

Exploring the Opportunities and Challenges of Implementing Electronic Waste Disposal Sites on Dalhousie's Studley and Sexton Campuses

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EXECUTIVE SUMMARY

The objective of our research is to investigate the accessibility of electronic waste (e-waste) disposal methods on Dalhousie campuses, with the overarching question: How can we increase electronic waste disposal accessibility for Dalhousie University students on the Studley and Sexton campuses? E-waste is the fastest-growing waste stream in the world, and its increasing volume poses significant risks to both the environment and human health (Sahajwalla, 2018). The current e-waste management system at Dalhousie's Studley and Sexton campuses only provides resources for faculty and not students, highlighting significant areas for improvement within the system. We hypothesized that due to the lack of disposal sites on campus, Dalhousie students are not disposing of their e-waste properly; therefore there is a demand for a public e-waste disposal space at the university. The research employed a range of methods including interviews, surveys, literature reviews, and program reviews at Dalhousie University. The study found that a large proportion of students are not disposing of their e-waste correctly. For instance, 78.4% of undergraduate students keep their e-waste at home, 23.5% of students throw their electronics in the garbage, 41.1% trade them in, 44.1% sell them, and only 17.6% use an e-waste disposal facility. Additionally, 93% of Sexton students reported that they would use a disposal site on the Sexton campus, and 83.3% of Studley students would use a disposal site on Studley Campus, highlighting the need for accessible e-waste disposal sites for students.

To address this issue, the report suggests several options to increase accessibility. Such as holding a one-day e-waste disposal event at the Studley campus, or expanding the Sexton Makerspace as a drop-off location during open hours. These options were discussed with the Dalhousie Makerspace and Sustainability office. The report concludes that there are viable options to increase e-waste accessibility for students on Dalhousie's Sexton and Studley campus, going forward we hope that Dalhousie acknowledges our recommendations for increasing e-waste disposal accessibility.

1.0 INTRODUCTION

Electronic waste (e-waste) or Universal waste is the fastest-growing waste stream in the world, with only 15% of e-waste being properly disposed of (Sahajwalla, 2018). Dalhousie University calls this stream Universal Waste, which refers to electronics, batteries, lightbulbs, small appliances, paints, aerosols and much more. These materials, while not deemed hazardous, can be toxic in large amounts and require special disposal (Adebambo & Owen, 2017). Every year increasing amounts of e-waste have been entering our landfills, adding more risk to human and environmental health. In 2019, globally we produced 53.6 million tons of e-waste and this number is only expected to increase over time, due to increased rates of consumption, shorter electronic life spans and reduced availability of electronic repair services (Ali, & Shiraz, 2022). E-waste disposal is not standardized or regulated in Canada. However, most of it falls under the household hazardous wastes (HHW) category which must be handled and disposed of in a manner that meets those regulations (Adebambo & Owen, 2017). Furthermore, in Nova Scotia, most electronics, cell phones and batteries are banned from the landfill entirely (Adebambo & Owen, 2017).

Currently, at Dalhousie's Studley and Sexton campuses, there is a disposal program for staff and faculty but there is nothing offered for students. A report was done in 2012 by Dalhousie students (Gezelius et al., 2012), and another in 2017 by the Office of Sustainability where they identified similar issues and made several recommendations (Adebambo & Owen, 2017). However, the issues have yet to be addressed by the university and we have seen no significant change to the waste management system or policies to be more inclusive of students in the past 11 years. E-waste contains high levels of heavy metals, plastic, and other hazardous materials that have the potential to affect both the environment and human health if not disposed of properly (Gezelius et al., 2012). Furthermore, many electronic products destined for landfills still contain valuable materials, such as gold, silver, and tin (Ali, & Shiraz, 2022). While proper recycling will not offset all of the issues related to e-waste, it is an excellent start to recovering these valuable materials and stopping e-waste from being improperly disposed of.

1.1 OBJECTIVES

The goal of our research was to identify areas of improvement to the current electronic waste disposal system at Dalhousie University. While exploring the interest of creating an accessible space for students to dispose of e-waste on Dalhousie campuses. We hypothesized that Dalhousie students are not disposing of their e-waste properly and that there would be a demand for a disposal space at the university. We believe more needs to be done to ensure Dalhousie students are aware of these issues and have an accessible place to bring their electronic products for safe disposal. It is the inaccessibility and

miseducation around proper e-waste disposal that perpetuates the issues surrounding e-waste. We predict that with the correct education and the implementation of an accessible disposal site, we will be able to divert more waste from landfills and increase overall campus sustainability.

2.0 METHODS

The research conducted for this report encompassed a range of methods including interviews, surveys, literature reviews, and program reviews at Dalhousie University located at 6299 South St, Halifax, NS, Canada. To commence the research, we conducted a thorough literature review on electronic waste to gain a holistic understanding of the issue and its global impacts before narrowing our focus to the university level. Additionally, we examined the current waste management programs and practices at Dalhousie by examining reports and documents provided by the university and the Office of Sustainability. These resources proved valuable in comprehending the specific procedures employed by the university for managing and disposing of waste, as well as for obtaining relevant statistics.

The survey and interview data collection phase of our research was conducted from March 2nd to March 19th, 2023 at Dalhousie University's Campus. Prior to participating, all potential participants were fully informed of the purpose of the study and provided with an explanation of the procedures involved. Participation in the study was completely voluntary, and participants were assured that they could withdraw their information at any time without penalty (Appendix B). To select interviewees, we utilized a non-probabilistic purposive sampling approach, which enabled us to identify key stakeholders who possessed significant knowledge about e-waste management on campus. The interview questions were designed to elicit the respondents' personal insights on e-waste and the university's disposal system. As well as, how much e-waste is produced on campuses in coursework and within the research facilities. We tailored the questions to each interviewee to ensure they were relevant and could generate meaningful responses (Appendix A). Our goal was to obtain diverse perspectives by interviewing professors and staff who work in fields such as robotic labs, battery labs, waste management, and sustainability. Interviews were conducted in person or virtually, each one was recorded and transcribed for easier coding later on; with the exception of one individual who chose to email us their answers in a Word document.

