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iWaste: Analyzing Apple's Sustainable Technology Production

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iWaste: Analyzing Apple's Sustainable Technology Production

Ashley Lefebvre

Abstract

Electronic waste is a global issue that has not received the attention it deserves; there is an enormous amount of e-waste from the rapid industrialization of many countries throughout the world. Apple is the largest technology company in the world, with the highest revenue and the largest number of products manufactured. Therefore, it is important to see what they are doing to mitigate their efforts to the electronic waste crisis that is expected to increase in the next seven years. Three policy options are examined in this paper to evaluate and determine how well Apple is following the goals within their 2022 Environmental Progress Report. The first policy addresses Apple's efforts to use recycled and renewable materials in the production of new products. The second policy is the elimination of plastics in Apple's packaging. The third policy is Apple starting to focus on creating products for longevity by producing long lasting and easily repairable goods. As the largest technology producer in the world, Apple is setting the standard for other companies in the industry: valuing profit over the environment. Their neglect of the environment has led to a large issue that has been thrown to the waste side because these companies choose to export waste to poorer countries to hide how bad this crisis really is. The research from these policies recommends that governmental regulations need to be put in place to facilitate the safe disposal of e-waste, Apple must increase their number of recycling centers, make different software updates for specific models, and remove the built in obsolescence that is part of their products.

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1. INTRODUCTION

1.1 Background

The heaviest artificial object on the Earth is The Great Wall of China, and the world's total amount of electronic waste is heavier than this (Leprince-Ringuet). The world's electronic waste generation is equivalent to throwing out **1,000 laptops every single second**, or **86,400,000 laptops a day** ("Electronic Waste Facts"). Technology is rapidly advancing, and companies continue to market the newest version of their products, resulting in the abundance of new purchases of electronics. Consumers are marketed and swindled into buying the newest technology to replace their old and slow devices, and depending on how the consumer and company dispose of these old technological devices is what considers these electronic devices as electronic waste or not. **Electronic waste (e-waste)**, "consists of devices that owners no longer want, have stopped working or are obsolete compared to new emerging technologies" (Miller). The average consumer replaces their phone every 2.75 years (Healthy Journal). Many data plans even support the constant upgrade of a new phone by offering great deals when a consumer turns in their old phone, but what exactly happens to that old phone when they turn it in?



Figure 1: "Computer and E-Waste Recycling in Africa", University of Oxford, Aug. 2016.

Most consumers assume that the phone's parts are reused or are recycled and because they will never see the phone again, they tend to not think about this issue. However, a large portion of this waste is sent overseas into developing countries to rot and negatively affect the

lives of people who must live in close proximity to this waste, and consumers in the United States reap none of the negative externalities from their consumption because they do not see this waste pile up.

The United States has not passed federal laws to facilitate the management and safe disposal of e-waste, so instead they export 10-40% of the waste to be broken down using rudimentary and unsafe methods in other countries (Singh). Every single day Americans throw out over 120,000 laptops and 350,000 cell phones, yearly that amounts to 43.8 million laptops and 127.75 million cell phones (Singh). Therefore, Americans send about 94.9 million to 132.13 million total pieces of electronics as e-waste overseas to rot.

1.2 The Company of Apple

When talking about e-waste, it is important to consider the biggest technology company that produces and sells the most products. Apple is the largest tech company as of 2021, with an enormous \$366 billion in revenue (Silverstein). In 2022, Apple generated \$394.3 billion in revenue, with 52% of this coming from iPhone sales (Curry). Figure 2 shows how much more revenue Apple

