TITLE OF DISSERTATION

Towards a Greener Future: The Vape Battery Recycling Challenge.

Recycling Practices and Environmental Impact of Disposable Vape Batteries in Monkstown.

Research dissertation presented in partial fulfilment of the requirements for the degree of MSc in program Procurement and Supply Chain Management

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I certify that the dissertation entitled:

submitted for the degree of MSc in Program Name here is the result of my own work and that where reference is made to the work of others, due acknowledgment is given.

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Dedication

I would like to express my most sincere gratitude to all the people who made the completion of this thesis possible.

To my family, especially my father, Ramón Pureco Pamatz, for being my guide and support during this period of education. His words of encouragement and example of perseverance were a constant source of motivation for me.

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Finally, I thank all the participants in this study, and the Monkstown community for their willingness to contribute their time and knowledge, without which this research would not have been possible.

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Lastly, I thank everyone who, in one way or another, contributed to this project and helped me reach this important milestone.

Abstract.

In the first stage, it will evaluate if it is a waste management system of that type. Afterwards, their actions are measured to identify where they fall short and locations assistance is accessible on the maintenance side. The study will have the advantage of access to sales data related specifically in terms of how many vaporizers were ordered, sold weekly, and returned to store. It was the foundation to give more precise metrics on analyzing and prototyping an in-store recycling bin. This mimic will help ensure the recycling (or other disposal) of single use vaporizers for more sustainable waste management.

This will be achieved through utilizing qualitative processes, such as semi-structured interviews and participant observation. Consumer interviews shall be performed to learn about consumer behaviour post use of vaping waste and current practice observations within the store regarding handling waste management. Customer attitudes and perceptions toward recycling disposable vaping batteries that will be investigated via closed-ended questionnaires.

By taking such a broad approach, this will find the obstacles and possibilities of recycling at retail sites from disposable vape batteries. The research will end in the proposal of a better waste management system that can be implemented for Monkstown as well, addressing its problems and moving further to aid other communities having similar difficulties. This research has the power to change policy and practice into a sustainable responsible waste management of tomorrow.

This research will not go into detail about consumer behavior of vaping, such as flavors or brand preferences and how long consumers have been consuming. It will also only be done with the brands marketed by Spar Monkstown, and only on disposable vapers too, excluding other types of vapers or electronic cigarettes. At the same time, it will not deal with any of the social ethics on consumption issues such as legality or harm to health in the use of substances whether it is right or wrong to consume and even individual perceptions. It also won't qualify as environmental harm, rather trying to show that there is a gap in the recycling loop for trash from dispose of VOLCANO vaporizers.

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1 Introduction

1.1 Overview

Lithium is a chemical element with the symbol Li and atomic number 3. It is a soft, silvery-white alkali metal and, under standard conditions, is the lightest metal and the lightest solid element(Gunther, 2017).

Millions of consumers benefit every year from its use, thousands of industries can transform this material into a series of different products such as lithium-ion batteries, ceramics, greases, and lubricants. Although it is known that it is a non-renewable resource, in economic matters it has been considered "white gold" due to its high demand and its scarce existence. The "lithium triangle", formed by Argentina, Bolivia, and Chile, concentrates 56% of the world's resources (Obaya, 2020).

Lithium is a key element in the energy transition, since it is an essential and irreplaceable component in the manufacture of lithium-ion batteries, it is one of the critical metals for the energy transition as it is an irreplaceable input in the production of used batteries for electromobility. Currently, lithium is used to make batteries for storing energy from renewable sources and, to a greater extent, to produce electric vehicles, which have positioned themselves as the dominant technology to reduce emissions from the transportation sector, since only emissions from internal combustion automobiles represent 7% of the contribution to global emissions (Peace, 2020).

One of the products that use lithium batteries are electronic cigarettes, some have been designed to look like regular cigarettes, cigars or pipes, others look like pens, USB flash drives or other everyday items. They consist of three parts that are assembled: the battery (usually lithium), the atomizer and the cartridge (Llambi, 2020). In most devices the cartridge is rechargeable, although there are a series of vapers that are only disposable, our point of interest here is disposable vapes or electronic cigarettes.

In 2021, a study by the UK Cancer Center was carried out and showed that the use of disposable e-cigarettes in Britain grew rapidly between 2021 and 2022, especially among younger adults, but the overall prevalence of inhaled nicotine use remained stable over time. The majority of young adult vapers in Britain now use disposable products (Cancer Reaserch UK, 2022). but despite this, it was demonstrated that there is no recycling policy on waste derived from the consumption practices of electric vapes.

1.2 Research Purpose

In a country like Ireland, where smoking habits have notably changed, traditional smoking has dropped from 23% in 2015 to 17% in 2019. Among school-aged children, only 5% are current smokers. However, e-cigarette use is on the rise, particularly among youth. Approximately 22% of those aged 12 to 17 have tried e-cigarettes, and 18% of 15–16-year-olds are current users. This shift highlights a new trend in nicotine consumption, raising concerns about the potential health effects of e-cigarettes in the long term(Health Service Executive, 2019). there is no waste management system for these that can be effective for the reuse of batteries from electric vapers.

In 2023, the prevalence of tobacco and e-cigarette use has shown divergent trends in Great Britain. The prevalence of smoking among adults has been recorded at approximately 13.3%, with the highest rates observed in the 25-34 age group (17.8%). However, the prevalence of vaping has increased significantly, reaching 9.1% of the adult population, which is equivalent to 4.7 million individuals. This increase is particularly notable among young adults, especially in the 18-24 (11%) and 25-34 (12%) age groups. Although most vapers are ex-smokers (56%), an increase in the number of dual users (those who smoke and vape) has been observed, up to 37%. These figures reflect a growth in the use of vaping compared to smoking, highlighting a growing trend towards e-cigarettes among different demographic groups in Britain (Faculty of paediatrics, 2023).

In Ireland, the use of disposable vapes has increased significantly, especially among young people. Healthy Ireland data in 2022 shows that 11% of under 25s in Ireland use vapes regularly or occasionally. Additionally, the 2019 European Schools Project on Alcohol and Other Drugs (ESPAD) report found that 37% of 16-year-olds in Ireland had tried vaping and 15% were currently using it. (Faculty of paediatrics, 2023)While In 2021, in the US, individuals aged 18–24 were the most likely to use e-cigarettes among adults, with 11.0% of this age group reporting current use. Overall, 4.5% of adults aged 18 and over were e-cigarette users, with men showing a slightly higher prevalence (5.1%) compared to women (4.0%). Among those aged 25–44, e-cigarette use was more common in men (7.9%) than in women (5.1%). Usage rates were lowest in adults aged 45 and older, with little difference between men (1.9%) and women (2.0%). Notably, the likelihood of using e-cigarettes decreased with age for both men and women(Kramarow, 2023).

For this reason, it seeks to carry out a study that can demonstrate that the system lacks efficiency and create a new system capable of carrying out safe and functional recycling of batteries from electronic vapers.

1.3 Significance of the Study

The increased use of disposable vaporizers poses significant environmental challenges. Improper handling and use of disposable vaping batteries can cause soil and water contamination, releasing toxic chemicals into the environment; In turn, they are batteries that can be reused and materials that can be recycled. This issue is particularly relevant in Monkstown, where the focus of this investigation is the management of disposable battery waste at a local store.

Using lithium, a precious metal, in the battery of disposable vaporizers wastes valuable resources needed for greener transportation. Lithium is a key component in electric car batteries. Research from the United Kingdom found that approximately 10 tons of lithium are wasted annually from discarded disposable vaporizers, the equivalent of 1,200 electric vehicle batteries, according to research from the Faculty of Paediatrics of the Royal College of Physicians of Ireland in a study conducted in 2023 .(Cancer Research UK, 2022)

Which leads us to ask the following?

1.What are the current practices for managing disposable vaping waste at your local Monkstown store?

2.What are the main challenges and weaknesses of the existing waste management system for disposable vaporizers?

3.How can an improved system for managing disposable vaping waste be developed and implemented at the local store?

1.4 Research Objective

The main objective of this work is to identify weaknesses in the management of disposable vaping waste at a local store in Monkstown and to propose an improved system for the management of this waste. To achieve this goal, a comprehensive exploration of current in-store waste management practices, primarily among vaping consumers, as well as the contextual factors that influence this management will be conducted.

1.5 Structure of the Study

This study is organized into five key chapters, each contributing to a comprehensive understanding of the research topic:

1. Introduction: This chapter sets the stage by introducing the research topic, stating the research purpose, and outlining the objectives. It also discusses the significance of the study and provides an overview of the issue of disposable vape waste in Monkstown.
2. Literature Review: The second chapter reviews relevant literature on waste management practices for disposable vapes, including legislation, recycling challenges, and proposed solutions. This chapter establishes the theoretical foundation for the study and identifies gaps that the research aims to fill.
3. Methodology: This chapter describes the research design and methods used to conduct the study. It covers the research approach, data collection techniques, and how the data will be analyzed. Ethical considerations and potential limitations of the study are also discussed.
4. Findings and Discussion: In this chapter, the results of the research are presented and analyzed. The discussion focuses on how these findings answer the research questions and what they mean for current waste management practices in Monkstown.
5. Conclusion and Recommendations: The final chapter provides a summary of the key findings, offers recommendations for improving the management of disposable vape waste, and suggests directions for future research.

2 Literature Review.

2.1 Overview.

Lithium is an essential metal with widespread applications in next-generation technologies such as energy storage, electric mobility, and wireless devices. (Gunther, 2017) As demand for a product increases, so does its production, which generates use of resources and waste, particularly in disposable vapes, which do not have a functional and efficient recycling system. In Ireland and specifically in Monkstown, the increase in the use of disposable vapes poses significant challenges to waste management.