For the survey portion of our data collection, we strived for a randomized approach, to gain a large and diverse sample of the university population. The survey consisted of eleven questions. Primary promotion for the survey was done through social media. To ensure we had respondents from varying faculties, we asked the study population a number of fielding questions to determine what demographic the respondents belonged to. Along with a number of questions that helped us gain insight into their recycling habits and level of interest in the implementation of a disposal site. The survey was created

using Google Forms which allowed us to export the responses as an Excel file for further analysis. Using Excel we created graphs to visualize the patterns and results from the raw data.

3.0 RESULTS

3.1 INTERVIEWS

The interviews conducted during the term provided us with valuable insights into the current waste management system, lab work, and past initiatives and projects. These insights were instrumental in enhancing our understanding of the issue of e-waste on Dalhousie campuses.

3.1.2 OFFICE OF SUSTAINABILITY

The Dalhousie Office of Sustainability works to integrate sustainable practices into the university's policies, programs, and planning. Rochelle Owen, the executive director of the Sustainability Office, played a key role in establishing the current e-waste programs at Dalhousie, while Kareina D'souza, the Sustainability Manager, collaborates with Rochelle on various projects, including waste management. Through our discussions with Owen and D'souza, we gained valuable insights into the inner workings of the Universal Waste program and obtained access to past reports detailing waste disposal at Dalhousie. For instance, if a university-issued computer malfunctions, the department must complete an online form with specific details about the device. Subsequently, the computer is collected by trucking and taken to the Killam Library ITS¹ department for assessment. If the computer is repairable, it is returned to the fleet; if not, it is transported to either the Evergreen program² or an Enviro Depot (Figure 1). To prevent sensitive information leakage, electronics containing hard drives are crushed by the ITS team at the university. However, this program is currently unavailable to students and members of the public, who must transport their electronics directly to the depots located throughout the province. Additionally, Owen discussed the *Call2recycle* program, an industry-sponsored initiative that collects batteries that weigh under 5kg from various departments at the university. At present, these batteries are collected in cardboard boxes placed in different locations and then shipped to Ontario or Quebec for processing. The *Call2recycle* program is open to students but lacks adequate awareness and accessibility on Dalhousie campuses (Adebambo & Owen, 2017).

¹ Information Technology Services

² The Evergreen program is a free electronic recycling facility that aims to divert electronics from the landfill

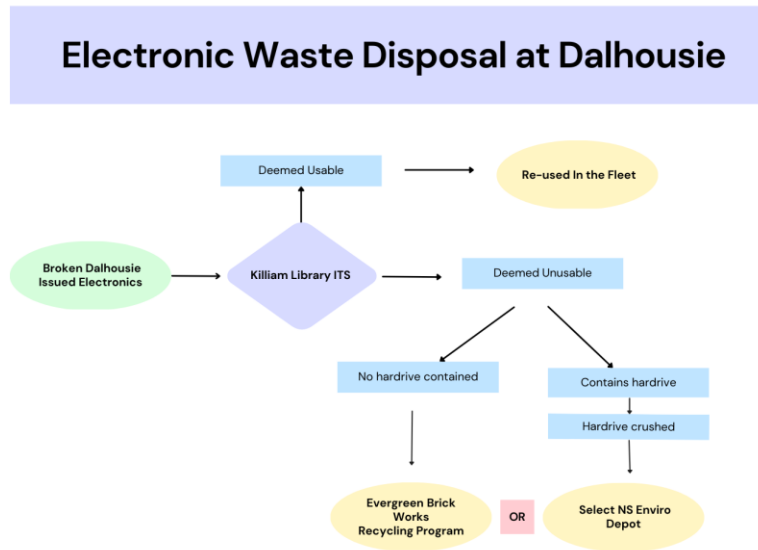


Figure 1. Current electronic waste disposal system at Dalhousie University. Information from the Office of Sustainability and the Universal Waste Management report Dalhousie University Halifax, Nova Scotia, Canada (2017).

3.1.3 FACILITIES MANAGEMENT

We also interviewed Mike Wilkinson from Facilities Management at Dalhousie who provided us with a technical viewpoint of the resources it would take to implement a system for students at the university. Implementing a system of this nature would require significant resources, including policy changes, funding, and physical space. The cost of such a system would need to take into account transportation, maintenance, and staffing costs, which could be significant. One of the main challenges that Wilkinson identified was finding sufficient space on campus for the storage of e-waste, which would be needed to maximize transportation efficiency. “Space is a major constraint on campus so interim storage of e-waste is problematic” (Wilkinson, 2023). Currently, the electronic waste is stored until there is enough to fill a truck which is then transported to the Enviro Depot. Additionally, there is a concern that the implementation of such a program could actually exacerbate the issue of dumping on campus if not properly managed. These factors highlight the importance of carefully considering the feasibility and potential challenges of implementing a student e-waste disposal system at Dalhousie University.

