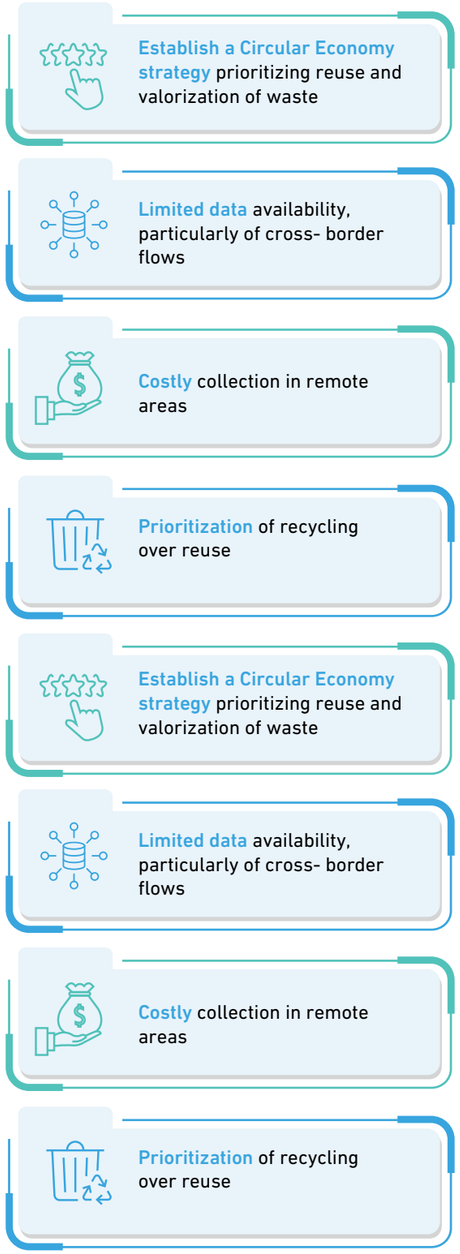


Figure 8: Best Practices in Benchmarked Countries

GAP ANALYSIS

The gap analysis, conducted by comparing the current capabilities disclosed by the GCC Member States and the best practices, highlights the need for a consistent definition and tracking of e-waste categories and their volumes across the value chain, following the principle: "What gets measured, gets done."

In addition, cross-border and national collaborations have strong potential for further development, leveraging both national stakeholder networks as well as international and regional capabilities.

Finally, governments need to define mechanisms that will foster the development of both tangible and intangible assets in e-waste management systems.

Even if through private sector companies are present in the market, the capacity and innovation in collection and recycling do not match the demands of e-waste generation. In addition, initiatives such as awareness campaigns and partnerships need to be strengthened to drive change among both consumers and businesses.

These gaps can be addressed through an e-waste management framework that helps governments identify, design and implement effective mechanisms, from transparency to awareness. While some GCC Member States are more advanced in the e-waste management journey, regional efforts should be put in place to scale up capabilities for greater social, economic, and environmental impact.

Below the table, we estimate the gaps of the GCC Member States across the analyzed dimensions, where 0 represents low adoption of best practices (major gaps), while 4 indicates that the Member State is an example of best practices (no gaps).

	The Kingdom of Bahrain	The State of Kuwait	The Sultanate of Oman	The State of Qatar	The Kingdom of Saudi Arabia	The United Arab Emirates	AVERAGE in the Region
DRIVERS – Mandatory	1	2	1	1	2	3	2
DRIVERS – Voluntary	1	1	2	2	2	2	2
STAKEHOLDERS – Public	2	3	2	3	4	4	3
STAKEHOLDERS – Private	3	3	1	2	3	3	2/3
STAKEHOLDERS – Social	2	1	0	1	3	2	1/2
PRODUCT – Types	1	0	0	0	0	0	0
PRODUCT - Volume	1	0	0	0	0	0	0
ENABLERS – Tangible	1	1	2	2	3	3	2
ENABLERS – Intangible	2	2	1	1	4	3	2
LOCATION – National	0	0	1	1	2	2	1
LOCATION – Cross-Border	1	1	0	1	2	3	1
AVERAGE	1/2	1	1	1	2/3	2/3	*NA*

Table 3: Gap Analysis of E-Waste Management in the GCC Member States

The gap analysis, conducted by comparing the current capabilities disclosed by the GCC Member States with best practices, highlights the need for a consistent definition and tracking of e-waste categories and their volumes across the value chain, following the principle: "What gets measured, gets done."

A NEW E-WASTE MANAGEMENT FRAMEWORK FOR GOVERNMENTS

A NEW E-WASTE MANAGEMENT FRAMEWORK FOR GOVERNMENTS

Despite the critical contributions of private and social sector actors in developing and supporting the e-waste management systems, the government plays a pivotal and irreplaceable role in its design, establishment, and long-term effectiveness.

Governments are uniquely positioned to create the necessary regulatory, institutional, and operational mechanisms required for the efficient management of e-waste at both national and cross-border levels.

Building on the findings of this research and drawing on established frameworks for e-waste management nd circularity, the DCO has developed a comprehensive framework to address pressing e-waste management challenges.

This framework focuses on key mechanisms where government intervention and leadership are essential for building sustainable and efficient e-waste management systems.

FRAMEWORK OVERVIEW: E-CYCLE IN ACTION FOR GOVERNMENTS

The new E-Cycle in Action for Governments Framework outlines four key subcomponents of government mechanisms for establishing robust e-waste management systems both nationally and across borders throughout the value chain.

The framework is coupled with a four-step implementation plan that guides governments in utilizing and adapting the framework to suit their national needs. It also outlines key success factors and actionable mechanisms within each subcomponent that can be deployed and adapted to diverse national contexts.

By offering a structured overview of best practices, the framework goes beyond traditional policy recommendations, integrating practical mechanisms such as capacity building and infrastructure development, and incorporating input from the participants of the global roundtables that the DCO conducted in the second half of 2024 in Singapore, London, and Riyadh.

It is designed to be versatile, accommodating countries at various stages of e-waste management maturity while addressing the entire value chain, from import or generation to disposal or export.

The framework unifies domestic and international strategies, fostering collaboration and harmonization across borders. Its comprehensive and actionable approach empowers governments in the GCC Member States to strengthen regulatory systems, drive sustainable practices, and build capacity, positioning them to tackle the challenges of e-waste management effectively and with long-term sustainability.