2.2 Current State of Waste Management for Disposable Vapes.

Global waste from e-cigarettes is rising a projected 844 million were thrown away last year alone. This is worrying as every e-cigarette consists of roughly 0.15 grams of lithium and the aggregate grand total for all discarded devices includes more than enough lithium to power batteries for more than 16,500 electric vehicles. This increase in the waste created by vaping disposable e-cigarettes debris accounted for around 5 million per week just within the UK come 2023 is emblematic of a burgeoning eco-problem, spurred on as millions turn to alternatives, they believe are green-friendly. The problem is compounded by the fact that these products are not recyclable in any effective way and e-cigarettes mostly end up in landfills or discarded into ecosystems, thus causing pollution waste of non-renewable resources(Oceancare, 2024)

To this note, early in 2023 the government of Ireland put public feedback about the environmental and safety risks associated with disposable vaping devices like electric vapes due to their intricate components (which includes both power generating batteries made from heavy metals) and poor disposal practice. There was a clear message at the public consultation that there is great support for robust policy in relation to managing e-scooters and their environmental impact. This could be (and probably should) done several ways, such as banning disposable vapes or introducing deposit-and-return and ensuring the producer responsibility system rewards better recycling practice. (Department of the Environment, Climate and Communications, 2023)

Tobacco uses in Spain and tobacco consumption (including Electronic Nicotine Administration Systems [ENDS]) have both public health effects, as well as significant environmental implications. Tobacco trash has more than 7,000 dangerous chemicals that contaminate the environment. Every day in the world is sold and more than 15 billion

cigarettes, of these practically once every two within only the remains of butts inopportunely thrown away; it largely still lands at sea or taken, litter mountain which performs coastal cleanups as well as urban. (National Committee for Smoking Prevention, 2021),

Bystanders in the US can be exposed to secondhand and thirdhand aerosols which are harmful as well, particularly considering that emissions from e-cigarettes contain many toxins (which vary), including carcinogens such as polycyclic aromatic hydrocarbons, metals like aluminum or lead. Defective e-cigarette batteries are known to explode, leading to burns and fires while children with nicotine exposure from accidental ingestion of liquid even in small quantities are at serious risk for ill-health. Furthermore, upon heating the liquids used in e-cigarettes can evoke toxins such as formaldehyde and acrolein which do harm not only to our own health but also peril environment. Such concerns highlight the necessity for tighter regulations and larger-scale public campaigns that raise awareness on environmental and health problems regarding vaping waste(Douglass, 2020).

In Canada, for instance one of the central concerns is formaldehyde, acetaldehyde and acrolein may be generated by heating e-liquids. These can lead to lung disease as well as cardiovascular problems. As well, when the same substances (eg nickel or tin) are inhaled into the lungs as contaminants within vaping products can indeed present additional risks to human health. In addition, there has been concern about the inhalation of secondhand emissions from e-cigarettes in that non-users (third parties) could be exposed to a variety of potentially harmful components(Drug Free Kids, 2022).

The rich nicotine waste gets added to the environmental regulations that are followed in Minnesota for disposal of vaping products (including e-cigarettes and liquids). The Minnesota Pollution Control Agency (MPCA) classifies nicotine waste which includes the unopened and used e-cigarettes, as well as vaping liquids that will be turned over in New Prague a hazardous waste, one requiring special handling to avoid environmental contamination. In the most unfortunate cases, improper disposal releases toxic chemicals into the environment which could put both human health and nearby ecosystems at risk. Minnesota law requires businesses to determine the type of nicotine waste they produce; and carry out disposal according to certain requirements such as acquiring a Hazardous Waste Identification Number, while as well getting licensed in hazardous waste generator. The agency also stresses the need to recycle e-cig batteries, which have been known to catch on fire if they are not disposed of correctly. Businesses are encouraged to recycle or properly and safely dispose of these devices, including their

related waste in accordance with their state regulations as a way that can be done to help reduce the environmental impact(Minnesota Pollution Control Agency, 2022).

2.3 Legislation

Lithium-ion battery recycling in practiced and performed without any barrier or extra conditions under European Union (Batteries and Accumulators) Regulation 2014(as amended) specifically targeting Ireland. Producer Responsibility Organizations (PROs) such as WEEE Ireland and ERP Ireland run approved compliance schemes which means battery producers need to join them to meet their collection and recycling obligations (Environmental Protection Agency, 2023).

In countries such as Ireland, the UK, Germany, and Sweden have amalgamated vape battery recycling into their e-waste management streams. The likes of WEEE Ireland and ERP Ireland carry out e-waste recycling in the country which incorporates Lithium-ion batteries from vapes under the purview of European Union Batteries and Accumulators Regulations. In the UK, campaigns like Material Focus also detail out how disposable vapes can be recycled and create awareness about it with collection points at retail outlets. Both Germany and Sweden have elaborate e-waste management infrastructure in place, with initiatives such as the El-Kretsen program running an efficient electronic waste disposal system to recycle vapes(Environmental Protection Agency, 2023).

The Waste Electrical and Electronic Equipment Directive in the UK [22] came into force on 1 January :2007, this is a set of rules concerning most types of electronic waste. to perform the collections, treatments, and disposal of these products. Anything less powerful is insufficient, but law enforcement and consumer awareness are still the biggest obstacles to progress (Smith and Sunderland, 2022).

Those are then categorized as Waste Electrical and Electronic Equipment (WEEE) and should be taken to your local Household Recycling Centers or retailer take back programs. Few of these consumers realize, however, that disposable vapes can be and should be recycled — all too often they end up in common trash containers. (Smith and Sudderland, 2022).

The jump in consumption was largely due to new products with so-called next-generation nicotine delivery systems. However, in countries like Brazil where there is the national restriction of all nicotine vapes continues to be limited and may explain why it also lags other continents with less widespread use. ESD banned in Brazil, Brazil's ban on ESD seems

to have been a precaution against the consumption of an unproven quit-aid tool that carries significant toxicity (Silva, 2019).

The Resource Conservation and Recovery Act (RCRA), a Federal statute, regulates the storage and disposal of hazardous wastes throughout California only in the United States. As ever, RCRA governs what counts as hazardous waste and how it must be disposed of. Nicotine liquid and lithium-ion batteries are regulated hazardous waste. (Public Health Law Center, 2024).

For its part, in Mexico the Federal Commission for Protection against Sanitary Risks (Cofepris) has proceeded with various actions to regulate and even ban vapers because of health risks. A decree was established on May 31, 2022, that directed the circulation and commercialization of electronic nicotine delivery systems, such as similar to a regular smoke free procedure or which means an alternative device consumption with intention (NDS0. This included the use of scientific evidence demonstrating risks to health from these weapons and a commitment by the Mexican government to protecting its citizens' right to health as well as securing a safe environment (Ponciano, 2023).

This executive decree regulates the use, import, and commercialization of electronic nicotine addiction systems (cigarillos) as well as that they are accessories to this type of products in Panama by affecting users. This act is clear in its intent: to shield the public from the health, societal, environmental, and financial consequences of those products. (Ministry of Health Panama, 2023).

Additionally, the European Union's "Fit for 55" package will soon ban new CO2-emitting cars sales after ages such as reducing lithium load. Because this legislation will necessitate the release of zero-emission vehicles (ZEVs), primarily electric vehicles (EVs) in addition to gas-guzzling pick-up trucks, we ought to see lithium consumption skyrocket and a surge in demand. EVs require lithium-ion batteries, which rely heavily on access to Lithium. The growing lithium demand could lead to more frequent mining drives that would create a strain on worldwide lithium resources and environment. But the legislation also promotes battery-technology and recycling improvements that might alleviate some of this demand if better lithium extraction from used batteries is possible. What is more, the impetus for resource sustainability and efficiency may also speed up the advancement of alternative lithium-lithium battery technologies(European Commission, 2024).

2.4 Problem with recycling.

Disposable e-cigarettes and the lithium-ion batteries they contain act irresponsibly when not properly disposed of, which creates a real risk to the environment. The batteries include reactive chemicals and toxic heavy metals that may contaminate the soil and

water. When lithium-ion batteries are damaged, they can also become a fire hazard and release toxic gases. According to the Environmental Protection Agency (EPA), used batteries can cause a lot of harm if not disposed through proper recycling outlets. (Environmental Protection Agency, 2023).

When thrown away in an improper fashion, these items give way to thousands of tons of hazardous plastic/electronic/chemical waste which can cause soil and water pollution. The lithium batteries in these units can start a fire if they short-circuit. The Lancet and an Afghan clinic that drew concern for the health risks from discarded devices influenced my own heightened awareness after reading embedding 3rd party java script. (Smith and Sunderland, 2022).

The recycling industry has suffered, particularly in Australia, from a range of challenges that are often attributed to its complex regulatory environment as well as the market volatility and lack of domestic markets for recycled products. Historically, exporting recyclable materials has been a major resource for the industry, however Chinese policy changes have placed pressure on export routes and led to higher cost recovery rates pushing towards landfill. But the country also has an ongoing investment problem in its recycling infrastructure, with many of facilities currently operational struggling to meet international standards and operating on outdated processes. And while it is tempting to brush your hands off from dealing with this crisis for the sake of championing a broader shift towards a domestic circular economy that will dismantle and recycle these mountains of waste, we are no closer than ever in real term(Commonwealth of Australia, 2018).

The care industry is another, due to the complexity of materials like nickel, cobalt and lithium from recycling electric vehicle (EV) batteries making their extraction a significant challenge that needs developed environmentally sound methods. Given the projected emergence in quantity, however, existing infrastructure especially for automotive applications in Europe and Japan is insufficient to manage waste batteries; economic viability has been reported as a concern given recovered materials return little value relative to recycling costs. In addition, regulatory and policy voids exacerbate efforts to form a sustainable and comprehensive recycling system even more by the unsuitable environment of current recycling procedures.(Institute for European Environmental Policy, 2023).

But managing and recycling plastics in Canada remains tough. This has resulted in the country having a linear economy where only around twenty-five per cent of plastic waste is recycled with rest ends up at landfill or leaks into the environment, representing billions of dollars' worth economic loss every year. These initiatives are helping but as of

March 2021, the industry experienced just a 16% diversion rate due in part to sub-optimal recycling outcomes caused by poor product recyclability design, limited collection processes and inadequate chemical recycling infrastructure. Economics are also at play, with cheap virgin resin prices driving down any returns on recycled materials and few end markets available for many grades of post-consumer plastics. Furthermore, regulatory and policy frameworks are too weak to drive up diversion rates so a large portion of the plastic waste ends uncollected /unrecycled(Environment and Climate Change Canada, 2019).

However, in cities such as very large ones like Mexico City the challenge is different because kilometers and tons of waste are generated daily but there simply is not enough infrastructure to manage it. The city is not equipped to recycle most of the waste which reaches its landfills or open dumps, resulting in serious environmental and health implications. A great deal of waste management is also undertaken by informal workers working beyond regulation, deepening inefficiencies and creating dangerous work environments. Waste Management and recycling initiatives are affected by these issues on a local level in the form of corruption, political & social problems: Prestige waste removal brokers control who gets access to what route(Mora Reyes, 2004).

New York State has a major solid waste problem, standing as the fourth-largest emitter of greenhouse gases within its own boundaries with enormous quantities "taking make dissolve" endemic to disposable culture and consequential massive overgeneration of garbage. Global recycling markets are volatile, and trade policies like China's National Sword increase the cost of processes that add value to recycled material while disrupting global industries for sale of some collected materials. Meanwhile, inefficient information-sharing due to all data remaining in silos and poor technology adoption makes waste management ineffective because on top of these waste facilities are often located low-income areas making it an environmental justice issue(New York State Department of Environmental Conservation, 2023).

2.5 Lithium and plastic.

Many vapes use rechargeable lithium-ion batteries, which means they are considered hazardous waste due to their heavy metal content and tendency to burn into flames in your household garbage can when thrown away 1. These batteries mean dangerous litter that may not be thrown in the general waste. Other electronic parts such as circuit boards, wires and cables are present in vapes which also contribute to e-waste along

with batteries. Improper disposal of these components can release toxins into the environment (Ponciano, 2023).