3.1.1 MAKERSPACE

To briefly explain, the Makerspace is a workshop located on the Sexton campus where any Dalhousie student can go and create. A program predominantly led by students facilitates skill building through creating physical projects, where students have access to raw and electronic materials, along with

any tool they would need for a project ranging from a small DIY³ to building a functional robot (DAL Idea, 2023). We had the opportunity to speak with an employee of the Makerspace, Connor Keay, and explore incorporating the space as an e-waste disposal site. From talking with Keay we learnt that the Makerspace deals with a fair amount of e-waste, producing about 0.5 to 1 pound of e-waste per week. This estimated amount does vary, for instance, they can go weeks with no e-waste and then receive a bulk amount the next week. The system in place involves a plastic bin, labelled e-waste, where all electrical waste goes (image 1). Once that bin is full a Makerspace employee will place it on a trolley and bring it down to shipping and receiving, located at the Sexton campus. When it is handed over to Dalhousie custodial staff, they then follow the e-waste protocol that's listed on Dalhousie's website⁴. The e-waste is held in shipping and receiving until they have enough e-waste to be worthy of a recycling pick up. When asked if disposing of the e-waste is ever difficult, Keay stated "It's easy in the sense there's not a lot of accountability, I just have to make sure the bin gets downstairs when it is full. The difficulty comes determining what belongs in the e-waste bin" (Keay, 2023).

3.1.4 BATTERY LAB DIRECTOR

In the interview conducted with physics and atmospheric science professor Michael Metzger, Ph.D., he disclosed his current understanding of the e-waste management system set up at Dalhousie University and how he implements it in his lab. Metzger is currently working with Dalhousie University to research ways to create more sustainable batteries. His main focus is on advanced lithium and sodium-ion batteries optimized for energy density, cost, sustainability, lifetime, and safety (Metzger, 2022). Their lab work generates a lot of e-waste, which is not disposed of through the university e-waste recycling facilities. During the interview, Metzger explained that in the two years he has been at the University he was never made aware that there was an e-waste disposal system set up for professors. Instead, they keep the e-waste created in the lab in a corner where it is only accessible to those working within the space. This habit of leaving recyclable materials to collect dust is often a result of not having an accessible disposal site. Although there is a system in place for faculty, it is difficult to use and time-consuming—time that could be better spent doing research. From this interview with Metzger, we can conclude that not only would an e-waste disposal site be good for students, but it could also increase faculty access.

3.2 SURVEY

³ Do it yourself

⁴ <https://www.dal.ca/dept/sustainability/campus-initiatives/waste/UniversalWaste.html>

An online survey was designed to elicit information regarding students' recycling habits and gauge interest in disposal sites at either the Sexton or Studley University campuses. Here, we will examine and analyze the results obtained from the survey. First, in the question discussing how students disposed of their e-waste, we allowed the respondents to select multiple answers so we could understand the percentage of people doing each task. We determined that a large proportion of students are not disposing of their e-waste in the proper manner. Figure 2 is a flowchart that represents this information. It is separated by each type of student (graduate, undergraduate, or prefer not to say) and how they choose to dispose of their e-waste. Following the undergraduate branch of the flow chart, we can see that 78.4% of undergraduate students keep their e-waste at home, 23.5% of students throw their electronics in the garbage, 41.1% trade them in, 44.1% sell them, and only 17.6% use an e-waste disposal facility. These results represent students who selected multiple options, but it is clear that using an e-waste disposal site is the least reported way that students dispose of their e-waste. It is also clear from our survey that most people are confident with paper/plastic recycling, 74.3% are mostly confident, 16.5% are confident and 8.3% reported not being confident, while 0.9% do not recycle. Additionally, a large proportion of students reported difficulties when disposing of their e-waste from home. 61.5% of students reported finding it very difficult or difficult to dispose of, 21.1% were neutral and 17.4% reported not very difficult or easy (figure 7). When asked if they would use a public e-waste disposal site located on Dalhousie Campuses, the students responded positively. 14 out of 15 or 93% of Sexton students reported that they would use a disposal site on the Sexton Campus (Figure 3), and only one student answered "unsure". Furthermore, 70 out of 84 or 83.3% of students at the Studley Campus reported that they would use a disposal site on the Studley Campus (Figure 4). While only 12 (14.29%) respondents answered "unsure". At the top of the Google survey, there was a brief definition of electronic waste for the respondent to read. Figure 5 shows, 66 out of the 105 (62.8%) respondents stated prior to the survey, they already knew the definition of e-waste. While 24 (22.8%) did not know what the definition was, and 15 (14.2%) respondents reported being unsure. Based on the results from the question "If you are a student, on what campus do you primarily study?"; We determined that the majority of our respondents 84 out of 102 (82%) were from the Studley campus. 15 (14%) were from Sexton and 3 (2%) were from Carleton (Figure 6).

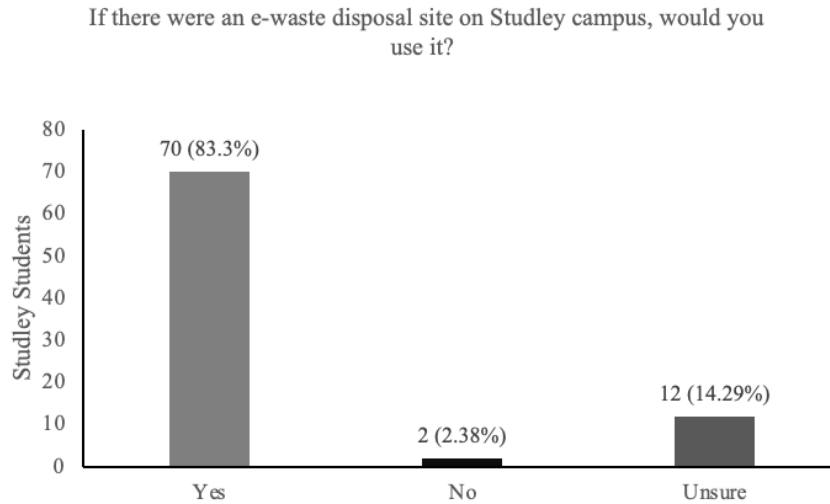


Figure 4. Represents the responses given by Dalhousie Studley students answering the question of whether or not they would use an e-waste disposal site on Dalhousie's Studley campus. Results were pulled from a Google Forms survey and were extracted so the visual solely represented the number of students who attend the Studley campus the most.

