

## **E-WASTE MANAGEMENT IN ACHIEVING SDGs IN NEGARA BRUNEI DARUSSALAM: A MAQASID SHARIAH PERSPECTIVE**

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### **Abstract**

*'Electronic waste', 'Waste Electrical and Electronic Equipment' or commonly known as 'E-waste' or 'WEEE' is referred to any electrical object or equipment that no longer possesses any value which has been disposed of by its owner. As other unused items, E-waste, which has not been used and thrown away as waste without being intended for reuse, becomes a big problem to contemporary life. Due to its complex chemical component and inorganic toxic material, E-waste requires special treatment and management different from that of conventional waste. Incorporating e-waste management into the framework of Maqasid of the Shariah provides a holistic approach to achieving Sustainable Development Goals (SDGs) in Brunei. By harmonizing the protection of religion, life, intellect, progeny and wealth with sustainability principles, this approach not only tackles the environmental challenges associated with e-waste but also ensures the well-being of the community in a manner that is in line with the Islamic teachings. To carry out a detailed analysis of e-waste management in achieving SDGs in Negara Brunei Darussalam, a qualitative approach is adopted in order to fulfil the research objectives and a semi-structured interview method is used by the researchers. A total of 10 employees from 6 organizations (inclusive of both government and private sector) were interviewed. The results have shown issues, problems and threats posed by e-waste with time consuming, health concerns, and a lack of awareness to be the main highlights. Aside, an effort from the government body in introducing the 'Extender Producer Responsibility (EPR) scheme' in handling and managing e-waste was also discussed. By nurturing a culture of environmental responsibility, increasing awareness through education and implementing efficient waste management approaches, Brunei can not only address the immediate risks associated with e-waste but also contribute to the global pursuit of the SDGs in a way that is spiritually and materially rewarding.*

*Keywords. E-waste, Environment Management, SDGs, Well Being, Maqasid Shariah, Brunei Darussalam*

### **Introduction**

'Electronic waste', 'Waste Electrical and Electronic Equipment' or commonly known as 'E-waste' or 'WEEE' is referred to any electrical object or equipment that no longer possesses any value which has been disposed of by its owner. The rapid pace of technological advancements has revolutionized modern lifestyles, bringing with it an exponential rise in the consumption of electronic devices. However, this progress comes with a significant environmental and health cost due to the proliferation of electronic waste (e-waste). Comprising discarded electrical or electronic devices, e-waste contains hazardous substances such as lead, mercury, and cadmium, which pose severe risks when improperly managed. Globally, e-waste represents one of the fastest-growing waste streams, projected to reach alarming levels in the coming decades. (Bhat, V., & Patil, Y. 2014; Bhat, Viraja. 2023). In Brunei Darussalam, e-waste has emerged as a pressing issue due to increasing digitalization and limited public awareness about proper disposal methods.

This study explores the integration of Maqasid Shariah principles with e-waste management to achieve Sustainable Development Goals (SDGs). By aligning the Islamic objectives of protecting faith, life, intellect, progeny, and wealth with sustainability practices, a holistic framework is proposed to address the environmental and social challenges associated with e-waste. This approach not only mitigates immediate risks but also promotes ethical and sustainable practices in line with Islamic teachings.

## METHODOLOGY

The research methods employed a qualitative approach, with semi-structured interviews conducted among ten participants from six organizations, including government bodies and private companies, which include recycling companies that have been involved with waste management. These interviews provided detailed insights into the challenges of e-waste management, ranging from operational hurdles to public perceptions. The data were analyzed using thematic analysis, enabling the researchers to identify key patterns and derive actionable conclusions. By focusing on stakeholder experiences, the study captured a comprehensive understanding of e-waste dynamics in Brunei Darussalam. The organization and companies demographic background is represented in Table 1.

| Name of Company                               | Company Specialization                    | Employer No. (n) | Gender of employers    | Position within the company                     |
|---|---|------------------|------------------------|---|
| Kawan Bumi                                    | Paper, Plastic and E-waste                | 1                | Male                   | Chief Executive Officer                         |
| V&N Recycling Sdn Bhd                         | Metal                                     | 2                | Male                   | Supervisor                                      |
| EnviroIdaman, Sungai Akar Transfer Station    | General Waste and E-waste                 | 3<br>4           | Female<br>Male         | HR and Admin Executive<br>Operational Executive |
| EnviroIdaman, Sungai Paku Engineered Landfill | General Waste and E-waste from government | 5<br>6           | Male<br>Male           | Branch Manager<br>Health and Safety Officer     |
| Daikyo Recycling Sdn Bhd                      | Metal, Paper and E-waste                  | 7                | Female                 | Admin Executive                                 |
| JASTRE, Ministry of Development               | Policy Maker                              | 8<br>9<br>10     | Male<br>Male<br>Female | Environment Officers                            |

## RESULTS AND DISCUSSION

### Time Consuming

E-waste management presents a number of challenges, the most significant of which is time consumption. This section examines three major factors that contribute to the time-consuming nature of e-waste management: the intensive dismantling process, slow return of investment, and complex documentation processes.