Vaping liquid, even with nicotine in it is their equivalent of household hazardous waste. These chemicals can then seep into our water resources and prove deadly to aquatic life there. In addition to that e-cigarettes thrown into the streets all over Delhi are adding up in an estimated 2000-plus tones of electronic and plastic waste, not recyclable. But a scant few of the materials are recyclable and most go to landfills, where plastic takes centuries to decompose, making environmental pollution worse.(Lung Foundation Australia, 2023).

2.6 Product consumption in the electric vape market.

In countries where they are marketed, experimentation and use of electronic cigarettes by young people is popular. The draft of the mollusk's recommendations follows a 28% increase in e-cigarette use among US high school students alone from 1.5 percent in 2011 to more than one-in-five or about two-seventh by population figure (20.8%) (Silva, 2019).

In Spain, this market takes off with a little delay compared to the header countries, but it is estimated that add nearly 1 million vapers generating an activity ratio which could exceed in volume of business 100 million EURs for year end of 2020. Population and sales growth rates have exceeded 25 percent from the year produced in late 2019 to early 2020, with similar high levels of maintenance expected over future years. In data from the survey on alcohol and other drugs in Spain (EDADES, OEDA, 2021a) it was observed that between 2015–2019 there were increases in prevalence of electronic cigarette consumption among men and women aged a span heightening to litmus paper age, using nicotine compared with not consuming them without containing it. Nicotine use is associated with age.(Ministry of Health, 2021).

Over the span of the last few years vaping has grown into a huge market and Spain has caught up. Launched in India initially 2006, the market has grown immensely over just a decade and even more so since post-2010. In 2014 it was already possible to find more than 300 shops, specializing in e-cigarettes or related products on the territory of Spain and over 20 brands have emerged. All these brands had their beginning in Italy, and some have even managed to explore themselves within the Spanish territory. Amongst the notable examples of success are Puff Cigarette who increased their sales twelve times more in less than a week (it presumes it was for just this term) from 2013 to 2104, and Valencian company Essenz which went on to open over seventy new stores by March 2014.(Blake, 2014).

The fuzz about vapes in the Belgian market in 2018, overall infrequent (use less than weekly) and current use among those aged ≥15 years were around 5.1% and 4%, respectively of these, 2.7% are using e-cigarettes more than one day a month and little over half of them (1%) reported that they use on a daily basis. The biggest number of e-cigarette users are in the 15-24 age group, with around a quarter (25.4%) having tried vaping and just over one-in-twenty (5.5%) vapers reporting recent use although only 0.6% do so daily(Sciensano, 2019).

Regarding the situation in France, vaping has gained some prevalence. Specifically, by 2022, 41.2% of people aged 18-75 years had ever tried e-cigarettes. At the same time, 7.3% were current users, and 5.5% used them daily. All these indicators are much higher than they were in previous years, indicating the current high prevalence and frequent use of vaping products in the country. More notably, these metrics are increasing most rapidly among young people, who are willing to experiment with this type of tobacco usage compared to traditional smoking(Pasquereau, 2023).

2.7 Proposed Solutions and Best Practices

There is need to enforce these guidelines to prevent environmental contamination, hazardous situations during handling of waste or storage and mitigates the potential loss for useful materials.

There is mandatory recyclability labeling for packaging included within the Environment Act 2021 by 26 / 27, where this increased consumer awareness could have a positive impact on recycling. Retailers and manufacturers are invited to set up in-store recycling collection points, Industry stakeholders can establish vanished collection points at retail outlets also promote the people awareness drive of tier personnel. (Smith and Sudderland, 2022).

Any tobacco merchant who must get rid of tobacco products are largely considered a hot hazardous waste generator. Generators are separated by the quantity of waste that they generate and is based on their class as Large Quantity Generators (LQG), Small Quantities (SQG) or very small quantities generators (VSQg). Reciprocally there needs to commit according to standards according to generator type (Public Health Law Center, 2024).

Findings from the research conducted in Mexico suggest that reinforcing applicable laws and promoting compliance could mitigate vape waste. Penalties for lack of recycling and refundable deposit policies. (Ponciano, 2023).

Schools should securely store single use vapes in fireproof bins and wait until they have enough to bring them all to the designated recycling centers or back through stores, rather than placing them individually with regular waste that could create a serious threat of fires. Incaution to prevent the risk reduces in proper way by identifying an undertaking of a chain of thought for child labor, while resources are migrated and if possible quickly positioned in vending machine or directed back bars A rapidly soothing confectioner shalt be organizing consumers about its true composition .(Hampshire County Council, 2023).

The UK Vape Position Statement (2023) recommended a range of measures to control vape waste including outlawing disposable vapes by 1 January, increasing enforcement action under the maker pays principal billing and making businesses report on what proportion of their returned vaping devices electronics are recycled. It highlights the need for greater public and business awareness to drive up collections, bring down pollution levels and help create a circular economy (Marine Conservation Society, 2023).

Only 100 tonnes of e-waste are disposed every financial year, with the Australia Vape Waste Management as Queensland a major region in question. What remains is a combinatorial mess of lithium-ion batteries, circuitry plastic and harmful chemicals like nicotine lying in wait to form what one imagines could be an environmental catastrophe. The release notes call for greater public and business awareness to raise recycling rates, lessening environmental impact and progressing towards a circular economy.(Mead, 2022).

The organization recommendations and measures:

1. Vaping Devices Extinguish Not: Creation of a return scheme for vaping devices is recommended, with the necessary funding obtained through adding money on to the retail price. This would enable users to add their devices and take them back to any certified drop-off center for recycling, with a monetary incentive in return.
2. Sales Reporting: Improve sales reporting for better visibility into the volume of e-waste generated, which can help in formulating more effective waste management policies.
3. Dangerous Littering Fin: Introduces a specific fine for littering vaping devices, categorizing them as dangerous waste under the Waste Reduction and Recycling Act 2011(Mead, 2022).

2.8 Conclusion

Literature review reveals several disruptions of waste management including issues in recycling lithium batons from cigarette disposables. And even though there are regulations and laws in place that have been established with the input of e-waste concerns, this enforcement or its effectiveness is inadequate especially when focusing on disposables. And the fact that it is happening this fast for some of these items just ads to the steadily increasing pile of potential harmful waste.

Consumer perception of the recyclability of disposable vapes is low, and there is no existing infrastructure for as well no one knows where to throw used magic devices causing environmental harm. However, the review noted areas of opportunity such as developing best practice and mechanisms to deliver waste streams that may be successful with other nodes in Monkstown.

While we are just beginning to get a sense of the scope and implications of disposable vape waste, these results clearly suggest that studying potential strategies for dealing with it in an integrated (and circular) manner would be worthwhile. The following part of this study will work towards establishing a framework for investigating these questions further, with the ambition to author an industrial waste management system that is better than it currently exists.

3 Methodology and Research Design

3.1 Overview

The research methodology will deal with defining the framework of data collection, analysis and interpretation so that it can achieve the objectives of the study. A quantitative approach is adopted as the research deals only with multiple choice surveys and an open-ended question to investigate the practice of recycling vape batteries among consumers. The key aspect of the quantitative approach lies in the collection of quantifiable and generalizable data that gives an accurate view of the pattern of recycling behavior and attitude of consumers.

Since the objective of this research is to investigate the practices of recycling batteries from vapes, behaviors and perceptions are the basis of the information, proposing strategies that can improve these practices is what is sought to find. The survey was designed to be simple and direct enough to capture a broad panorama of information, specific enough to provide relevant data that informs on the subject.

Therefore, the research was based on the hypothesis that increased knowledge about recycling processes and benefits correlates with increased consumer participation in vape battery recycling programs. Therefore, surveys were created to gather the relevant information needed to have a solid database for data-driven analysis and decision making.

3.2 Research Philosophy and Approach

The philosophical approach that guided this research was positivism, as it focused on the use of quantitative methods to collect and analyze data objectively. Positivism, within the context of research, assumes that knowledge can be measured and evaluated through empirical and observable data, which allows the researcher to establish causal relationships between variables.

This positivist approach was chosen because the main goal of the study was to quantify consumer behavior and perceptions about recycling vape batteries. Through collecting numerical data, I was able to notice common patterns in people's responses and analyze the factors that influence their decisions. I looked beyond intuition or personal judgment, searching for more trends and patterns that could be statistically significant. This allowed me to be confident in my results, but also allowed me to offer evidence-based recommendations beyond doubt.

The study was based on a quantitative approach. By conducting the structured surveys, quantitative and measurable data could be obtained, which, in turn, allowed for quantitative statistical analysis. As a result, a clear and objective understanding of consumer behaviors and perceptions was obtained. This approach is often the most useful in studies that seek to measure the frequency with which a certain behavior takes place or to identify the factors that influence the decision. Thus, the study of customer attitudes towards recycling e-cigarette batteries falls within this approach. The multiple-choice survey allows for standardizing the answers in order to compare respondents with each other and find general patterns in large populations.

Furthermore, it can be said that the main approach was quantitative, the inclusion of the open question gives the opportunity to capture qualitative responses that can enrich the analysis. In this mixed approach, it is possible to obtain a broader and more complete vision of the subject under study, since it complements the numerical data and behaviors with more detailed and personal observations of the respondents.

3.3 Research Strategy

The main strategy of this research was selected from structured online surveys, that is, they contributed to a large sample of vape consumers. This kind of method was chosen due to certain advantages: online surveys allow reaching a large number of participants in a short period of time, which makes them a great tool that is efficient enough for studies with time and resource limitations.

These surveys are also accessible from any geographic location, ensuring geographic diversity of responses and increasing the diversity of the sample. Most often, surveys were sent via social media messages and emails to communities of active vaping consumers. This also made possible a higher rate of active responses, as participants shared the research idea and the subject of the survey.

The survey design used both closed, i.e. multiple choice, questions and an open question. This format allowed the author to collect quantitative data, while providing participants with the opportunity to express their opinion, ideas or comments on the battery recycling operation. In other words, this open question allowed me to have the qualitative information necessary for a broader approach.

This combination of methods allows us to critically analyze patterns of behavior in the population to be surveyed and, in turn, allows us to obtain clear and decisive responses

regarding the points of view of the population. Another advantage is that we can see the contradiction between behavior and thoughts.

The survey consisted of a number of multiple-choice questions that focused on different aspects of the behavior of not only consumers but also the general population regarding their waste management practices and batteries. The main categories covered in the surveys included:

Demographic Information: Questions designed to collect information about age, gender, and location of respondents. This data is essential to identify certain demographic groups and view respondent trends. This data is essential to identify certain demographic groups, whether they are more likely to participate in recycling.

The second section addresses common practices, questions aimed at understanding how consumers handle waste after consuming vapes, how much they consume to get an idea of the volume of waste and to analyze a little of the product's life cycle. This section allows us to understand the degree of awareness of the participants about the options of how much can be recycled.

