

Research Article

Assessment of the Disposal of Electrical-Electronics Waste in Queen's Row, Bacoar City

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ABSTRACT

Electrical and electronic waste (e-waste) presents a rapidly escalating environmental challenge globally, impacting homes, workplaces, and communities. This study aims to assess the e-waste disposal practices in selected barangays of Queen's Row, Bacoar City, Cavite, and to recommend strategies for improved waste management. The research explores the awareness levels of barangay officials, staff, and homeowners regarding proper e-waste disposal, focusing on responsibilities, waste segregation, collection and transport, and recycling programs. The study employs a descriptive methodology, utilizing questionnaires to gather data. Findings indicate that respondents generally exhibit strong awareness of most e-waste management aspects. Specifically, functions and responsibilities of officials, as well as waste segregation practices, received the highest awareness ratings. However, recycling programs were noted as less familiar to the respondents. Additionally, a significant difference in awareness levels was found among different groups (officials, staff, homeowners) concerning functions and waste segregation practices. Common types of e-waste identified included household appliances (e.g., electric fans, televisions) and telecommunication gadgets (e.g., mobile phones, laptops). Based on these findings, an action plan is proposed to enhance awareness and compliance with e-waste management practices in Queen's Row, emphasizing ongoing education and community involvement. The study provides a foundation for further research and serves as a springboard for improved environmental practices in waste disposal.

Keywords: Waste disposal; waste management; segregation; e-waste; disposal practices

1. INTRODUCTION

Electrical and electronic waste, commonly referred to as e-waste, is rapidly emerging as one of the most pressing environmental challenges confronting communities, including Bacoar City. E-waste poses significant risks to both human health and ecological well-being, stemming from the hazardous materials it contains. While many individuals associate e-waste primarily with modern devices like computers and smartphones, its definition encompasses all discarded electrical and electronic equipment. Alarming, the volume of e-waste ending up in landfills continues to increase each year, threatening local ecosystems and contaminating water supplies if not disposed of properly. This situation aligns with Sustainable Development Goal 12 (Responsible Consumption and Production), which calls for sustainable waste management practices.

In the Philippines, household waste contributes significantly to the country's overall waste management issues, with electronic waste often ending up in illegal dumpsites or improperly discarded in areas prone to waste accumulation. Addressing this, Bacoar City must focus on raising awareness among its residents about the importance of responsible disposal practices for electronic waste, ensuring adherence to environmental guidelines. The Ecological Solid Waste Management Act of 2000 (RA 9003) outlines the obligation of barangay officials and community members to separate solid waste into categories such as compostable, recyclable, residual, and special wastes. E-waste is classified under special waste, encompassing items like hazardous household materials, batteries, paints, thinners, and electronic devices, all requiring proper handling and disposal through Materials Recovery Facilities (MRFs). Encouraging community participation in following these practices can lead Bacoar City toward more sustainable e-waste management, minimizing environmental damage and fostering long-term ecological benefits. Several key challenges in solid waste management, especially concerning e-waste, demand immediate attention. First, the volume of waste generated is steadily increasing, emphasizing the need for effective systems for its collection, processing, and disposal. Furthermore, significant portions of e-waste remain unaccounted for in national municipal solid waste (MSW) data, resulting in gaps in understanding the issue and

inadequacies in resource allocation.

Moreover, a lack of clear definitions for terms related to solid waste management contributes to confusion and inconsistencies in implementation across various regions and agencies. Insufficient data quality hinders effective decision-making and complicates the development of comprehensive management strategies. There is an urgent need for defined leadership roles and responsibilities at the government and local levels to ensure that waste management practices are well-coordinated and effective. Additionally, consistency in enforcing regulations and standards is essential for fostering an equitable and effective waste management framework. Addressing inter-country and intra-locality waste management challenges is critical for the success of MSW management efforts. As Bacoar City strives to handle its e-waste disposal practices effectively, aligning these efforts with the SDGs can help ensure a sustainable and healthful environment for its residents, ultimately contributing to a more resilient community.

Studies on E-Waste Management

These complex issues have been thoroughly examined in the influential work of Tchobanoglous and Kreith (2002), whose insights illuminate the multifaceted nature of solid waste management and provide guidance for developing more effective systems. Asiimwe and Ake (2012) highlight that the rapid growth of Information and Communications Technologies (ICTs) has led to increased demand for electronic devices such as mobile phones and computers, resulting in significant amounts of e-waste from discarded electronics. This e-waste poses serious risks to both human health and the environment due to its toxic chemical components. Therefore, the authors assert that proper management practices are essential to mitigate these risks. However, data on e-waste management in East African Community (EAC) countries is limited, prompting the authors to conduct semi-structured interviews with government officials and a comprehensive literature review. Their findings indicate that EAC governments recognize e-waste as an emerging issue; however, despite this awareness, there are currently no effective solutions in place to address the problem. The study suggests practical strategies for addressing e-waste challenges within the EAC region. Chandrappa and Das (2012) mentioned the importance of life cycle assessment (LCA) in understanding waste management systems. LCA serves as a comprehensive method for waste prevention by examining the entire lifespan of a product or process, including stages such as raw material procurement, manufacturing, distribution, usage, maintenance, recycling, and disposal. They highlight that societal safety can be maintained as long as plastics and metals are sourced from virgin materials or treated appropriately to eliminate potential hazards. In a comparative study, Bo and Yamamoto (2010) explored e-waste management practices in Japan and China. In Japan, home appliances are collected through a recycling ticket system, making it challenging to recycle and treat them. Consequently, most e-waste is outsourced to other facilities for processing. The Japanese system, while capable of tracking data and ensuring environmental sustainability, faces significant challenges. Conversely, China's e-waste management system is characterized by high reuse rates and low treatment costs, although it suffers from producing low-quality reused products, contributing to environmental pollution, and difficulties in data acquisition due to illegal imports.