#### *Intense Dismantling Process and the Need of Expert*

Improper dismantling leads to inadequate treatment posing serious health issues. Dismantling electronic waste is often a meticulous and labor-intensive process. Effective e-waste recycling necessitates the disassembly of electronic devices or equipment to isolate hazardous materials from valuable components. This procedure necessitates a high level of precision and the need for expertise to ensure that all components are handled correctly, which can be both time-consuming and resource-intensive. Two participants from the private sector who running recycling companies during the interview have stressed these issues noting:

“Another issue with E-waste is that we cannot export it as it is, we have to do dismantling and store it into a bag. Most importantly, making sure it did not leaks” - Employer 7 Interview - Female employer from Daikyo Environmental and Recycling Sdn Bhd

“E-waste dismantling involves a lot of work” Employer 1 - Male employer from Kawan Bumi

Beside the intense dismantling process, the number of labor should also be highlighted. The recycling companies highlighted the limited number of laborers in dismantling e-waste is also an issue and it is very difficult to employ more laborers in the country. They believe that in order to speed up the dismantling process, more laborers are required.

“To speed up the dismantling process, we need more labor, but normally we only have one labor working on e-waste dismantling” Employer 7 Interview - Female employer from Daikyo Environmental and Recycling Sdn Bhd

“I would say the dismantling process of E-waste is very dangerous, and it requires more man power to dismantled it” Employer 2 - Male employer from V&N Recycling Sdn Bhd

“We need more laborers to handle e-waste. However, when we apply for visas, most often the application gets rejected. As an example, we apply for 10 labors, but they only approved for 2 labors, this is an issue, we have less labor to operate” Employer 2 - Male employer from V&N Recycling Sdn Bhd

On the other hand, Employer 8, from JASTRE believes distinctly claiming that to achieve efficient dismantling procedures, the need of a special skill set is required from the laborer.

“When dismantling e-waste, it needs a special skill set” Employer 8 Interview - Male employer from JASTRE, Ministry of Development

However, Employer 8, from JASTRE further emphasized the recycling companies unwillingness and reluctance to send their labor for training is also an issue:

“Some of the recycling companies do not want to invest in training. That might be a problem” Employer 8 Interview - Male employer from JASTRE, Ministry of Development

The dismantling of electronic waste is a complex and labor-intensive process that presents significant challenges for recycling. The perspective of various employers or stakeholders demonstrates the multifaceted nature of these challenges. Employers from Daikyo Environmental and Recycling Sdn Bhd and Kawan Bumi underscore the time-consuming and resource-intensive nature of this task. The requirement to handle hazardous materials with caution to avoid and prevent leakage further complicates the process.

Furthermore, the complexity of these issues is added by the shortage of skilled laborers, as noted by several employers. The difficulty in recruiting a sufficient workforce, compounded by visa application rejections, and some companies’ reluctance to invest in specialized training all contribute to the slow dismantling process. Moreover, Employer 8 from JASTRE emphasizes the importance of specialized skill sets for effective dismantling, as well as training, which is not always prioritized by recycling companies.

Addressing these challenges would require a multifaceted approach in every aspect. Increasing the investment in labor training, integrating efficient recruitment strategies, and developing more efficient dismantling technologies could further streamline the process. Furthermore, fostering collaboration among stakeholders to improve workforce capabilities and infrastructure is pivotal for overcoming the barriers to efficient e-waste management. By addressing these issues, recycling companies could become more efficient and effective in handling and managing growing numbers of e-waste.

### *E-Waste and Investment Return*

A better understanding and more data on e-waste will contribute to the achievement of several goals of the 2030 Agenda for Sustainable Development. It will help address the SDGs related to SDG No 1: No poverty; SDG No. 2: Zero hunger and SDG No. 3: Good health and wellbeing. This is because E-waste management could become an investment that will also address employment and economic growth since the sound management of e-waste can create new areas of employment and drive entrepreneurship.