Level three analyzed the level of knowledge about information and waste management, asking about the knowledge and practices of waste management generated by vapers, as well as the perceived importance of recycling. This section allows us to understand the degree of awareness of participants regarding the environmental impact of vaping.

Finally, motivations and barriers are questions designed to explore the reasons why practices are or are not being carried out in relation to vaping products. This section is vital for identifying obstacles that hinder the adoption of more conscious practices and the motivations that could drive consumers to participate more actively in such programs.

Open question.

At the end of the survey, an open-ended question was included with the intention of gathering information from participants to share their additional comments. This question was designed to capture any aspect or area of battery recycling that was not covered by the multiple-choice questions. Respondents were able to express their different views and opinions on recycling, suggest improvements to existing programs, or share personal experiences.

As can be seen, most of the analysis was based on quantitative data, the response to the open question was analyzed using basic qualitative techniques. The most common

themes were identified and the information was organized in summary form to complement the findings of the quantitative results.

3.4 Collection Primary Data

The data was collected through the online survey distributed to vaping consumers. The survey was organized as mentioned above, i.e. it refers to a one-minute survey and is completely intuitive. This is essential to ensure maximum participation and avoid respondent drop-out. By distributing the survey online, it is ensured that data collection can be done smoothly and without the need for personal intervention.

Moreover, as this survey could be filled again and none other versions of the questionnaires are available in any language all over Spain; participating was very easy for many subjects who now can enjoy filling it at home when they experience less pain. Additionally, this way we decreased possible biases as participants answered more candidly since a researcher was not present at the time. The simplicity of the survey guided participants through which as a result decreased default response.

3.4.1 *Sources*

Primary data will be collected from the following sources:

The online survey was disseminated to vaping consumers through a variety of platforms, including social media, online-based community groups, specialized forums, and a QR code in the branch. The use of these channels was intended to ensure audience diversity, which comparatively diversified the survey population and predetermined the acquisition of numerous perspectives and experiences.

Using an online survey: Implementing an online survey allowed for the participation of individuals of different ages, genders, and backgrounds, which improves the scope of the data with analysis that allows segmentation by demographic classifications. Enough information can be obtained to be useful.

3.4.2 *Access and Ethical Issues*

To ensure the ethical integrity of the study, several measures were implemented. All participants were informed about the purpose of the study and their participation was completely voluntary. Respondents' anonymity was guaranteed and no personal data

that could directly identify them was collected. Furthermore, all data was stored securely and was only used for research purposes.

The study has also obtained the approval of the participants regarding the use and management of data, even though it has been carried out anonymously, they were informed about the procedures and the use of the information, emphasizing the norms and ethical standards of this research.

Participants were explicitly told that their safety was the primary concern and they could ask questions at any time during this study. They were also assured that they would not be penalized if they opt to participate and the data collected will only be used for academic projects respectfully, by following privacy protocols. The strategy was meant to build a good partnership with participants, establish and keep clear communication lines and respect the autonomy of everyone throughout.

3.5 Approach to Data Analysis

The collected data were analyzed using several quantitative methods, focusing mainly on the use of descriptive and inferential statistics. Firstly, the multiple-choice questions were analyzed with particular attention to trends, patterns and correlations that could be revealed between the key variables. In addition, differences between subsamples were analyzed and frequency distributions were analyzed in the context of common characteristics. As for the open question, the responses were analyzed qualitatively using a thematic categorization process that identified the key motives. The results of this task were used to complement the quantitative analysis and contextualize the observed patterns. Several advanced statistical analyses were carried out to explore correlations between the investigated variables and test a hypothesis. Not only simple correlations but also interactions between variables were analyzed. The results of these tasks were used to test the hypothesis that a higher level of knowledge about battery recycling is positively correlated with higher participation rates. The results were presented in various tables, bar charts and pie charts to facilitate understanding and interpretation.

This analysis will contribute to the research objectives, answering questions related recycling programs rates of success thus far, consumer behavior and whether there are opportunities for improvement in managing vaping battery waste.

3.6 Conclusion

Quantitative data analysis for the quant should be done not through some statistical methods and this data is obtained by interviewing with questions are. The descriptive statistics will consist of standard deviation, mean and median to summarize the data and find out what are the common trends among participants opinions from behaviors on vaping battery recycling. Inferential statistics such as chi-square tests or t-tests may also be used to examine relationships between variables (eg, Do people who know more about recycling programs do a better job of participating in these programs).

Analysis of Qualitative Information: A thematic evaluation might be conducted using the qualitative responses obtained from the open query inside the questionnaire and particular observations made within Monkstown save to answer RQ2 about how persuasive cues in garb shops make Dirty Fashion attainable. This process relates to the recognition, analysis of most re-occurring patterns (themes) within data. Thematic analysis is the third component and will provide a deeper understanding of the participants perception, barriers toward recycling, and ideas for improvement.

Triangulation: To enhance the validity of findings triangulated with comparisons from quantitative and qualitative. This will facilitate a more thorough exploration of the research problem, enhancing scope for deduction and recommendations.

This analysis will also help to cover some of the research objectives allowing us an insight into how effective current recycling programs and consumer behavior can be, as well as provide some information on what could potentially do better in managing vaping battery waste.

4 Presentation and Discussion of the Findings

4.1 Overview

In this chapter we will find the results of the survey applied in the information gathering process, likewise, the findings made will be shown, to emphasize a survey was carried out with 17 closed questions (appendix A) that was carried out based on a quantitative study and an open question to broaden the point of view of the respondents in order to understand their point of view regarding battery recycling.

The population that responded to the survey was 60 people. It is mentioned that the population was selected at random, no person was ever discriminated against based on age or gender, but it was applied to a local population located in Monkstown, Dublin, Ireland.

The survey was divided into 4 sections that will help us define the development and correct use of information collection, as well as delimit its price.

- Section 1 - General Demographic Information
- Section 2: Use of disposable vapes.
- Section 3: Outlook on Recycling awareness, Attitude towards recycling
- Section 4: Efficiency of Recycling Programs

4.2 Findings

4.2.1 *General Demographic information*

We can see that most of the population according to age was 35%, being a population between 18 and 24 years of age, followed by people between 25 and 34 years old with 33.3%, 25% between 35-44%, also 5% between 45-54 years old and finally 1.7% between 55-64.

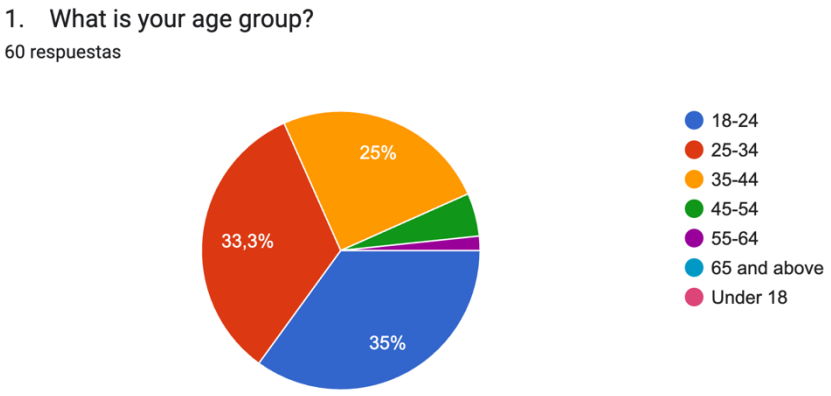


Figure1Age group.

While in question number two, we focused on observing the gender with which the people surveyed identified themselves, which resulted in 65% male and 35% female, likewise, the non-binary and anonymity options were proposed in this question in order not to offend the population surveyed.

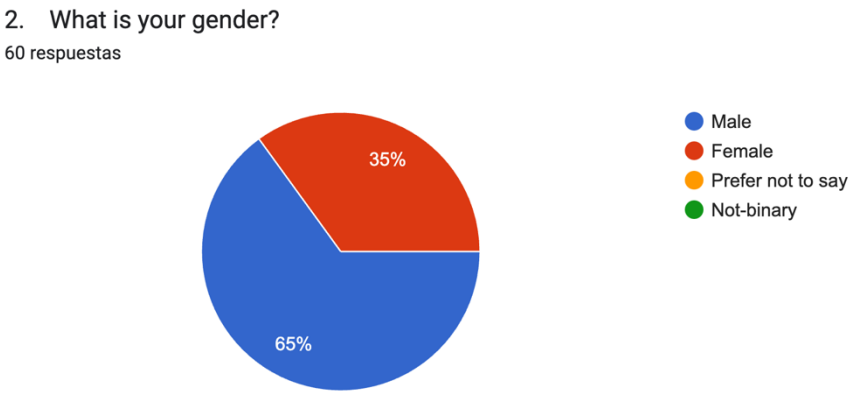


Figure 2Gender.

4.2.2 *Use of disposable vapes.*

During the second section, starting with question 3 of the survey, the use of disposable vaping devices was investigated, that is, whether people have consumed the product, obtaining as information that 38.3% of the population has used it but not currently, 38.3% you have never used a vape and 23.3% continues to use the disposable vape.

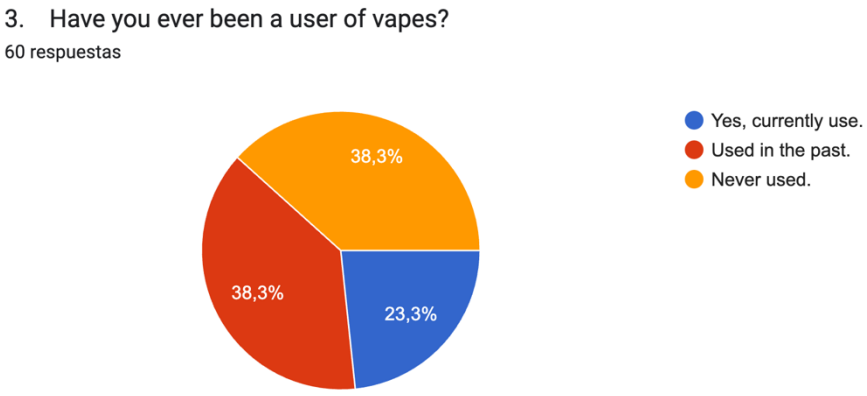


Figure3 Use of Vapes.

After that, the question was asked about the period of consumption of vapes, resulting in 53.3% of the population having stopped consuming it (the reasons are unknown), followed by 21.7% who rarely bought a vape, while 13.3% continued to buy occasionally , 1.7% consume vapes monthly, while 10% buy weekly.