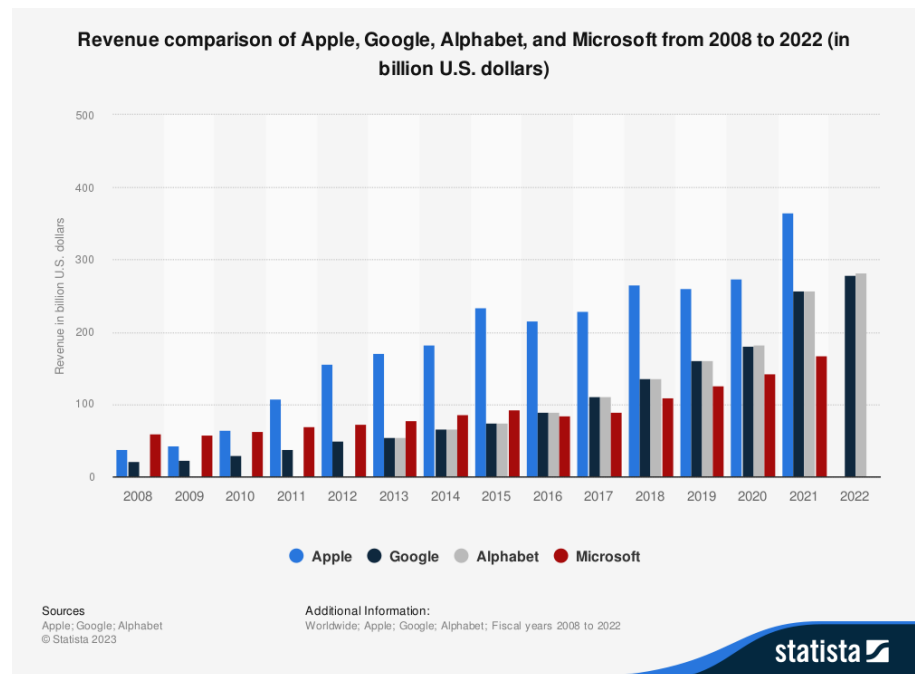


Figure 2: Revenue comparison of Apple, Google, Alphabet, and Microsoft from 2008 to 2022 (in billion U.S. dollars), Statista, 2023.

brings in compared to other well-known technology companies, Google, Alphabet, and Microsoft.

On April 1, 1976, Apple Computers Inc. was founded by Steve Jobs and Steve Wozniak (Richardson). Jobs and Wozniak were college dropouts with a vision of changing the way people viewed computers, to something that is small enough for people to have in their homes and offices. The first Apple computer was sold out of Job's garage without a monitor, casing, or keyboard which they added on later.



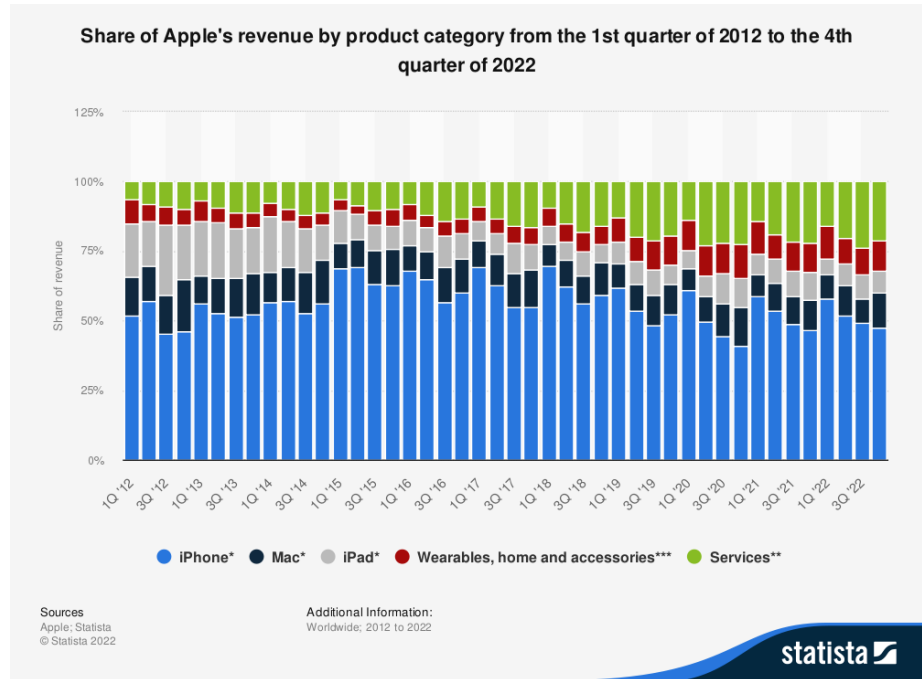
Figure 3: Computers before and after the creation of the first Apple computer, Cult of Mac, 2011.

