

Electronic Waste Collection Event Proposal

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	2
Executive Summary	4
Background/Context	5
Recommended Action	5
Stakeholder Identification	6
James Rabe:	7
Brad Spanbauer:	7
Dawn Eyre:	8
Tyler Rueth:	8
Daniel Hartsig:	9
Pam Ruder:	10
Mariana Rosado:	10
Charlie Wallace:	11
Benchmarking	11
Costs	13
Barriers	14
Significance for Sustainability	16
Summary/Conclusion	18
Stakeholder Contact Information	19
Works Cited	20

Executive Summary

Throughout the years, as electronics have become more prevalent in United States households, issues have arisen pertaining to the disposal of these products. A large portion of electronics that have reached the end of their usability are sent to developing countries, where workers are required to dispose of these items in ways that heavily degrade the environment, and subsequently their health. Due to these environmental and health concerns, the best method of disposing of electronic waste (e-waste) is by recycling it in environmentally friendly ways, to form new products when possible. This is termed “closing electronics life cycles” (Satyro, L. C., et al., 2018).

In order to move towards more sustainable electronics recycling, our group is proposing that the City of Oshkosh implements twice yearly electronic waste collection events, in which residents bring their used electronics. These events would be advertised to ensure that residents have a clear understanding of the implications of improper disposal, and awareness of methods of proper disposal. The City of Oshkosh would implement these events with the help of a third-party company, who specializes in the recycling of electronic products. We are suggesting that this company be Recycle That Stuff, which we will provide information about further into the Recommended Action portion of the report. We have also included information on other companies who specialize in electronics waste recycling in the Stakeholders section, in order to provide multiple third-party options.

As mentioned previously, electronics recycling is becoming an increasingly important topic, when it comes to sustainability, and the City of Oshkosh would benefit from making residents aware of proper disposal and recycling methods. We have outlined in the Benchmarking section what other cities within Wisconsin do to provide resident access to electronics recycling services, as these cities can provide the City of Oshkosh with an excellent framework for how to run the proposed events. Two collection events a year would provide residents with multiple options for recycling their electronic products, and would not pose significant costs to the city. Price projections are outlined within the Costs section below. Overall, hosting electronics recycling events would be beneficial to the city in its sustainability initiatives, and would provide residents with convenient access to recycling services.

Background and Context

In 2009, Wisconsin introduced a law banning the disposal of electronic waste in landfills, 2009 Wisconsin Act 50. Because of increased legislation within Wisconsin to ban the disposal of electronic waste in landfills, other means of disposal need to be

accessible to citizens within the state. In order to raise awareness of issues pertaining to improper disposal, knowledge needs to be more easily accessible to the public. Granting the public increased knowledge of the importance of electronic waste recycling and providing them with easier access to facilities that will dispose of these electronics, will benefit associated companies, residential families, and the environment.

While Wisconsin does not allow electronic waste to be placed into landfills, lest the person face harsh fines, Oshkosh still does not have a policy preventing electronic waste from being sent to developing countries. As mentioned in the Significance for Sustainability section within this report, shipping electronics to developing countries creates both ethical and environmental concerns. Because of this, the importance of providing services that will accept electronic waste, and manage it sustainably within our own borders is important in ensuring we are being both ethically and environmentally conscious.

To help fix this problem, advertising different methods of disposing of e-waste must become more straightforward and easier to find. Many websites for local companies that recycle e-waste are difficult to navigate, making it hard to find information on whether or not they accept specific electronic waste from the public. This results in a large portion of the population simply hoarding their e-waste or going to the landfill against regulations, which hinders the recycling of a great deal of reusable materials. The solid waste facility within Oshkosh currently accepts electronic waste for residents within Oshkosh, but as mentioned previously, the city's website is difficult to navigate, and often residents are left with more questions than answers when it comes to how to dispose of their electronic waste. In creating a collection event within Oshkosh, residents would have accessible opportunities to dispose of their electronic waste in a sustainable manner.

