

VAPE/E-CIGARETTE WASTE MANAGEMENT IN AUCKLAND: NAVIGATING THE PATH TO ENVIRONMENTAL RESPONSIBILITY

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ABSTRACT

In recent years, the popularity of vaping has surged, with a growing number of individuals turning to electronic cigarettes as an alternative to traditional smoking. However, this rise in vaping has brought forth a pressing issue: the management of electronic cigarette waste. There is a lack of established guidelines for the proper disposal of electronic cigarettes worldwide despite the presence of rare metals, harmful chemicals, and intricate components in both the devices and the batteries. Addressing the issue of e-cigarette waste management is imperative for the wellbeing of our ecosystem and communities.

This study explores the existing practices and barriers to vape waste management in Auckland, New Zealand. The analysis explored existing recycling policies and guidelines of the Ministry for the Environment and Auckland Council, discusses the challenges faced by recycling companies, and presents the perspective of the vape stores and the place they see for themselves in the recycling process. This information is compared with best international practices to present practical recommendations which could improve the current recycling practices for electronic-cigarette products.

Keywords: Waste Management; E-waste; Vape Recycling; Environmental Policy

INTRODUCTION

Electronic waste (e-waste) is a significant source of pollution and a challenge to recycle. It includes a wide range of complex electronic products, such as old computers, tablets, mobile cell phones, computer screens, household appliances, and vapes, which all contain metals, polymers, and potentially dangerous compounds like lead, mercury, and cadmium (Amer et al., 2019; Canavati et al., 2022; Goswami, 2019; Paranjape & Yadav, 2023). The improper disposal of e-waste can result in electronic waste pollution, contributing to environmental degradation and potential harm to ecosystems, not to mention the loss of valuable production resources (Leclerc & Badami, 2023; Minashkina & Happonen, 2022; Shaikh et al., 2020; Tukiman et al., 2021). A vape or electronic cigarette (e-cigarette) is a gadget that mimics smoking by giving users nicotine or other chemicals in the form of vapour or an aerosol that may be inhaled (Edwards et al., 2023). Most vaping devices are imported from China (Gravelly et al., 2019). Shenzhen is a recognised global hub for e-cigarette manufacturing (Gravelly et al., 2019). Vapes consist of a heating element, microprocessor, a cartridge or pod that carries a liquid solution known as vape juice or electronic-liquid (e-liquid), and a battery, typical components of e-waste (Aaron, 2021; Buttler, 2023). Electronic cigarettes are hazardous waste and require immediate attention lest they cause severe pollution to soil and groundwater (Awasthi et al., 2018; Belot, 2023; Turaga et al., 2019; Mor et al., 2021; Van Yken et al., 2021).

Euromonitor International highlights the magnitude of the issue, with a record 55 million people using e-cigarettes globally in 2021, compared to seven million in 2011 (Van Reenen, 2022). The escalating number of users directly correlates with the growing environmental impact caused by the accumulation of e-cigarette waste (Mock & Hendlin, 2019). In March 2023, Auckland Council commissioned an audit of kerbside refuse bins (Personal Communications, Auckland Council, 2024). In the 575 kerbside refuse bins sampled, 132 vapes were found. This was similar to the number of household loose batteries (145 items) that were found (Personal Communications, Auckland Council, 2024). Vapes have effectively doubled the number of small batteries disposed of in domestic kerbside refuse bins (Personal Communications, Auckland Council, 2024).

In response to this challenge, some initiatives have emerged within the vaping industry to tackle the issue. Companies like Gaiaca, Terracycle, DotMod, Shanlaan, Dovpo, and Vinn have introduced recycling programmes, disassembling and repurposing vaping devices into raw materials for new products (Buttler, 2023). However, disposing of vapes remains a complex problem due to the lack of comprehensive and complete national or municipal-level solutions, with efforts primarily consisting of private, disparate initiatives. The disposal of e-liquid containing nicotine poses a significant risk to children, pets, wildlife, and water sources. Therefore, raising awareness about proper disposal methods is crucial, discouraging the discarding of these substances in kerbside refuse bins or sewers (Beutel et al., 2021).