It was the Apple II that revolutionized the computer industry by introducing color graphics, which is when they saw sales skyrocket from \$7.8 million in 1978 to \$117 million in 1980

which is the same year that Apple went public (Richardson). Figure 3 shows what computers looked like before Apple had created their idea of a personal computer, and the succeeding models after the Apple II. The creation of Apple II had the idea of changing how people consume computers; instead of them being designed as a DIY for more engineers and hobbyists like the Apple I, they would come pre-assembled and work out of the box to resemble more of a home appliance (Richardson).

When Apple was first created, they were known for their desktop computers with the success from the first Macintosh (Curry). The company started to struggle with competition from Microsoft on software and Windows manufacturers on hardware sales over the 1990's.

In an effort to save the company, the iPod and iTunes were launched in 2001 which did indeed help. After the iPhone was released, Apple became one of the most valuable companies in the world with their revenue increasing from \$37.8 billion in 2008 to \$65 billion in 2010 (Curry). The iPhone has been and still is the most valuable product and main source of Apple's revenue, since 2008. Figure 4



shows the breakdown of Apple's revenue by product category from 2012 to 2022 broken down by quarter.

Figure 4: Apple's revenue by product category from 2012 to 2022 broken down by quarter, Statista, Oct. 2022.

The success that is derived from the iPhone has let Apple launch new product categories such as their iPad (Curry). However, revenues from the iPhone have become stagnant forcing Apple to look for new ways to generate revenue, mainly from accessories tied to the iPhone. One of these accessories to the iPhone is the Apple Watch, launched in 2015 which tracks various health and fitness metrics (Curry). The next accessory are the wireless headphones known as AirPods. After that, Apple made its subscriptions services bigger to provide music and video streaming, video games, cloud storage, and fitness, which has grown to become Apple's second largest segment (Curry).

1.3 Recent E-Waste Pollution and the Current Issue

Apple's introduction to the idea of a computer coming pre-built and ready to use out of the box led to a great revolution in the tech industry with many companies close behind with their own version of the same idea. Computers were now designed so consumers could have their own to enjoy in the comfort of their home.

However, with the rapid development of technology computers quickly turned into personal cellular phones with updated versions coming out yearly if not monthly. New versions of phones are marketed to the consumer, so they can enjoy newer and faster technology, but at what cost to the environment? The United Nations Reports that more than 50 million tons of electronic waste was discarded in 2019, the majority of this ended up in scrap heaps and landfills (Economic Times); this amount is estimated to grow by 30% within the next 7 years (Miller).

Discarded waste contains silver, copper, gold, platinum, and highly prized rare earth metals, and the United Nations estimates that materials worth more than \$55 billion are being wasted every year. This is because only 17% of products are being recycled (Economic Times).

Since these products are not being recycled, more rare earth metals need to be mined to make



Figure 5: "iPhone mineral miners of Africa use bare hands", Daily Mail, Mar. 2023.

new products, triggering human and environmental rights fears (Economic Times). Figure 5 shows what the conditions look like for iPhone mineral miners in Africa.