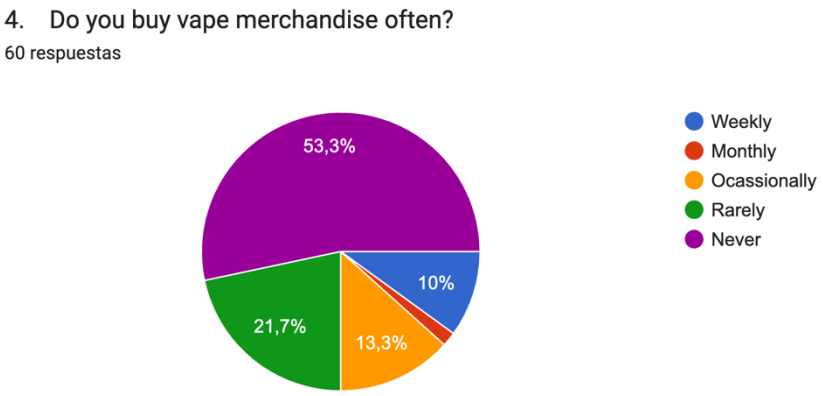


Figure4 Period of merchandise often.

The fifth question mentioned how people manage waste, specifying that more than one option could be marked, of which it was highlighted that the majority of the population with 59.6% gets rid of waste by throwing it in the general garbage can, 28.8% of them have never had a low vape battery laid before, while 9.6% have left the waste at home, 5.8% have returned it to the store, while only 1.9% of all of them have decided to do it at a recycling center.

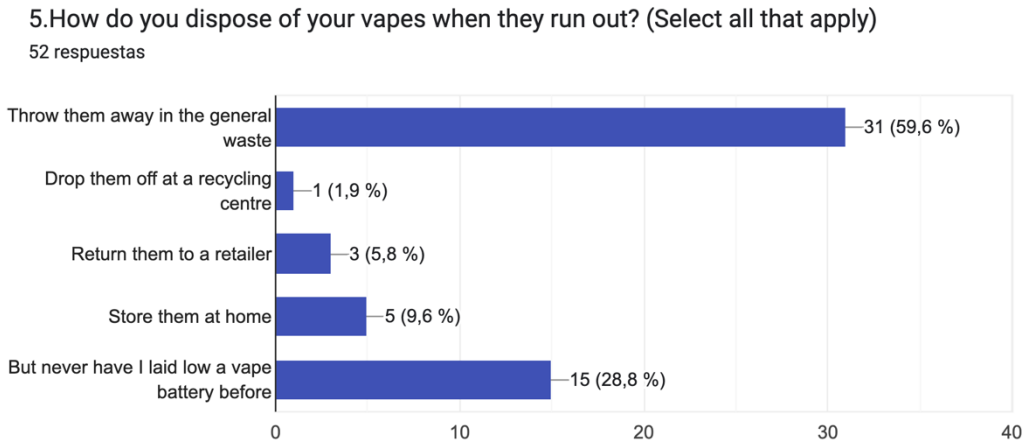
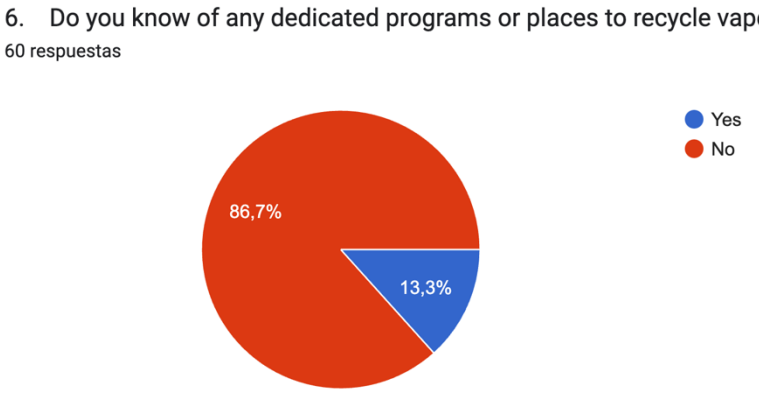


Figure5 Vapes when they run out.

In question number six, the task was to ask if people knew of any dedicated program or a specific place for the management of waste from vapes, highlighting batteries, therefore, it was observed that 86.7% considered that there is no specific place or program, while 13.3% know of a specific place or program.



4.2.3 *Outlook on Recycling awareness.*

To start the third section of the survey, focused on analyzing the point of view that the population has on the notion or idea about waste from vapers, the seventh question has been asked if the population considers that the waste of vapes is a problem, for which it was asked if they considered that waste represented a current problem. The result was that 90% of the population has considered that they do indeed represent a problem, 6.7% are not sure if it is a current problem, while 3.3% do not see it as a problem.

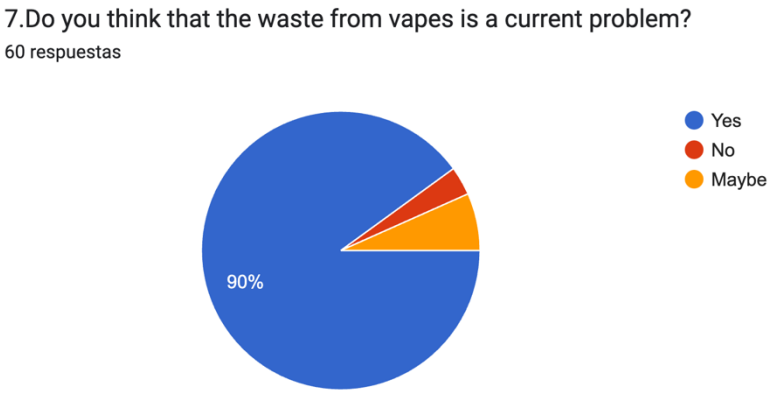


Figure6 Waste from vapes is a current problem.

Afterwards, the level of importance that the population thinks the proper recycling of vapers has been consulted, highlighting the batteries coming from these, taking a scale from 1 to 5, where 1 being not important and 5 being very important, showing different levels of importance. The result was that 61.7% considered it to be very important (5), while 26.7% considered it important (4) and 11.7% saw it as moderately important (3).

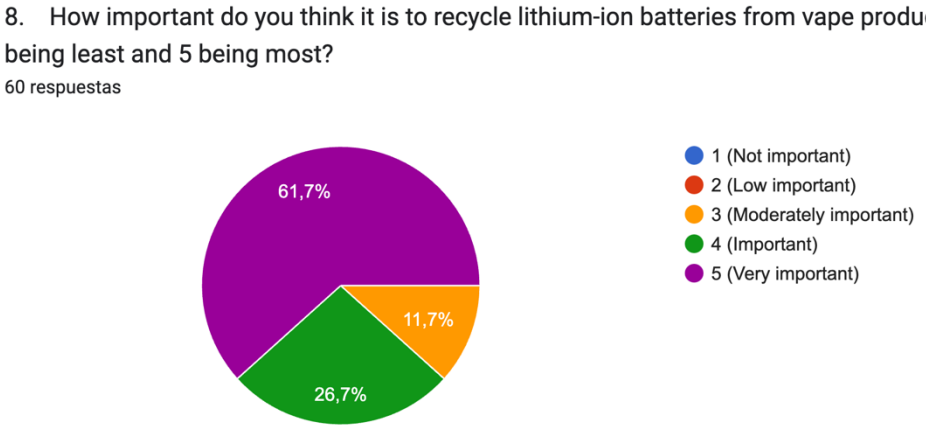


Figure7 Level of importance for recycling batteries from vape products.

In question number 9, an attempt was made to delve into the obstacles that the population faces to properly manage waste once the vapes have fulfilled their function, for which certain options were given. In this question, more than one option could be marked, resulting in: 35 people (59.3%) have no idea where to even begin recycling, while 25 (42.4%) of them consider that the points to do so are very far away, which generates long distances to travel to the recycling centers, 27 of them (45.8%) do not know the ways in which they can recycle waste from vapers, while 11 of them (18.6%) consider that they do not have time to carry out the process correctly, two of them (3.4%)

considered that recycling this kind of products is a waste of time, while 1 (1.7%) considered that there is a lack of information on where to do it.

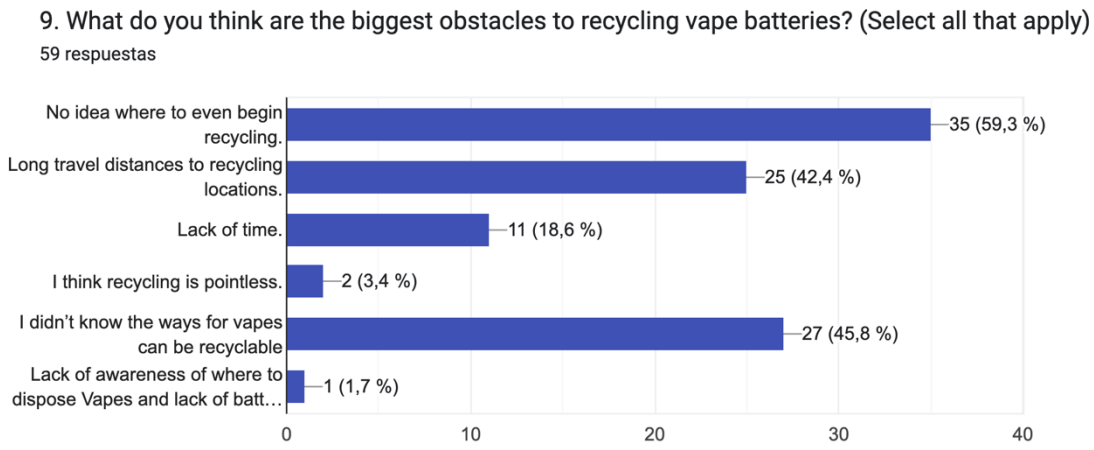


Figure8 Obstacles to recycling vape batteries.

4.2.4 *Efficiency of the recycling and waste management program.*

In section 4, the behaviors and points of view on the current waste management programs for these products have been analyzed, an attempt has been made to investigate the usual practices of consumers, knowledge of the programs and their efficiency.

Therefore, in question number 10, it was asked if people would deposit vapes in recycling places if this process were easier, for which 69% mentioned that they strongly agree with this, while 22.4% agree and 8.6% mentioned being in a neutral position.

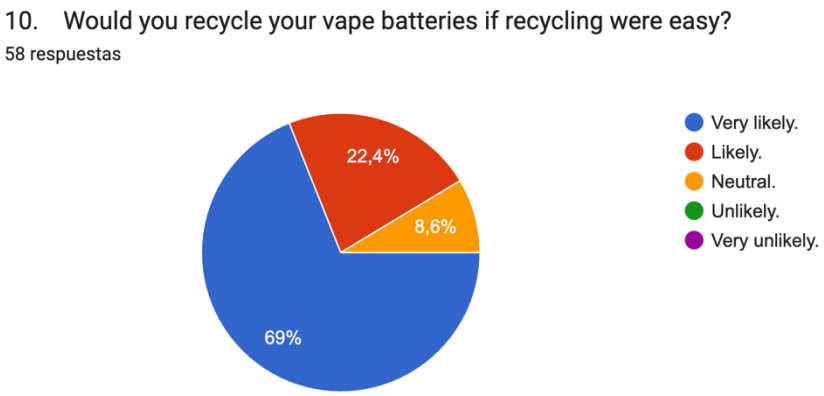


Figure9 Recycling was easy.