Recommended Action

To promote the proper recycling of local electronic waste in Oshkosh, and guarantee no waste is deposited into landfills, we are proposing that the city host bi-annual electronic waste collection events at Oshkosh City Hall. The electronic waste collection event would be hosted bi-annually, allowing those who miss one event to have another opportunity to recycle their electronic waste. These events should be hosted by a third-party company, who partners with the city. Within our stakeholders section, we detail three different representatives from companies who we interviewed, and showed interest in our proposal. These three companies are Recycle That Stuff, Sadoff Electronics Recycling, and Refrigerant Depot. Based on information that we received from each company, we have determined that Recycle That Stuff would be the best option for a third-party company to pair with, due to the barriers that may arise in

partnering with the other two companies. Recycle That Stuff provides the most resources for the event, the most materials, and the lowest fee structure out of all three companies. Additional details about Sadoff Electronics Recycling and Refrigerant Depot can be found within the Stakeholders Section of the report.

Every year, two collection events should occur on Saturdays in spring and fall, between April and June, and between September and October, respectively. After covering the event fee, the city is responsible for providing an area to collect waste, which should include adequate space for unloading materials from resident vehicles and one exit and one entrance for smooth traffic flow. To allow greater accessibility to all Oshkosh residents, the event should also be held in a central location within the city. Based on these recommendations, James Rabe recommended that City Hall would be the most appropriate suggestion.

The second portion of our proposal consists of recommending a thorough advertising campaign in which most, or every social media platform would be used to promote the event. Similarly, newspapers, magazines, posters, fliers, brochures, and word of mouth would get information out about the event. Additionally, we recommend that the City of Oshkosh website be updated to reflect the importance of proper electronic waste recycling. The current City of Oshkosh website does not include adequate information for residents to determine where to take their electronic waste. The city website can be updated to include information on issues associated with improper disposal, as well as detailed information on the benefits of electronics recycling.

A common theme of our stakeholder interviews was the difficulty consumers have in determining where to take their electronic waste. These collection events would bring the means to recycle their electronic waste directly to the consumers. This course of action would also ensure that the electronics that are dropped off will be recycled in an environmentally friendly manner. Details on logistics of the event, as well as costs will be provided within the following sections of this report.

Stakeholder Identification

Included below are a number of relevant stakeholders that were interviewed regarding their interest in the project. In this section, we will discuss pertinent information/ perspectives that each stakeholder provided, and following the Conclusion section is the contact information for each stakeholder.

James Rabe

When meeting with James Rabe, Director of Public Works for the City of Oshkosh, he was optimistic about our group's initiative to promote e-waste recycling outside of what the Winnebago County Solid Waste (WCSW) facility provides. He mentioned that because WCSW is located on the North side of Oshkosh, this limits any residents who can not easily travel to that area. Because Recycle That Stuff gives a flexible requirement for picking a location, the city can choose a central location to encourage more residents to properly recycle their unwanted electronics. After inquiring about a sufficient location to host an e-waste recycling event, he recommended the Oshkosh City Hall as the best option.

Rabe assured our group that the fee for the event would not be a great barrier to hurdle because the city would have to spend a greater amount of funds to run their own e-cycling event, and they would benefit from the third party's strict focus on specialized recycling. The Wisconsin DNR will fund the city approximately 25-30 percent of the cost to support recycling events. Because Recycle That Stuff is certified by the Wisconsin DNR, this should be an attractive event to sponsor.

Brad Spanbauer

Next we met with Brad Spanbauer, a biologist who addresses biodiversity issues and community ecology. He works in the UWO campus sustainability office and teaches both biology and environmental studies courses at the university. He helped create the Earth Week E-waste recycling event, which led us to interview him as a key stakeholder for our E-waste project.

For the Earth Week collection event, Brad said that not having pre-registration helps to encourage people to come out to the event if they had only just learned about it at the last minute. Determining a limit or cap on the amount of waste they will take in will be dependent on the scale of the event, but if a fee is being charged for the individual waste items, then Brad advised that it is not necessary to have a cap. Allowing large pieces of electronic waste to be taken in is a good way of generating revenue from the event, and if the overall event is operated properly, then it would be difficult not to walk away with a profit. There is more information on this within the costs section.