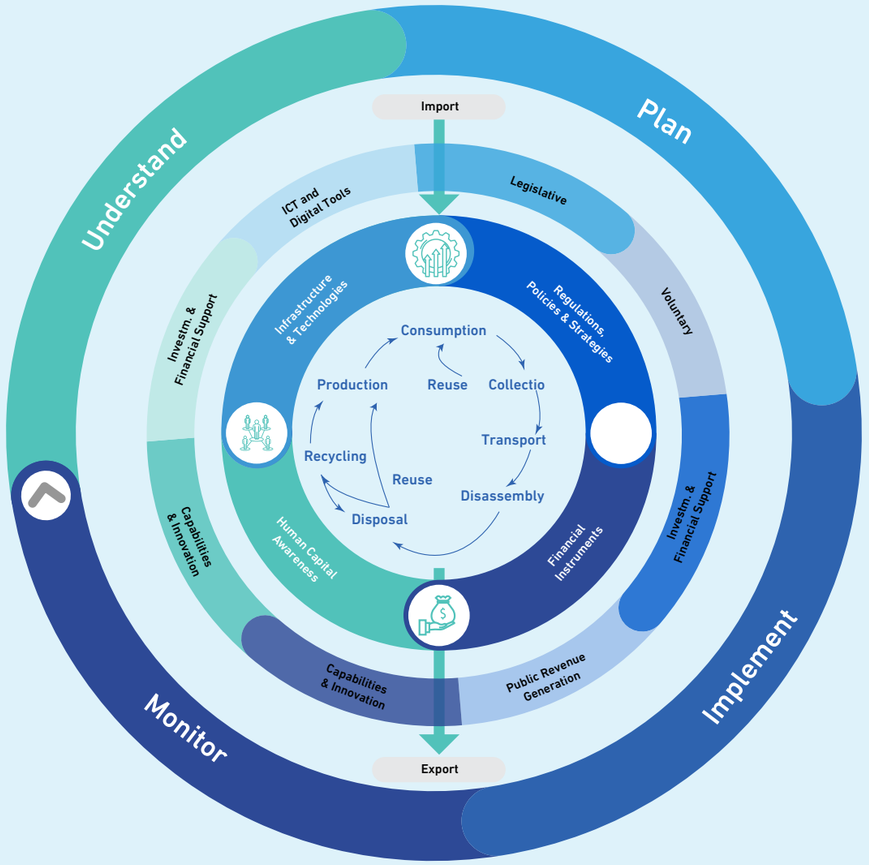


Figure 9: E-Cycle in Action for Government Framework

REGULATIONS, POLICIES, AND STRATEGIES

Regulations, policies, and strategies are critical for establishing a robust e-waste management framework.

E-waste regulations, policies, and strategies encompass two broad categories: legislative mechanisms and voluntary mechanisms. Legislative mechanisms consist of mandatory directives issued by authorities, including regulations, policies, mandatory standards, international conventions, and bilateral agreements.

They provide strategic direction for managing e-waste systems by setting clear targets and assigning producer responsibility, ensuring compliance and safety across the value chain.

Furthermore, they define the roles and responsibilities of key stakeholders, including government ministries, regulators, non-governmental organizations (NGOs), and private sector entities, creating a structured governance framework.

These mechanisms ensure compliance and safety across the e-waste value chain, providing a legally enforceable foundation for e-waste management practices. In contrast, voluntary mechanisms focus on recommended practices, such as strategies and guidelines, that encourage alignment with policy objectives and promote responsible behavior without legal enforcement.

These mechanisms enable flexibility while fostering adherence to sustainable e-waste management principles. Together, these categories balance regulatory enforcement with guidance, enabling comprehensive and adaptable approaches to managing e-waste challenges.

These mechanisms guide sustainable practices by fostering a consistent approach to e-waste handling that is ethical, efficient, and environmentally sound.

Importantly, they regulate and facilitate international cooperation (e.g., through bilateral agreements), enabling the alignment of efforts to improve recycling rates and address global challenges associated with e-waste management. Collectively, these elements form the foundation for achieving effective and sustainable e-waste management practices.

SUCCESS FACTORS

To ensure the success of regulations, policies, and strategies in e-waste management, it is critical to adopt a multifaceted approach.

01 First, e-waste governance must be defined across institutions and stakeholders to establish clear roles and responsibilities.

02 Collaboration is equally important, requiring engagement with both local and international private and social sector stakeholders to foster comprehensive and inclusive frameworks. Failing to consult organizations on the ground when designing policies and regulations could create tension and slow implementation.

03 Additionally, regulations should be both "flexible" to adapt to new trends and clear and simple to be effective. During the roundtables, there was a strong emphasis on the fact that legacy technologies are very different from the latest devices. Old regulations may be suitable for legacy items, but policymakers should keep up with technological trends by including the latest electronic and electrical devices within the scope of new regulations.

04 Lastly, harmonizing legislation with international conventions and fostering bilateral agreements can ensure global alignment, streamline cross-border cooperation, and support the scalability of e-waste management practices.

Together, these factors create a robust foundation for effective regulatory frameworks.

ECONOMIC INSTRUMENTS

Economic instruments play a critical role in e-waste management by establishing investment and funding mechanisms to support sustainable practices throughout the value chain. These mechanisms are designed to generate revenue for the government, offer financial support to actors in the value chain, and incentivize the behavior of consumers and businesses to align with e-waste management goals.

Economic instruments in e-waste management should aim to achieve two primary objectives:

A Generating public revenue to fund governmental initiatives.

B Encouraging private and social sector investment through targeted incentives and financial support mechanisms. These instruments drive efficiency, foster sustainable practices, and strengthen social sector involvement in the e-waste management ecosystem.

Public revenue generation involves leveraging tools such as taxes, tariffs, and fees to create sustainable funding streams.

These funds enable governments to invest directly in critical areas, including the development of infrastructure, the adoption of advanced technologies, capacity-building initiatives, and enforcement mechanisms.
Simultaneously, investment and financial support mechanisms, such as tax breaks, grants, and low-interest loans, are designed to incentivize private and social sector engagement.

By fostering innovation and addressing key bottlenecks, these instruments align stakeholders with national and global objectives for sustainable e-waste management.

SUCCESS FACTORS

To maximize the effectiveness of economic instruments, several success factors must be considered.

First, there should be a balance between taxes and investments to support the formal sector and ensure that informal actors are not discouraged from integrating into the formal value chain.

Second, targeted financial incentives and funding must be directed toward areas with the greatest bottlenecks to promote private investment, scalability, sustainable solutions, and innovation.

Finally, managing market dynamics is essential to strengthen the trade of e-waste and the market for recycled materials. This includes addressing price volatility and supply-demand imbalances to create a robust and efficient economic framework for e-waste management.

HUMAN CAPITAL AND AWARENESS

The Human Capital and Awareness subcomponent emphasizes the importance of building capacity and fostering innovation among e-waste stakeholders across the value chain. This includes equipping stakeholders with the skills necessary to effectively manage e-waste and raising awareness among consumers and businesses about the environmental and social urgency of responsible e-waste management.

The subcomponent encompasses:

A Capabilities and innovation mechanisms, which focus on skill development and strengthening capacity across sectors.

B Awareness mechanisms, which aim to inform stakeholders about the impacts of e-waste and promote sustainable behaviors.

Human capital and awareness play a pivotal role in driving sustainable e-waste management. They facilitate the development of capacity and capabilities to manage systems effectively, encourage changes in consumption and disposal practices, and uplift the informal sector by integrating it into formal systems.

Furthermore, they support innovation throughout the value chain and ensure that stakeholders acquire the necessary skills to foster environmentally sound practices.