4.0 DISCUSSION

Our research aimed to identify ways to enhance the accessibility of electronic waste disposal at Dalhousie University, specifically on the Studley and Sexton campuses. After conducting the research, we discovered that a significant number of students are not utilizing the designated electronic waste disposal facilities around the city. Furthermore, a majority of students reported facing challenges in disposing of their electronic waste from home. We suspect that the inaccessibility of proper disposal sites may be a contributing factor, leading to a significant amount of e-waste generated by these students not making it to the designated facilities. According to Zhang et al. (2019), perceived convenience is positively correlated with individuals' willingness to conduct e-waste recycling. We believe that the implementation of public e-waste disposal sites would help to combat this issue. Our study also identified that the majority of students reported that they were confident or mostly confident with their ability to dispose of plastic/paper recycling. This finding tells us that students are good at and willing to conduct proper recycling when they have the resources and education to do so. Wang et al, (2011), identified 'recycling habits', as the most significant factor in individuals' willingness to recycle e-waste. Based on these findings we can deduce that with better education on proper e-waste disposal and recycling, Dalhousie students would become more confident in e-waste recycling as they are with paper/plastic recycling. Additionally, from our findings, we determined that the majority of students would use a disposal site at both the Studley and Sexton campuses.

From our interview with Key at the Makerspace we uncovered a solution to our research question. In our discussion on how to increase e-waste disposal accessibility on the Sexton campus. Key suggested building a larger bin and promoting it to Dalhousie students as a place where they can come and dispose of their personal e-waste. Expanding the current set-up to be inclusive of all students, and not just those utilizing the Makerspace would address this issue. This would place a greater responsibility on the Makerspace employees when it comes to determining what belongs in the bin, but a brief recycling education session with the posting of a small infographic near the bin could decrease recycling uncertainties. With this new information, we became optimistic that creating student-accessible e-waste disposal can be accomplished. Since there is already a system in place for e-waste disposal connected to the Makerspace, switching it to an inclusive disposal site can be done without changing much of the framework.

While discussing viable options to increase e-waste disposal accessibility on Dalhousie campuses it is wise to explore how other Canadian universities are managing their e-waste and how accessible it is for students. Upon examining the e-waste management system implemented by the University of British Columbia (UBC), it was found that they have incorporated students into the e-waste disposal program. UBC has designated the back of their University Services Building so that students can bring personal e-waste during regulated hours (UBC Facilities, 2023). There is a list of electronic devices on their website that they will accept, ranging from phones to display products, and if a UBC student wishes to recycle something large or unique, for instance, a vacuum cleaner or a sewing machine, the student can pay a small fee (UBC Facilities, 2023). This e-waste disposal location doubles as a space where administrative departments can dispose of their e-waste, making it a one-stop shop. As mentioned above, Wilkinson illustrated that space at Dalhousie remains a limitation to implementing a program similar in nature to UBC's. However, with the help of the Sustainability Office, we identified an alternative solution: a one-day e-waste disposal event partnering with either the Office of Sustainability or the Student Office of Sustainability. In its simplest form, this event could be one day a year or semester where we book a room in the Student Union Building or wherever deemed appropriate and advertise it as a free drop-off day open to all students. From there, a truck is hired and takes the e-waste directly to the Clifton Street Enviro Depot, where the drop-off is free. This solution would eliminate the limitation of storage space because we would collect students' e-waste and take it to a recycling facility on the same day.

4.1 LIMITATIONS

Since we were not able to collect enough responses from faculty and staff for a representative sample, we only used the responses from the students in our analysis, even so, we could not reach the desired sample size of 386. Using Excel we were able to find patterns and trends in the data which are

illustrated in the figures and our results. This also was due to many faculties not responding to our query for interviews, which severely limited our faculty perspective. Furthermore, our data from the Sexton students is less conclusive due to the majority of our respondents reporting being from the Studley campus. These results could be bettered with additional sampling to produce a more representative sample of the Sexton population. The limited time available for data collection was a constraining factor that influenced the sample size. With only a one-week window to collect data within one semester, the resulting sample may not be fully representative of the population. Seeing as most of our responses were from environmental science and sustainability majors, the knowledge of e-waste recycling was significantly higher than expected and shifted the understanding of the entire sample. Hence, for future research, extending the sampling period and outreach to other faculties could help obtain a more comprehensive sample.

5.0 CONCLUSION

In the exploration of how to increase the accessibility of e-waste disposal sites for students at Dalhousie University, we uncovered many valuable insights to address the issue. Through our research, we discovered both the need and desire of students for a more accessible e-waste disposal site (Figures 3 and 4). The lack of accessible disposal sites surrounding the university coupled with respondents' reports of difficulty when disposing of their e-waste from home are the main contributors to the stock-piling of e-waste. Keeping e-waste at home prevents the materials contained within the devices such as gold, silver, and tin from being recycled (Ali, & Shiraz, 2022). Additionally, improper disposal can decrease environmental health and threaten the quality of life for humans (Gezelius et al., 2012). These circumstances can be changed by implementing a disposal site on either of the main Halifax campuses; however, the concern for space, staffing and funding shortages remain as constraints to the implementation of such a program. It was prevalent in our findings that the Studley campus could not sustain a year-round e-waste disposal site for these reasons. This, however, is not a downfall, as the Office of Sustainability offered the idea of hosting a one-day e-waste drop-off event to combat those issues. With adequate advertisements and education, this option could be a great way to increase e-waste accessibility on campus. This, coupled with the expansion of the Sexton campus Makerspace disposal site and more awareness of these programs have the potential to increase overall campus sustainability while addressing the issue of inaccessibility.