In order for this to be a successful event, according to Brad, advertising for the event would need to be adequate enough to get the information out to each demographic that could benefit from the event. This would have to be done in multiple ways. Social media platforms have a lot of potential for getting this information out to each and every demographic that would have a use for an e-waste collection event, however, knowledge of which demographic uses which platform is paramount to allowing this information to permeate the entire community. Similarly, the web pages that share information regarding an event, and also which companies take electronic

waste in and what is involved in that process on an individual level for these companies. Brad reported how many citizens around Winnebago County feel somewhat lost in regards to what they should do with their electronic waste. Similarly, in seeking out information for this project, our group had some trouble navigating web pages to find information on what individual companies' policies were for e-waste. If these companies, and primarily the city website, fleshed out their page on the internet, it would help residents find ways to deal with their waste instead of hoarding it in their houses.

Similarly, using every method possible will allow for the information to permeate the public and get the word around about the event. This could include newspaper/magazine ads, talking about it over radio broadcasts, putting out fliers or posters around local businesses, and getting the right people "in the know" to pass on the information to a wide audience.

Dawn Eyre

Dawn Eyre was the next person we interviewed. She is the owner of a business called Segues, which helps senior citizens relocate. The company helps downsize the client, pack their belongings, get them moved, completely furnish their new house, and then they go back to the old house to completely clear it to be placed back on the market. In doing so, her company comes across many stashes of old electronics that families did not know how to dispose of.

To manage these piles of e-waste, Dawn and her crew must find third parties or drop off locations where they will manage the e-waste. Segues typically use a third party that they know personally who comes out in a truck and loads up all of the recyclables to be dealt with. However, the specific company is based in Milwaukee and they must travel a long distance to get to certain job sites where they can collect the materials. Her recommendation consisted of getting the word out about places that take in e-waste in ways that senior citizens will likely come across. She reported that many of her clients are unaware that such places exist near where they live, so they are unable to utilize them for the recycling of their end of life electronics.

Tyler Rueth

Tyler Rueth is employed by Recycle That Stuff in Appleton. RecycleThatStuff is a third party certified by the Wisconsin DNR that hosts E-waste recycling events throughout the state of Wisconsin. Mr. Rueth was able to provide information on the company's service and how to set up an event for the City of Oshkosh. Because Tyler is employed by Recycle That Stuff, he has a direct connection to the E-waste recycling process and would be considered as a primary stakeholder to our cause. His work is dedicated to keeping electronic waste out of the landfill. Tyler even said that as part of the cost for the recycling event, the City of Oshkosh will obtain a certificate that

guarantees none of the equipment they allocate will end up in the landfill. Because Recycle That Stuff offers this guarantee, the city is able to represent a reputable third party that handles the citizens waste in an environmentally sustainable way.

He informed our group that the copper from wires and other parts of electronics are sourced from their collections, but unfortunately, other pieces are exported because some materials are less recyclable than others. From our conversation on the phone, I felt that he knew exporting materials was a moral responsibility facing the company. Tyler still believes that E-waste recycling is the correct step forward to eliminate toxic chemicals from entering the landfill and human resources such as water and soil. This is an attitude that needs to be implemented more often. Sustainability will not be a seamless business model to start. If sustainable values are established and held at a great importance at the start of a business, the company should be able to continue to use additional sustainable practice as growth proceeds. As Recycle That Stuff continues to host more events and more manufacturers source metals from recycled electronics, less toxic components will be found in water and soil matrices.

As a primary stakeholder, Tyler is valuable because he is most likely one to work with the city if they decide to follow through on a contract with Recycle That Stuff. The city would need to provide an area to host the event, the charge depending on time frame, a signature on the contract, and Recycle That Stuff will provide labor, trucks, packaging and advertising posters. This information was helpful to get an estimate of costs that the city will have to face in order to host these events.

Additionally, Tyler has experience running events in cities like Oshkosh. The City of Neenah holds two E-waste recycling dates through Recycle That Stuff in May and October. Neenah is a city housing almost 26 thousand people, which would represent about forty percent of the population of Oshkosh. After exploring Recycle That Stuff, I noticed my hometown of almost eight thousand people has E-waste days as well. Assuming Oshkosh has a larger budget than both Mount Horeb and Neenah, the fee should be a small price for sustainable practice.