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Not all countries have the necessary resources to recycle vapes and other e-waste, so international cooperation and national policies play a crucial role in managing and effective recycling (Shaikh et al., 2020; Tian et al., 2024). By mandating responsible practices and enforcement mechanisms, such legislation ensures accountability among stakeholders, fostering a sustainable approach to e-waste management. Stakeholders, in this case, are those who are potentially concerned with the sale, purchase, use, control of turnover or disposal of vapes, such as consumers, vaping stores, waste collectors and preprocessors, recyclers and government officials (Chygryn et al., 2020;).

In Auckland, New Zealand vape waste management is directly or indirectly regulated by four pieces of legislation: the Basel Convention, the Resource Management Act 1991, the Waste Minimisation Act 2008, and the Smokefree Environments and Regulated Products (Vaping) Amendment Act 2020 (Ministry of Health New Zealand, 2023). The 2023 amendment to vaping regulations introduced restrictions on the sale of vapes with non-removable batteries from December 21, 2023, and obliges vape stores to sell only reusable vapes from March 21, 2024 (Ministry of Health New Zealand, 2023). Finally, in accordance with the Waste Management and Minimisation By-law 2019, Auckland Council's waste collection service strictly prohibits the disposal of vape waste, including lead-acid or lithium batteries, in refuse bins collected from kerbsides (Auckland Council, 2023).

New Zealand has started a few initiatives in response to the rising issue of vape waste (Egan, 2022). Together with TerraCycle, a global leader in recycling, vape companies Vapo and Alt New Zealand have developed a programme for recycling vaping gadgets (Egan, 2022). With this programme, participants in Auckland, New Zealand may deposit their collected e-cigarettes at Vapo stores or send them in by courier (Auckland Council, 2024). Recycling involves breaking down vaping equipment into its component parts, which are subsequently recycled into new goods, like patio furniture (Schyns & Shaver, 2021). The collaboration between vape stores and TerraCycle in Auckland, New Zealand is a prime example of transitioning from a linear waste system to a circular economy model (Fogarassy & Finger, 2020).

Although these recycling programmes are a step in the right direction, we are still a long way to effective vape recycling either in Auckland, New Zealand or abroad (Buttler, 2023; Canavati et al., 2022; Gillingham & Stock, 2018). However, within the new framework regulating the turnover of e-cigarettes, some steps have been taken to reduce the harm of e-cigarette waste to the environment. Once a fully removable battery is required for all single-use and reusable vapes which should make it more manageable for the users to follow Auckland Council battery disposal bylaws (Ministry of Health New Zealand, 2023).

To advance Auckland, New Zealand's sustainability goals, it is vital to study the complex characteristics of e-cigarette waste and develop strategies supported by evidence and tailored to regional needs (Amer et al., 2019). Key problems include the lack of clear legislation and enforcement; lack of a clear and simple roadmap for the collection, preprocessing, processing, recycling and disposal of vapes or their components; and lack of public awareness of the recycling procedures and collection points (Ali & Akalu, 2022; Attia et al., 2021; Chioatto & Sospiro, 2022; Kamateros & Abdoli, 2023; Lopes dos Santos & Jacobi, 2022). A singular focus on carbon dioxide (CO₂) emissions could detract from equally pressing environmental concerns, such as e-waste management and plastic pollution (Tombe & Winter, 2015). While initiatives like the Cities Climate Leadership Group (C-40) strive to minimise CO₂ emissions through innovative urban planning and policies, the e-waste problem remains relatively unaddressed within these frameworks (Hsu et al., 2017).

METHODOLOGY

This study adopted an exploratory design (Nakash et al., 2022). It synthesised publicly available information from the Auckland Council, and other relevant government agencies on the relatively novel problem of managing vape waste in Auckland, New Zealand. This included databases, official guidelines, practice recommendations, policy papers, and statistical data to create a comprehensive picture of the current regulatory and policy framework. Data from public sources and inquiries to the Auckland Council and the Ministry for the Environment were used in accordance with the Official Information Act (OIA) 1982 (Laugesen, 2020). Additionally, the study included semi-structured interviews with three recycling companies and seven vape shops.

The study utilised thematic analysis to interrogate the collected data, employing an inductive methodology to scrutinise official documents and communications and the semi-structured interview data (Ahmed, 2021; Braun, 2023). The semi structured interview data were categorised into five key themes (refer to Figure 1).