LITERATURE CITED

- Ali, & Shirazi. (2022). A Transformer-Based Machine Learning Approach for Sustainable E-Waste Management: A Comparative Policy Analysis between the Swiss and Canadian Systems. *Sustainability*, 14(20), 13220–. <https://doi.org/10.3390/su142013220>
- Adebambo, O., Owen, R. (2017). Universal Waste Management Dalhousie University. Office of Sustainability. *Divert NS*.
- DAL Idea. (2023). *Idea Sandbox and Makerspace*. IDEA Sandbox and Makerspace. <https://dalidea.ca>
- Gezelius, M., Childs, A., Hristow, C., Williams, H., & Wilson, M. (2013). E-Waste and Battery Recycling at Dalhousie University. *Environmental Problem Solving II: The Campus as a Living Laboratory. Student Papers*. <https://dalspace.library.dal.ca/bitstream/handle/10222/77227/EWaste%20and%20Battery%20Recycling.pdf?sequence=1&isAllowed=y>
- Metzger, Michael. Metzger Group Research. 2022. <https://www.metzger-group.com/research>
- Sahajwalla, V. (2018). The Present and Future of E-waste Plastics Recycling. *Current Opinion in Green and Sustainable Chemistry*, Volume 13. Science Direct. <https://www.sciencedirect.com/science/article/pii/S2452223618300452>
- UBC Facilities. (2023). E-waste. UBC Facilities: Building Operations. <https://buildingoperations.ubc.ca/accountability/sustainability/zero-waste/e-waste/>
- Wang, Zhang, B., Yin, J., & Zhang, X. (2011). Willingness and behaviour towards e-waste recycling for residents in Beijing City, China. *Journal of Cleaner Production*, 19(9), 977–984. <https://doi.org/10.1016/j.jclepro.2010.09.016>
- Zhang, Du, Z., Wang, B., & Wang, Z. (2019). Motivation and challenges for e-commerce in e-waste recycling under “Big data” context: A perspective from household willingness in China. *Technological Forecasting & Social Change*, 144, 436–444. <https://doi.org/10.1016/j.techfore.2018.03.001>

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APPENDICES

APPENDIX A

Survey Questions:

1. What type of student are you at Dalhousie University?
 - a) Undergraduate
 - b) Graduate
 - c) Professional
 - d) Other
 - e) Prefer not to answer
2. If you are a student, what is your major?
3. On what campus do you primarily study?
4. If you are staff, what is your role on campus? (custodial, management etc.)
5. If you are faculty, what is your area of study?
6. On what campus do you primarily work?
7. Which of the following do you identify with the most, when it comes to paper and plastic recycling at home?
 - a) I am confident every time I recycle it is done correctly
 - b) I mostly understand but can still get confused
 - c) I am not good at recycling but I try my best
 - d) I do not recycle
8. Prior to this survey, did you know the definition of electronic waste (e-waste)?
Yes or No or Unsure
9. What do you do with the electronics you no longer use/want?
 - a) Go to the store and trade them in
 - b) Sell them to others at a reduced price
 - c) Throw them in the garbage
 - d) I keep them
 - e) I recycle them through e-waste disposal sites
 - f) Other: Please state below
10. How difficult is it for you to dispose of your e-waste at home?
 - a) Impossible
 - b) Somewhat difficult
 - c) Neutral

- d) Easy
 - e) Very Simple
11. How useful to you would an e-waste disposal site be on the Dalhousie campus?
- a) Very useful
 - b) Somewhat useful
 - c) Not useful
 - d) Unsure
12. If there were an e-waste disposal site on the Sexton campus would you use it?
Yes or No or Unsure
13. If there were an e-waste disposal site on the Studley campus would you use it?
Yes or No or Unsure

Interview questions:

Student Interviews

- 1) What type of student are you?
 - a) Undergraduate
 - b) Graduate
 - c) Professional
 - d) Other
 - e) Prefer not to say
- 2) If you are a student what is your current major?
- 3) On what campus do you primarily study?
- 4) Do you know what e-waste is? (If they don't the interviewer will give a description of electronic waste)
- 5) How have you disposed of your e-waste in the past?
- 6) Approximately how much e-waste do you produce each year?
- 7) How useful would an e-waste disposal site be on the Dalhousie Campus?
- 8) How are you currently managing your e-waste?
- 9) If you have disposed of e-waste in the past, was it an easy or difficult process?
- 10) If you find it difficult to dispose of your personal e-waste, how does this affect your life, if at all?

Professor Interviews:

- 1) Of what Dalhousie faculty are you a part?
- 2) Where are the majority of your classes held (Studley or Sexton Campus)?
- 3) Do you know what e-waste is? (If they don't the interviewer will give a description of electronic waste)
- 4) How have you disposed of your personal e-waste in the past?
- 5) If you accumulate e-waste within your coursework / in the classroom how do you dispose of it?
- 6) Approximately how much e-waste do your classes produce each year?
- 7) How are you currently managing your coursework/classroom e-waste?
- 8) If you have disposed of e-waste on campus in the past, was it an easy or difficult process?

- 9) Can you briefly explain that process?
- 11) If you find it difficult to dispose of classroom/coursework e-waste, how does this affect your life, if at all?
- 12) Do you think Dalhousie has an effective system in place for e-waste disposal?