The feasibility of establishing an e-waste treatment facility in Indonesia, citing a 70% collection rate. They emphasized the necessity for sustainable financial support to ensure the facility's success. Furthermore, they recommend integrating the existing informal e-waste sector into the formal waste management system and promoting manual dismantling due to lower labor costs, which could generate profits based on intrinsic values. However, the authors stress the need for additional financial backing and the enactment of specific regulations for effective e-waste management. Implementing an efficient recycling system could create new avenues for recovering valuable materials, while also promoting public health and generating employment opportunities (Andarani & Goto, 2012). Ghiani and Triki (2012) underscore the increasing complexity of urban waste management, which necessitates significant resources and has substantial environmental impacts. They focus on the design aspect of waste management systems, particularly the strategic placement of waste collection sites. Their integer programming model assists decision-makers in selecting appropriate locations for unsorted waste bins in residential areas and determining the capacity of each bin. This model ensures that each collection area can accommodate the expected waste while meeting citizens' quality-of-service expectations. In their tests in Nardo, Italy, they demonstrate that both the exact and heuristic methods yield superior solutions compared to the current system, resulting in a reduced number of bins needed. For Honda and Li (2008) said the troubling issue of e-waste containing mercury, particularly focusing on obsolete electronic equipment like fluorescent lamps. Despite these items generating lower earnings compared to more lucrative types of e-waste, informal collectors in developing countries actively seek them. This reliance on informal collection arises from the grim reality that many mercury-containing products are ultimately disposed of as municipal solid waste, primarily due to a lack of public awareness, inadequate systems for waste separation, and insufficient facilities for managing hazardous materials. While Lundgren (2012) further emphasizes the oversight in current waste management strategies, noting that many primarily focus on environmental issues while neglecting inherent social challenges. A holistic approach is necessary to tackle these multifaceted problems.

Recognizing this necessity, the International Labour Organization (ILO) emerges as a critical player in promoting sustainable waste management practices. The ILO's potential impact lies in its ability to address social concerns and the dynamics of labor within the e-waste sector. To facilitate meaningful change, the ILO can undertake several strategic steps, such as developing an understanding of labor dimensions in different countries, which will provide invaluable insights into the specific challenges faced by workers. Additionally, it can offer technical assistance coupled with social programs aimed at improving the conditions of those involved in e-waste recycling, ensuring that all recyclers are equipped with the necessary tools to operate responsibly. Furthermore, the ILO can play a crucial role in disseminating vital information by launching an e-waste code of practice, which would outline best practices and promote awareness among stakeholders. Collaborating with other organizations will strengthen the ILO's advocacy for green jobs and e-waste management (International Labour Organization, 2020). Ongondo and William (2010) found that informal recycling in developing nations could significantly enhance the recycling of Waste Electrical and Electronic Equipment (WEEE) if aligned with modern safety standards. Nevertheless, achieving this is challenging due to associated costs. Moreover, global progress in developing and implementing legislation to address WEEE has been slow, with some regions lacking such frameworks entirely. The review suggests that effective management of discarded electronic products will necessitate rapid, coordinated, and decisive technical and non-technical responses on a global scale. In an article "No Solution in Sight for E-Waste," Mayuga discusses the growing problem of electronic waste (e-waste) in the Philippines as categorized by the National Solid Waste Management Commission (NSWMC). E-waste encompasses broken home appliances, electrical devices, and gadgets, all contributing to the nation's solid waste management crisis. The Global E-Waste Monitor 2017 defines e-waste as all discarded electrical and electronic equipment (EEE) without the intent to reuse. In the Philippines, each inhabitant produces approximately 2 to 5 kilos of e-waste, classified as hazardous waste that requires specialized disposal and recycling processes (Mayuga, 2017).

Zurbano (2017) emphasized the role of environmental groups in promoting e-waste recycling, citing the Eco-Waste Coalition's program as a successful example. This program actively collected and transported various unusable electronic items, such as batteries, cell phones, and kitchen appliances, to government-approved recycling facilities, thus emphasizing responsible e-waste management. Alano (2018) reported that the Eco-Waste Coalition held a public outreach program to promote e-waste prevention, reduction, and safe management, raising awareness about the rapidly growing e-waste issue. E-waste grows rapidly worldwide, posing major environmental risks. While e-waste contains valuable metals that can be economically beneficial, it poses hazardous risks due to the presence of toxic chemicals. In 2014, e-waste amounted to 41 million tons, growing annually by 3-5%. They noted a direct correlation between a country's GDP, population, and the amount of e-waste generated, suggesting that countries with higher GDP and populations produce more e-waste (Kumar & Espinosa, 2017). According to Agarrado (2011), the Philippines is grappling with a significant crisis related to electronic waste (e-waste) due to its volume and toxicity. A 2005 study estimated that around 2.7 million units of various appliances, including televisions, refrigerators, and air conditioners, became obsolete, with approximately 1.8 million units ending up in landfills. Between 1995 and 2005, about 25 million units became outdated, with an additional 14 million expected to be discarded by 2010. The e-waste generation problem is more pronounced in developed countries.

Mobile phones and chargers are the most widely used electrical and electronic equipment in Cagayan de Oro City, with televisions and refrigerators generating the largest volumes of e-waste. Many households lack knowledge about proper disposal methods for e-waste, primarily due to the absence of collection mechanisms and a lack of awareness about the negative consequences of mismanagement. Common disposal practices include selling to scrap dealers, keeping items at home, or attempting repairs. Effective e-waste management is essential to minimize the release of toxic substances that harm human health and the environment. Implementing a waste management hierarchy can help, focusing on reducing toxic materials in production, reusing e-waste to extend product life, and promoting recycling to recover valuable materials and conserve natural resources (Cultura, Aranico, Vedra, & Amparado Jr., 2013).

In Mañalac's (2011) paper, "Electronic Waste: A Threat in the Future," highlights the significant risks posed by e-waste to both human health and the environment. She argues that effective environmental planning and management hinge on accurate waste statistics, which serve as a crucial indicator of the e-waste entering landfills and waterways. Mañalac critiques the traditional Local Consumption and Disposal Analysis (LCDA) equation, which relies solely on appliance sales data and fails to account for current ownership. Her proposed approach integrates present ownership into the equation, offering a more accurate representation of e-waste generation.

2. MATERIALS AND METHODS

In this research conducted in Queen's Row, Bacoor City, the primary aim was to identify and enhance waste disposal management, particularly concerning electrical supplies and equipment. It employed a descriptive research design, which provided a comprehensive view of the current waste disposal situation, while also seeking to justify existing practices and develop relevant theories. To gather insights, purposive sampling was used, a method in which participants are selected based on specific criteria aligned with the study's objectives. The study involved a total of 240 respondents, including 27 barangay officials (11.25%), 63 barangay staff (26.25%), and 150 homeowners (62.50%).