Aside from toxic metals like lead and cadmium, e-waste contains many valuable metals of economic value such as silver and gold. Heavy metals, whether hazardous or valuable are finite resources, contributing the most economic value in electronic scrap. Valuable metals recovery locked in e-waste has been one of the most attractive activities from a financial standpoint. That is why many e-waste companies in Brunei collect the e-waste for the mentioned purpose but lately, they have faced several challenges since their investment in this sector has not profited as anticipated. As we know, every business demanded making a profit and would try to avoid suffering from loss. Businesses would prioritize products that could potentially generate more revenues in comparison to products that demanded less. Another challenge

associated with e-waste management is the slow return on investment. As quoted by employers from Kawan Bumi and Daikyo Environmental and Recycling Sdn Bhd:

"I think our company will not sustain if we focus solely on e-waste, as I mentioned earlier it took us four years to fill a forty-foot container. In other words, we only earn in every four years and this does not make sense, that is why we are accepting other recycling material as well" - Employer 7 Interview - Female employer from Daikyo Environmental and Recycling Sdn Bhd.

"It took us more than a year to fill a forty-foot container" - Employer 1 Interview - Male employer from Kawan Bumi.

Besides, Kawan Bumi also highlighted in term of profit making, E-waste is rank last before paper and plastic:

"If I compared E-waste, Paper and Plastic waste in terms of profit making. I would rank first, Paper. Second, Plastic and Third, E-waste" - Employer 1 Interview - Male employer from Kawan Bumi

Kawan Bumi explained the reason behind it by comparing it with the time taken to fill in a forty foot containers with paper or plastic with e-waste:

"Within a month, I could fill around ten containers of Paper and a few containers for Plastic, but for e-waste, it might take a year or more to fill in one full container" - Employer 1 Interview - Male employer from Kawan Bumi

The slow return on investment in e-waste management addresses the challenge the recycling industry faces. As highlighted by Daikyo Environmental and Recycling Sdn Bhd and Kawan Bumi, the time required to fill one shipment container, which normally takes several years, has made it difficult for companies to rely solely on e-waste to generate their revenue. This slow profit cycle forces recycling companies to diversify into other materials, such as paper and plastic, which could offer quick and higher profit returns compared to e-waste.

Even though managing e-waste is important in sustaining and protecting the environment, e-waste is ranked last in terms of profitability compared with other recyclable materials. The time and resources required to fill in one shipment container of e-waste are highly unbalanced and these could be justified through the profits generated by the recycling companies. The comparison to paper and plastic recycling, which are proven to provide multiple full containers in a shorter period of time, emphasizes the financial challenges of e-waste management.

In order to improve the sustainability of e-waste recycling, it is important to explore strategies that could shorten the profit cycle of e-waste management. This could include increasing the amount of e-waste processed, investing in more efficient collection and processing methods, or creating incentives to make e-waste recycling more attractive. Without these considerations, the slow return on investment will persist and hinder the growth of e-waste management in the country.

### *Complex Documentation Process*

In many countries, the exportation procedure involves the submission of documents. However, the documentation process for e-waste management is frequently complex and time-consuming, requiring strict regulations and detailed record-keeping to ensure compliance with environmental and safety standards. This complex process necessitates precise tracking of e-waste from collection to disposal, which can be time-consuming and resource-intensive for businesses. As mentioned by Daikyo Environmental Sdn Bhd: "We need to write a letter and make a report to Jastre before every shipment to the importing countries. This process consumes so much time and may take up to a year" - Employer 7 Interview - Female employer from Daikyo Environmental and Recycling Sdn Bhd

Employer 7 further elaborated:

"We need to comply with the government regulation and there's a lot of documentation required. Whenever we submit the documentation and there is a correction needed, they would pass it back to us and ask us to re-write it again. Only after everything is good, we can proceed" - Employer 7 Interview - Female employer from Daikyo Environmental and Recycling Sdn Bhd

Employer 8 from JASTRE acknowledges this situation and expresses his thoughts regarding the issue from the perspective of a competent authority, noting:

"As competent authorities (in Brunei), we have to deal with other competent authorities from respective importing companies or transit countries. When we receive requests from the local recycling companies about export permits, we do our prior informed consent with these transit countries. What took it long is these countries are out of our hands in terms of getting their approval. Once these countries give us approval, only then can we issue the export permit." Employer 8 Interview - Male employer from JASTRE, Ministry of Development

The complex documentation process involved in e-waste management presents a significant challenge amongst recycling companies, as highlighted by Daikyo Environmental and Recycling Sdn Bhd. The strict requirement of documentation, which involves making detailed reports and other compliance, can lead to substantial delays, which would extend the process up to a year or more. These challenges not only consume much time but, at the same time, hinder the business flow, which complicates overall business operations.