SUCCESS FACTORS

Key success factors for this subcomponent include:

01 Building and training the government's capacity to oversee e-waste initiatives.

02 Running long-term awareness campaigns for consumers and businesses to boost collection rates.

03 Additionally, fostering international collaboration for knowledge sharing and enabling joint initiatives with the private and social sectors is critical to promoting innovation and capability development.

These efforts ensure a coordinated and informed approach to e-waste management across all stakeholders.

INFRASTRUCTURE AND TECHNOLOGY

The Infrastructure and Technology subcomponent focuses on developing essential physical and digital infrastructure to support effective e-waste management. It includes:

A Infrastructure and equipment, such as collection points, recycling technologies, and hazardous waste systems.

B ICT and digital tools for data-driven monitoring, compliance, and streamlined e-waste operations. These elements are critical for ensuring efficiency, transparency, and accountability throughout the e-waste lifespan.

Effective infrastructure and technology are fundamental to streamlining collection and processing, enhancing recycling capabilities, and improving disposal practices for hazardous materials.

They also enable data-driven decision-making, ensuring transparency and informed regulation, and facilitate public participation by making e-waste disposal accessible and convenient. Together, they form the backbone of a sustainable e-waste management systems.

SUCCESS FACTORS

Achieving success in this area requires:

A Mapping value chain bottlenecks and strategically investing in areas of constraint.

B Prioritizing the development of collection systems to align capacity with feedstock availability.

B Additionally, selecting context-appropriate technology, including manual processing where relevant, ensures sustainable practices while creating job opportunities. These steps are essential for building an efficient and scalable e-waste management infrastructure.

B Reinforcing robust data collection and monitoring to measure impact and guide decision-making. Transparency in data and international collaboration are crucial, enabling better tracking and understanding of e-waste flows to enhance global management efforts.

IMPLEMENTING THE E-WASTE MANAGEMENT FRAMEWORK

The e-waste management framework should be implemented through a structured four-step approach designed to drive effective interventions:

UNDERSTAND

Value Chain Mapping: Assess the current state of the e-waste value chain by identifying stakeholder roles (private, public, and social sectors), activities, and interactions, and mapping e-waste flows, including imports, generation, collection, processing, and export.

Ecosystem Assessment: Evaluate the current state of the four key subcomponents:

1. Regulations, Policies, and Strategies.
2. Economic Instruments.
3. Human Capital and Awareness.
4. nfrastructure and Technology.

PLAN

Define Desired Outcomes: Establish clear objectives for e-waste management and conduct a gap analysis, comparing desired outcomes with the ecosystem's current state and identifying key areas and priorities for intervention.

Develop an Action Plan: Create a detailed plan that integrates stakeholder feedback and clearly defines objectives, targets, roles, and resource allocation to ensure alignment and accountability for both short- and long-term initiatives.

IMPLEMENT

Communicate the Plan: Share the action plan with all stakeholders, secure their buy-in, and establish governance structures to actively involve stakeholders in execution, ensuring transparency and collaboration.

Execute Initiatives: Mobilize resources, set up necessary administrative systems, and coordinate efforts across subcomponents and value chain steps to implement the action plan.

MONITOR

Track Progress: Collect both quantitative metrics and qualitative feedback to measure the effectiveness of initiatives and identify areas for adjustment, utilizing the initial value chain mapping and ecosystem assessment as a baseline.

Compare and Adjust: Regularly compare results against objectives and refine interventions to ensure continuous improvement and alignment with goals.

This iterative process ensures the framework's adaptability and effectiveness in diverse contexts, supporting sustainable e-waste management at both national and cross-border levels.

CONCLUSIONS

CONCLUSIONS

This research and the series of roundtables highlight the urgent need for comprehensive and integrated strategies for e-waste management at both national and cross-border levels.

By utilizing findings from current state assessments, benchmarking studies, and structured guidance from the framework, countries can tackle challenges such as inadequate infrastructure, weak regulatory frameworks, and low public awareness while seizing opportunities for economic growth, environmental protection, and closing the digital divide.

We also leveraged the DCO Digital Space Accelerator (DSA), an innovative cooperation mechanism that the DCO General Secretariat created to bring together Thought Leaders, Subject Matter Experts, and Decision-Makers from diverse sectors, including governments, the private sector, international organizations, academia, and civil society.

The primary aim of the DSA is to foster multi-stakeholder collaboration to design and propose actionable solutions that address the key barriers to a thriving, sustainable, and inclusive digital economy.

Through the DSA, we organized four roundtables: the first as part of SWITCH (Singapore Week of Innovation and Technology), the second within the Internet Governance Forum (IGF) in Riyadh, the third in Riyadh hosted by the GCC Headquarters, and finally, a stand-alone event in London focused solely on the DCO's e-waste agenda.

These events brought together diverse stakeholders from across the globe to explore opportunities for collaboration in e-waste management and identify key mechanisms for developing effective global e-waste systems.

By fostering dialogue and highlighting actionable solutions, the roundtables aimed to contribute to the creation of a comprehensive framework for sustainable e-waste management by global governments.

The DCO organized a panel in collaboration with the UNDP during COP16 in Riyadh, titled E-Waste and the Future of Green Tech: Navigating the Sustainability Challenge, where experts from the DCO, UNDP, Kearney, and ERM discussed lessons learned and best practices to address this important issue.

The new E-Waste Framework was also introduced to both the GCC and DCO Member States to collect feedback and comments. In addition, a session with the DCO Observers was organized to present the initiative, gathering their positive feedback and willingness to further contribute to tackling this critical issue.

GUIDING THE WAY FORWARD IN E-WASTE MANAGEMENT FOR THE GCC

With e-waste emerging as an increasingly urgent global issue, this report highlights key actions that GCC governments can undertake to enhance both national and cross-border e-waste management systems.

The following recommendations aim to tackle existing challenges, capitalize on opportunities, and promote sustainable development. They offer practical, actionable solutions tailored to local contexts while encouraging regional and international cooperation.

RECOMMENDATIONS FOR NATIONAL DEVELOPMENT

01 Identify key stakeholders, define clear roles for government agencies, foster and promote private sector development, and integrate the informal sector into the value chain

- Government Agencies: Establishing well-defined regulations ensures clarity and accountability for all actors in the e-waste value chain while facilitating compliance and effective implementation. Governments need to clearly define which authorities oversee e-waste flows. It is crucial to highlight the collaborations that different agencies must put in place: while ICT ministries and regulators need to be involved in the discussion, ministries responsible for waste management and manufacturing best practices are also important government stakeholders to involve in the definition of policies, standards, and mechanisms.

- Informal Sector: Governments should integrate the informal sector through training, incentives, and partnerships, harnessing its efficiency while ensuring environmental and health standards are maintained. It is important not to view the informal sector as a negative stakeholder and to understand its financial dynamics: administrative and compliance costs might reduce profitability and hinder adoption.

- Non-Governmental Organizations (NGOs): Nonprofit local charitable organizations and other third-sector actors should be leveraged to help with advocacy, raising awareness, and monitoring compliance. They have the advantage of being close to the community, thus reaching consumers and the informal sector and driving behavioral changes.