Makerspace Interview:

- 1) What is your role within the Maker's Space?
- 2) Do you know what e-waste is? (If they don't the interviewer will give a description of electronic waste)
- 3) Approximately how much e-waste is accumulated in the Maker's Space each week? (Can use pounds as a tool of measurement or can describe the electronic objects that are disposed of/deemed as garbage each week)
- 4) What are the current systems in place to manage the Maker's Space e-waste?
- 5) If you have been in charge of this disposal process in the past, was it an easy or difficult process?
- 6) Can you briefly explain that process?
- 7) If you find it difficult to dispose of the maker's space e-waste, how does this affect your life / the space, if at all?
- 8) Do you think Dalhousie has an effective system in place for e-waste disposal that supports the Maker's Space?
- 9) Does Maker's Space ever try to reuse old/used/broken electronic waste?
- 10) Would the Maker's Space be interested in reusing electronic donations received from Dalhousie students?
- 11) Is there anything else you would like to share?

Staff who are not professors interview:

- 1) Of what Dalhousie faculty are you a part?
- 2) While working, which campus are you most involved with (Studley or Sexton Campus)?
- 3) What do you know about electronic waste?
- 4) Can you briefly tell us about how the current electronics recycling program for faculty/staff at Dalhousie works?
- 5) Approximately how much electronic waste does this program produce each year?
- 6) Do you think Dalhousie has an effective system in place for electronic waste disposal?
- 7) In what ways can the current electronic recycling program for faculty at Dalhousie Sexton and Studley campus be improved?
- 8) What is your opinion about implementing a program for students to dispose of electronic waste at Dalhousie?
- 9) Is there anything else you would like to share?

Email: Use for initial contact with Dalhousie professors/faculty.

Hello Dr. _____,

I hope this email finds you in good spirits.

I am an environmental science student currently conducting a research project about electronic waste (e-waste) on Sexton and Studley campuses. This research project is a part of the ENVS/SUST 3502 course. My group and I were hoping to do a short interview with you (11 questions- approx 10 mins) to discuss your knowledge of e-waste management at Dalhousie University. Our goal is to create a more manageable and accessible e-waste disposal system for students and faculty here at Dal.

If this is something you are willing to participate in, we can meet in person, talk over the phone or we can conduct a virtual interview in which I email you the questions and you answer them at whatever time you see fit, (before March 15th).

Thank you,

APPENDIX B

Consent Form

You are invited to participate in a research project examining electronic waste (e-waste) disposal on Dalhousie's Sexton and Studley campuses.

Electronic Waste Definition:

E-waste and electronic devices contain high levels of heavy metals, plastic, and other hazardous materials that have the potential to affect both the environment and human health if not disposed of properly (Gezelius et al., 2012). Every year increasing amounts of e-waste have been entering our landfills, adding more risk to human health and environmental degradation. In 2019, globally we produced 53.6 million tons of e-waste and this number is only expected to increase over time, due to increased rates of consumption, shorter electronic life spans and reduced availability of electronic repair services (Ali, & Shiraz, 2022). For these reasons and more, e-waste has been identified as the fastest-growing waste stream in the world (Deathe et al., 2008). Furthermore, many electronic products destined for landfill still contain valuable materials, such as gold, silver, and tin (Ali, & Shiraz, 2022). While proper recycling is not going to offset all of the issues related to e-waste, it is an excellent start to recovering these valuable materials to be put back to use and to stop e-waste from being improperly disposed of (Deathe et al., 2008).

You will be asked to complete a survey involving 11 questions. Your participation in this study is completely voluntary, and you may withdraw at any time without penalty. Please note that by consenting to participate, you have not waived your rights to legal recourse should you experience any research-related harm. This study is being conducted as part of a course requirement for the Research Project for ENVS/SUST 3502. All information obtained is strictly confidential. Please note that any data sent electronically or stored online may be legally accessed by domestic or foreign authorities. All responses

will be analyzed as a group and all data will be presented in summary form; no individual data will ever be presented. Only the researchers will see the raw data. While the results of this study will be included in a paper submitted for ENVS/SUST 3502 and will be presented to other students in the ENVS/SUST 3502 course as part of a course requirement, as mentioned prior, only summary statistics will ever be presented and no individual data will ever be included in the paper or in the presentation. This study will take approximately 5-10 minutes to complete. There are no known harms from the completion of this study. There are no direct benefits to you in terms of research results; however, your participation will contribute to a dataset that will be used to further our understanding of the relationship between these variables.

If you have any further questions or need to contact us please reach out to:

Mackenzie Korthals at mc489086@dal.ca

Alix Broughton at al324519@dal.ca

Grace Robinson at gr402280@dal.ca

Yuemiao Xin at ym632553@dal.ca

By filling out this form, I acknowledge that I have read and that I understand the above information and have been given the opportunity to ask questions and have them answered to my satisfaction.

APPENDIX C

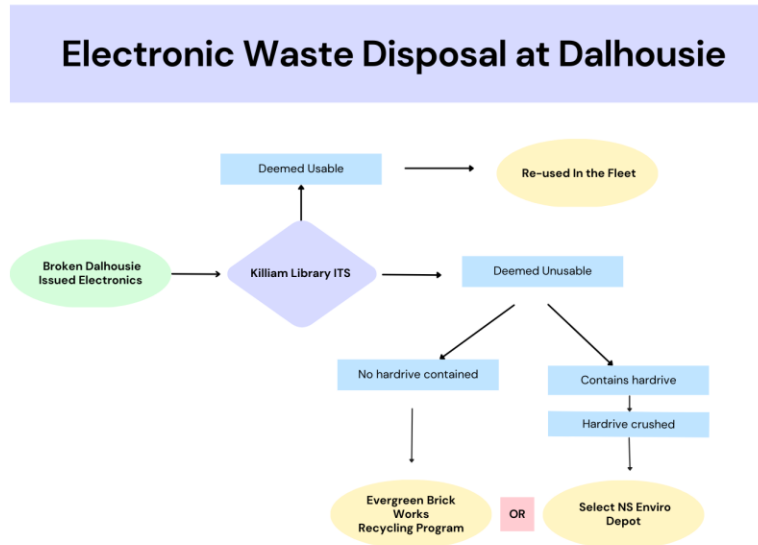


Figure 1. Current Electronic waste disposal system at Dalhousie University. Information from the Office of Sustainability and the Universal Waste Management Report Dalhousie University Halifax, Nova Scotia Canada (2017).