On the other hand, from the perspective of regulatory bodies, JASTRE, the challenge is intensified in coordinating with competent authorities from importing and transit countries, which can cause delays in the issuance of export permits. These external dependencies are frequently beyond the control of JASTRE, which adds another layer of complexity to acquiring export permits. Addressing these documentation processes is crucial in ensuring efficient and smooth business operations.

### **Hazardous**

According to several studies and research, all e-waste contains many dangerous and poisonous components such as lead, mercury, cadmium, chromium, arsenic, polyvinyl chloride, and many other compounds that require particular handling and EOL treatment. Electrical and electronic equipment is essential to a country's development, but proper disposal of e-waste is vital (Sthiannopkao, S., & Wong, M. H. 2013; Pinto, V. 2008). Thus, electronic waste's growing complexity and volume have raised concerns about its potential hazards, particularly the toxic substances found in many electronic components.

The term "Hazardous" often refers to "a potentially damaging physical event, phenomenon and/or human activity, which may cause loss of life or injury, property damage, social and economic disruption or environmental degradation." (Schneiderbauer and Ehrlich, 2004). According to the interviewed participants, E-waste is more hazardous in comparison with general waste, as improper e-waste management or disposal could cause an explosion, open fire, and threaten human life. As stated by the employers in regard to the hazard that e-waste could pose:

"E-waste is much more dangerous, because e-waste could leak mercury" Employer 5 Interview– Male employer in Enviroidaman, Sungai Paku Engineered Landfill

"E-waste when thrown or disposed of improperly to general waste machinery could potentially cause explosion" Employer 4 Interview - Male employer in Enviroidaman, Sungai Akar Transfer Station.

"Previously, improper e-waste disposal have cause open fire in landfill at Sungai Paku, and it takes us three days to completely extinguished the fire... this have forced us to shut down our operation for a while, and this have complicate the public" Employer 3 Interview - Female employer in Enviroidaman, Sungai Akar Transfer Station

"what we also need to do and which is important is to ensure that the motherboard (E-waste) does not enter the landfill, what will happen if that occurs is that overtime, the harmful chemical inside it will spill out, this is obviously hazardous to the environment." Employer 1 Interview - Male employer in Kawan Bumi

It cannot be denied that managing e-waste is crucial in sustaining the environment and protecting human health. This aligned with one of the Maqasid of the Shariah especially objective number two; the Protection of Life and could be associated with SDGs Goal 3 (Good Health and Well Being). The protection of life involves providing security, preserving the environment, and protecting one's health. Improper e-waste management was against all these as it posed a threat to all security, environment, and health. As an example, as mentioned by one of the interviewees, one of the harmful chemicals that could leak through improper e-waste disposal is mercury. According to Table 1, mercury could not only contaminate the soil but it could also contaminate both the water and the air. Soil, water, and air are important resources not only to humans but also to other living things. Furthermore, it could also affect human health, affecting certain organs including the brain, respiratory system, kidneys, heart, and the liver. All of these are the crucial organs of the human body, and if not taken seriously could potentially cause death. Moreover, this chemical is prone and known to hinder child development as stated in Table 1. Taking all these into consideration, the hazard that e-waste posed not only could affect one's life, but it could harm future generations by hindering children's development, and one's intellect as it could damage the brain, scraping one's wealth through extensive medical treatment expenses and what most importance is that it against the Islamic virtue of making corruption to the earth. These were all against the five Maqasid of the shariah and are not inclined toward achieving SDGs.

## Community Consciousness

### *Lack of Awareness*

One more important target of SDGs is the reduction of the adverse per capita environmental impact of cities which can be achieved with improved awareness of SDGs. SDG goals: Goal 3 (Good health and Well-being), Goal 6 (Clean water and Sanitation), Goal 11 (Sustainable Cities and Communities), Goal 12 (Responsible Consumption and Production) needs proper knowledge and management of e-waste.