- Academic and Research Institutions: Universities and research organizations can assist in mapping the value chain, collecting data on e-waste flows, developing new technologies for e-waste recycling, and providing data to support policy decisions.

- Producers and Manufacturers: They play a critical role in designing products that are easier to recycle, participating in EPR schemes, and developing the necessary infrastructure (see recommendations below).

02 Define clear and up-to-date regulations, technical guidelines, and enforcement mechanisms. [Subcomponent: REGULATIONS, POLICIES, AND STRATEGIES]

- Up-To-Date and Relevant Regulations: Regulations should address both legacy technologies and new technologies. Keeping policies and legislation up to date and following the latest trends in electronic and electrical devices will ensure a proactive approach by governments.

- Extended Producer Responsibility (EPR): This should be among the first regulations defined. EPR mandates that producers take responsibility for the entire lifespan of their products, particularly for take-back, recycling, and final disposal.

- Import and Export Controls: These regulations are crucial to preventing the illegal dumping of e-waste in countries with less stringent environmental protection.

- Labeling, Recycling, and Disposal Standards: Setting high standards across the e-waste value chain, from the labeling of products (indicating their environmental impact, recyclability, and disposal instructions) to recycling processes (e.g., ISO 14001), is important to ensure that they are environmentally friendly and do not lead to further contamination.

- Only if e-waste is managed in an environmentally sound manner can it be traded under the Basel Convention. Thus, these initiatives will also support cross-border e-waste flows.

03 Leverage the private sector to fund, develop, and administer systems and infrastructure. [Subcomponent: ECONOMIC INSTRUMENTS]

- Public-Private Partnerships (PPPs): Governments can enter into PPPs with multiple objectives. First, they can be an effective mechanism to build and maintain state-of-the-art e-waste recycling facilities. Second, private sector technology and expertise in waste management can support governments in improving e-waste processing efficiency and service quality. Lastly, private companies often provide the necessary capital for the startup and ongoing costs of e-waste management programs, reducing the financial burden on public funds.

- Administer E-Waste Programs: Local councils can work with private waste management companies to collect and process e-waste, enhancing the efficiency and reach of recycling programs.

- Tax Incentives: Governments can offer tax breaks or rebates to companies that invest in e-waste recycling facilities or achieve certain recycling quotas. This method is often used to encourage companies to go beyond the minimum regulatory standards.

- Joint Ventures: Governments can facilitate joint ventures between local universities and private companies to research and develop more effective e-waste recycling methods.

- Benefits of Private Sector Engagement: Encouraging private-sector involvement through Extended Producer Responsibility (EPR) schemes, financial incentives, and public-private partnerships can reduce the burden on public systems and drive investment in infrastructure and technological innovation.

04 Prioritize and develop the e-waste collection infrastructure and consumer awareness in parallel [Subcomponent: HUMAN CAPITAL AND AWARENESS]

- Synchronized Efforts: It is crucial that consumer awareness and collection infrastructure are developed in parallel, as one without the other would undermine the impact. Imagine a consumer who now knows about the importance of e-waste but cannot access any collection points, or consider spreading collection points across the country while consumers remain unaware of the urgency and need to recycle e-waste. In addition, this step should be prioritized compared to investments in recycling infrastructure, as the downstream operations of the value chain need feedstock. A business focused on repairing and recycling electronics will not be sustainable if there is a weak collection system to supply products for operations.

- Public Education Campaigns: Governments should design and launch campaigns in collaboration with nonprofit organizations or a network of businesses. These initiatives need to inform the public about the environmental and health impacts of improper e-waste disposal, but also about the collection infrastructure available. While central governments can lead a national-level campaigns, they should also mandate local authorities to foster communication in a more granular way within the territory, targeting especially youth and children, who represent the next generation of citizens.

- Local Community Initiatives to Repair Devices: An innovative and tangible way to promote a circular economy in the community is the setup of repair workshops. These community events help extend the lifespan of electronic devices, create a sense of community, and increase awareness. They can also be associated with collection points in case the devices might are not repairable. The role of the government is to facilitate the nonprofit and private sectors in organizing and promoting these events, potentially providing space for free. Singapore's Repair Kopitiam initiative involves volunteers assisting residents in fixing their gadgets, reducing the volume of e-waste.

- Convenient Collection Programs: Accessible e-waste collection points encourage proper disposal. Governments need to fund or give the mandate to local authorities and private sector companies to set up collection points throughout the territory, associated with a clear description of which devices can be collected. Collection points can be placed in retail stores, schools, offices and waste facilities, ideally distinguishing them based on a specific logo and/or color. In the UK, Cambridge City Council introduced bright pink bins specifically for small electronic devices, making it easier for residents to recycle e-waste.

05 Set up data collection systems to support informed decision-making and system evaluation [Subcomponent: INFRASTRUCTURE AND TECHNOLOGY]

- Data Definition, Protocols, and Registries: It is important to align on the definition of e-waste, identify legacy products, and monitor new trends in the market. Accurate data on waste generation, recycling rates, and processing outcomes can guide policy development, track progress, and identify gaps for improvement in e-waste management systems. The development of standard protocols across all regions and sectors involved in e-waste management ensures that data is comparable and aggregated efficiently. Implementing national databases to track e-waste from generation to final disposal helps assess the effectiveness of existing policies and identify areas for improvement.

- Reporting Mandates: Implementing regulations that require precise and regular reporting from e-waste collectors and recyclers helps build a comprehensive dataset for policy evaluation.

- Technologies for Data Collection: Enterprise Resource Planning (ERP) systems can manage data across various stages of e-waste management, from collection to recycling, helping to coordinate operations and maintain records systematically. Geographic Information Systems (GIS) can also be used for mapping e-waste collection points, analyzing the spatial distribution of e-waste generation, and planning logistical operations to optimize collection routes. Internet of Things (IoT) devices, such as sensors in e-waste bins or tracking chips in electronic products, can provide real-time data on e-waste volumes and conditions, facilitating immediate and precise decision-making.

06 Prioritize repair and reuse to extend the lifespan of e-waste prior to recycling and address the digital divide [Subcomponent INFRASTRUCTURE AND TECHNOLOGY and REGULATIONS, STRATEGIES, and POLICIES]

- Repair and Reuse Initiatives: Governments should maximize the value of used electronics, reduce waste, and provide affordable technology to underserved communities, bridging the digital divide. This means aligning strategic targets, policies, incentives, and awareness campaigns in a cohesive way, respecting the circular pyramid (or zero-waste hierarchy).

- Eco-Design Regulations: It is important to promote the manufacturing of more sustainable products that increase repairability and recyclability and have a longer lifespan, thus decreasing the total volume of electrical and electronic equipment (EEE) and e-waste. Indeed, products should be easily recyclable and repairable while also containing fewer hazardous materials, thereby reducing environmental impact and lowering recycling costs.