Data collection was facilitated through a specially designed questionnaire, enriched by documentary analysis and unstructured interviews aimed at further exploring respondents' perceptions. The questionnaire employed a 5-point Likert scale, effectively measuring awareness and attitudes toward waste disposal management. Before proceeding with data collection, permission was obtained from the barangay and finalized the research instruments. The instruments were personally administered and ensured that responses were collected securely.

For data analysis, a variety of statistical techniques were employed. Percentages compared different magnitudes, while ranking emphasized the importance of specific items. The weighted mean provided a qualitative assessment of the responses. Additionally, a One-Way Analysis of Variance (ANOVA) was utilized to assess differences in perceptions among barangay officials, staff, and homeowners regarding proper e-waste disposal practices. Respondents' awareness levels were categorized using a Likert scale, ranging from "Strongly Aware" to "Not Aware." Ultimately, the study aimed to rigorously evaluate and enhance understanding of waste disposal practices within the community, using ANOVA to test hypotheses regarding the significant differences in assessments among the various respondent groups. The null hypothesis was set to be rejected or accepted based on whether the computed F value met predetermined criteria at a significance level of $\alpha = 0.05$.

3. RESULTS AND DISCUSSIONS

In this comprehensive assessment of awareness regarding electrical-electronics waste disposal among respondents in Queens' Row, Bacoor City, several findings emerged across various criteria related to electronic waste management.

1. Level of awareness of the selected barangay officials, staff and homeowners on the features of proper E-waste disposal in terms of:

1.1. Functions and responsibilities of the concerned officials

Analyzing Table 1 reveals a strong understanding of electrical-electronics waste disposal responsibilities among barangay officials, staff, and homeowners in Queen's Row, Bacoor City. The data, represented by weighted mean values, indicate a generally high level of awareness across various criteria related to e-waste management. The highest-ranked criterion, with a weighted mean of 4.39, emphasizes the importance of regularly reviewing the City or Municipal E-Waste Management Plan to ensure its sustainability and relevance. This suggests a proactive approach to adapting to evolving e-waste challenges. Closely following were criteria related to long-term e-waste management and developing specific implementation guidelines, both scoring 4.36. These high rankings indicate a clear understanding of the need for comprehensive and well-defined strategies. While most criteria were rated with strong awareness, the lowest-ranked criterion, at 4.17, focused on recommending measures against pollution and preserving the ecosystem. Though still indicating awareness, this slightly lower score might suggest an area where further emphasis or education could be beneficial. Overall, the high average weighted mean of 4.29 demonstrates a collective strong awareness of e-waste management functions and responsibilities. This strong awareness implies that the community understands and supports long-term e-waste management, including integrating various plans and providing logistical support. They also recognize the need for safeguards against pollution and ecosystem preservation. These findings align with the observations of Peralta and Fontanos (2005), who noted the increasing quantity of e-waste in the Philippines. Their research highlights the importance of using data to develop effective management schemes, such as buy-back policies and recycling centers. The need to strengthen the recycling market is crucial to divert e-waste from landfills, extend landfill life, and create a new source of material recovery.

Table 1. Composite Mean of Responses on the Functions and Responsibilities of Concerned Officials in Queen's Row.

CRITERIA	Barangay Officials		Staff		Homeowners		Composite Weighted Mean		Rank
	WM	VI	WM	VI	WM	VI	WM	VI	
1. Ensures the long-term management of solid waste, as well as integrate the various E-waste management plans and strategies of the barangays in jurisdiction.	4.43	SA	4.36	SA	4.28	SA	4.36	SA	2.5
2. Adopts measures to promote and ensure the viability and effective implementation of E-waste management programs in its component barangay	4.35	SA	4.39	SA	4.32	SA	4.35	SA	4
3. Monitor the implementation of the City or Municipal E-Waste Management Plan through its various political subdivisions and in cooperation with the private sector and the NGOs;	4.35	SA	4.37	SA	4.21	SA	4.31	SA	7
4. Adopts specific revenue-generating measures to promote the viability of its E-Waste Management Plan;	4.14	A	4.22	SA	4.24	SA	4.20	SA	10.5
5. Convenes with the constituents on regular meetings for purposes of planning and coordinating the implementation of the E-waste management plans of the respective component barangays;	4.31	SA	4.40	SA	4.04	A	4.25	SA	8
6. Oversees the implementation of the City or Municipal E-Waste Management Plan;	4.33	SA	4.32	SA	4.03	A	4.23	SA	9
7. Reviews every two (2) years or as the need arises the City or Municipal E-Waste Management Plan for purposes of ensuring its sustainability, viability, effectiveness and relevance in relation to local and international developments in the field of e-waste management;	4.46	SA	4.37	SA	4.34	SA	4.39	SA	1
8. Develops specific mechanics and guidelines for the implementation of the City or Municipal E-Waste Management Plan;	4.47	SA	4.34	SA	4.26	SA	4.36	SA	2.5
9. Recommends appropriate local government authorities specific measures or proposals for franchise or build-operate-transfer agreements with duly recognized institutions, to provide either exclusive or non-exclusive authority for the collection, transfer, storage, processing, recycling or disposal of municipal E-waste. The proposals shall take into consideration appropriate government rules and regulations on contracts, franchise and build-operate-transfer agreements;	4.37	SA	4.36	SA	4.22	SA	4.32	SA	5.5
10. Provides the necessary logistical and operational support to its component cities and municipalities;	4.31	SA	4.41	SA	4.25	SA	4.32	SA	5.5
11. Recommends measures and safeguards against pollution and for the preservation of the natural ecosystem;	4.02	A	4.32	SA	4.17	A	4.17	A	12
12. Coordinates the efforts of its component barangays in the implementation of the city or municipal E-Waste Management Plan.	4.06	A	4.30	SA	4.24	SA	4.20	SA	10.5
Overall Mean	4.30	SA	4.35	SA	4.22	SA	4.29	SA	

1.2. Waste Segregation

The composite assessment of the respondents on electrical-electronics waste disposal in terms of waste segregation in Queen's Row, Bacoar City are presented in Table 2.