There is a close linking between awareness of E-waste and SDG's achievement. It has been globally noted several times that improper disposal leads to inadequate treatment posing serious health issues (Borthakur, A., & Govind, M. 2017). In this regard, educating the public about the dangers of e-waste is critical to promoting responsible disposal and recycling practices. Despite this need, many organizations struggle to implement effective training and awareness programs. Cultivating one's awareness of the harm that e-waste could pose is pivotal to handling and managing issues that surround it. However, most of the employers have highlighted a significant lack of awareness regarding e-waste disposal. As noted by the participants:

"There is not much awareness regarding e-waste. There are sometime we hear it in the radio, but it is not frequent" Employer 7 - Female employer in Daikyo Recycling Sdn Bhd

"E-waste awareness in Brunei is moderate, one of the factor most probably because there is less e-waste in Brunei compared to the neighboring countries" Employer 1 - Male employer in Kawan Bumi

"I would say the level of awareness about e-waste in Brunei is less" - Employer 2 - Male employer in V&N Recycling Sdn Bhd.

"I believe there is still a lack of knowledge (regarding e-waste)" Employer 3 - Female employer in Enviroidaman, Sungai Akar Transfer Station

"The level of awareness (on e-waste) is low, especially garbage dump near the residential area, they normally dispose their e-waste there, and this is improper" - Employer 4 - Male employer in Enviroidaman, Sungai Akar Transfer Station

"When it comes to e-waste, I still think people are not aware of it" Employer 8 - Male employer in JASTRE, Ministry of Development

In relation, one of the employers believed that efforts had already been made to raise public awareness regarding e-waste through radio and television broadcasting and making good use of social media platforms; however, the results have been less significant.

"I observed that even though there is effort on raising awareness through radio broadcasting and social media, I can still find people dispose their E-waste at the general waste sites" Employer 3 - Female employer in Enviroidaman, Sungai Akar Transfer Station

On the other side, one of the interviewed employers responded in a distinct perspective and highlighted that public awareness is not the main issue but more toward the public convenience to dispose of their e-waste and hence one of the reasons why they would prefer to wait for a recycling event to be held in each district to dispose of their e-waste.

"I think awareness is not the main issue, it's just that practically, the public used to be very comfortable that they are not really used to being disposed of from afar. So when they know there's a recycling day event in each district, they take it as an opportunity instead of going to Sungai Akar. They know there is a depot center, it's just that it's not convenient for them." Employer 9 - Male employer in JASTRE, Ministry of Development

This argument is later supported by a justification from Employer 8 from JASTRE, which mentions that a higher record number of e-waste is collected during recycling events compared to normal working days.

"When we held recycling events, we would collect more compared to the normal working day, even though the depot is open every day." Employer 8 - Male employer in JASTRE, Ministry of Development.

### *Raising E-waste Awareness in the Perspective of Maqasid of the Shariah*

One more important target of SDGs is the reduction of the adverse per capita environmental impact of cities which can be achieved with improved awareness. Thus, raising awareness on E-waste is not only crucial but it aligns significantly with the Maqasid of Shariah, especially objective three; Protection of Intellect. The protection of the Intellect could be achieved through development, preservation, and the utilization of the mind and it could be related to 'proper thinking, education, and modern skill' in today's world (Shihan, Amanullah & Zaroum, 2023). When dealing with E-waste, the protection of the intellect

comes to preserve one's mind through instilling understanding and knowledge when regarded into issues, threats, and problems posed by e-waste which is then supported by the other four Maqasid of the Shariah simultaneously. In order to achieve this, suggestions imposed by the employers suggested increasing more awareness through exposure toward the existence of recycling companies to the public, organizing roadshows at schools and institutions, optimizing the use of social media, and most importantly government involvement.

Since E-waste is being generated everywhere and hence it is particularly important to properly manage e-waste. To achieve the SDGs there is a need to improve awareness leading to better and formal collection, recycling rates, and reduction of e-waste dumped in dumpsites. Awareness also helps in purchasing products having chemicals with tolerable limits leading to sound management of chemicals and all waste throughout the life cycle. With this in mind, the interviewees stressed with suggestions in the following words:

"I think the public needs more awareness, conduct talks, go to schools and provide education. I think education is very important... and then make awareness through local newspaper and social media, and other effort would should also emphasizes that e-waste is actually toxic, because not many are aware its toxic" Employer 7 – Female Employer from Daikyo Environmental and Recycling

"I think we need to educate the public, we should organize a roadshow. What I meant by roadshow is not solely organizing the event at one place, but we become more mobile. As an example, why don't we try and organize a visit to each school in Brunei to spread knowledge and awareness on E-waste. I believe the children can be easily nurtured and they can apply for it in the future" Employer 3 - Female employer from Enviroidaman, Sungai Akar Transfer Station.