Daniel Hartsig

Another stakeholder that we interviewed was Daniel Hartsig from Wastecap Solutions, the Director of Project Management for a private consulting and waste disposal company. We chose this stakeholder because of the interest that their company has regarding privatized E-Waste, and it was interesting to see how they do not work with municipalities in the way our other stakeholder's companies do such as Recycle That Stuff. Wastecap works with a list of alliances that provide each other with services and consultations, working together to combat problems such as E-Waste, cleaning rivers, and developing Green Building strategies. The nature and motivation of this company is very different from companies that assist in disposal of citizen's E-Waste, but is found in the same industry in combating this issue. In looking at the

differences of privatized E-Waste versus companies who work publicly, it was obvious to us that companies that work with municipalities would be the most beneficial to our goal of hosting an E-Waste event with the City of Oshkosh.

Pam Ruder

Pam Ruder is the Executive Director of Oshkosh Healthy Neighborhoods in Oshkosh. Oshkosh Healthy Neighborhoods is a collection of recognized neighborhoods that allocate funds for events of similar interest. A popular way that neighborhoods would spend their money was renting dumpsters for a day so neighbors could get rid of their garbage sitting at home. Pam mentioned that while attending one of these events, she noticed quite a few items thrown away that could have been donated, recycled or refurbished. Some of these items could have been unwanted electronics making their way to the landfill.

Pam would be considered a secondary stakeholder because she is indirectly affected by the city's motivation to establish e-waste recycling days for the public. She made it clear that the neighborhoods would be very happy to hear if the city would host e-waste recycling days, and that she personally knows quite a few people who have a pile of unwanted electronic waste sitting in their home. Because Pam is on the council for Oshkosh Healthy Neighborhoods, she would be a useful contact for advertising E-waste recycling events, as well as support from Oshkosh residents to establish better education and service to recycle unwanted electronics. Part of our proposal to the board is better information presented to residents of Oshkosh, thus having Pam as a contact will help to spread education on e-waste recycling.

Mariana Rosado

Another relevant stakeholder that we met with is Mariana Rosado, the owner of Refrigerant Depot, a company located in Milwaukee, WI. Refrigerant Depot works with many municipalities within the Milwaukee area to run collection events, so Ms. Rosado has extensive experience in these events, and was able to provide lots of information on what has worked within other cities, and what could be improved upon within different types of events. First of all, collection events should be limited to a 3-4 hour period in the morning to ensure that adequate time is allotted following the event for clean-up and packaging of electronic materials. Refrigeration Depot has staff available to work collection events, but this would add additional costs to the total for the event.

Additionally, there are different types of collection events that can be operated, ranging from limited electronic acceptance to more complete acceptance. The City of Oshkosh could limit the collection event to only small electronics (cell phones, electronics cords, desktop computers, laptops, etc.). The collection of these small electronics is free of charge, and would allow for easier acceptance and packaging. We

could also increase acceptance to include full electronic collection, which would expand collection to include desktop printers, keyboards, VCR players, DVD players, and other larger electronics. The largest available collection would include all electronics as well as appliances, such as microwaves, dehumidifiers, A/C units, and other smaller household appliances. Refrigerant Depot was not able to provide specific cost projections for an event, but would be able to provide detailed cost information when the City of Oshkosh determines exactly what type of event they will host. Mariana Rosado provides perspectives of a key stakeholder, as her company's interests in the proposal are for business purposes.

Charlie Wallace

The final stakeholder that we interviewed was Charlie Wallace, the chief coordinator for electronics management within Sadoff's electronics disposal program. Sadoff has various locations throughout the Fox Valley area, including a location within Oshkosh. Mr. Wallace discussed similar points as other third party companies we met with, pertaining to logistics and item acceptance. Sadoff, similar to the previously mentioned third party companies, works with various organizations to provide materials and dispose of electronics following collection events.

One important factor to emphasize about Sadoff's electronics disposal program, is that they work with UWO to run their collection event, as a part of Earth Week activities. As a result of this, the City of Oshkosh could easily communicate with the university to discuss factors that have led to the success of the university's annual event. Additionally, because of the location of Sadoff within the city, transportation and organization of an event could be easily organized and executed. Similar to Refrigerant Depot, Sadoff was not able to provide specific cost projections for an event, but is willing to provide accurate costs upon the finalization of details of the collection event. Similar to Mariana Rosado, Charlie Wallace also provides important information from the lens of a key stakeholder, as his company's interest in the proposal is for business purposes.