In question number 11, the question was asked if they knew of a specific place where vape waste could be deposited, so 91.5% mentioned that they did not know if there was a specific place to deposit vape waste, while 8.5% mentioned that they did know of a place to deposit vape waste.

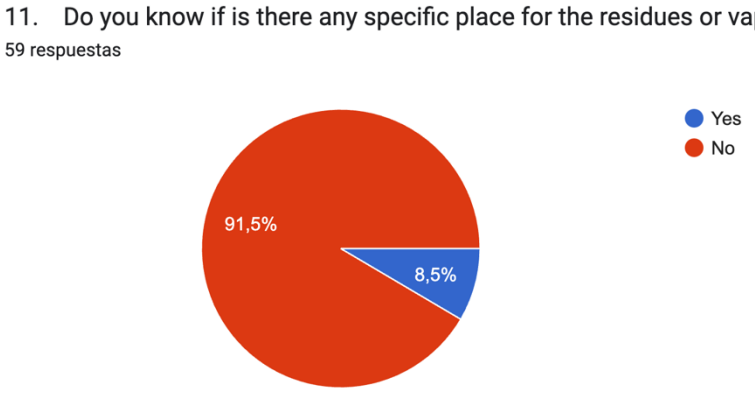


Figure10 Vapes waste place.

Afterwards, they were asked if they knew the nearest place to recycle them correctly, to which 88.1% mentioned that they did in fact know a place, while 11.9% mentioned that they did not know a specific place to recycle them.

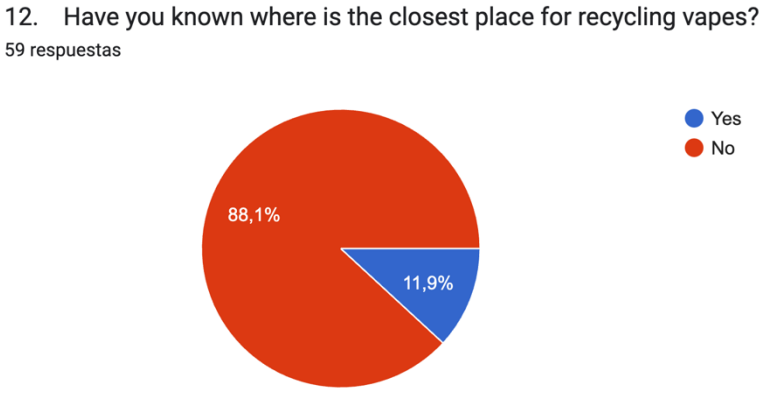


Figure11 Closest place for recycling vapes waste.

In Ireland, the government has proposed, with a campaign that has gone unnoticed by the population, to deposit vapes in a blue box, where disposable batteries are usually found, so in question 13 it was asked if the population knows where the nearest blue box or battery box is, so 85% mentioned that they do know where it is, while 15% do not know..

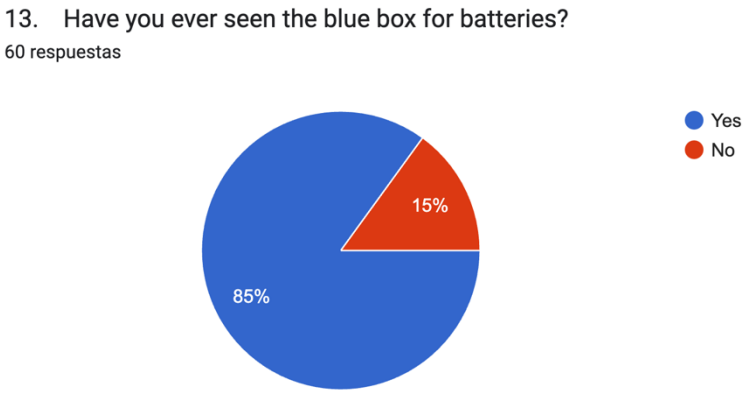


Figure12 Blue box for batteries.

After that, a question was asked, in which it is questioned if the population has followed the program, therefore, it has been asked if they have ever deposited a vape in the blue battery box. Therefore, the population answered the following: 62.7% have mentioned that they have never followed that practice, while 27.1% mention that they have seen it but have never practiced it and 10.2% have never seen or used the blue box for depositing vapes.

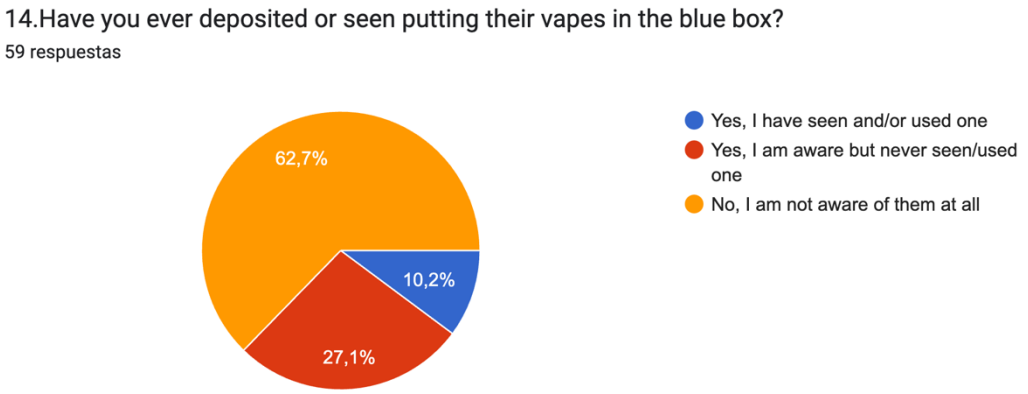


Figure13 Putting their vapes in the blue box.

In question number 15, the population's point of view was investigated, emphasizing the point of whether it is time to have a more effective recycling program, for which 81.4% of them have considered that it is time for a more effective recycling program, while 18.6 % consider that it is not necessary.

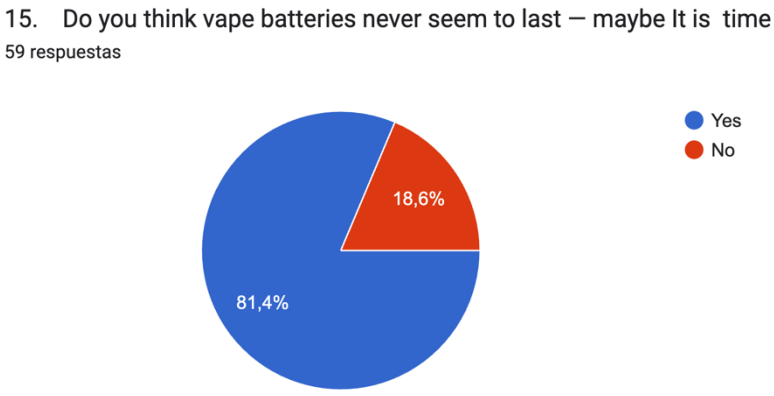


Figure14 Time to use a recycling program.

Once that has been asked, question 16 has been launched where it is mentioned how effective the population considers the current system to have been with the management of waste from vapes, which is why in this question it has been divided into six options (Excellent, Good, OK, Poor, Very poor, Not applicable), giving as findings: 53.3% of the population considers the program very poor, while 21.7 considers it poor, meanwhile 15% considers it Ok, 5% see it as not applicable, in turn, 3.3% considers the program good and 1.7% excellent.

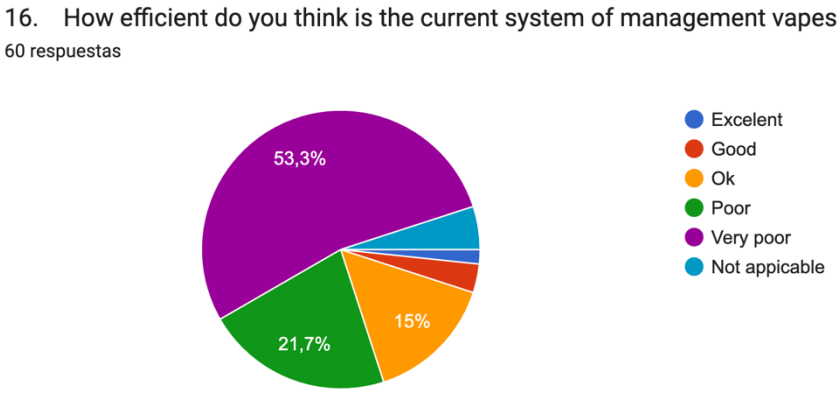


Figure15 Efficiency of the current system for managing vapes waste.

In question 17, the question was asked if the system were to change and, in any case, become larger, more accessible and more efficient, the population would be able to manage waste appropriately, which is why 86% mentioned that they would indeed do so appropriately, while 10.5% still doubt whether they would do so if those circumstances changed, while 3.5% would not take any opportunity to dispose of vape waste properly.

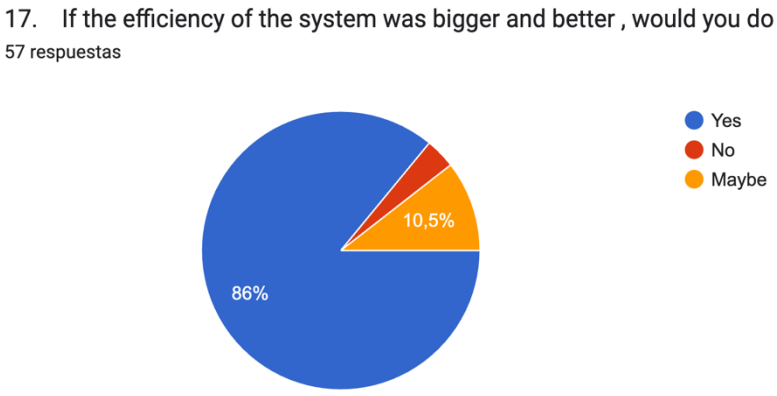


Figure16 proper management waste if the factors change.

Question number 18 was an open-ended question (appendix B) , asking how the handling and recycling of vapes and their batteries could be improved.

The responses spanned a wide range of opinions on correcting the matter. Several suggested that collection points needed to be more obvious and better marked, while others said the government should spend resources on marketing campaigns warning consumers of the risks that batteries present. Some recommended incentives such as deposit-return schemes for recycling or rewards for appropriate battery disposal, others demanded stricter legislation in order to make vapes and their components (especially the batteries) easier to recycle.

Below, as a summary, are the most notable comments about how to improve vape battery recycling currently:

1. Education and awareness: Although most people surveyed recognize the importance of recycling their vape waste correctly, most responses underline the importance of educating the public on how and where to recycle vape batteries. This highlights there is an overarching need to create significantly more public awareness through social media and the news media, as well as at points of sale. People acknowledge they should recycle, but don't know how to.