"I think we should make good use of social media to spread awareness" Employer 4 - Male employer from Enviroidaman, Sungai Akar Transfer Station.

"We can increase more awareness by letting the public know that there is a company in Brunei that accepts E-waste.. and let them know and understand the threat e-waste posed" - Employer 1 - Male employer from Kawan Bumi

"I think the government first needs to put initiative in terms of conducting campaigns in regard with e-waste, for example making advertising campaigns on e-waste" Employer 6 – Male employer in Enviroidaman, Sungai Paku Engineered Landfill.

These suggestions, need a proper knowledge and management of e-waste, from the employers mainly highlight the importance of providing knowledge and education on e-waste to the public that in line with SDG goals: Goal 3 (Good health and Well-being), Goal 6 (Clean water and Sanitation), Goal 11 (Sustainable Cities and Communities), Goal 12 (Responsible Consumption and Production). Even though most of the suggestions look aligned with SDG Goals as well as aligned with the third objective of the Maqasid Shariah (protection of mind), through awareness it could also justify the other four of the Maqasid of the Shariah. For example, the protection of faith could be instilled in the public through education by instilling religious knowledge about the importance of preserving the environment in the context of Islam. The protection of life could be inculcated through education on the impacts and threats e-waste could impose on the environment and one's health. The protection of progeny could be preserved by promoting education on e-waste to the younger generation to prepare them for the future. Finally, the protection of wealth could be protected through promoting the concept of repurposing to reuse and resell e-waste as what has been suggested or highlighted by the employers during the interview.

"We have customers who went to our sites during the weekend just to get some CPUs, and we will sell it at a lower price. They will then fix the CPUs and resell it back to others. Normally, e-waste material is actually repairable" Employer 7 - Female Employer in Daikyo Environment and Recycling Sdn Bhd

Most importantly, when asked about re-use e-waste, the interviewee said:

"Repurposed back electronic devices or waste" Employer 6 - Male employer in Enviroidaman, Sungai Paku Engineered Landfill

"I think one of the solution is to reuse (e-waste) or repurpose it" Employer 10 - Female employer in JASTRE, Ministry of Development

## **Addressing the Informal Sector**

### *Challenges and Implications of Informal Sectors in E-waste Management*

Among the aims of e-waste approach in Brunei Darussalam is to achieve the environmentally sound management of chemicals and all waste throughout the life cycle, in accordance with agreed-upon

international frameworks, and to significantly reduce their release into air, water, and soil to minimize their adverse impacts on human health and the environment.

Study shows that e-waste is often processed in the informal sector, and many e-waste disposal and recycling jobs are unsafe and not protected by formal regulation (Brett et al. 2009; Leung, et al. 2008). The informal sector plays a significant role in various industries, including waste management, by offering flexible and accessible services that cater to immediate needs. The term 'informal sectors' refers to an individual or organization whose establishment or presence is not regulated. In other words, it 'comprises all unregistered and unlicensed enterprises' (Swaminathan, 1991). Although this sector provides convenience to the public such as door-to-door garbage collection services, it cannot be denied from an economic point of view that it brings more negative than positive impacts (De Paula & Scheinkman, 2007). Three of the interviewed employers have raised issues regarding the informal sector stating:

"Another problem with e-waste is that there are people out there who offer door-to-door collection service. (Once they collected the e-waste), they would then dismantle it, separate the valuable metal and the unwanted part would normally be disposed of on the side of the village's road or at the water village"  
Employer 1 - Male employer in Kawan Bumi

"There are groups of what we call the informal sector which are mostly run by foreign workers, where they offer door-to-door waste collection. This informal sector is also part of the problem (when regard with e-waste), because we don't know where the waste go once they collect it"  
Employer 10 - Female employer in JASTRE, Ministry of Development

"We start off from the waste collectors. Preferably, these collectors should register under us, because when they register, they will be listed in our website, in a way they are more regulated. However, at the same time there are still companies that are not registered under us as registration is not mandatory yet. So these (informal) collectors, we are not certain on how they conduct their business. We are not certain whether or not they use the right vehicle, whether they have the proper equipment or are they properly regulated"  
Employer 8 - Male employer in JASTRE, Ministry of Development

The responses from the participants highlighted the uncertainty and impropriety of handling e-waste in most of the informal sectors. The way their business is conducted remains vague as no proper regulation regulates them, as the policy has not been mandatory for a waste collector company to register. Furthermore, another claim has been made that these sectors would often be caught dumping unwanted parts of e-waste on inappropriate dumping sites such as roadsides. The participant from Kawan Bumi also stressed about the activity these sectors often conducted, mentioning that these sectors would not hesitate to dispose of their e-waste into the river. Such action contradicts with SDGs mainly with Goal 6 (Clean Water and Sanitisation) and Goal 14 (Life below water) and solutions were needed to handle these issues surrounding the informal sectors.