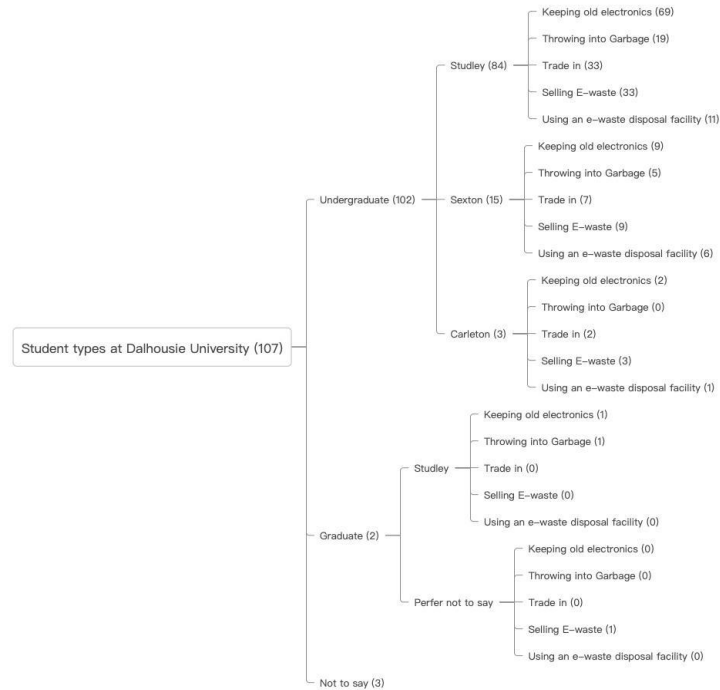


Figure 2. How students from different campuses in Dalhousie handle their e-waste. Data was collected by online google forms survey, survey questions allowed multiple choice.

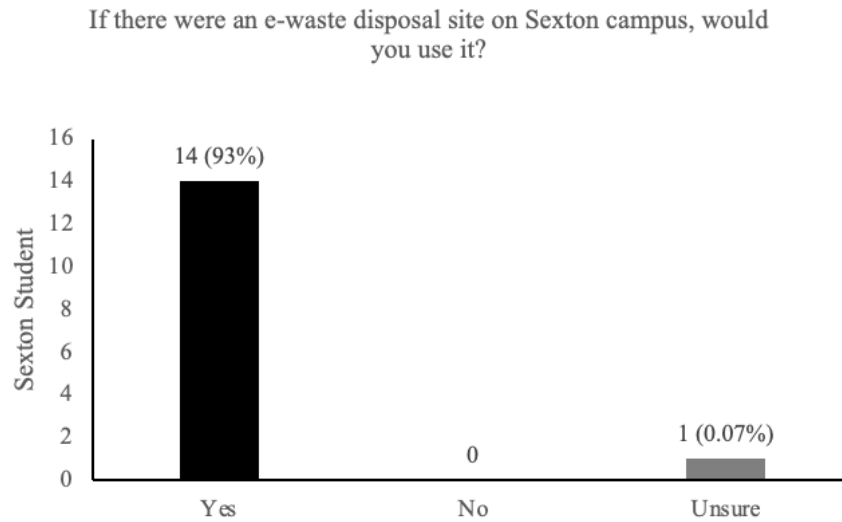


Figure 3. Represents the responses given by Dalhousie Sexton students answering the question of whether or not they would use an e-waste disposal site on Dalhousie’s Sexton campus. Results were pulled from a google forms survey and were extracted so the visual solely represented the number of students who attend the Sexton campus the most.

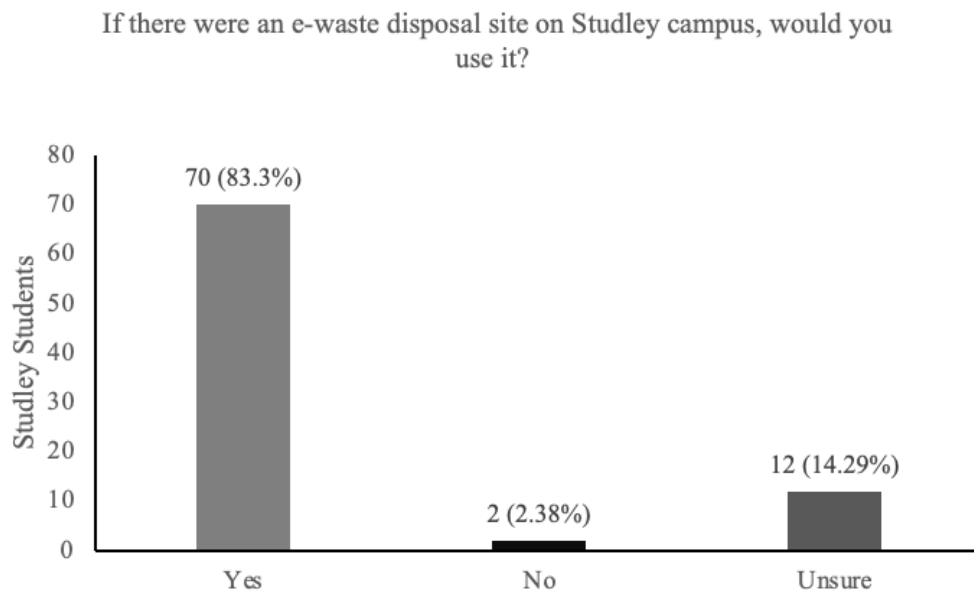


Figure 4. Represents the responses given by Dalhousie Studley students answering the question of whether or not they would use an e-waste disposal site on Dalhousie’s Studley campus. Results were pulled from a google forms survey and were extracted so the visual solely represented the number of students who attend the Studley campus the most.