Table 2. Composite Mean of Responses on Waste Segregation

CRITERIA	Barangay Officials		Staff		Homeowners		Composite Weighted Mean		Rank
	WM	VI	WM	VI	WM	VI	WM	VI	
1. Provides for the residents a designated area and containers in which to accumulate source separated recyclable materials to be collected by the municipality or private center; and	4.40	SA	4.38	SA	4.24	SA	4.34	SA	1
2. Notifies the occupants of each building of the requirements of RA 9003 and the regulations promulgated pursuant thereto.	4.24	SA	4.33	SA	4.15	A	4.24	SA	4
3. Educate the residents regarding segregation schedule of collection of the electrical-electronic wastes materials	4.34	SA	4.41	SA	4.21	SA	4.32	SA	2
4. Disseminate information as to the schedule of collection of the electrical-electronics waste materials	4.31	SA	4.26	SA	4.25	SA	4.27	SA	3
Overall Mean	4.32	SA	4.35	SA	4.21	SA	4.29	SA	

Table 2 reveals a strong understanding of electrical-electronics waste segregation among barangay officials, staff, and homeowners in Queen's Row, Bacoor City. Respondents assessed various criteria related to waste segregation, with high levels of awareness indicated across the board. The top two criteria, both with a weighted mean of 4.34, are the provision of designated areas and containers for recyclable materials and the education of residents regarding segregation and collection schedules. This tie suggests a dual focus on both infrastructure and community education, both of which are crucial for effective waste segregation. Following closely, the dissemination of collection schedule information scored 4.27, and notifying building occupants of RA 9003 requirements scored 4.24, further supporting the overall high level of awareness. The overall weighted mean of 4.29 confirms that the community is strongly aware of e-waste segregation practices. This indicates that information dissemination regarding the separation of recyclables and the e-waste collection schedule is being effectively implemented. This finding aligns with Alam's (2015) research on e-waste management in the Philippines, which highlights the need for data collection and efficient management guidelines. Alam's study also points out that many households store obsolete electronic devices, suggesting a potential for a "Take Back Scheme" for items like personal computers, laptops, and cellular phones to encourage recycling and proper disposal. Such schemes could effectively bring these stored e-waste items into the proper disposal and recycling chain, addressing the issue of large amounts of e-waste remaining within households.

1.3. Collection and Transport of E-Wastes

The composite assessment of the respondents on electrical-electronics waste disposal in terms of waste segregation in Queen's Row, Bacoor City is presented in Table 3.

Table 3. Composite Mean of Responses on Collection and Transport of E-Waste

CRITERIA	Barangay Officials		Staff		Homeowners		Composite Weighted Mean		Rank
	WM	VI	WM	VI	WM	VI	WM	VI	
1. All collectors and other personnel directly dealing with collection of waste shall be equipped with personal protective equipment to protect them from the hazards of handling wastes	4.43	SA	4.43	SA	3.85	A	4.24	SA	2
2. Necessary training shall be given to the collectors and personnel to ensure that the E-wastes are handled properly and in accordance with the guidelines pursuant to this Act	4.27	SA	4.14	A	4.07	A	4.16	A	3
3. Collection of E-waste shall be done in a manner which prevents damage to the container and spillage or scattering of E-wastes within the collection vicinity.	4.43	SA	4.55	SA	3.97	A	4.32	SA	1
Overall Mean	4.38	SA	4.37	SA	3.96	A	4.24	SA	

As stated in the table, the barangay officials, staff, and homeowner respondents in Queen's Row, Bacoor City generally assessed the presented criteria on the electrical-electronics waste disposal in terms of collection and transport of E-wastes, rank 1 is criterion 3 "collection of E-waste shall be done in a manner which prevents damage to the container and spillage or scattering of E-wastes within the collection vicinity" rated strongly aware as proven by the weighted mean value of 4.32; rank 2 is criterion 1 "all collectors and other personnel directly dealing with collection of waste shall be equipped with personal protective equipment to protect them from the hazards of handling wastes" rated strongly aware as strengthened by the weighted mean value of 4.24; rank 3 is criterion 2 "necessary training shall be given to the collectors and personnel to ensure that the E-wastes are handled properly and in accordance with the guidelines pursuant to this Act" rated aware as attained by the weighted mean value of 4.16. This affirms that the barangay officials, staff, homeowners of in Queen's Row, Bacoor City are strongly aware on the presented variables on the electrical-electronics wastes disposal in terms of collection and transport of E-wastes as evident by the overall weighted mean value of 4.24. As supported by Magasih and Schleup (2011) regarding e-waste in Tanzania which showed that the use of ICT equipment is still low in Tanzania compared to other countries in the world, but it is growing at a staggering pace. In the last decade for instance, the penetration rate of personal computers has increased by a factor of 10, while the number of mobile phone subscribers by a factor of 100. This implies that there will soon be an increasing growth of E-wastes stream as more and more ICT equipment reaches their end-of life. Hence, it is the right time to engage in addressing the problem of increasing e-waste volumes. Not addressing the fact of growing e-waste volumes bears the risk of a developing informal sector, with all its social and environmental drawbacks.

1.4. Recycling Program

The composite assessment of the respondents on electrical-electronics waste disposal in terms of recycling program in Queen's Row, Bacoor City is presented in Table 4.

As revealed by the data in table 4, on the assessment of the respondents on the electrical-electronics waste disposal in Queen's Row, Bacoor City in terms of recycling program, rank 1 is criterion 1 "measures providing economic incentives and assistance including loans and grants for the establishment of privately-owned facilities to manufacture finished products from post-consumer materials" rated as aware as confirmed by the weighted mean value of 3.85; rank 2 is criterion 3 "maintains a list of prospective buyers, establishing contact with prospective buyers and reviewing and making any necessary changes in collecting or processing the materials to improve their marketability" rated aware as affirm by the weighted mean value of 3.84; rank 3 is criterion 2 "guaranteed by the national and local governments to purchase a percentage of the output of the facility" rated aware as attained by the weighted mean value of 3.63.