#### *Regulatory Measures and Enforcement for Managing Informal E-Waste Collection and Encouragement of Collaborative Effort*

Stakeholders must address the problems caused by informal waste management practices, and a structured approach is required. To ensure proper waste management, regulatory measures must be implemented, and oversight must be strengthened.

One of the solutions proposed in handling the informal sectors is by making the mandatory registration of waste collection companies to the relevant authority, that is, JASTRE. Besides, enforcing the law on the uncontrolled disposal of e-waste needs to be strengthened. These actions would not only help regulate the companies, but the transparency of how they conduct their business would be clear and, at the same time, would reduce the habit of disposing of e-waste in inappropriate places.

On the other hand, it is worth taking into account the authorized recycling companies that are registered as they lack the convenience that the informal sector offers to the public, such as the door-to-door collection.

"One of the reasons why people are reluctant to dispose of their e-waste is because they have to throw it themselves, for example, they are reluctant because they have to use their own cars even though the depot is there. At the same time, the recycling company also do not offer or willing to take it from them as its far from reach"  
Employer 8 - Male employer in JASTRE Ministry of Development

"We only provide collection and transportation (of E-waste) when we have a lot"  
Employer 7 - Female employer in Daikyo Environmental and Recycling

A suggestion of a joint collaborative effort between these companies would also be encouraged to bridge the gaps and make it convenient for more people to dispose of their e-waste persistently. For

example, these informal sectors could send their unwanted e-waste parts to the authorized recycling companies for further proper disposal, as they might not have adequate facilities or machinery compared to the authorized recycling companies. Moreover, the authorized recycling companies could also work collectively with these informal sectors to take over certain processes, such as dismantling. This collaborative effort would reduce the intense labour and would also speed up the dismantling process, which would normally be time-consuming. Hence, not only should the government sector play a role, but the private sector should also be significant in an effort to manage e-waste properly.

### *Initiatives and Efforts by the Government in Handling E-waste in Brunei*

The study shows that e-waste is often processed in the informal sector, and many e-waste disposals and recycling jobs are unsafe and not protected by formal regulation (Brett et al. 2009; Leung et al. 2008). It is, therefore, necessary for countries to formalize the environmentally sound management of e-waste and to take advantage of the business opportunities it offers. To materialize SDGs on E-waste management, the Government of Brunei, in accordance with agreed international frameworks, and to significantly reduce their release into air, water, and soil in order to minimize their adverse impacts on human health and the environment, has taken the following initiatives.

#### *One-Stop Disposal Center*

In Brunei, the volume of e-waste is relatively small compared to other countries. Despite the low amount of e-waste generated, the government of Brunei is still putting their initiative and efforts in order to control e-waste disposal in the country. One of the notable initiatives is the establishment of a one-stop e-waste disposal center in Sungai Akar Transfer Station (SATS), which is open to the public and in Sungai Paku Engineered Landfill (SPEL), which is accepting e-waste from the government. As what has been stated by Employer 1:

"In Brunei, E-waste has two official disposal sites, one is located in Sungai Akar and the other is in Sungai Paku. They will leave a large 40 foot container on the site. E-waste collected will be gathered inside it and we and Daikyo are the only authorized company by JASTRE to collect it once it is full, while the other could not. This is because they already gave us approval and license to collect. After collection, we will make a report and report it to them" Employer 8 - Male employer in JASTRE Ministry of Development

The public could dispose of their e-waste in a designated container for e-waste prepared by JASTRE in SATS, while government bodies could dispose of e-waste in SPEL. Following that, the waste will be collected by a registered recycling company such as Kawan Bumi and transported to their facility, where they will make a detailed report to be reported to JASTRE and do their dismantling procedure.

This initiative shows the government's alertness to potential hazards posed by e-waste. It also shows the effort to make the disposing and collecting experience convenient for both the public and recycling companies by providing a one-stop center in SATS and SPEL. Addressing this effort is pivotal in integrating efficient e-waste management.