Benchmarking

One municipality that was used for benchmarking was the City of Neenah, and Gerry Kaiser who is the City of Neenah's Director of Public Works. The City of Public Works hosts a very successful E-Wasting event twice a year, and provided us with information on how we could use municipal locations, municipal media outlets to provide

citizens with information, and creating a schedule to host this event. The City of Neenah also provides “punch cards” with 5 punches to their citizens every February to use in events such as E-Waste Disposal, Lawn Trimming Disposal, and other municipal events that assist in disposal of citizen’s recycling or trash. These punch cards eliminate the cover fee specifically for citizens of Neenah, but 5 more punches can be purchased for an additional \$25 if someone has used all of their punches. Or, you can pay the entry fee of \$25 to get your foot into the door of events such as the E-Waste and Lawn Trimming Disposal events. The City of Neenah had a noticeably more informational website in regards to dates of E-Waste events, lists of devices that are accepted and not accepted, and costs associated with disposing the E-Waste. The City of Oshkosh can learn a lot from the City of Neenah’s outreach and ways of providing information, which would lead to a better understanding of E-Waste events for our citizens. The City of Neenah also provides information regarding the third party used (Recycle That Stuff), which would likely be open to contract to the City of Oshkosh due to population size, and demand for disposal of E-Waste.

A couple of examples of companies in and around Milwaukee include GreenTek solutions and ShredIt. GreenTek Solutions offers a buyback program to incentivize citizens to turn in their electronics. ShredIt offers both drop off and pick up services for a fee. The pick up service entails a crew of professionals with a truck who load up the electronics and take it back and properly dispose of them. Citizens in Milwaukee are able to take their electronic waste to local drop-off sites to dispose of their electronic waste for a fee. Local services include GreenTek solutions and ShredIt, which take in the waste for a fee and recycle usable materials while ensuring the destruction of confidential information stored on harddrives. ShredIt offers drop-offs for small loads of waste as well as scheduled pick up services.

An additional municipality within Wisconsin that we examined for benchmarking, is the city of Columbus, WI. An interview with the electronics waste program coordinator provided the following information. Columbus hosts three collection events per year, in which residents bring their used electronics for recycling. Residents are able to bring their unbroken/ undamaged electronics, with no volume limits to how many they can bring. These events are staffed by the City of Columbus's solid waste employees, and they have not run into any issues with understaffing. We spoke with Candace, the manager for the organization of these events, and she explained that having three events per year makes the turnout more manageable, and that these events are very popular within the community. Being that the city advertises these events year-round, residents have a better understanding of the benefits of properly disposing of their electronic waste, and have easy access to information about collection events held within their city. The City of Columbus provides a great framework for electronic waste management considerations within the City of Oshkosh.

Costs

Within this section we will discuss specific cost projections of an electronics collection event within the City of Oshkosh. First, if this city is to use Recycle That Stuff, there are certain costs associated with different periods of time that the event would run. As mentioned in the Stakeholders section of this report, a successful collection event would last 3-4 hours to allow for adequate clean-up and packaging time for the collected items. If the city holds a three hour event, Recycle That Stuff will charge \$200 for their services, while a four hour event would cost \$275. Additionally, Recycle That Stuff has a price system for larger items such as TVs, desktop computers, and fax machines. Residents will pay for each item separately, depending on what they are upon drop-off. These fees are necessary because they cover transportation and recycling costs for Recycle That Stuff to dispose of these larger items. Fees for these larger electronics are listed on the informational flyer provided by Recycle That Stuff, so residents will be aware of costs prior to attending the event. Recycle That Stuff accepts fees by either cash or credit card.

One more cost to consider if the City of Oshkosh utilizes Recycle That Stuff is the fee for printing flyers to advertise the event. Recycle That Stuff provides formats for flyer advertisements, but the city is responsible for providing printing services. Costs for distributing and printing of these flyers would be minimal if the City of Oshkosh includes them within their recycling information flyer that is already provided regularly to residents. Additionally, per the discussion with James Rabe, the City Hall would serve as an ideal location for an electronic waste collection event. Because the City Hall is municipal grounds, there would be no rental charges in utilizing this space.