Figure 1: Semi-structured Interview themes and findings.

RESPONDENT	COLLECT AND/OR RECYCLE	DO NOT COLLECT OR RECYCLE	MAIN CHALLENGES					
			LACK OF AWARENESS	LACK OF MOTIVATION	LACK OF FACILITIES	INSUFFICIENT LEGISLATION	LACK OF ROADMAP	
Vape store #1	X		X	X			X	
Vape store #2		X	X					
Vape store #3	X		X				X	X
Vape store #4		X		X			X	
Vape store #5		X						
Vape store #6		X	X					
Vape store #7	X			X			X	X
Recycler #8		X	X	X		X		X
Recycler #9		X		X		X		X
Recycler #10		X	X	X		X	X	X

This analytical approach helped address the core research questions regarding Auckland, New Zealand’s current struggle in managing e-cigarette and potential methods for improving these practices to lessen environmental impacts. Thematic analysis was also used to explore publications, publicly available data and responses from authorities and companies.

Ultimately, the analysis revealed four main themes contributing to the challenges of e-cigarette management: regulatory hurdles, public awareness and participation, technological and logistical challenges in recycling, and financial and economic considerations.

FINDINGS

The study showed that there is a serious problem with e-cigarette waste management in Auckland, New Zealand the main causes of which are a lack of awareness and motivation of stakeholders (refer to Figure 1), indicating either a lack of understanding of the recycling mechanics (Attia et al., 2021) or a lack of interest in it. Motivation can be boosted by financial incentives or fines and a communal sense of responsibility (Xiang & Mangmeechai, 2024).

Four of the seven vape stores surveyed did not collect vapes from customers and did not inform them about the consequences of incorrect vape disposal. Respondents of three vape stores claimed that they were participating in the collection programme, but only one of these vape stores had a collection box for spent vapes. The respondent of vape store 6 explicitly said that their main goal was to sell vapes and make a profit and not to pay attention to issues of recycling and environmental impact.

There were also significant problems among waste recyclers. Recyclers 8 and 9 pointed out the lack of financial interest in collecting and processing vapes due to the complexity of the process of disassembly and low content of valuable materials. Recycler 10 noted the difficulties in sorting vapes from the main waste stream and the lack of consumer interest in the proper disposal of e-cigarettes.

The lack of a clear roadmap or guidance on e-cigarette waste management is another significant problem in Auckland, as evidenced by data obtained during the semi-structured interviews with respondents of both the recycling companies and vaping stores. A respondent from Recycler 9 expressed concern about the lack of clear instructions and procedures for collecting, sorting and processing vapes. They noted that “without a clearly defined action plan, their company faces difficulties in determining how to properly handle vaping waste, which makes it much more difficult to dispose of it” (Personal Communication, Respondent 9, 2024). Recycler 10 stated: “We do not have recycling capacities for vape waste. We could collect them, but what is the next step? (Personal Communication, Respondent 10, 2024)”

The same problem was reflected in the responses of vaping store 7, who stressed that their main task is to sell products, and they face uncertainty about what to do with vapes after collecting them. The respondent said, “We just don’t know what to do with vapes if we start collecting them. There are no instructions, there is no set path by which we could send

this waste for recycling or disposal (Personal Communication, Respondent 7, 2024).” Responses to inquiries sent to the authorities confirmed the respondent’s claim that an effective vaping disposal scheme has not yet been developed. The authorities propose to return them back to stores or find special reception points for electronic hazardous waste, which indicates a lack of integration and specialised solutions for the problem of waste management from vaping.