There are two primary methods to mining rare earth

metals, yet both of these processes release toxic chemicals into the environment (Nayar). The first process starts by removing topsoil to create a leaching pond then adding chemicals to the extracted earth to separate the metals; the chemicals dissolve the rare earth which enable it to be concentrated and then refined (Nayar). Nevertheless, these leaching ponds are full of toxic chemicals that if not properly secured can leach into groundwater and affect entire waterways (Nayar). The second method of mining rare earth metals entails drilling holes into the ground with polyvinyl chloride (PVC) pipes and rubber hoses which then pump chemicals into the earth, ultimately creating a leaching pond with the same problems previously mentioned. Also, sometimes these PVC pipes in these areas are not cleaned up and removed properly (Nayar). Rare earth element ores (unrefined rock) contain metals that when mixed with the leaching pond chemicals, contaminate water, soil, and air. However, what is alarming about rare earth ores is that often they are laced with radioactive uranium and thorium which cause detrimental health effects (Nayar). All in all, for every ton of rare earth mined, there is 2,000 tons of toxic waste produced (Nayar).

In Europe alone, there are nearly 700 million old “hibernating” mobile phones that contain some 14,920 tons of silver, gold, copper, cobalt, palladium, and lithium, that value over a billion euros (Economic Times). This reiterates the idea that e-waste is a worldly issue that each country is dealing with, and Figure 6 shows that this issue is not predicted to slow down anytime soon.

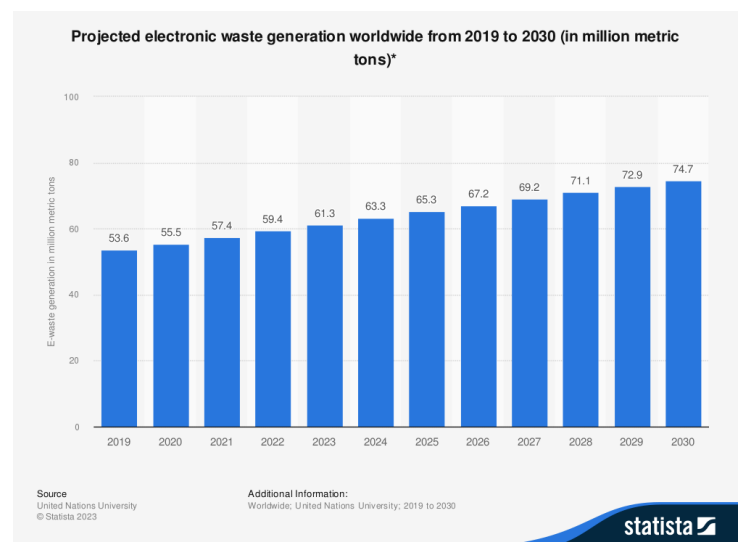


Figure 6: Projections for worldwide generation of electronic waste from 2019 to 2030, Statista, 2020.

Technology with precious metals is rotting away in landfills that consist of flame retardants, toxic metals, and persistent organic pollutants which are harmful to the environment and humans; when electronics are not recycled, these chemicals will taint landfills and through the process of leachate, enter the water supply (Smith and Hall-Pogar).

1.4 Apple's Pollution in Past Years

The estimated duration of use for an iPhone is three to four years. Meaning that consumers will go through at least a dozen different versions of phones throughout their lives. The Product Environmental Report estimated that an iPhone 13 emits a total of 64 kg of CO₂; 81% of emissions are related solely to the production of the phone which consists of extraction, production, and transport of the raw materials, in addition to the manufacture, transport, assembly, and packaging (Gendre). This is where the most pollution is derived from in Apple's processes, and where they should look to make changes. Apple has made changes in the composition of the iPhone, and to make the phones lighter they are being made with less cadmium and lead which as a result makes them more environmentally friendly (Kinney). However, inside a phone there are still harmful substances to both people and the environment such as lead, cadmium, beryllium, and arsenic (Kinney).