Table 4. Composite Mean on Recycling Program in Queen's Row

	Barangay Officials		Staff		Homeowners		Composite Weighted Mean		Rank
	WM	VI	WM	VI	WM	VI	WM	VI	
1. Measures providing economic incentives and assistance including loans and grants for the establishment of privately-owned facilities to manufacture finished products from post-consumer materials;	3.61	A	4.06	A	3.89	A	3.85	A	1
2. Guarantees by the national and local governments to purchase a percentage of the output of the facility;	3.78	A	3.41	A	3.71	A	3.63	A	3
3. Maintains a list of prospective buyers, establishing contact with prospective buyers and reviewing and making any necessary changes in collecting or processing the materials to improve their marketability.	3.72	A	4.22	A	3.59	A	3.84	A	2
Overall Mean	3.77	A	3.90	A	3.73	A	3.78	A	

Generally, this implies that barangay officials, staff, and homeowners from East, Central, and West in Queen's Row, Bacoor City are aware on electrical-electronics waste disposal in terms of recycling program as evidenced by the overall weighted mean value of 3.78. Chung and Suzuki (2008) confirmed that the three countries have constructed their respective E-wastes recycling systems based on EPR, but the details of each system differ significantly. This implies that it is essential that relevant existing conditions are to be understood, and challenges are clarified to effectively implement E-wastes recycling in developing countries. Then, the government is left with a choice between a manufacturer-centered recycling system and a commercial recycling company-centered recycling system should be made. Finally, regarding the general flow of E-wastes, a similar pattern is confirmed in the three countries. This indicates that despite the adoption of a system based on their economic or physical EPR, significant hidden flow in developing countries, attention should be paid to the relations between commercial recycling companies and manufacturers, particularly in terms consistent of e-waste collection stage.

The summary of the assessment of the respondents on the level of awareness on electrical-electronics waste disposal in Queen's Row, Bacoor City is presented in Table 5.

Looking at the summary table, the barangay officials' respondents from Queen's Row (East, Central, and West), Bacoor City rated strongly aware on variables 1, 2 and 3 "functions and responsibilities of concerned officials," "waste segregation," and "collection and transport of E-wastes" with their respective weighted mean values of 4.30, 4.32, and 4.38 respectively. However, they rated aware variable 4 "recycling program" with weighted mean value of 3.70. Thus, resulting to an overall composite weighted mean value 4.18 verbally interpreted aware

Table 5. Summary of the Assessment on the Level of Awareness on Electrical-Electronics Waste Disposal

Variables	Barangay Officials		Staff		Homeowners		Composite Weighted Mean		Rank
	WM	VI	WM	VI	WM	VI	WM	VI	
1. Functions and responsibilities of concerned officials	4.30	SA	4.35	SA	4.22	SA	4.29	SA	1.5
2. Waste segregation	4.32	SA	4.35	SA	4.21	SA	4.29	SA	1.5
3. Collection and Transport of E-wastes	4.38	SA	4.37	SA	3.96	A	4.24	SA	3
4. Recycling program	3.70	A	3.90	A	3.73	A	3.78	A	4
Overall Mean	4.18	A	4.24	SA	4.03	A	4.15	A	

On the part of the staff respondents also from Queens' Row (East, Central, and West), Bacoar City they rated also variables 1, 2, and 3 strongly aware "functions and responsibilities of concerned officials," "waste segregation," and "collection and transport of E-wastes" with their respective weighted mean values of 4.35, 4.35, and 4.37. Meanwhile, they rated aware variable 4 which is "recycling program" with weighted mean value of 3.90. This mean value yielded an overall composite weighted mean value 4.24 verbally interpreted as strongly aware. On the other hand, the homeowners' respondents from Queen's Row (East, Central, and West), Bacoar City rated variables 1 and 2 strongly aware "functions and responsibilities of concerned officials" and "waste segregation" with their respective weighted mean values of 4.22 and 4.21. They rated aware on variables 3 and 4 "collection and transport of E-wastes" and "recycling program" with their respective weighted mean value of 3.96 and 3.73. This mean value yielded an overall composite weighted mean value 4.03 verbally interpreted strongly aware. Summarily, the barangay officials, barangay staff, and homeowners respondents from Queen's Row (East, Central, and West), Bacoar City generally assessed the variables presented on electrical-electronics waste disposal, rank 1.5 are variables 1 and 2 "functions and responsibilities of concerned officials" and "waste segregation" rated strongly aware with their composite weighted mean of 4.29; rank 3 is variable 3 "collection and transport of solid waste" rated strongly aware with weighted mean of 4.24; rank 4 is variable 4 which is "recycling program" rated aware with weighted mean of 3.78. The result indicate that the barangay officials, barangay staff, and homeowner respondents from Queen's Row (East, Central, and West), Bacoar City were aware on the presented variables on electrical-electronics waste disposal in terms of functions and responsibilities of concerned officials, waste segregation, collection and transport of E-wastes, and recycling program as evident by the overall composite weighted mean of 4.15. This further stressed by Lundgren (2012) in her study, "The Global impact of e-waste: Addressing the challenge" most waste management strategies are largely technical and are focused on environmental aspects, leaving out underlying social problems and relevant solutions. The ILO has the potential to bring a more holistic approach to waste management, contributing its expertise in labor. The ILO could work on social concerns and improve environmental management through building understanding of labor dynamics. Prior to intervention, it is important to study a country's labor dimensions on the ground to develop sound understanding of key issues. The ILO can intervene in a variety of ways, using technical assistance along with a host of social programs, and assist e-waste recyclers in both the informal and formal sectors. It can also share information through launching an E-wastes code of practice and publicizing best practices cooperate closely with other organizations and promote green jobs.

2. Significant difference on the assessment of the selected barangay officials, staff and homeowners in Queen's Row on the level of awareness on the electrical-electronics waste disposal

The result of mean comparison on the assessment of the barangay officials, barangay staff and homeowners in Queen's Row (East, Central and West), Bacoar City in the electrical-electronics waste disposal in terms of functions and responsibilities of concerned officials is presented in Table 6.

Table 6. Result of Mean Comparison in terms of Functions and Responsibilities of Concerned Officials

Source of Variation	SS	df	MS	F-ratio	Decision	Verbal Interpretation
Between	0.1041	2	0.052	4.5677	Reject H_0	Significant
Within	0.376	33	0.0114			

Critical value of F at .05 = 3.32

It could be gleaned by the result of the mean comparison among the barangay officials, barangay staff and homeowners in Queen's Row (East, Central and West), Bacoar City on electrical-electronics waste disposal in terms of functions and responsibilities of concerned officials, it obtain a computed F value of 4.5677 which found to be of greater value than the F critical value of 3.32 at five percent level of significant with 2 and 33 degree of freedom leading to the rejection of the null hypothesis of "there is no significant differences on the assessment of selected barangay official, barangay staff and homeowners on electrical-electronics waste disposal in terms of functions and responsibilities of concerned officials" Hence, interpreted significant. This result implies that the barangay officials, barangay staff and homeowners in Queen's Row (East, Central and West), Bacoar City does not concur with their perception on the variables presented on electrical-electronics waste disposal in terms of functions and responsibilities of concerned officials.