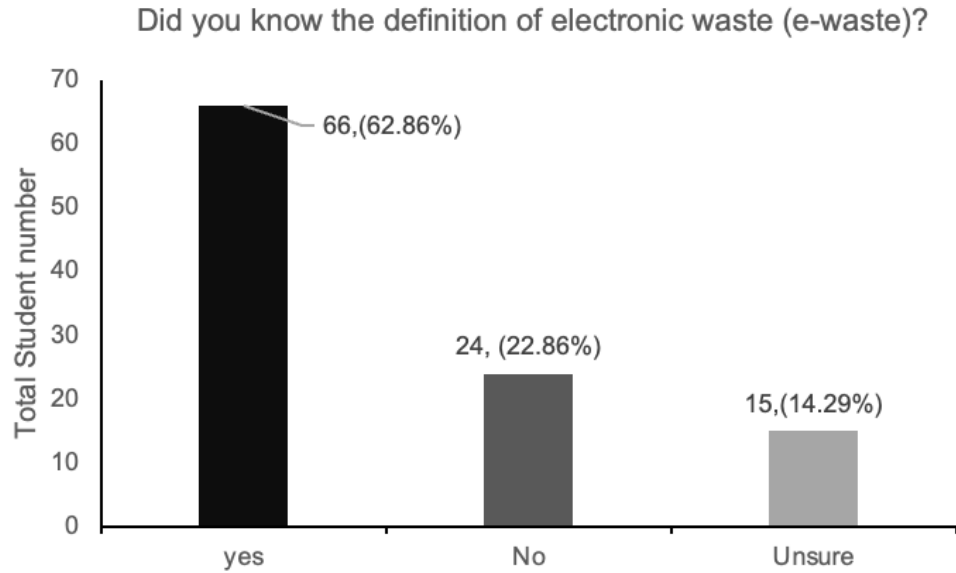


Figure 5. Represents the number of students who did and did not know the definition of electronic waste prior to starting the survey. Results were pulled from a google forms survey.

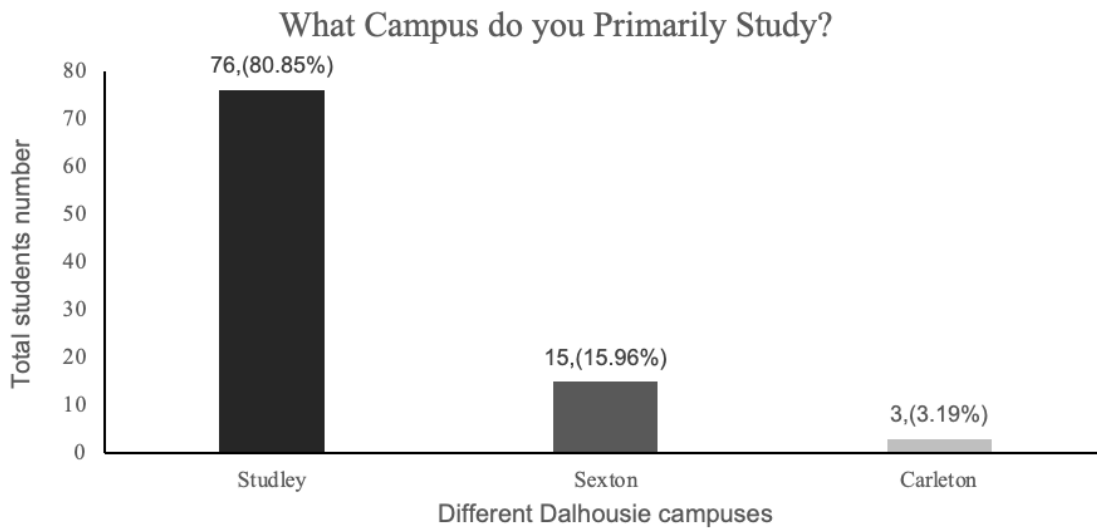


Figure 6. Represents where the students that were responding primarily study. These results help us gauge how to measure the responses to other questions given throughout the survey. Results were pulled from a Google form survey.

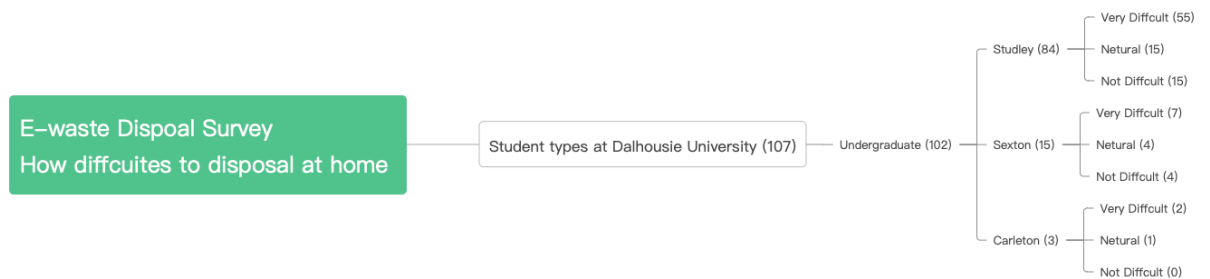


Figure 7. The coding tree shows how different campus undergraduate students think about e-waste disposal. Data was collected by online survey.



Image 1: Current e-waste recycling bin in the Makerspace for reference.