The reason why Apple consumers find themselves buying a new version of the iPhone faster than they would like is due to the build-in-obsolence within them (Laville). *The Economist* defines **built-in/planned obsolescence** as, "a business strategy in which the obsolescence (the process of becoming obsolete—that is, unfashionable or no longer usable) of a product is planned and built into it from its conception. This is done so that in future the consumer feels a need to purchase new products and services that the manufacturer brings out as replacements for the old ones". Apple has been found guilty of gluing and soldering together

internal components which makes any repair nearly impossible, and the charges that are proposed for repair by Apple can be so expensive that it is more economical to replace the product completely than to repair the current version (Laville).

Although, the idea of built-in-obsolence does not seem so bad since Apple takes back phones, and the workable ones are refurbished and resold, while the non-workable ones are broken down and sold for parts to a smelter where the phone is then melted down and the liquids are then reconstituted; this process is not always feasible at 100% (Kinney). This is not 100% feasible because only 20% of owners recycle their phones (Kinney). While recycling of technology by companies is important, it can be difficult to keep up with the rate of demand needed to recycle these products since many companies have built these planned obsolesces into their products to intentionally shorten the lifespan of them; causing consumers to continuously buy more because they cannot have their current products fixed (Laville). Also, technology waste is sold overseas; more specifically, 1.5 million pounds of cell phone waste are dismantled in Guiyu, China by workers without gloves, and the extras are burned in open flames deteriorating the health of these workers and the environment at the same time.

1.5 Urgency

Apple's technology pollution is worrisome because as we continue to develop as a country and as others follow closely behind, there will continue to be a constant flow of technology polluting landfills. Companies continue to come out with newer versions of phones and market them to ignorant consumers; instead of understanding what will happen to their old phone they are sold on the benefit of a newer and faster phone. The world is becoming more and more connected with the industrialization of more countries. It is becoming easier to afford a

phone, and it is expected now that each person owns a phone. This is shown by the fact that the global technology industry has nearly doubled internet access in less than 20 years (Flynn).

In addition, since most cell phones are not recycled, new rare earth metals will need to be mined to make new products, polluting the earth further and negatively affecting the lives of the people who dig for them. Apple is currently the largest tech company which is why they need to change their processes of selling and recycling phones to set a precedent to the other companies in the technology sector for more environmentally sustainable practices. Large tech companies must encourage sending less waste to landfills, as well as begin showing greater concern for the human rights of the people who mine rare earth metals and who dismantle old phones.

1.6 Statement of Purpose

The purpose of this paper is to evaluate the policies that Apple currently has in place in its Environmental Progress Report with a critical lens to assess how well they are doing and if they are on track to meeting these standards. The specific problem that this paper will target is looking at how Apple deals with their e-waste and the policies that they have implemented to decrease the pollution of their devices and increase the recycling of the parts within them. Also, Apple being one of the largest companies in the world it is important to look at the policies regarding their general waste that results in the manufacturing of their products. Each policies advantages and disadvantages will be outlined to reach a final policy recommendation.

2. POLICY #1 - Recycled and Renewable Materials

2.1 Origin of this Policy

Apple understands that as each year progresses, "the technology we make [touches] more lives than ever, teams across Apple never [stop] innovating to protect the planet" (Apple 3). To protect the planet Apple has developed an Environmental Progress Report to update their employees and consumers about how they are fulfilling their goals to ultimately become a more sustainable company; the information accessed is for the fiscal year 2021. Apple takes responsibility for how they source, use, and recycle the materials that make their work possible, yet they are looking to redefine where their resources are obtained to make sure they are "using only responsibly sourced recycled and renewable materials" (Apple 34).

2.2 Overview

Apple's policy is to, "use only recycled and renewable materials in our products and packaging, and enhance material recovery" (Apple 33). There are three different parts of this one policy. The first is the sourcing and efficiency of these resources; Apple wants to source recycled and renewable materials for their products and packaging and use them as efficiently as possible (Apple 35). The second part of this policy is designing long-lasting products in order to make the most out of the materials they use. Apple claims to "design durable hardware, leverage software updates to extend functionality, provide convenient access to safe and high-quality repair services, and direct devices and parts to be refurbished or reused" (Apple 35). The third focuses on product end-of-life; Apple seeks to improve the use of their products at the end of their life, in an effort to increase recycling innovation. This allows them to use old devices as raw material sources for the future before these devices become e-waste (Apple 35).