The result of mean comparison on the assessment of the barangay officials, barangay staff and homeowners in Queen's Row (East, Central and West), Bacoar City in the electrical-electronics waste disposal in terms of waste segregation are presented in Table 7.

Table 7. Result of Mean Comparison in Terms of Waste Segregation

Source of Variation	SS	df	MS	F-ratio	Decision	Verbal Interpretation
Between	0.0402	2	0.0201	5.6113	Reject H_0	Significant
Within	0.0323	9	0.0036			

Critical value of F at .05 = 4.26

Looking at the data in the table, it could be observed by the result of the mean comparison among the barangay officials, barangay staff and homeowners in Queen's Row (East, Central and West), Bacoar City on electrical-electronics waste disposal in terms of waste segregation, it obtain a computed F value of 5.6113 is greater than the F critical value of 4.26 at five percent level of significant with 2 and 9 degree of freedom leading to the rejection of the null hypothesis and verbally interpreted significant. Since, it failed to accept the null hypothesis, there is a strong indication that there is a significant difference on the assessment of selected barangay officials, barangay staff and homeowners on electrical-electronics waste disposal in terms of waste segregation. This result manifest that the barangay officials, barangay staff and homeowners in Queen's Row (East, Central and West), Bacoar City perceived different evaluations on the variables presented on electrical-electronics waste disposal in terms of waste segregation.

The result of mean comparison on the assessment of the barangay officials, barangay staff and homeowners in Queen's Row (East, Central and West), Bacoar City in the electrical-electronics waste disposal in terms of collection and transport of E-wastes are presented in Table 8.

Table 8. Result of Mean Comparison in Terms of Collection and Transport of E-Waste

Source of Variation	SS	df	MS	F-ratio	Decision	Verbal Interpretation
Between	0.3334	2	0.1667	7.6703	Reject H_0	Significant
Within	0.1304	6	0.0217			

Critical value of F at .05 = 5.14

As revealed in the table, that the result of the mean comparison among the barangay officials, barangay staff and homeowners in Queen's Row (East, Central and West), Bacoar City on electrical-electronics waste disposal in terms of collection and transport of E-wastes, it obtain a computed F value of 7.6703 is greater than the F critical value of 5.14 at five percent level of significant with 2 and 6 degree of freedom leading to the rejection of the null hypothesis and verbally interpreted significant. Since, it rejected the null hypothesis, there is a strong indication that there is a significant difference on the assessments of selected barangay officials, barangay staff and homeowners on electrical-electronics waste disposal in terms of collection and transport of solid waste. The result manifests that the barangay officials, barangay staff and homeowners in Queen's Row (East, Central and West), Bacoar City perceived different perspectives on the variables presented on electrical-electronics waste disposal in terms of collection and transport of E-wastes.

The result of mean comparison on the assessment of the barangay officials, barangay staff and homeowners in Queen's Row (East, Central and West), Bacoar City in the electrical-electronics waste disposal in terms of recycling program is presented in Table 9.

Table 9. Result of Mean Comparison in Terms of Recycling Program

Source of Variation	SS	df	MS	F-ratio	Decision	Verbal Interpretation
Between	0.0659	2	0.033	0.4614	Accept H_0	Not significant
Within	0.4285	6	0.0714			

Critical value of F at .05 = 5.14

As stipulated in table 9, it could be noted by the result of the mean comparison among the barangay officials, barangay staff and homeowners in Queen's Row (East, Central and West), Bacoar City on electrical-electronics waste disposal in terms of recycling program, it obtain a computed F value of 0.4614 is less than the F critical value of 5.14 at five (5) percent level of significance with 2 and 6 degree of freedom leading to the acceptance of the null hypothesis and verbally interpreted not significant. Since, it accepted the null hypothesis, there is a strong indication that there is no significant difference on the assessments of selected barangay officials, barangay staff and homeowners on electrical-electronics waste disposal in terms of recycling program. This shows that the barangay officials, barangay staff and homeowners in Queen's Row (East, Central and West), Bacoar City share common perceptions on the variables presented on electrical-electronics waste disposal in terms of recycling program.

The summary of the result of mean comparison on the assessments of the barangay officials, barangay staff and homeowners in Queen's Row (East, Central and West), Bacoar City in the electrical-electronics waste disposal is presented in Table 10.

Table 10. Summary Table on the Result of Mean Comparison

CRITERIA	F-ratio	Decision	Verbal Interpretation
1. Function and Responsibilities of concerned Officials	4.5677	Reject H_0	Significant
2. Waste segregation	5.6113	Reject H_0	Significant
3. Collection and Transport of E-wastes	7.6703	Reject H_0	Significant
4. Recycling program	0.4614	Accept H_0	Not Significant
Overall	4.5778	Reject H_0	Significant

Degree of freedom = 2, 9; Critical value of F at .05 = 4.26

It could be gleaned in the table, on the result of the mean comparison among the barangay officials, barangay staff and homeowners in Queen's Row (East, Central and West), Bacoor City on electrical-electronics waste disposal, the functions and responsibilities of concerned officials, waste segregation, and collection and transport of E-waste obtain a computed F value of 4.5677, 5.6113 and 7.6703, respectively, which all rejected the null hypothesis and verbally interpreted as significant. However, recycling program obtain a computed F value (0.4614) which is less than the critical value. Hence, accept the null hypothesis and verbally interpreted not significant. Thus, the obtain values yielded an overall computed F value of 4.5778 which resulted to the rejection of the null hypothesis and interpreted significant. This implies that the barangay officials, barangay staff and homeowners in Queen's Row (East, Central and West), Bacoor City does not concur with their perception on electrical-electronics waste disposal in terms of functions and responsibilities of concerned officials, waste segregation, collection and transport of E-wastes and recycling program. The findings further strengthened by the study of Namias (2013) that pictured despite the many reasons to recycle e-waste, U.S. recycling and recovery of E-wastes is limited due to: (1) insufficient collection (2) no federal legislation or policy mandating e-waste recycling (3) lack of recycling and recovery technologies and (4) illegal exports of hazardous E-wastes to developing countries where recycling processes pose serious risks to human and environmental health. To increase the e-waste recycling rate in the U.S. Federal Regulation is needed in a cohesive approach to E-wastes recycling. Federal regulation will provide the necessary structure and framework by setting mandatory recycling targets and establishing the implementation of financing and enforcement mechanisms for E-wastes collection and recycling. However, EPA is generally reluctant to tell State authorities should focus on the increased collection of e-waste through efforts geared towards convenience of collection and increased public awareness. Increasing the ease with which consumers can bring electronics to collection points, will contribute to collection growth rates.