The lack of specialised legislation regulating the management of e-cigarette waste as part of e-waste is one of the main obstacles to effectively solving the problem in Auckland. In Aotearoa/New Zealand the management of e-waste is primarily regulated by the Waste Minimisation Act 2008 and the Litter Act 1979. These Acts provide the legal framework for reducing waste, including e-waste, and improving resource efficiency throughout the country. It enables measures such as product stewardship schemes, where manufacturers, importers, and retailers take responsibility for the entire lifecycle of products, including disposal and recycling. Nevertheless, these laws do not give a clear idea of the problem of e-cigarette waste management as part of e-waste and possible solutions in this area (Ministry for the Environment, 2023). This aspect was specified in the responses of recyclers and vape stores, highlighting the deep uncertainty and legal vacuum in this area. The respondent of recycler 10 pointed out the difficulty of working in the absence of clear regulatory acts concerning the specifics of collecting, transporting, storing, and processing waste from e-cigarettes. They expressed the opinion that “without a legislative framework defining the responsibilities and procedures of all participants in the process, their recycling activities remain unregulated and risky (Personal Communication, Respondent 10, 2024).” Similar problems were identified in the responses of the respondent of vape store 7, where the lack of legal responsibility of all parties led to passivity and unwillingness to get involved in recycling processes. “We do not know what obligations we have under the law and how to properly dispose of these products (Personal Communication, Respondent 7, 2024),” the respondent noted, emphasising the need for legal clarity.

DISCUSSION

The effective management of e-cigarette waste in Auckland faces significant hurdles due to a lack of awareness and motivation among key stakeholders, reflecting a wider global challenge. Addressing these issues is crucial for fostering sustainable waste management practices and promoting environmental responsibility (Attia et al., 2021).

Awareness is foundational in catalysing change. Despite the substantial environmental risks posed by improperly disposed of e-cigarette products, such as contamination from hazardous liquids and challenges in recycling electronic components, there remains a notable gap in stakeholder awareness. Literature highlights the importance of informed consumers in adopting sustainable behaviours, pointing out that awareness can lead to more environmentally friendly practices (Shahabuddin et al., 2023). This underscores the need for targeted educational campaigns to enhance understanding of the environmental impacts of e-cigarette waste and the benefits of proper disposal methods.

Motivation, however, is equally crucial. For consumers of e-cigarette products, motivation can stem from financial incentives or from the recognition that their actions contribute to a greater communal virtue, protecting the environment. This dual approach to motivation—combining tangible rewards with the satisfaction of contributing to environmental sustainability—can significantly enhance participation in e-cigarette- waste management initiatives. The literature on recycling behaviours supports this, indicating that personal commitment and the presence of incentives are key drivers for recycling actions (Attia et al., 2021).

For commercial entities such as vape stores and recyclers, the primary motivation is profit. Ensuring that e-waste collection and recycling processes are financially viable is essential for engaging these stakeholders in sustainable e-waste management practices. Without a clear financial benefit, participation from commercial stakeholders may be limited. This is confirmed by the experience of Shanghai, which continues to increase the pace of e-waste recycling, thanks to the recycling subsidy programme. A special programme introduced in Shanghai, the ‘Old for New’ scheme (OfN), tries to make the formal collection system more attractive in two ways. On the one hand, electronics retailers and other formal take-back entities were given subsidies to offer incentives to consumers to return their e-waste to formal channels. Recyclers also received comparatively high subsidies, enabling them to compete successfully with informal collection systems and cover part of their expenditures connected with the recycling process. The level of electronic waste collection at special collection points and at retailers of electronic equipment reached 2.1 kg/cap/year and keeps growing (Qu et al., 2019).

There are special e-waste collection centres in Vancouver which could help with further insight in e-waste collection. Electronic waste is sent to special recycling centres and the e-cigarettes that Canada cannot recycle are sent offshore according to the extended producer responsibility (EPR) principle. EPR requires manufacturers, brand owners, and initial importers to be accountable for the financing and operation of e-waste management programmes. These obligations are established through legislative or regulatory means (Compagnoni, 2022). At the same time, fines are provided for releasing electronics, including e-cigarettes, into containers for other types of waste. However, statistics on the quantitative collection of electronic waste in Vancouver are not provided by official sources (Tutton et al., 2022). As the Vancouver experience shows, legislation can play a critical role in increasing motivation by creating a framework where compliance with e-waste management and recycling practices is not only environmentally responsible but also legally required, thus avoiding potential penalties.

The data obtained during the study, including feedback from respondents of vape stores and recycling organisations, confirm that the current legislation does not impose clear obligations on any of the parties involved in the process of e-cigarette waste management. This means that there are no legal requirements for vape stores, recyclers and consumers to take a responsible approach to the disposal and processing of e-cigarette products. In addition, the legislation does not provide for extended responsibility of manufacturers for the final fate of their e-cigarette products after their use (Lopes dos Santos & Jacobi, 2022).