Provided within the Stakeholders section of this report are also two more companies who specialize in hosting electronics collection events (Sadoff Electronics Recycling and Refrigerant Depot). These companies were not able to provide exact cost estimates, but are willing to work with city officials to examine pricing options when the details of the event are more concrete. Sadoff Electronics Recycling has a facility within Oshkosh, so transportation costs would be at a minimum, and while Refrigerant Depot is a further distance away from Oshkosh, the owner is willing to work on pricing options to minimize transportation fees. Although these two companies were able to provide an abundance of information in regards to company information, they are not able to provide exact cost details until the city determines logistical specifications for the events.

The Wisconsin DNR will also reimburse municipalities that host an event such as this. If Oshkosh were to carry out these biannual events, the DNR would provide a 28% reimbursement for the costs to host it.

Listed below are two possible methods for payment and the collection of income:

- Punch cards can be purchased for \$20-25 for citizens to come to the collection events. After five uses, the card would need to be renewed for an additional fee.
 - Refer to the Benchmarking section for details about the City of Neenah's punch card system
- Recycle That Stuff would be paid by the city to come to the event, and the city would make money off of the collection of the items which they then send off with Recycle That Stuff to deal with.

Barriers

After meeting with the Public Works director James Rabe, as well as the Director of the Sanitation Department Bob Salm, we were able to closely identify the barriers that could be presented in the process of creating an electronic waste collection event specific to Oshkosh. In our conversation with the directors on the behalf of citizens interested in creating an electronic waste collection event, we were able to pitch our ideas of how this could be possible. According to Bob, traffic regulations, scheduling and employee conflicts, and liability issues are some of the potential barriers we could come across.

- Traffic:
 - One of the most important barriers James and Bob mentioned was the use of a facility, and the potential traffic issues that this possibly created. According to Tyler from Recycle That Stuff, the accessibility of the E-Waste drop-off required one entrance, and one exit so that people could easily form a line and exit without creating traffic. One of the areas suggested by the Public Works staff was the Oshkosh Town Hall parking lot, which is municipal property. In using the municipality, this would assist in having liability issues covered with hosting an E-Waste event. We could potentially create a barrier ourselves by scheduling this event on weekends that the Oshkosh's Farmers Market is happening, but this is something that would be worked out by the City's Special Events Coordinator.
- Potential Employee Conflicts:
 - Another potential barrier that we analyzed was the use of employees for both the third party (Recycle That Stuff), and the City of Oshkosh. Although the third party provides the employees to run the event, the City of Oshkosh would need to allot scheduled time for overtime for employees

of the Sanitation Department as stated by Bob Salm, the department's director. This overtime would include approximately 3 to 4 hours of overtime in the department's budget for paying these employees, but would not serve as a potential barrier for the completion of this event. For this event to have employees, it would have to be scheduled accordingly to not interfere with holidays. The City of Oshkosh does not interfere with holidays due to the employee's availability, which makes it harder to find people to work these events. Holidays that we were alerted to stay away from were Memorial Day, Labor Day, and the opening seasons of gun and bow hunting in the fall. This information provided will not only allow us to avoid employee barriers, but also assists in selecting appropriate dates for hosting these E-Waste events that would work best for employees as well as citizens.

- Insurance Policy:
 - Another interesting barrier that was presented by our stakeholders, was the insurance policy side of hosting an event. The City of Oshkosh would be liable to almost everything that occurs at the E-Waste drop-off event, so hosting this event at a municipality would be the best option for their own policy needs. The City would want to insure their protections and requirements, and would require that the third party's insurance coverages align with what their policies require. This would require the City of Oshkosh's Lawyer to meet with Recycle That Stuff's lawyer to work out an agreement between the policies, which is not seen as a barrier due to the amount of contractors the city works with.

- Cost:
 - Another barrier that was presented was cost, and how would the City of Oshkosh handle fees associated with hosting an E-Waste event. To our knowledge presented by James Rabe, the Wisconsin Department of Natural Resources provides partial reimbursements for municipalities that host events such as an E-Waste event. Although the City of Oshkosh would pay approximately \$200-\$500, they would immediately become eligible for a 28% reimbursement from the Wisconsin DNR. Although it was stated that cost would not be a barrier in the first place, they would receive financial reimbursement from the Wisconsin DNR for even hosting the event, which proves to be beneficial for the City of Oshkosh Public Works financially.