2. Recycling points available: Many believe that more recycling stations should be created in public places, such as in retails stores (particularly those which sell vaping products), on the street or in areas near bars or clubs (where used vapes are common) to make recycling easier to access.

3. Government initiatives and policies: Some comments suggested a deposit scheme, like bottles, to encourage the return of vapes after use. This is a tried and tested method of encouraging return and recycling. Imposing significant bans or levies on disposable vapes are also suggested to encourage sensible disposal and use of vaping products.

4. Provide information about products: information should be on product packaging and at points of sale so that customers are better informed at the time of purchase of the options available to them to dispose of their product when it has been consumed.

5. Innovation of the product: some responses point to the need to improve the manufacturing of reusable vapes or those with recyclable cartridges to reduce the impact. This could be extended to ensure that all components (particularly the battery) are separate, removable and recyclable. Some recurring responses identified in the table are access to recycling points and adequate education/information are further recurring responses.

Consumer awareness and social media campaigns are also a recurring theme. Banning or regulating disposable vapes was also a recurring response.

4.3 Discussion

The findings from this research paint a clear picture of the current practices and attitudes toward disposable vape battery recycling in Monkstown, Dublin. The results suggest significant challenges in the effective management and recycling of these batteries, exacerbated by a lack of public awareness, insufficient infrastructure, and inadequate policy implementation.

1. Recycling awareness and attitudes.

The survey has yielded revealing data, that although most of the participants surveyed (90%) mention and recognize that it is a problem with waste management, there is a considerable gap in the processes of management of waste from vapes, as well as its recycling. 87.6% of respondents were completely unaware of the existence of the current program, as well as the specific places dedicated to battery recycling, which is a critical factor in the weakness of the system, causing a deficiency in conscious practices in the management of waste of this type. The information is correlated with the fact that there is a large part of the population (59.6%) that will simply throw away waste in general garbage, contributing not only to environmental pollution but generating an impact on

general waste management practices. Batteries (especially lithium-ion cells) can become corrosive, unstable and combustible, that is why the impact occurs until the processing of waste when general garbage is contaminated making it useless.

The findings highlighted the need for best practice, educational campaigns and clearer, more specific labeling of vaping products to inform consumers about the negative impact of improper disposal and the availability of recycling programs. The gap found between concern and recognition that it is a problem and behavioral practices suggested by agencies and their knowledge suggests that making a change by raising awareness among the population could significantly improve recycling rates and contribute to a green supply chain.

He also stressed that there is no part of the surveyed population that does not identify that there is a problem in the management of waste from vapes, but, even so, being aware of this, waste management policies continue to be ignored.

Many consumers have expressed in the open response that manufacturers should provide more visible information on substances for monitoring recycling policies on product packaging.

2. Infrastructure and accessibility.

The study highlighted barriers to effective recycling of e-cigarettes in the system infrastructure. A significant portion of respondents (42.4%) cited distance between recycling points as the main problem for following proper waste management practices, while 59.3% were completely unaware of where to start recycling. These obstacles have pointed to the need to create more conveniently located recycling points, particularly in high-traffic areas such as retail outlets, colleges, universities and public spaces. It could easily be argued that all retailers who offer vape products for sale should be obliged to also collect waste products for recycling.

Furthermore, it is worth highlighting the fact that 85% of respondents know where the nearest blue box for recycling batteries is, while 62.7% have never seen or used the box for disposing of vapes, suggesting that accessibility alone is not enough. The infrastructure of the programs must be accompanied and encouraged by initiatives that allow and facilitate the use of the practices; Possibly through incentives or stricter regulations, the percentage of the population that follows the policies for managing vape waste can be increased.

It is also interesting that only 27.1% had used or seen someone use the box for vape disposal. This reveals that recycling infrastructure is not the only factor, but also distance or people being motivated to cooperate is another of the factors that was observed the most.

3. Efficiency of current programs.

Another critical finding was the perceived ineffectiveness of current waste management programs of this type. With 75% of respondents rating the system as "poor" or "very poor," there is a clear recognition the current system is inadequate an there is demand for improvement. The feedback indicates that an overwhelming majority (86%) would engage in proper recycling practices if the system were more effective and accessible, but despite this, 20% of the population remains unsure whether improving the system would be enough to encourage people to improve their waste management practices. This feedback relates to the potential of a more structured recycling program that not only meets the logistical needs of a community, but also aligns with its environmental values.

4. Suggestion for improvement.

The open-ended responses provided valuable insights into possible improvements. These included more drop-off points within establishments, more general recycling sites, increased environmental education and a campaign to promote good waste management practices, and call for government initiatives in this area, such as more structured approaches to vape drop-off or simply banning non-recyclable vaping products. These suggestions are aligned with global best practices and could form the basis of certain local policies, both for citizens and companies.

Furthermore, it is mentioned that the introduction of innovative designs of these types of products that prioritize recyclability could significantly reduce the environmental footprint of vapers and help create a more functional logistics system for the collection and recycling of batteries. The movement of the industry towards more sustainable products combined with effective waste management strategies generates a positive impact on the community, which could serve as models for other regions facing the same challenge.

5. Implications for policy and industry.

The findings of this study have had important implications for policy making, both for the population and the industry. From a policy perspective, a clear need can be observed to develop and enact laws that more strictly regulate vape waste management

practices, including possible bans on non-recyclable products or the introduction of incentives for recycling these products. Collaboration between government, businesses and non-governmental organizations should be crucial to establish a regulatory framework that not only promotes but also helps enforce the terms and conditions.

From an industry perspective, manufacturers can create and lead sustainability practices that help in market growth, adopting different ecological design practices, educating consumers and actively participating in a reuse chain.

4.4 Conclusion.

It has been observed that the state confirms that, although there is awareness about environmental problems and the challenge of managing vape waste, as well as the disposal of its batteries, there are important barriers that hinder acting on correct waste management practices. Addressing these challenges may require a more multifaceted approach, including improved infrastructure, specific educational campaigns that help to know and promote good recycling habits, and stricter political measures.

By implementing these types of changes, Monkstown could not only improve its local waste management practices, but also contribute to efforts to broaden the scope of waste management, reduce the environmental impact of batteries, and possibly expand the program to other communities.

It also suggests that a team of local businesses, community organizations and government agencies working together may make these efforts even more powerful. Public Private Partnerships can significantly contribute by providing resources, incentives, and creative ideas to address the problem of vape waste disposal. This will inculcate sense of shared responsibility among the residents and administration both to pave way for Monkstown towards more sustainable and waste management system that takes all constituents on board ensuring their partaking too spearheading an environment friendly initiative as a communal drive.

5 Concluding Thoughts on the Contribution of this Research, its Limitations and Suggestions for Further Research

5.1 Implications of Findings for the Research Questions

This study addressed several critical questions related to the management and recycling of lithium batteries from disposable vapes in Monkstwon. Through the collection of empirical data and the analysis of consumer behavior, it has been possible to draw relevant conclusions on how to have a transcendent impact both locally and in broader contexts.

First, what are the current practices for managing disposable vape waste in Monkstown?

The results have revealed that current waste management practices in Monkstown are ineffective, as most consumers, despite being aware of the negative environmental impact and risks of waste products containing batteries, continue to dispose of them in the general waste. This kind of behavior is partly due to the lack of a specific, specialized and appropriate structure for recycling, as well as a low awareness of alternative waste disposal options. This is a clue to how current practices are not good enough but are also caught up in a constant cycle of contamination.

Second. What are the main challenges and weaknesses of the current waste management system?

Major challenges have been identified, including: a lack of more accessible recycling points, a lack of information from more effective educational campaigns, and a lack of incentives that can encourage consumers to engage in such conscious practices. The lack of information was clear and visible, as vaping products also contributed to confusion and poor waste management. The implications of these findings are suggesting that any improvement in the waste management system for these products should focus not only on the structure, but also on consumer education and motivation.

Third. How could an improvement in the waste management system for disposable vapes at the local store be developed and implemented?

Research has suggested that an improved system should include and focus on a comprehensive, accessible framework, educational campaigns, and incentive policies. A deposit system with refund possibilities of some kind could be a good example of how

to encourage consumers to return their used vapes, creating a more sustainable cycle of use and recycling. The implication here is that a successful improved system should focus on improving both physical and psychological barriers that may impact proper recycling.

5.2 Contributions and Limitations of the Research

This study has made important contributions to the field of waste management containing batteries, particularly in vaping products. However, like any research, it has its limitations.

1. Contributions of the study.

One of the main contributions of this research was the identification of specific barriers that prevent the recycling of vape batteries in the community of Monkstown. With the help of the survey and qualitative analysis, it has been shown that, although consumers are aware of the problem of waste management of batteries and vapes, there are still structural and knowledge factors that limit their actions. This information is crucial and provides a basis for future changes and interventions at both local and national levels.

Furthermore, the results contribute to the existing literature on the importance of an adequate and accessible infrastructure for recycling. In several studies on waste management, the importance of an effective system has been discussed, but this research has provided empirical evidence of how the absence and lack of more recycling points or specific places for this type of waste can negatively affect the participation of the population in recycling practices.

Another relevant contribution was the focus on education and public awareness. The results confirm the lack of a recycling culture and proper disposal of vapes, which suggests that improving the system at recycling points is not enough: it must be accompanied by educational campaigns that properly explain how, why and why to recycle vape batteries, this implies public policies, advertising aimed at improving consumer practices.

Finally, the study provides practical recommendations that can be applied by local authorities and businesses to improve waste management practices. These suggestions, based on the study and its findings, have the potential to bring about a change in waste management in Monkstown and extend it to other communities.

2. Limitations of the study

The study has several limitations that need to be acknowledged. Firstly, the sampling was carried out locally and at a single branch in Monkstown, which has limited the generality of the results. Although the findings have been relevant and provide valuable insight into the practices and attitudes of the population, they may not reflect the experiences and behaviors that neighboring communities in other geographical and cultural contexts may have.

Furthermore, the study focused only on disposable vapes, excluding other types of electronic devices that may present the same characteristics and challenges for recycling. This elimination suggests that the results do not capture the entire problem surrounding waste, which could be relevant to having a broad range of products.

Finally, periodic monitoring is essential, which can help assess changes in attitudes and behaviors over time. This means that we cannot determine whether the suggested interventions can generate a sustained impact on consumer behavior.

5.3 Recommendations for Practice

Based on the findings of the investigation, several recommendations can be proposed for improving vape waste management practices in Monkstwon and potentially other communities.

1 Improvement in recycling infrastructure.

One of the key recommendations for structural improvement in Monkstan would be to have more visible and accessible recycling points to encourage and increase consumer participation. Local authorities should, in turn, consider installing more points strategically located, such as retail stores, public transport stations, universities and other high-traffic spaces. These points should be clearly defined, marked and easy to use.