The respondents emphasised that the lack of such regulation leads to insufficient motivation for the development and implementation of effective programmes for the collection and recycling of e-cigarette waste. As a result, a significant portion of this e-cigarette waste ends up in landfills, where it can harm the environment by polluting soil and reservoirs with chemicals contained in batteries and cartridges (Kamateros & Abdoli, 2023).

An additional problem is the lack of mechanisms to effectively track e-cigarette waste flows, which makes it difficult to assess the extent of the problem and plan measures to address it. This creates obstacles not only for the organisation of collection and recycling processes but also for the development of policies aimed at reducing the volume of this waste and minimising its impact on the environment. Moreover, current legislation does not provide for extended manufacturer responsibility when a manufacturer obligated by law would be forced to take e-cigarettes back for recycling. Such an approach would be the fundamental for the development of a roadmap based on such a possibility provided for by law (Ministry for the Environment, 2023).

Based on these findings, it became obvious that there is a need to adopt new or modify existing legislation, which will include clear provisions on all aspects of e-cigarette waste management. Such legislation should ensure the expanded responsibility of manufacturers for the disposal and recycling of their products, establish requirements for the collection and recycling of e-cigarette waste, and provide mechanisms for monitoring and tracking the flow of this waste.

The lack of a roadmap and capacities for the collection and disposal of e-cigarette introduces significant obstacles to the effective management of this type of waste, which in turn leads to a number of negative consequences for the environment, public health and economic sustainability. This problem stems from insufficient regulation and coordination of actions between manufacturers, consumers and waste disposal authorities, which makes the process of collecting and recycling e-cigarettes unstructured and inefficient (Shahabuddin et al., 2023).

Without a well-defined roadmap, the process of disposing of e-cigarettes remains chaotic, which leads to their improper handling and disposal. Electronic cigarettes and their components often end up in landfills, where they can decompose for a long time, releasing toxic substances such as heavy metals and nicotine into the environment. These substances pollute the soil and water resources, posing a threat to ecosystems and human health.

In addition, the lack of a roadmap makes it difficult for public awareness and participation in the recycling process. Without accessible and understandable information on how and where to recycle used e-cigarettes, many consumers simply throw them into the kerbside refuse, which exacerbates the pollution problem (Hsu et al., 2017).

The economic consequences are also significant (Tombe & Winter, 2015). Electronic cigarettes contain a number of valuable materials that could be extracted and reused if an effective collection and recycling system existed. The lack of such a system leads to a loss of potential income and opportunities for the development of the processing industry (Tombe & Winter, 2015).

Scientific research confirms that the development and implementation of a roadmap for the collection and disposal of e-cigarettes can significantly improve the situation (Xavier et al., 2021). Such measures not only contribute to reducing environmental damage but also stimulate the development of recycling technologies, create new jobs and contribute to the formation of a more responsible attitude towards the environment among the population (Xavier et al., 2021).

In the context of proper and reasonable legislation, the creation of a roadmap for e-cigarette waste management stands as a critically important next step. This will make it possible to systematise the collection and disposal process, determine the responsibility of the consumers, and ensure proper control and monitoring of the implementation of established procedures. Only an integrated and coordinated approach will make it possible to achieve significant progress in solving this problem, minimise its negative consequences and ensure the sustainable development of society.

RECOMMENDATIONS

Based on the findings and discoveries, several steps should be proposed to improve e-cigarette waste management in Auckland, New Zealand. First of all, the Government should develop relevant legislation in the field of e-waste management. It is necessary to provide for a section of e-waste (which includes e-cigarettes) and identify all stakeholders and their responsibilities. The experiences of Vancouver and Shenzhen demonstrate the positive effect of introducing a system of extended producer responsibility (EPR) into legislation. This does not allow cities such as Auckland, where recycling is

poorly developed, to sidestep the issue of incomplete recycling of e-cigarette waste. It is also proposed in the future legislation to provide for a system for monitoring e-cigarette waste as part of e-waste management. This will allow Auckland to obtain statistical data on the import, consumption, and disposal of e-cigarette, understand the data, and take steps to improve the management of e-cigarette waste further.