- Ease of Access:

- The City of Oshkosh's landfill does accept electronic waste, however, hosting an event will be of more benefit to the residents of the city as the location could be more convenient than going all the way to the landfill. It will also double as a learning opportunity where the citizens can come to a better understanding of why it is important to recycle and what happens with the recyclable materials. Similarly, they will also get a feeling of helping out the environment as well as the community by taking it to a company that will properly dispose of the e-waste.
- Potential conflicts with possible event locations include the ability for the public to actually access the location. This means that we need to find an ideal location in which the majority of the people of Oshkosh can travel by a variety of means to bring their devices to the event. Similarly, we need to take into consideration the flow of traffic to the area and ensure that traffic can flow smoothly and not get backed up. This leads into our final barrier which is the potential for citizens to not be able to easily transport their electronic waste, which could make this event difficult for them to participate in. If this is the case for certain people, they can always rely on local pick up services that will come to their property and collect the e-waste for them.

Significance for Sustainability

The adverse health effects of exposure to e-waste mismanagement are severe in areas that dispose of electronics in unsustainable ways. The human body, as well as the environment, are impacted in a multitude of ways by electronic waste, because of the materials that comprise them. These hazardous materials include mercury, cadmium, lead, polybrominated flame retardants, barium, and lithium. The results from exposure to these components include damage to the heart, liver, kidneys, brain, skeletal system, and birth defects.

The contamination levels present within Guiya, China have been recorded as 100 times higher than the published data from the past. This was found by comparing the data from other areas and basing them off of the guidelines they have drawn up, scientists have been able to confirm that the pollution levels within Guiya are far worse than originally thought. Their open burning and the dumping of the processed materials are the main factors that are causing pollution in the area (M. H. Wong et al. 131-140).

As electronics are becoming increasingly common within households, many studies have been conducted to determine the typical life cycles of these electronics. It has been determined across many studies that electronics are being built in ways that promote obsolescence, in order to force consumers into continually purchasing new

products. This practice is termed “planned obsolescence” (Goering, G. E., 2007). Planned obsolescence has been observed within a large number of companies. This practice has made electronic waste grow significantly within the last two decades (Guiltinan, J., 2008).

Planned obsolescence is an issue that is not easily going to phase out, as producers have incentive to continue the practice. In the *Quarterly Journal of Economics*, Waldman explains that, “in many settings the incentive for a durable goods monopolist to introduce new products that make old units obsolete will be above that which is socially optimal” (Waldman, M., 1993). Because of this, electronics recycling options need to be more clearly available to consumers, as electronics disposal rates are only going to increase with time. Currently, there are many unsustainable electronics disposal practices in place throughout the United States, that involve shipping electronic products to developing countries.

The generation of E-waste and subsequent improper disposal of the products have significant consequences for the natural environment. In developing countries, e-waste is buried, burned in the open air, or dumped into surface water bodies due to a lack of infrastructure to manage disposal properly. Most developed countries have legislation that mandates companies take-back used goods at their end-of-life (EOL) based on extended producer responsibility (EPR). However, developing countries do not have these forms of legislation, allowing rampant pollution of the nearby environment to go nearly unchecked (Nnorom, I. et al. 843-858).

According to an article titled, “The Human and Environmental Effects of E-Waste,” recycling markets within countries such as China, India, Pakistan, Vietnam, and the Philippines manage from 50% to 80% of global e-waste. They shred it, dismantle it, and burn it in “backyards.” The emitted gases damage the environment as well as human and animal health. This e-waste that they handle comes from developed nations, and from internal consumers. The e-waste that is handled within India is majoritively from other nations which account for 70% of the total (McCallister, L. 183). According to this article, which is from 2013, television waste was estimated by UNEP to double, computer e-waste would increase by five times, and cell phone e-waste would increase by 18 times between 2007 and 2020.