- It is crucial that the GCC Member States collaborate to share the lessons they have learned in setting up strong national e-waste management systems, leveraging their proximity and shared culture.

- Through the application and guidance of the new E-Waste Management Framework and the best practices highlighted in the previous chapters, the GCC Member States have the tools to scale up efforts to make the digital economy more circular, bridge the digital divide, and at the same time reduce the negative environmental impact on their territories. Having a strong national e-waste management system is crucial to initiating e-waste exports.

RECOMMENDATIONS FOR CROSS-BORDER COLLABORATION

A Strategically invest in national recycling capabilities for common e-waste streams and components:

- Countries should align investments in recycling technologies with the volume and composition of their e-waste feedstock, ensuring sustainable and efficient resource recovery.

- Critical Raw Materials (CRMs) and Rare Earth Elements (REEs): Governments should identify materials that are critical for the national economy and explore initiatives to recover valuable materials like gold, silver, and other rare earth elements to reduce reliance on imports.

- E-waste Products or Components: Another angle for identifying which capabilities to develop in-house is to look at the common e-waste streams in the country (e.g., laptops, TVs, smartphones, etc.) and other critical components for both the country and its regional allies (e.g., lithium-ion batteries, printed circuit boards, etc.)

B Enable collaboration through regionally harmonized e-waste categorization and technical standards:

- Harmonizing standards across the GCC can facilitate the seamless movement of e-waste across borders, improving management efficiency and compliance with international regulations.

- Common Categorization: GCC Member States need to align on a common definition of e-waste, including different product types (e.g., household appliances, mobile phones, computers, and batteries); what constitutes hazardous versus non-hazardous waste (e.g., distinguishing between lithium-ion batteries and general electronics); and material composition (e.g., presence of valuable metals, plastics, or toxic substances).

- Technical Requirements Across the Value Chain: Standard definitions and processes should not only describe what constitutes e-waste but also the different activities across the entire value chain: collection and transportation (e.g., safe handling of hazardous components like batteries); sorting and dismantling (e.g., defining the standards and the process for identifying products that can be repaired and reused, etc.); material recovery (e.g., efficiency standards for extracting rare metals); recycling facility certification (e.g., environmental safety measures for recyclers).

- Digital Standardization of E-Waste Tracking: GCC Member States should identify technologies that will facilitate the tracking of e-waste across borders and the whole value chain. For example, electronic waste passports (e.g., QR code tracking systems

or RFID-based identification for electronics to track product lifespan and facilitate responsible disposal) or a common blockchain system (to ensure traceability and transparency in e-waste shipments and prevent illegal trade and fraud).

- Regional GCC E-Waste Database: Governments should launch a common database to track the different types and volumes of e-waste. Indeed "what gets measured, gets done".

C Collaborate across the GCC to exchange expertise and address knowledge, resource, and capability gaps:

- International partnerships can provide access to advanced technologies, specialized knowledge, and capacity-building opportunities, addressing limitations in domestic systems.
- GCC E-Waste Taskforce and Knowledge Hub: A potential initiative to foster governance and knowledge-sharing in the region is the creation of a taskforce comprising Member States' representatives, policymakers, researchers, and industry players who would periodically meet to discuss solutions and progress on e-waste management. This would serve as a forum for presenting national experiences while also identifying collaborative opportunities by sharing complementary capabilities and resources.
- Harmonized Regulations: GCC Member States need to leverage each other expertise and experience to draft a unified GCC e-waste management or EPR framework. It is crucial to implement common e-waste transportation policies, including standards for import/export to enable movement between GCC states for treatment and recycling.

D Share specialized infrastructure regionally to ensure profitable recycling through economies of scale:

- Regional collaboration can enable countries to develop specialized processing hubs, reducing costs and maximizing the efficiency of resource recovery.
- Specialized Technologies: Each type of component or product to be recycled might require a particular technology or investment in R&D to optimize the process. Having a consortium of companies or countries that invest in a common infrastructure will speed up progress and increase impact. They could look into hydrometallurgical processing (to extract valuable metals like gold and silver without the heavy pollution associated with smelting); robotics and AI sorting systems (which require further research to be effective and efficient in segregating different types of e-waste); or plasma arc recycling (converting hazardous e-waste into usable materials with minimal waste.)
- Shared Regional E-Waste Processing and Recycling Hubs: GCC Member States can pool resources to establish shared upcycling, repair, and recycling centers, rather than each Member State developing separate facilities. These hubs could specialize in different components of e-waste (e.g., heavy metals recycling vs. lithium-ion battery recycling). This initiative would increase operational efficiency, knowledge sharing, innovation, and economies of scale, all crucial for scaling up economic, social, and environmental impact.

E Formalize collaborations through bilateral agreements:

- Governments should establish bilateral agreements to outline shared responsibilities, ensure transparency, and foster equitable partnerships in cross-border e-waste management.
- Compliance with the Basel Convention: It is crucial that all cross-border e-waste trade complies with the Basel Convention, aligning trade policies, ensuring consistent e-waste management standards across borders, and guaranteeing that e-waste is managed in an environmentally sound way.
- Roles and Responsibilities for Processing E-Waste from countries with limited infrastructure. (Please add more details to this bullet point)
- Private Sector Collaborations: Bilateral agreements are crucial for allowing and encouraging private sector companies to engage with other businesses in neighboring countries. GCC Member States need to align their internal mechanisms, such as financial incentives, tariffs, and taxes, with an overarching regional e-waste management strategy. Companies and different actors in the value chain are fundamental enablers in building a regional infrastructure and adopting the latest tracking and operational technologies. Without formal agreements and support from the governments, companies will be reluctant to embark on the journey.
- Establishing a cross-border collaboration can be challenging at the outset. Begin by identifying key stakeholders—such as relevant authorities, and private and social sector partners—and work together to develop a mutually beneficial value proposition that benefits both countries. Once this foundation is in place, it will serve as a catalyst for greater impact.

By implementing the recommendations outlined in this report and embracing the new holistic E-Waste Management Framework, GCC Member States can accelerate the transition toward a circular economy in the ICT sector, address the digital divide, and harness the economic potential of material recovery.

These efforts will require a concerted commitment from governments, the private sector, and civil society to operationalize the framework and foster sustainable e-waste management systems that deliver environmental, social, and economic benefits on a global scale.

We can turn this global challenge into an opportunity for economic growth, environmental stewardship, and equitable cross-border collaboration.

