E-TADWEER

An Ecosystem for Green Electronic Components and Systems in Qatar

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Introduction

At the pace of rapid technological advancement comes an equally critical responsibility to manage the growing volume of electrical and electronic equipment reaching the end of its lifecycle. In the absence of coordinated systems for reuse, refurbishment, or recycling, this discarded equipment turns into what is commonly known as Electronic Waste (e-waste), creating mounting environmental and sustainability challenges. In Qatar, e-waste poses both an environmental challenge and a strategic opportunity, containing valuable and hazardous materials that demand regulated management. While the country has made commitments to sustainability through its Qatar National Vision 2030 and the Third National Development Strategy, the current e-waste management construct remains fragile, lacking a comprehensive nationwide system. Effective solutions require coordination across the entire value chain, from material suppliers and manufacturers to consumers and recyclers. Addressing these complexities requires an integrated and adaptive approach that acknowledges Qatar's unique material flows and market dynamics.

Within this context, E-TADWEER introduces a circular ecosystem for green electronics management tailored specifically to the country's needs. It aims to develop an integrated framework that combines digital platforms, AI-driven recommendations, and physical infrastructure to rethink how e-waste is managed nationwide. Central to this effort is the development of a mobile application to recommend optimal circular practices for each device. Alongside this, physical kiosks and a dedicated digital marketplace will be deployed to encourage the exchange of electronic devices, with QU as the pilot location. These technological solutions are complemented by targeted awareness campaigns and educational seminars, steering Qatar towards a zero-waste electronics industry. Its core objectives are to:

1.Enable intelligent decision-making through a mobile application that recommends the most effective circular strategy for each device based on its condition.

2. Promote recycling and refurbishment behavior through the deployment of physical kiosks and a digital marketplace, including targeted five kiosks strategically located across Qatar University (QU), to make sustainable disposal convenient and rewarding.

3. Engage stakeholders across sectors, with a strong emphasis on educating and empowering youth, to build societal awareness and shape environmentally responsible behaviors.

Methodology

1. Overview of the Digital Framework

E-TADWEER adopts a multidisciplinary approach that blends technological innovation with practical implementation to establish a holistic e-waste management system, as illustrated in Figure 1. The initiative is anchored in the 6R principles: Reduce, Reliability, Repair, Reuse, Refurbish, and Recycle, integrating powered tools to support sustainable practices across the electronic product lifecycle. The process begins with users registering their electronic items and uploading product images via the online platform: https://etadweerqa.com/login . AI algorithms then analyze and classify the items by type and condition, generating a detailed report and quotation for t he user. Following this, collection is scheduled, and devices deemed suitable are reintegrated into a digital marketplace for resale, promoting reuse and extending product lifecycles.

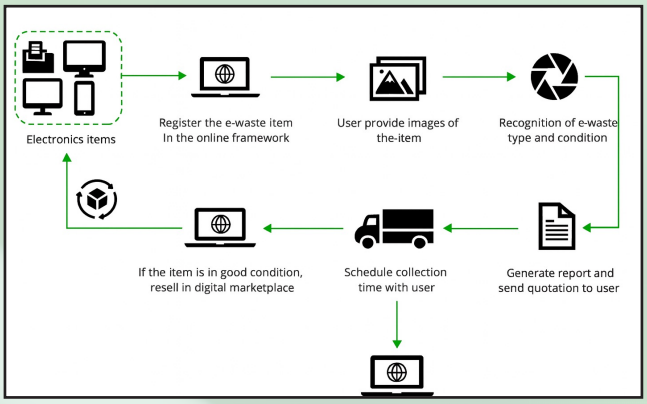

Figure 1: Workflow of the E-TADWEER platform.

2. Pilot phase: Kiosk and Mobile Application

The initiative includes the deployment of smart physical kiosks to enable convenient device drop-off. The system integrates geolocation features and a reward-based credit mechanism to encourage active participation. Overall, E-TADWEER aims to achieve a 25% reduction in e-waste and attract at least 1,000 users to the platform.

As of October 2025, we are currently in the pilot implementation phase of this project. Initially, we developed a collection kiosk in collaboration with the Facilities and General Services Department at QU. This kiosk, shown in Figure 2, represents the backbone of the system and will be strategically installed in key campus locations to encourage students and staff to engage in responsible e-waste disposal practices. Moreover, it is designed to be interconnected with a mobile application, as illustrated in Figure 3. Through the platform, users will be able to register their devices, receive tailored recommendations for circular actions (such as reuse,

repair, or recycling), and track their contributions to sustainability efforts: an essential component for the success of E-TADWEER. Moreover, this will also enable the collection of valuable behavioral insights to inform future system improvements. To illustrate its pilot phases, Figure 3(a) illustrates the registration interface, whereas Figure 3(b) presents the account details, including the user profile and accumulated reward points. Figure 3(c) highlights the recycling request submission page, where users upload device images to receive disposal recommendations. Finally, Figure 3(d) shows an interactive map interface for locating the nearest kiosk, marked by red pins.

Figure 2: Developed kiosk in collaboration with the Facilities and General Services Department, to be installed across the QU campus.

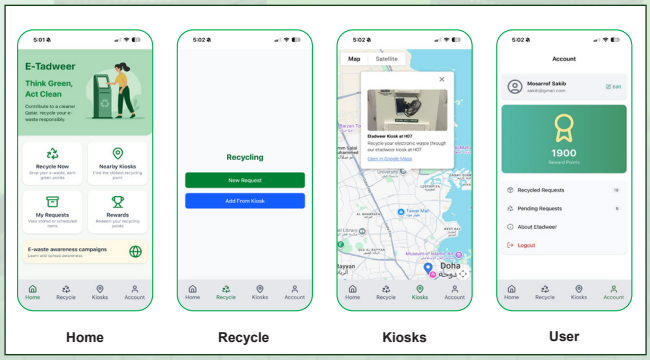

Figure 3: Pilot phase interfaces of the E-TADWEER mobile application: (a) registration screen; (b) account page with reward points; (c) recycling request submission; (d) interactive map for locating nearby kiosks.

3. Educational Outreach

Alongside its technological focus, E-TADWEER puts strong emphasis on a human-centric approach by building awareness and sharing knowledge through education. To ensure lasting impact, the project will include a series of outreach and training initiatives, such as summer schools, workshops, and capacity-building sessions. These are supported by collaborations with institutions like the IEEE student branch at QU, helping to engage students and young professionals.

Conclusion

The E-TADWEER initiative underscores several critical policies, institutional, and operational gaps within Qatar's evolving e-waste management landscape. Key challenges include the lack of structured and accessible data, fragmented management of end-of-life electronics across multiple stakeholders, and limited public engagement, all of which hinder the development of a shared culture of environmental responsibility. These gaps emphasize the need for an integrated approach that combines policy alignment, technological innovation, and active societal participation. Beyond its technological tools, E-TADWEER places strong emphasis on behavioral change and community engagement. It integrates educational initiatives to raise awareness, strategically located kiosks to provide accessible drop-off points, and reward-based mechanisms to incentivize responsible behaviors. This combined approach ensures that individuals, particularly youth, are active participants in shaping sustainable e-waste practices, supporting Qatar's transition towards a circular economy and advancing the environmental development pillar of Qatar National Vision 2030.