Exposure to the burning gases from E-Waste, which are given off from toxic metals such as lead, result in numerous adverse health effects. A study from the Chinese city of Guiyu, which is known as the largest e-waste recycling city in the world, revealed that workers and city residents exhibit substantial neurological, digestive, respiratory, and skeletal problems. 80% of children in Guiyu suffer from respiratory ailments and are at an increased risk for lead poisoning. Brett Robinson, a researcher and professor at Lincoln University in New Zealand warns that wind patterns carrying toxic particles from Southeast China place increased exposure on the 45 million people that live within the Pearl River Delta Region. Toxic chemicals from the burning of

e-waste enter the soil via the “soil-crop-food pathway. This route for toxic chemicals is one of the most significant routes for heavy metal exposure. Considering that these chemicals cannot biodegrade, they persist for long periods of time within the environment and increase risks associated with exposure.

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal is a ban on the exchange of hazardous waste between developed countries and developing ones. E-waste is included in this ban and the U.S., the world's largest generator of electronic waste, is the only industrialized nation in the world that has not yet ratified the Basel Convention. This is because the convention does not have enough domestic statutory authority to be implemented with all of its provisions.

Due to increasingly unsustainable means of disposing of electronic waste, exacerbated by the increase in the production of electronics, recycling options need to become more easily accessible to consumers. In order to reduce the amount of electronics being shipped to developing countries, states and cities need to begin more intensive electronics recycling systems. When electronics move from point of sale, to consumer use, to disposal, the life cycles of these products are linear. Linear life cycles are unsustainable, as the amount of waste produced outweighs the amount of items reused. In order to close these life cycles, and make them circular, electronics recycling methods must be implemented where parts, or the entirety, of electronics are reused. This reuse reduces the amounts of waste generated, and provides a more sustainable approach when navigating electronics waste management practices by reducing the need of mining for precious materials.

For the city of Oshkosh specifically, the collection of e-waste for the purpose of recycling it later on helps reduce the damage to the environment over time by reducing the amount of materials that need to be taken from the Earth. This applies worldwide, but focusing on one region or area at a time allows the overall trend of our production of electronics to become more efficient and sustainable. Without proper recycling, the amount of materials that need to be mined increases, which is accompanied by the shipping of those materials as well as the manufacturing of the raw materials into usable parts. This process is highly inefficient, and exacerbates the destruction of the environment due to human action. Working to systematically reduce these detrimental practices will go a long way in sustaining the environment.

In dealing with increasingly high rates of electronic waste generation, state and city governments must remain up-to-date with best management practices for dealing with electronic waste recycling. Due to increased state legislation aimed at reducing electronic waste being sent to landfills, cities and municipalities have begun placing an increased importance on implementing recycling options for residents. Municipalities typically conduct electronic waste collection “either directly, through contract with private entities, or through arrangements with other municipalities” (Wagner, T. P., 2009). This

variance on collection method is often dependent upon demographics of the population present within the municipality, but as mentioned above in the Benchmarking section, municipalities similar to Oshkosh typically have well-structured collection events.

Summary/Conclusion

The nature of technological advancements is an exponential growth pattern. This exponential growth causes the amount of electronic waste produced annually to increase by greater amounts each year. Since the early 1990's, the amount of electronic devices that families and corporations purchase and use has grown exponentially, resulting in more and more electronic waste being produced each year. While infrastructure has grown to compensate for the increase of electronics consumption in developed nations, developing countries have not been able to keep up in terms of disposing of the electronic waste in sustainable ways. This problem is also exacerbated by slow implementation of policy for dealing with the electronic waste in proper ways, and a lack of resources available to build the necessary infrastructure in these developing nations.

Developing nations have little to no legislation in place for proper electronic waste disposal, and developed nations such as America still allow electronic waste to be shipped across the seas to developing countries, which decreases the amount of materials that we collect in the recycling process, and harms the environment in the process. By implementing biannual electronic waste collection events, the City of Oshkosh would move forward with its sustainability initiatives, and provide residents education on the topic, as well as a convenient service to dispose of their electronics.

Providing adequate information to our citizens regarding an E-Waste collection event would not only benefit families by disposing of their e-waste in environmentally sustainable ways, but would also give the responsibility of hosting a successful E-Waste event to the City of Oshkosh. The City of Oshkosh has sustainable options for disposal, as well as receiving financial benefits from sustainably disposing of electronic waste, which protects the surrounding environment and prevents e-waste from being sent to developing nations where their methods for disposal are not environmentally sustainable.

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