#### *Extended Producer Responsibility Scheme*

Not limited to a one-stop center, another initiative taken by the government is to introduce the Extended Producer Responsibility (EPR) scheme in Brunei. This is highlighted by Employer 8 from JASTRE in regard to EPR:

"Extended Producer Responsibility is a scheme, where the producer of the waste is responsible in terms of disposing of the waste. They should bear the cost and be responsible for the waste that they have generated. As an example, in a country like Singapore, the authorized sellers of electrical waste reach an agreement with their government, or with their consumers that if they want to dispose of the waste, the sellers will take it from them. They would sell it to you, but once you want to dispose of it, 'I will take it and bear responsibility for the collection of the disposal'. So this scheme will facilitate that habit of throwing away e-waste" Employer 8 - Male employer in JASTRE Ministry of Development

This effort signifies Brunei's recognition of the need for sustainable waste management practices, particularly e-waste management. Implementing EPR in Brunei would be a positive step forward, holding waste producers accountable for their products' environmental impacts throughout their product life cycle. Not only does Brunei promote awareness about recycling or the environmental impacts to the public, but now they are putting effort into shifting the responsibility of e-waste management from the public to producers.

However, the successful implementation of EPR in Brunei would need a well-defined regulatory framework, effective enforcement mechanisms, and close cooperation between government agencies, private agencies, producers, and consumers. Even though the initiatives contain a lot of potential, ongoing efforts will be required to address the challenges, such as raising awareness among both producers and consumers, developing e-waste recycling infrastructure, and ensuring compliance.

## Summary of Key Findings

The study identified several critical challenges in e-waste management. First, the dismantling and recycling processes are labor-intensive and require specialized skills. Many recycling companies in Brunei face shortages of trained labor, compounded by restrictive visa policies that limit the recruitment of foreign workers. For example, one company reported delays in dismantling due to insufficient manpower, while others highlighted the reluctance of firms to invest in worker training. These factors contribute to the inefficiency and high costs of e-waste processing.

Another significant challenge is the complex regulatory framework governing e-waste exports. Companies must navigate stringent documentation requirements, including obtaining export permits from multiple authorities. One participant noted that these processes often take months, hindering business operations and delaying recycling efforts. Such bureaucratic bottlenecks discourage private sector participation in e-waste management.

The hazardous nature of e-waste poses severe risks to public health and the environment. Improper disposal methods, such as dumping e-waste in landfills, can lead to soil, water, and air contamination. Instances of open fires caused by e-waste in Brunei highlight the urgency of addressing these risks. Participants emphasized the need for stricter enforcement of disposal regulations to prevent such incidents.

Public awareness about e-waste remains limited in Brunei. While some individuals are aware of the environmental risks, many lack knowledge about proper disposal practices. Surveys revealed that a majority of respondents store e-waste at home or dispose of it with general waste. This underscores the need for targeted educational campaigns to promote responsible e-waste management. Suggested initiatives include organizing school road-shows, leveraging social media platforms, and partnering with community organizations to spread awareness.

The informal sector plays a significant role in e-waste collection in Brunei. However, unregulated practices by informal collectors often lead to improper disposal, further exacerbating environmental hazards. Participants recommended formalizing the informal sector through registration and collaboration with authorized recycling companies. This would ensure transparency and compliance with environmental standards.

## Recommendations

To overcome these challenges, the study proposes a multi-pronged strategy. Increasing public awareness is paramount. Educational initiatives should emphasize the importance of responsible e-waste disposal and highlight its alignment with Islamic values. Incorporating Maqasid Shariah principles into public campaigns can enhance community engagement and foster a sense of shared responsibility.

The government should expand infrastructure for e-waste management by establishing more disposal centers and simplifying regulatory processes. The Extended Producer Responsibility (EPR) scheme, where producers bear the cost of waste disposal, offers a sustainable solution. By shifting responsibility to producers, the EPR framework incentivizes the design of environmentally friendly products and promotes a circular economy.

Collaboration between formal and informal sectors is crucial. Authorized recycling companies can work with informal collectors to streamline collection and dismantling processes. Providing training and incentives to informal workers would ensure compliance with safety and environmental standards. Additionally, investments in advanced recycling technologies and labor training are essential to improve efficiency and profitability.

## CONCLUSION

The integration of Maqasid Shariah principles into e-waste management offers a holistic approach to addressing the environmental and social challenges associated with electronic waste. By aligning spiritual and ethical values with practical sustainability goals, this framework provides a unique opportunity to promote community well-being and environmental stewardship. The study underscores the importance of

collective efforts among stakeholders, including the government, private sector, and public, to achieve SDGs in Brunei Darussalam. Through education, collaboration, and innovation, Brunei can position itself as a model for sustainable e-waste management in the Islamic world and beyond.

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