3. Common electrical-electronic wastes disposed by the selected respondents in Barangay Queen's Row, Bacoor City

3.1. Household appliances

The assessment of the barangay officials on the household appliances disposal in Barangay Queen's Row, Bacoor City is presented in Table 11.

Table 11. Assessment of Barangay Officials on Household Appliances Disposal

Household Appliances	Frequency	Percentage	Rank
1. Electric fan	27	9	3.5
2. Airconditioning unit	9	3	13
3. Electric kettle	9	3	13
4. Refrigerators	24	8	8
5. Washing machine	27	9	3.5
6. Television	27	9	3.5
7. DVD Player	24	8	8
8. Rice cooker	27	9	3.5
9. Electric stove	9	3	13
10. Vacuum cleaner	9	3	13
11. Extension cord	21	7	10
12. Fluorescent lamp	27	9	3.5
13. Incandescent bulb	27	9	3.5
14. Radio	9	3	13
15. Compact Fluorescent Lamp	24	8	8
		100	

As indicated in the table, on the assessment of the barangay officials on the household appliances disposal in Barangay Queen's Row, Bacoor City, rank 3.5 or nine (9) percent are "electric fan," "washing machine," "television," "rice cooker,"

“fluorescent lamp,” and “incandescent bulb” with a frequency of 27; rank 8 or eight percent are “refrigerators,” “DVD players,” and “compact fluorescent lamp” with frequency of 8; rank 10 or seven (7) percent is “extension cord” with a frequency of 7; rank 13 or three (3) percent are “air-conditioning unit,” “electric kettle,” “electric stove,” “vacuum cleaner” and “radio” with a frequency of three (3). The assessment of the barangay staff on household appliances disposal Barangay Queen’s Row, Bacoar City are presented in Table 11.

On the assessment of the barangay staff on the household appliances disposal in Barangay Queen’s Row, Bacoar City, rank 2.5 or 9.05 percent are “electric fan,” “refrigerators,” “washing machine,” “television,” with a frequency of 60; rank 5.5 or 8.60 percent are “fluorescent lamp” and “incandescent bulb” with a frequency of 57; rank 8 or 7.24 percent are “DVD player,” “rice cooker,” and “extension cord” with a frequency of 48; rank 10.5 or 6.79 percent are “Air-conditioning unit” and “Compact Fluorescent Lamp” with a frequency of 45; rank 13 or 3.18 percent is “electric kettle” with a frequency of 21; rank 14 or 2.71 percent is “electric stove” with a frequency of 18; rank 15 or .90 percent is “vacuum cleaner” with a frequency of six (6).

Table 12. Assessment of Barangay Staff on Household Appliances Disposal

Household Appliances	Frequency	Percentage	Rank
1. Electric fan	60	9.05	2.5
2. Airconditioning unit	45	6.79	10.5
3. Electric kettle	21	3.18	13
4. Refrigerators	60	9.05	2.5
5. Washing machine	60	9.05	2.5
6. Television	60	9.05	2.5
7. DVD Player	48	7.24	8
8. Rice cooker	48	7.24	8
9. Electric stove	18	2.71	14
10. Vacuum cleaner	6	0.90	15
11. Extension cord	48	7.24	8
12. Fluorescent lamp	57	8.60	5.5
13. Incandescent bulb	57	8.60	5.5
14. Radio	30	4.52	12
15. Compact Fluorescent Lamp	45	6.79	10.5
		100	

The assessment of the homeowners on household appliances disposal in Barangay Queen’s Row, Bacoar City is presented in Table 13.

Table 13. Assessment of Homeowners on Household Appliances Disposal

Household Appliances	Frequency	Percentage	Rank
1. Electric fan	129	9.91	1
2. Airconditioning unit	42	3.23	14
3. Electric kettle	60	4.61	12
4. Refrigerators	90	6.91	9
5. Washing machine	105	8.06	6
6. Television	114	8.76	4
7. DVD Player	108	8.29	5
8. Rice cooker	99	7.60	8
9. Electric stove	45	3.46	13
10. Vacuum cleaner	18	1.38	15
11. Extension cord	78	5.99	10
12. Fluorescent lamp	123	9.45	3
13. Incandescent bulb	102	7.83	7
14. Radio	63	4.84	11
15. Compact Fluorescent Lamp	126	9.68	2
		100	

As revealed in the table, on the assessment of the homeowners on the household appliances disposal in Barangay Queen’s Row, Bacoar City, rank 1 or 9.91 percent is “electric fan” with a frequency of 129; rank 2 or 9.68 percent is “compact fluorescent lamp” with a frequency of 126; rank 3 or 9.45 percent is “fluorescent lamp” with a frequency of 123; rank 4 or 8.76 percent is

“television” with a frequency of 114; rank 5 or 8.29 percent is “DVD player” with a frequency of 108; rank 6 or 8.06 percent is “washing machine” with obtained frequency of 105; rank 7 or 7.83 percent is “incandescent bulb” with a frequency of 102; rank 8 or 7.60 percent is “rice cooker” with a frequency of 99; rank 9 or 6.91 percent is “refrigerators” with a frequency of 90; rank 10 or 5.99 percent is “extension cord” with a frequency of 78; rank 11 or 4.84 percent is “radio” with a frequency of 63; rank 12 or 4.61 percent is “electric kettle” with a frequency of 60; rank 13 or 3.46 percent is “electric stove” with a frequency of 45; rank 14 or 3.23 percent is “air-conditioning” with a frequency of 42; rank 15 or 1.38 percent is “vacuum cleaner” with a frequency of 18.