BIBLIOGRAPHY

KEY SOURCES

1. The Global E-Waste Monitor 2024 (incl. integration from previous reports 2014, 2017, 2020)

2. Global Transboundary E-waste Flows Monitor 2022

3. 3. E-waste and scrap (HS: 8549) Product Trade, Exporters, and Importers: Net Trade, The Observatory of Economic Complexity, https://oec.world/en/profile/hs/e-waste-and-scrap

4. Basel Convention, https://www.basel.int/

5. Regional E-waste Monitor for the Arab States, United Nations Institute for Training and Research, https://ewastemonitor.info/wp-content/uploads/2021/12/REM_2021_ARAB_web_final_nov_30.pdf

6. COMTRADE export report, 2024, https://wits.worldbank.org/WITS/WITS/QuickQuery/ComtradeByProduct/ComtradeByProduct.aspx?Page=COMTRADEByProduct

7. Global and complementary actions for electronics extended producer responsibility: High-level EPR and e-waste challenges, The UN Agency for Digital Technologies, https://www.itu.int/hub/publication/d-str-e_waste-01-2022/

8. Policy practices for e-waste management, International Telecommunication Union, https://www.itu.int/en/ITU-D/Environment/Documents/Publications/2021/Toolkit_Africa_final.pdf?csf=1&e=ivTocK

9. UN Statistics Division Environmental Indicators, Total e-waste generated report (2020), https://unstats.un.org/unsd/envstats/Questionnaires/2022/Tables/Total%20ewaste%20collected.xlsx

COUNTRY-SPECIFIC SOURCES

THE KINGDOM OF BAHRAIN

10. Decision No. (5) of 2021 regarding the Management of Electronic and Electrical waste, https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fwww.lloc.gov.bh%2FFullEn%2FRSCE0521.docx&wdOrigin=BROWSELINK

11. 11. Law No. 7 of 2022 on the Environment: Chapter 11, Supreme Council for the Environment, https://www.fao.org/faolex/results/details/en/c/LEX-FAOC223569

12. Government Plan 2023-2026, Government of Bahrain, https://sdgs.gov.bh/PDFfiles/EN/Policies/GovPlan2023-2026.pdf

13. Our Vision: The Economic Vision 2030, Bahrain Ministry of Health, https://www.moh.gov.bh/Content/Files/Vision_2030.pdf

14. The National Environmental Strategy, Supreme Council for Environment (2006), https://www.sce.gov.bh/Media/Documents/Startegy/Environment%20National%20Startegy-%202006.pdf

15. E-Waste Recycling – Crown Industries B.S.C., crownbahrain.com

16. Gulf City Cleaning, gulfcitycleaning.com

17. Supreme Council for Environment, Kingdom of Bahrain, sce.gov.bh

18. Masar Bahrain, https://www.masar.bh/

19. Zain Bahrain, https://www.bh.zain.com/en/zainbahrain/ewaste-schools.html

20. Bahrain Vision 2030 https://www.bahrain.bh/wps/wcm/connect/cc20ef28-552d-44b5-8af5-95566fdbe9f9/Vision%2B2030%2BEnglish%2B%28low%2Bresolution%29.pdf?MOD=AJPERES&CVID=kTtAKxR

THE STATE OF KUWAIT

21. Environment Protection Law number (42) for the year 2014: modified 2015, Environment Public Authority, https://kdipa.gov.kw/wp-content/uploads/2022/08/Law-No.-42-of-2014-regarding-Environment-protection.pdf

22. Kuwait National Waste Management Strategy 2040, https://www.umsicht-suro.fraunhofer.de/en/press-and-media/press-releases/2024/eMiskWaste-Project.html

23. Tadwire – About Us, https://tadwire.com/about-us/

24. MRC, MRC (mrckw.com)

25. Environment Protection Law number (42) for the year 2014: modified 2015, Environment Public Authority, https://kdipa.gov.kw/wp-content/uploads/2022/08/Law-No.-42-of-2014-regarding-Environment-protection.pdf

26. 26. The Kuwait Waste Management Atlas; https://www.umsicht-suro.fraunhofer.de/en/press-and-media/press-releases/2023/Waste-Management-Atlas-Kuwait.html

27. Environmental Protection Agency, Environmental Compliance Platform, https://epa.gov.kw/en-us/EnvCompliance

THE SULTANATE OF OMAN

28. Royal Decree 10/82 Promulgating the Law on Environmental Protection and Pollution Control, Oman, 1982, https://decree.om/1982/rd19820010/

29. MINISTERIAL DECISION No. (18/93) REGULATIONS FOR THE MANAGEMENT OF HAZARDOUS WASTE, Oman, 1993, https://vertic.org/media/National%20Legislation/Oman/OM_Regulations_Management_Hazardous_Waste_18-93.pdf

30. Ministry of Environment and Climate Affairs: Ministerial Decision 10/2017 Amending Some Provisions of the Hazardous Waste Management Regulation, Oman, 2017, https://decree.om/2017/meca20170010/

31. Royal Decree 119/94 Approving the Accession of the Sultanate of Oman to Some International Agreements, 1994, Oman, https://decree.om/1994/rd19940119/

32. Royal Decree 81/99 on the Accession of the Sultanate to the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, Oman, 1999, https://decree.om/1999/rd19990081/

33. Royal Decree No. 114/2001 ISSUING THE LAW ON CONSERVATION OF THE ENVIRONMENT AND PREVENTION OF POLLUTION, Oman, 2001, https://faolex.fao.org/docs/pdf/oma98254E.pdf

34. Royal Decree 46/2009 regarding the Management and Operation of Oman Environmental Services Holding Company SAOC of the Waste Sector, Oman, 2009, https://decree.om/2009/rd20090046/

35. Royal Decree 58/2020 Approving the Accession of the Sultanate of Oman to the Minamata Convention on Mercury, 2020, Oman, https://decree.om/2020/rd20200058/

36. Towards the Circular Economy in Oman, Ministry of Economy, Oman, Oman Vision 2040 | Vision Document, 2021 https://nwm.unescwa.org/sites/default/files/2023-04/oman-vision-2040-en.pdf

37. New e-marketplace for recyclable waste trading in Oman, 2023, https://www.omanobserver.om/article/1141901/business/new-e-marketplace-for-recyclable-waste-trading-in-oman

38. Oman is getting ready for the first ISWA World Congress in the Middle East, Waste Management World, https://waste-management-world.com/resource-use/iswa-world-congress-2023-oman/

39. Oman's e-waste plant to recycle 10,000 tons per year, 2019, https://www.zawya.com/en/projects/omans-e-waste-plant-to-recyle-10-000-tonnes-per-year-qnr7pyle

40. Oman's first electronic waste processing plant coming up in Salalah, Oman Observer, 2017, https://www.omanobserver.om/article/66838/Front%20Stories/omans-first-electronic-waste-processing-plant-coming-up-in-salalah

41. Spotlight on Be'ah, Anglo-Omani Society, https://www.britishomani.org/uploads/downloads/spotlight%20on-%20be'ah.pdf

42. Interview with Tariq Ali Al-Amri, CEO, Oman Environmental Services Holding Company (Be'ah), Business Focus, https://businessfocus.org.uk/interview-with-tariq-ali-al-amri-ceo-oman-environmental-services-holding-company-beah/

43. Oman to unveil new law on waste sector privatization this year, Oman Observer, 2024, https://www.omanobserver.om/article/1148081/business/oman-to-unveil-new-law-on-waste-sector-privatisation-this-year

44. E-waste and scrap (HS: 8549) Product Trade, Exporters, and Importers: Net Trade, The Observatory of Economic Complexity, https://oec.world/en/profile/hs/e-waste-and-scrap