In addition, it is recommended that local retailers be able to actively participate in the collection of waste. This could include creating incentives for consumers when returning the used device, such as discounts on future purchases or the inclusion of loyalty programs.

2 Implementation of a more robust campaign,

Campaigns to encourage and motivate the population are essential to generate a change in the population's behavior. This study can mention that many consumers do not recycle their vapes because they are not sufficiently informed about how to do so or about the importance of doing so. Campaigns should focus on educating the

population about the dangers and benefits, both environmental and consumer, about the good and bad management of batteries and provide clear guidelines on how, when and where to do so.

These campaigns can be carried out in collaboration with educational institutions, companies, media outlets, and social networks to achieve a larger scope and scale. In addition, educational material can be attached to product packaging to ensure that the consumer receives the information at the point of purchase.

3. Development of government policies.

Government policies play a crucial role in promoting recycling and sustainability practices. Local and national authorities are encouraged to implement policies that incentivize the recycling of vapes as well as an effective outreach program. This could include creating a deposit and refund system for devices, as is done with bottles and cans in other countries.

At the same time, policies should require vape manufacturers to include more specific product information and content so they can relate to the recycling system. These policies would not only increase the recycling rate but would also increase manufacturers' accountability and responsibility for the full life cycle of their products.

4 Innovation in the product range.

Manufacturers are encouraged to consider better designs that can be more sustainable. This could include developing vapes that are easier to disassemble, complying with the terms and policies of the Global Agenda and European Union Agenda sustainability plans, using materials that are less harmful to the environment. Design innovation would not only reduce the environmental impact of vapes, but can also differentiate certain brands in the market, impacting consumers who want to do so consciously.

5 Collaborations between the private and public sectors.

Finally, increased collaboration between the private and public sectors is recommended to address issues of vape recycling and new measures to control it. Private companies and governmental and non-governmental authorities should work to develop a comprehensive recycling system that is efficient and safe for the population. This collaboration could include shared funding and dissemination of recycling infrastructure and development, joint promotion and creation of campaigns, as well as the creation of their environmental and economic policies.

5.4 Recommendations for Future Research.

While the study provided a solid foundation for understanding the weaknesses, challenges and opportunities of vaping waste management in Monkstown, there are several areas that could benefit from future research.

Geographical extension of the study

One limitation of this study is that it focuses on a single location in Monkstown. To improve the generalizability of the data, researchers are encouraged to broaden the geographic scope to many locations, covering different regions. This would allow them to compare how practices and attitudes differ in various communities and see whether the solutions suggested in this paper are useful in different places.

Longitudinal research.

Another area for future research is longitudinal study of consumer behavior and attitudes. By observing participants over several years, researchers can determine the long-term impact of educational campaigns and infrastructure projects. This information can reveal important insights into the sustainability of strict interventions and provide regulators with data on whether strategies need to be modified.

Device extension and comparison.

Although this study was specific to disposable vapes, it would be valuable to compare these findings to waste management of other electronic equipment, including cell phones, non-disposable batteries, and other portable equipment. Such comparative research could point to common behavioral patterns and unique dilemmas in managing diverse types of electronic equipment.

Effectiveness of different methods of education and dissemination.

Moving on to identifying areas where future research should focus in relation to this article, one can propose a comparison of the effectiveness of public education and awareness methods. For example, experimental studies could compare social media campaigns with mass media campaigns, or on-site educational materials, which can help determine the most effective way to direct consumer behavior.

Economic impact of recycling policies.

Another topic of future research could be the study of the economic impact of the recycling policies contemplated in the proposal. This would involve a cost-benefit analysis of a deposit-and-return system and assess the impact of such a policy on

businesses, consumers and, more generally, on the local economy. I believe that such research can be very useful in policy formulation and business decisions.

5.5 Conclusion and Reflections

In conclusion, this study has yielded important findings on the challenges and opportunities in managing consumer waste from disposable vapes in Monkstown. Although there are some limitations in the scope of this study and the specification of the results, the implications of the findings are significant and many in terms of practice and others in terms of policy formulation. The research has proven and shown that while consumer recycling awareness has developed positively, there are still some significant barriers in this area. Specifically, these are related to lack of infrastructure, lack of awareness and absence of reward for management practices. However, it has been highlighted that with the right intervention, overall improved infrastructure, awareness campaigns and government policies can be achieved, which would cause the waste collection rate to grow significantly. Reflecting on the process of this research,

A process has been chosen that has approached the issue from a different point of view, that any approach to addressing an issue as gigantic as e-waste management must be complex. In this sense, although this study is limited in scope, it has provided a valuable source for future research and the implementation of more sustainable practices. The road to a more sustainable future in e-waste management is long and all sectors of society must work together on this journey. However, with continuity and implementation of the recommendations I have suggested, Monkstown can become an example for other communities facing similar challenges.

In turn, questions remain as follows:

What would happen if the system had ends for bad practices?

What impact could be achieved if a collection prototype were launched?

Will the vape market be just as relevant in the future?

How many batteries could be functional for reuse after recycling?

The age is determinate for having a different motivation for recycling.

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Appendices

Appendix A –

Research Towards a Greener Future: The Vape Battery Recycling Challenge.

Research dissertation presented in partial fulfillment of the requirements for the degree of MSc in Procurement and Supply Chain Management program.

The information collected in this survey will be treated with strict confidentiality and used solely for analysis purposes to enhance our understanding of vape battery usage and recycling. The data will remain anonymous, and no personally identifiable information will be collected. The results will be presented in aggregate form, and no individual responses will be shared with third parties. Your participation is voluntary, and you can withdraw at any time. We appreciate your cooperation and commitment to this research.

Do you agree with that?

- Forks.
- No.

Section 1 - General Demographic Information

1. What is your age group?

- Under 18.
- 18-24.
- 25-34.
- 35-44.
- 45-54.
- 55-64.
- 65 and above.

2. What is your gender?

- Male.
- Female.
- Non-binary.
- Prefer not to say.

Novel Approach Section 2: Use of an e-cigarette and disposal of the batter

3. Have you ever been a user of vapes?

   - Yes, currently in use.
   - Used in the past.
   - Never used.

4. Do you buy vape merchandise often?

   - Weekly.
   - Monthly.
   - Occasionally.
   - Rarely.
   - Never.

5. Do you simply chuck them into the garbage like we all used to do with cell phone batteries? (Select all that apply)

   - Throw them away in the general waste.
   - Drop them off at the recycling center.
   - Return them to a retailer.
   - Store them at home.
   - But never have I laid a low vape battery before

6. Do you know of any dedicated programs or places to recycle vape batteries?

   - Forks.
   - No.

Part 3: Outlook on Recycling awareness, Attitude towards recycling

7. Do you think that the waste from vapes is a current problem?

   - Forks.

   - No.

8. How imperative do you think it is to recycle lithium-ion batteries from vape products, with 1 being least and 5 being most?

- 1 (Not important)
- 2 (Low important)
- 3 (Moderately important)
- 4 (important)
- 5 (Very important)

9. What do you feel are the biggest obstacle to recycling vape batteries? (Select all that apply)

    - No idea where to even begin recycling.
    - Long travel distances to recycling locations.
    - Frequency of confusion in being recycled.
    - Lack of time.
    - I think recycling is pointless.
    - Other (please specify)

10. Would you recycle your vape batteries if recycling were easy?

    - Very likely.
    - Likely.
    - Neutral.
    - Unlikely.
    - Very unlikely.

Point 4: Efficiency of Recycling Programs

11. Do you know if there is any specific place for the residues or vape?

    - Forks.
    - No.

12. Have you known where is the closest place for recycling vapes?

    - Forks.
    - No.

13. Have you seen or known where is the blue box for batteries?

    - Forks.

- No.

14. Have you ever deposited or seen someone else putting their vapes in the blue box?

- Yes, I have seen and/or used one.
- Yes, I am aware but never seen/used one.
- No, I am not aware of the at all.

15. Do you think vape batteries never seem to last — maybe it is time to use a recycling program?

- Forks.
- No.

16. How efficient do you think that is the current system of managing vapes waste?

- Excellent.
- Good.
- Ok.
- Poor.
- Very poor.
- Not applicable.

17. If the efficient was bigger and better, would you do it properly with the vapes?

- Forks.
- No.

18.How do you think vape battery recycling can be improved upon at this moment in time? (Open-ended question)

Appendix B –

18.How do you think vape battery recycling can be improved upon at this moment in time? (Open-ended question)

1. Put some recycling bin on the streets, especially outside bars or clubs.
2. Request to the government more improvements in the recycling of lithium batteries.
3. Racing awareness about the consequences of lithium batteries waste and the process of recycling them
4. Easier ways of recycling
5. Make designated bins in shops and in public for the vapes.
6. More readily accessible disposal points
7. More awareness about it, I vape very rarely and wouldn't be aware that it should be recycled.
8. Recycling
9. Many things, from the Irish government side we need increased awareness of where to dispose of these things and an increased availability of the disposal bins. Also has anyone ever questioned, if the companies that make these Vapes can make their batteries rechargeable and as the same model that we use for normal appliances. Imagine finishing a vape, taking out the battery, recharging that battery and then putting that battery into your TV remote.
10. Ban disposable, non-rechargeable vapes.
11. I think disposable vapes should be either banned or severely taxed. Vapes should not be disposable and should be developed to be used with recyclable cartridges only. We need more government intervention when it comes to health risks, environmental concerns and licensing around vape selling.
12. Important
13. With more information available about how to recycle vape batteries, consumers can ensure they dispose of them safely and responsibly. Crafting a compelling message is crucial for grabbing attention, conveying your value, and persuading your audience to act.
14. All vape shops selling should have battery disposals for vapes in them as they sell the problem.
15. Information on how/where to dispose of vapes on every packet.
16. Greater availability and accessibility to recyclable deposits

17. easier access and advertisement of vape recycling bins
18. Put recycling stations in more places.
19. If people knew more about it
20. Better awareness.
21. Well, a recycling project for vaping products, some media campaigns.
22. more advertising and better programs
23. More places to recycle vapes. Another idea is to allow shops to take back old vapes.
24. Information on recycling options at purchase point and packaging
25. With more awareness on vape recycling and causes of not thinking about it
26. Some kind of return system maybe in shops
27. More public awareness and engagement by social media
28. Extra charge/deposit when buying so people can return them back to get deposit back.
29. First education - many don't realize there are batteries inside.
30. Two vapes are not like other household items that you change battery/dispose at home; Many people use them on the go and quickly replace with single use vapes so the street bins should have vapes/battery bin section.
31. Three have deposit scheme same as bottles and cans on them.
32. Education - Many people are not aware of where and how to recycle vapes.
33. prohibit the sale.
34. More social media coverage and information communicated in the store with each purchase. Another idea would be to get a discount once you bring the used one.
35. Enable more visible recycling points.
36. More Public Awareness Campaigns are needed.TV Radio.