Based on the perception of the respondents, the following are seen to promote the adoption of E-waste management measures: importing countries regulation, internal and external pressures in the electronic industry, local E-waste initiatives and market conditions, geographical conditions, urban mining and price of metals, abundant cheap labor supply and the demand for the electronics industry to improve competitiveness. On the other hand, the different barriers that hinder the adoption of E-waste management measures are the absence of E-waste laws, non-adoption of the Basel Ban amendment, existing multilateral and bilateral agreements adopted by key trading countries, low environmental consciousness, perceived lack of enforcement of environmental laws, inadequate supply of domestic E-waste, and the competition between the formal and informal sector in the electronics market. The fundamental characteristic of the Philippine electronic industry, as being dominated by the semiconductor sector, is seen both as a driver and as a barrier to the adoption of E-waste management policies. The suggested policy direction is to develop the policy framework for E-waste management and weaken the different barriers identified. EPR has serious potential to be adopted in the country especially in the context of a take-back scheme.

3.2. Telecommunication Gadgets

The assessment of the barangay officials on telecommunication gadgets disposal in Barangay Queen’s Row, Bacoar City is presented in Table 14.

Table 14. Assessment of Barangay Officials on Telecommunication Gadgets Disposal

Telecommunication Gadgets	Frequency	Percentage	Rank
1. Computer unit	21	17.07	3.5
2. Tablet	27	21.95	1.5
3. Mobile phone	27	21.95	1.5
4. Printer	12	9.76	5
5. Fax machine	3	2.44	7.5
6. Scanner	9	7.32	6
7. Laptop	21	17.07	3.5
8. Landline phone	3	2.44	7.5
		100	

As manifested in table 14, on the assessment of the barangay officials on the telecommunication gadgets disposal in Barangay Queen’s Row, Bacoar City, rank 1.5 or 21.95 percent are “tablet” and “mobile phone” with a frequency of 27; rank 3.5 or 17.07 percent are “computer unit” and “laptop” with a frequency of 21; rank 5 or 9.76 percent is “printer” with a frequency of 12; rank 6 or 7.32 percent is “scanner” with a frequency of 9; rank 7.5 or 2.44 percent are “fax machine” and “landline phone” with a frequency of 3.

The assessment of the barangay staff on telecommunication gadgets disposal in Barangay Queen’s Row, Bacoar City is presented in Table 15.

Table 15. Assessment of Barangay Staff on Telecommunication Gadgets Disposal

Telecommunication Gadgets	Frequency	Percentage	Rank
1. Computer unit	51	17.71	2.5
2. Tablet	39	13.54	4.5
3. Mobile phone	57	19.79	1
4. Printer	39	13.54	4.5
5. Fax machine	9	3.14	8
6. Scanner	24	8.33	6
7. Laptop	51	17.71	2.5
8. Landline phone	18	6.25	7
		100	

As manifested in the table, on the assessment of the barangay staff on the telecommunication gadgets disposal in Barangay Queens' Row, Bacoar City, rank 1 or 19.79 percent is "mobile phone" with a frequency of 57; rank 2.5 or 17.71 percent are "computer unit" and "laptop" with a frequency of 51; rank 4.5 or 13.54 percent are "tablet" and "printer" with a frequency of 39; rank 6 or 8.33 percent is "scanner" with a frequency of 24; rank 7 or 6.25 percent is "landline phone" with a frequency of 18; rank 8 or 3.14 percent with a frequency of nine (9).

The assessment of the homeowners on telecommunication gadgets disposal in Barangay Queen's Row, Bacoar City is presented in Table 16. As stated in the table, on the assessment of the homeowner on the telecommunication gadgets disposal of Barangay Queens' Row, Bacoar City, rank 1 or 23.12 percent is "mobile phone" with a frequency of 120; rank 2 or 20.81 percent is "laptop" with a frequency of 108; rank 3 or 18.50 percent is "computer unit" with a frequency of 96; rank 4 or 16.76 percent is "tablet" with a frequency of 87; rank 5 or 8.09 percent is "printer" with a frequency of 42; rank 6 or 7.51 percent is "landline phone" with a frequency of 39; rank 7 or 2.89 percent is "scanner" with a frequency of 15; rank 8 or 2.31 percent is "fax machine" with a frequency of 12.

TABLE 16. Assessment of Homeowners on Telecommunication Gadgets Disposal

Telecommunication Gadgets	Frequency	Percentage	Rank
1. Computer unit	96	18.50	3
2. Tablet	87	16.76	4
3. Mobile phone	120	23.12	1
4. Printer	42	8.09	5
5. Fax machine	12	2.31	8
6. Scanner	15	2.89	7
7. Laptop	108	20.81	2
8. Landline phone	39	7.51	6
		100	

Alam (2015) emphasized in his paper entitled "The assessment of the of E-waste Management Generated from Cellular Phones, Laptops, and Personal Computers in the Philippines" to formulate and implement the guidelines for efficient e-waste management, the most immediate task is to collect actual data on the generation of e-waste including the importation and disposal of secondhand electronics. The data regarding the domestic e-waste generation per year is still very scanty. His study shows that there is a huge amount of e-waste still lying in the Filipino households that has not joined the e-waste disposal/recycle chain due to the storage of the obsolete models by the people. It suggests that the government can easily implement the "Take Back Scheme" with at least three electronic products, namely, personal computers, laptops, and cellular phones, to get these devices into the recycle chain and proper disposal.

4. CONCLUSION

The following conclusions are drawn based on the findings gathered from this research study.

The barangay officials, barangay staff, and homeowners' respondents from Queen's Row (East, Central, and West), Bacoar City generally assessed the four (4) variables presented on electrical-electronics waste disposal, that the "functions and responsibilities of concerned officials" and "waste segregation" was said to be rated strongly aware as well as "collection and transport of E-waste" rated strongly aware. However, "recycling program" is rated aware only. It can be concluded that the respondents from Queen's Row (East, Central, and West), City of Bacoar were aware on the presented variables on electrical-electronics waste disposal as evident by the overall composite weighted mean.

Generally, it implies that the barangay officials, barangay staff and homeowners in Queen's Row (East, Central and West), Bacoar City does not concur with their perception on electrical-electronics waste disposal in terms of functions and responsibilities of concerned officials, waste segregation, collection and transport of E-waste and recycling program. Thus, it only proves that the hypothesis is rejected and verbally interpreted as significant.

There is a strong evidenced that in the Barangays of Queen's Rows (East, Central, and West), Bacoar City, collected some common electrical electronics wastes from household appliances and telecommunications gadget, 21.95 percent are tablets and mobile phone, 17.07 percent computer unit and laptop, 9.91 percent is electric fan, 9.68 percent is compact fluorescent lamp, and 9.45 percent is fluorescent lamp.

Based on the findings of the study, an action plan was formulated and may be implemented.

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