45. Oman's biggest e-waste recycling project launches, Oman Daily Observer, https://www.omanobserver.om/article/1145231/business/omans-biggest-e-waste-recycling-project-launches-in-salalah

46. To Conserve the Environment of our Beautiful Oman for our Future Generations, International Solid Waste Association, https://www.iswa.org/blog/national-member-blog-oman-to-conserve-the-environment-of-our-beautiful-oman-for-our-future-generations/?v=79cba1185463

47. Circular Economy, Invest Oman, https://investoman.om/circular-economy

48. Evergreen Gulf Recycling Hub, LinkedIn Page, https://www.linkedin.com/in/evergreen-gulf-recycling-hub-l-l-c-5519262a4/

THE STATE OF QATAR

49. The Environment Protection Law, for the year 2002 The Supreme Council for the Environment & Natural Reserves, https://www.wkcgroup.com/wp-content/uploads/2022/12/Qatar-Executive-By-Law-for-The-Environment-Protection-Law-Issued-vide-the-Decree-Law-No.-30-for-the-Year-2002.pdf

50. Draft resolution of the Minister of Municipality and Environment on the recycling and treatment of electrical and electronic waste, 2019 [unpublished]

51. Qatar's National Vision 2030 https://www.psa.gov.qa/en/qnv1/Documents/QNV2030_English_v2.pdf

52. Qatar Master Plan 2016 https://www.mme.gov.qa/QatarMasterPlan/Downloads-qnmp/QNDF/English/English_QNDF.pdf

53. Al Wakrah Municipality inks pact on e-waste disposal, Gulf Times, 2022, Al Wakrah Municipality inks pact on e-waste disposal - Gulf Times (gulf-times.com)

54. MOTC Launches Green Computer Club Initiative, Ministry of Communications and Information Technology, 2018, MOTC Launches Green Computer Club Initiative | Ministry of Communications and Information Technology (mcit.gov.qa)

55. Ooredoo Qatar and Seashore Group Strengthen Partnership in an E-Waste Recycling Agreement, Ooredoo, https://www.ooredoo.qa/web/en/press-release/ooredoo-qatar-and-seashore-group-strengthen-partnership-in-an-e-waste-recycling-agreement/

56. QIG signs MoU with ERF; recycles 3.65 tonnes of electronic waste, Gulf Times, QIG signs MoU with ERF; recycles 3.65 tonnes of electronic waste - Gulf Times (gulf-times.com)

57. Ministry of Municipality to launch waste recycling and treatment guideline, The Peninsula Qatar, www.thepeninsulaqatar.com/article/05/05/2023/ministry-of-municipality-to-launch-waste-recycling-and-treatment-guideline

58. Earthna, www.earthna.qa/qsw/e-waste-collection

THE KINGDOM OF SAUDI ARABIA

59. Royal Decree No. M/165 2020 issuing the Environmental Law, https://www.fao.org/faolex/results/details/en/c/LEX-FAOC201014

60. Royal Decree No. M/3 of 2021 issuing the Waste Management System https://www.fao.org/faolex/results/details/en/c/LEX-FAOC208390/ and sau_waste_management_system_english.pdf (iaeg.com)

61. Saudi Vision 2030, https://www.vision2030.gov.sa/media/rc0b5oy1/saudi_vision203.pdf

62. Vision and Mission, National Centre for Waste Management, https://mwan.gov.sa/en

63. 30-Year Tax Relief Added to Incentives for the Saudi Program for Attracting Regional Headquarters of Multinational Companies (2023) Saudi Press Agency, https://www.spa.gov.sa/en/N2009098.

64. Collaboration Communications, Space, and Technology Commission CST) https://www.cst.gov.sa/en/mediacenter/pressreleases/Pages/2023101101.aspx#:~:text=In%20a%20resounding%20commitment%20to,International%20Telecommunication%20Union%20(ITU).

65. Exitcom first for Saudi Arabia, Recycling International, Exitcom first for Saudi Arabia • Recycling International

66. Enviroservce, EnviroServe | E-Waste Recycling Facility In UAE

67. Tadweeer, Home • Tadweeer Company

68. Holoul e-waste recycling, Holoul - E-Waste Recycling (holoulrecycling.com)

69. Sorting and Recycling Co. for Environmental Services (EADA), https://eada.sa/

70. Saudi Investment Recycling Company (SIRC), https://www.sirc.sa/

71. National Center for Environmental Compliance (NCEC), https://ncec.gov.sa/ar/Pages/default.aspx

72. New Electrical/Electronic Device Regulations in Saudia Arabia, UL Solutions, https://www.ul.com/insights/new-electricalelectronic-device-regulations-saudi-arabia

73. Unlocking Saudi Arabia's Plastic Recycling Potential: A Green Investment Opportunity (2023) Frost & Sullivan https://www.frost.com/growth-opportunity-news/unlocking-saudi-arabias-plastic-recycling-potential-a-green-investment-opportunity/#:~:text=Saudi%20Arabia%27s%20Pledge%3A&text=With%20a%20pledge%20to%20invest, waste%20generated%20away%20from%20landfills

74. Saudi Vision 2030, https://www.vision2030.gov.sa/media/rc0b5oy1/saudi_vision203.pdf

75. Communications, Space and Technology Commission, Telecom Review, https://www.telecomreview.com/articles/reports-and-coverage/7594-driving-sustainability-in-the-digital-space-saudi-arabia-s-vision-and-cst-s-contributions/

UNITED ARAB EMIRATES

76. Federal Law No. 12 of 2018 concerning Integrated Waste Management, UAE Legislation, https://uaelegislation.gov.ae/en/legislations/1490/download

77. Cabinet Resolution No.39 of 2021 regarding the Executive Regulations of Federal Law No.12 of 2018 regarding Integrated Waste Management https://faolex.fao.org/docs/pdf/uae204427.pdf

78. UAE Circular Economy Policy, Ministry of Climate Change and Environment, UAE, https://www.moccae.gov.ae/assets/download/d15b52b/UAE%20Circular%20Economy%20Policy.pdf

79. UAE Vision 2021, United Arab Emirates, The Cabinet, https://uaecabinet.ae/en/uae-vision

80. UAE Green Agenda 2030: UAE national framework https://u.ae/en/about-the-uae/strategies-initiatives-and-awards/strategies-plans-and-visions/environment-and-energy/the-uaes-green-agenda-2030

81. Dubai Integrated Waste Management Plan 2012, https://u.ae/en/information-and-services/environment-and-energy/waste-management

82. EnviroServe | E-Waste Recycling Facility In UAE, enviroserve.org

83. BEEAH Group | Holding Company, beeahgroup.com

84. Dulsco - People and Environmental Solutions Company, dulsco.com

85. Reliable IT and Electronics Recycling Solutions in UAE, veracityworld.com

86. United Arab Emirates: On the Road to Zero Wastes, Gulf Enviro, United Arab Emirates: On the Road to Zero Wastes – Waste Management Company (gulfenviro.ae)