In accordance with contemporary legislation, a roadmap can be developed that will allow defining goals, objectives and guidance for all stakeholders. Despite the fact that no examples of a well-developed roadmap for e-cigarette waste management could be found in the literature due to the novelty of the problem, the data obtained from the study allowed us to conclude that such a detailed plan is extremely necessary for Auckland and the rest of New Zealand.

The next step is to increase awareness of the problem and develop methods of solution. It is proposed that a large-scale advertising programme be deployed for the proper disposal of e-cigarettes. This programme should not only include disposal methods but also provide knowledge about the harm caused by e-cigarette waste and its component parts. Knowing not only how but also why it is necessary to dispose of e-cigarettes correctly will increase motivation for this action. Awareness-raising activities can be selected based on the popularity of such communication channels with society, such as television, the Internet, billboards, booklets, and social media.

Motivation is an integral part of the process of bringing the used e-cigarette to be recycled. As already noted, motivation is important for all stakeholders. In the case of manufacturers, this may be their extended responsibility. In addition to realising the importance of the processing process, it is proposed to financially incentivise the consumer. For example, the introduction of an additional duty of \$2 per e-cigarette will require vape stores to return this money to consumers who bring their used e-cigarettes for recycling. The experience of countries that have implemented a system of refunds for packaging of goods or used goods suggests that there will be organisations who collect discarded e-cigarettes and take them to collection points to receive a refund. This will increase the collection and recycling of e-cigarettes, but it will also help clean up the environment and prevent further discarding of e-cigarettes in kerbside refuse or discarded inappropriately.

In addition, one of the recommendations is the introduction of additional containers for e-waste such as small household appliances and e-cigarettes in large cities like Auckland. Stockholm showed the greatest efficiency, where electronic waste is collected in the amount of 17.5 kg/cap/year, which is almost 80% of the total amount of electronic waste. This was achieved by installing special containers for electronic waste in private households. Kerbside collection at multifamily dwellings is a convenient option for residents of densely populated areas. A collection trial at a multifamily dwelling in Vienna (Austria) showed collection rates of 9 kg/cap/year, and kerbside collection with containers in Copenhagen (Denmark) reached 13 kg/cap/year (Salhofer, 2018). The problem of collecting e-waste like e-cigarettes is reduced due to the direct dependence on the convenience of receiving e-waste from the consumer. The introduction of small containers, as was done for organic produce, will allow the collection of not only e-cigarettes but also cables, computer mouse, phones and other e-waste.

Given the fact that Auckland is one of the world's leaders in the production of e-waste per capita, including waste from vaping, it is recommended to increase the number of collection points for receiving e-cigarettes and other e-waste and improve the infrastructure for its processing; recycling. However, e-cigarettes, as part of e-waste management, often do not contain enough valuable elements to be extracted during the recycling process to cover its costs. Therefore, the experience of Shanghai, where refiners began to be subsidised, is a positive example. In addition, this approach correlates with an increasing percentage of e-waste recycling.

CONCLUSION

In conclusion, the study on Vape/E-cigarette Waste Management in Auckland, New Zealand has shed light on the challenges and opportunities in effectively managing e-waste from vaping products. Through a thorough data analysis process employing thematic analysis, key themes influencing e-cigarette waste management have been identified, including regulatory hurdles, public awareness, technological challenges, and financial considerations. The inductive approach allowed for a nuanced exploration of the data, providing valuable insights into the current state of e-cigarette waste management in Auckland.

By addressing the research questions concerning the current challenges faced by Auckland Council in managing e-cigarette waste and potential strategies for improvement, this study has contributed to a deeper understanding of the complexities involved in e-cigarette waste management within the vaping industry. The thematic analysis served as a foundational tool for developing recommendations grounded in empirical insights from diverse stakeholders, paving the way for more sustainable e-waste management practices in Auckland.

In addition, it is important to recognise that this issue is holistic in nature and may be interconnected with further research, including studies on the health impacts of vaping. As the most effective approach to mitigating the issue of e-cigarette waste is by reducing vaping prevalence, there is a need for continued investigation into the broader implications of vaping. This could involve exploring strategies for the cessation of traditional smoking and e-cigarette smoking alongside e-waste management initiatives, thus addressing both the environmental and public health aspects of the vaping phenomenon.

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