Over the past five years Apple has made great strides to increase their use of certified recycled materials. In Figure 7, the full dark grey squares represent materials that when used in products include certified recycled

certified recycled materials. It does not mention that 100% of that specific material that makes up the product is sourced from recycled substances, just that this product

includes some sort of recycled content.

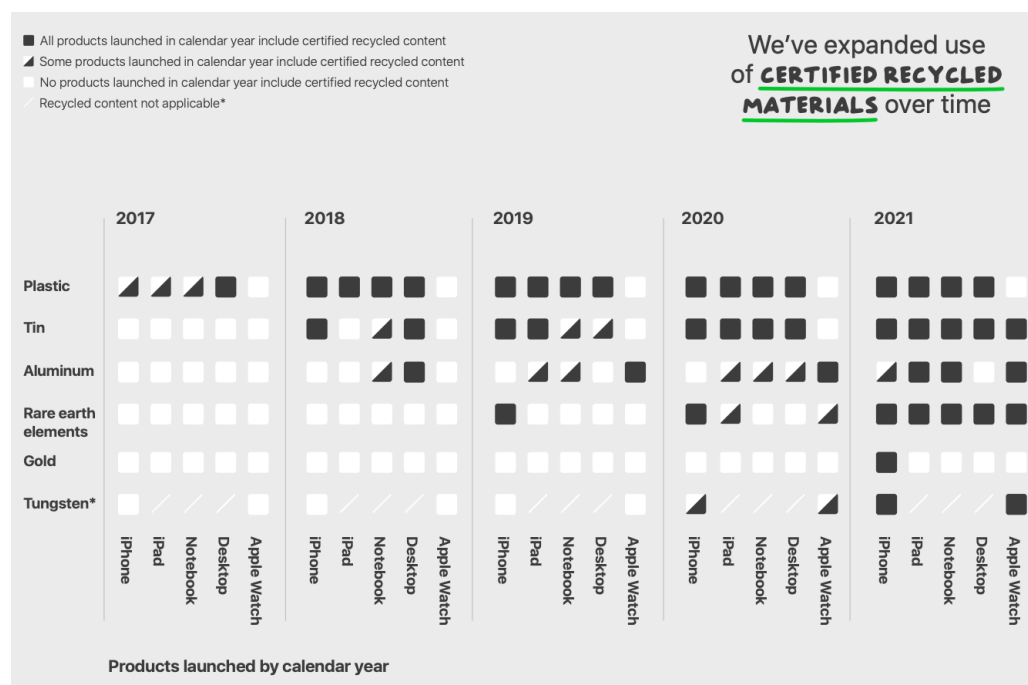


Figure 7: Apple's expansion of certified recycled materials over time, Apple, Apr. 2022.

2.3 Pros

- Less Need for Mining Resources** - One of the more obvious pros of this policy is that the more recycled content that is used to produce new products, then the less rare earth elements that need to be sourced. When less resources and precious metals need to be mined, there is a minimized risk to the health of the individuals who mine these products. Also, there is less of a risk to the earth because recycled content has a lower carbon footprint compared to primary materials (Apple 37).
- Pushes Apple to Create New Materials** - Apple takes pride in the materials they use, so when they do use recycled materials, they want to make sure that these are up to their quality standards. In order to add more recycled aluminum into their products, Apple designed a new alloy that incorporates recycled content while still being able to meet their high-performance standard

(Apple 36). Before creating the iPhone 13, Apple was having difficulty with the traceability of their resources, figuring out the source of materials. However, they were able to incorporate end-to-end traceability and build their first completely recycled gold supply chain to be implemented in the release of the iPhone 13 (Apple 36). The company is pushing itself to utilize more renewable resources and as a result this is setting an example for other technology industries, yet they still have a long way to go since only 18% of all the material shipped in products were recycled or renewable in the fiscal year 2021 (Apple 36). Figure 8 depicts Apple's process of sustainable product creation by generating products with circularity.