87. Environment Agency Abu Dhabi, https://www.ead.gov.ae/en

88. Emirates Environmental Group, https://www.eeg-uae.org/

89. Dubai Cares, https://www.dubaicares.ae/

E-WASTE FRAMEWORK SOURCES

90. Policy Practices in E-waste Management, https://www.itu.int/en/ITU-D/Environment/Documents/Publications/2021/Toolkit_Africa_final.pdf?csf=1&e=OHEtlM

91. Life Cycle Framework for E-waste Management, https://link.springer.com/article/10.1007/S11783-017-0985-8

92. Policy and regulation frameworks on waste and EPR in the EU, https://erp-recycling.org/wp-content/uploads/2021/07/adelphi_study_Analysis_of_EPR_Schemes_July_2021.pdf

93. Model Framework for E-waste Management in East Africa, https://eaco.int/admin/docs/publications/MODEL FRAMEWORK FOR E-WASTE MANAGEMENT.pdf

94. Handbook for the development of a policy framework on ICT/e-waste, ITU, https://www.itu.int/dms_pub/itu-d/opb/gen/D-GEN-E_WASTE.02-2018-PDF-E.pdf

95. Waste Hierarchy – from the EU Waste Framework Directive, https://environment.ec.europa.eu/topics/waste-and-recycling/waste-framework-directive_en

96. Strategic Framework for the Circular Economy, Journal of Cleaner Production, https://www.researchgate.net/publication/370696291_A_strategic_framework_for_the_circular_economy_Lessons_from_policy_instruments_in_the_EU

97. Waste and Climate Change: Strategy Framework, https://www.unep.org/resources/report/waste-and-climate-change-global-trends-and-strategy-framework

98. Strategic Framework for Working Toward Zero Waste Societies, https://www.mdpi.com/2313-4321/2/1/1

99. Plastic Waste Management Framework, Alliance to End Plastic Waste, https://www.endplasticwaste.org/insights/articles/plastic-waste-management-framework

FIGURES

TABLES

APPENDIX A: Context of the Initiative

The Digital Cooperation Organization (DCO) is dedicated to fostering inclusive and equitable digital economies where people, businesses, and governments can innovate and thrive. To achieve this, the DCO collaborates closely with governments, the private sector, international organizations, NGOs, and civil society, aligning efforts to drive sustainable progress.

As digital device usage continues to expand globally, it is critical to address the environmental and social impacts of electronic waste. E-waste presents a critical challenge with far-reaching implications for the environment, human health, the economy, and global equity. Recognizing the urgency of this issue, the DCO has made e-waste management a strategic priority, aligning it with its vision of a sustainable, human-centric digital economy.

PROGRAM OBJECTIVES

In 2024, the DCO launched the E-Waste Management Program to address sustainability challenges in the ICT sector and promote the growth of a sustainable digital economy. This initiative reflects the DCO's commitment to integrating sustainability into its core objectives and contributing to global development goals.

The E-Waste Management Program aims to achieve the following objectives:

- Sustainability Through E-Waste Reduction: By driving responsible e-waste management practices, the program advances progress toward the UN Sustainable Development Goals, including climate action.

- Harnessing E-Waste's Economic Value: Improved e-waste management unlocks valuable resources for reuse in manufacturing. For example, in 2019, global e-waste contained $57 billion in raw material value.

- Promoting Digital Inclusion: Redeploying just 1% of the five billion smartphones discarded in 2022 could provide affordable devices to 50 million people in DCO Member States, helping bridge the digital divide.

PROGRAM SCOPE

The E-Waste Management Program focuses on key strategic areas to drive sustainable and effective e-waste management within DCO and GCC Member States, and countries globally. Its core components include:

1. **Current State Assessment**
   Conducting a comprehensive evaluation of e-waste management systems across DCO and GCC Member States to identify challenges, opportunities, and key trends.

2. **Best-in-Class Benchmarking**
   Analyzing global best practices in e-waste management by benchmarking three high-performing countries, Finland, Australia, and the United States, to derive actionable insights for Member States and countries globally.

3. **Development of an E-Waste Management Framework**
   Collaborating with experts and stakeholders, the DCO has developed a practical framework that identifies key mechanisms, success factors, and actionable steps for governments to support the development of sustainable e-waste management systems aligned with global best practices.

Through these initiatives, the program aims to strengthen national systems, promote regional collaboration, and establish scalable solutions for managing e-waste sustainably.

APPENDIX B: Research Methodology

The Current State Assessment evaluated the e-waste management landscape across 17 countries, including all six GCC nations — the United Arab Emirates, the Kingdom of Bahrain, the Kingdom of Saudi Arabia, the Sultanate of Oman, the State of Qatar, and the State of Kuwait. It employed a range of qualitative and quantitative methodologies to understand current systems and identify areas for improvement.

PRIMARY RESEARCH

- Expert Engagement
  Conducted interviews with more than 12 experts, including professionals specializing in e-waste regulation, the circular economy, and sustainability.
  Contributors included representatives from international organizations, private sector leaders, and academics.

- Stakeholder Polls and Surveys
  A survey with open-ended questions collected responses from representatives of six Member States — the Kingdom of Bahrain, the Kingdom of Saudi Arabia, the Sultanate of Oman, the State of Qatar, Ghana, and Jordan.

An online poll gathered insights from representatives of nine Member States — the Kingdom of Bahrain, the Kingdom of Saudi Arabia, the Sultanate of Oman, the State of Qatar, and the State of Kuwait, Rwanda, Nigeria, Jordan, and Ghana — exploring key opportunities and barriers to e-waste management.

SECONDARY RESEARCH

- Entity Analysis
  Incorporated insights from more than 45 entities, including global organizations such as the International Telecommunication Union (ITU), United Nations University (UNU), and the African Circular Economy Alliance.

BENCHMARKING ASSESSMENT

The Benchmarking Assessment examined best practices in e-waste management in Finland, Australia, and the United States to derive actionable insights for DCO Member States.

PRIMARY RESEARCH

- Expert Engagement
- Conducted interviews with more than 5 senior stakeholders from organizations such as Business Finland, ANZRP, and ERI.
- Engaged more than 12 Kearney and ERM experts, providing specialized knowledge on sustainability, the circular economy, and e-waste regulations.

SECONDARY RESEARCH

- Entity Analysis
- Reviewed contributions from more than 25 organizations, including Hope Services, ISRI, TES, and ResourceCo, representing perspectives from the public, private, and NGO sectors.

FRAMEWORK DEVELOPMENT

The e-waste management framework integrates findings from both assessments above as well as additional research:

1. **Current State Assessments**
- Covered 17 countries (outlined above), evaluating their e-waste systems, challenges, and opportunities.
2. **Benchmarking Assessments**
- Focused on Finland, Australia, and the United States to identify best practices and advanced approaches.
3. **E-Waste and Circularity Frameworks**
- Reviewed eight e-waste management frameworks and five waste/circularity frameworks from leading organizations, including ITU, UNITAR, UNEP, and prominent academic institutions.

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