- **Seeing 100% Recycled Materials in Part of their Products** - While Apple has not reached 100% recycled finished end products, they are starting to see parts of these products reach 100% recycled material. Currently,

they sell eight products that have more than 20% recycled content. For example, the MacBook Air with M1 chip is only made with 44% recycled content throughout the whole device, yet there is 100% recycled aluminum in the enclosure (Apple 36). In addition, the previously mentioned iPhone 13 is not 100% recycled, but it does feature 100% recycled gold. Also, the plastic in the mesh of the ear cushions of the AirPods Max is made with 100% recycled plastic (Apple 36).

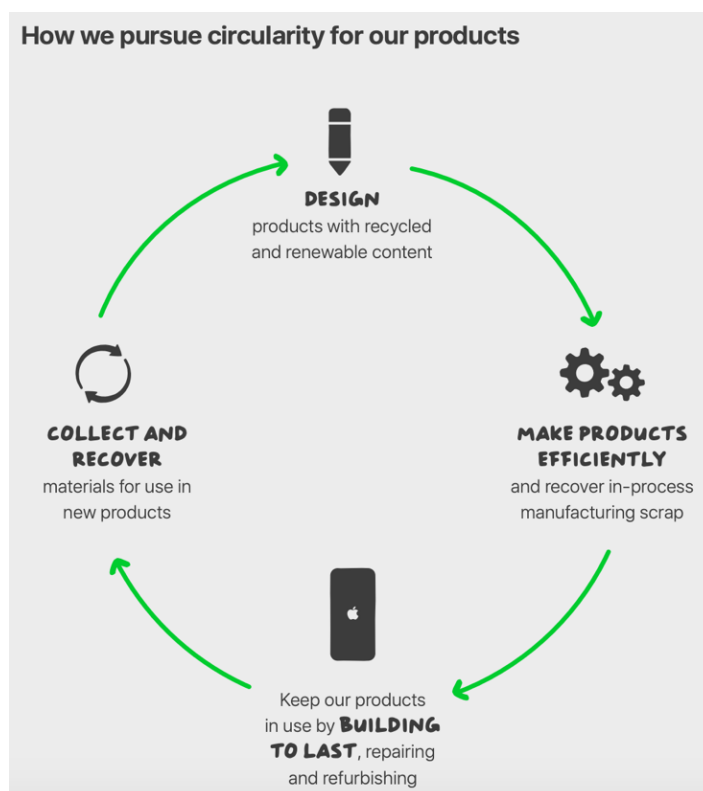


Figure 8: How Apple works towards producing products with a circular life, Apple, Apr. 2022.

2.4 Cons

- **Availability and Access** - The supply of recycled and renewable materials may not be available due to the limited accessibility of scrap sources or production of renewable content (Apple 39). The supply may exist around the world, but if these new suppliers are not incorporated into the supply chain, then these materials cannot be accessed. Even if some of these materials can be accessed some of them may not have the information Apple needs about the source of the material, whether it was mined, renewed, or recycled to see if it meets standards (Apple 39).
- **Technical Properties** - A recycled or renewable material may have different properties than the primary material needed. For instance, recycled plastic has different properties than other plastics (Apple 39). The recycling process can also cause some materials to become contaminated, leading them to no longer have the correct properties that are needed for use. In

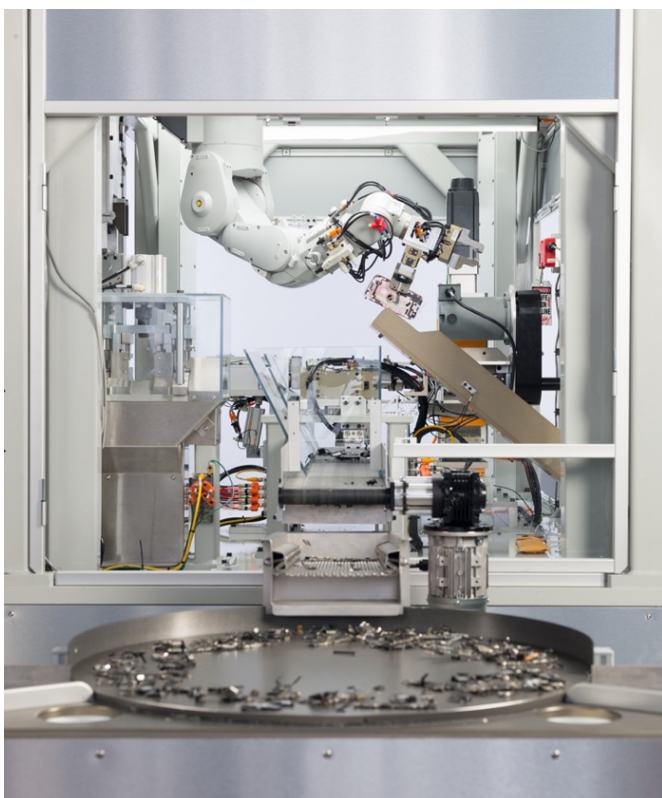


Figure 9: Daisy, Apple's latest innovation, can take apart nine different iPhone models, Apple, Apr. 2018.

addition, because many of these recycled and renewed materials are coming from hundreds of different suppliers, there is an increase in effort to figure out the status of these materials across products and components (Apple 36).

- **Facilities Capable of Recycling** - Apple products can be recycled, yet not every country has the facilities capable of recycling them and salvaging their parts (Baterna). Daisy (shown in Figure 9), a robot created by Apple, can disassemble up to 1.2 million devices per year, 200 iPhone devices per hour, and sort and disassemble

high-quality components of 15 models. The robot Dave then disassembles and recovers key materials from an iPhone's Taptic Engine such as tungsten, steel, and rare earth magnets (Baterna). While 1.2 million devices can be disassembled per year, Apple sold 49.26 million smartphones in quarter 2 of 2021 alone. Recycling products is a great idea, but not every country has the resources to do so, and no country can keep up with the number of products that are sold, rendering iPhones in landfills as e-waste (Baterna).

- **Forced Obsolescence** - The software within Apple products encourages consumers to upgrade to a new device more often than they need to. This is due to the forced obsolescence that Apple has built into its products because even when the hardware is usable the software that has been updated onto the phone may cause it to not work as well as it once used to (Baterna). Additionally, the contracts that Apple has with recycling centers penalizes the salvage of usable parts and the repair of usable devices, forcing the obsolescence of many repairable devices and restorable parts. Instead, they are taken through an extensive recycling process for the materials to reach a certain quality to meet Apple's needs once again (Baterna).

2.5 Assessment

Overall, this policy is forcing Apple to think differently when making their products to help them come up with new ways of sourcing their materials and deciding what resources to put into their products to make them easier to recycle in the future. In the Environmental Progress Report, it does not seem as though Apple is lying about the percentages of renewable materials in their products. However, it is obvious they are boasting 100% of a specific renewable material within a certain product instead of the overall percentage of recycled material within that product. For example, advertising that a portion of the product is 100% renewable appeals and engages a sustainable consumer, such as the gold in the iPhone 13, compared to only 44% total recycled material within the iPhone 13. Apple chooses to market 100% of recycled gold to appeal to the environmentally conscious consumers of today, when realistically Apple still must source and supply over 50% of

materials used to make the final goods with recycled material. There is still a high percentage of nonrecyclable materials in many of Apple's products, and to reach their goal of being 100% sourced with renewed and recycled materials they need to increase their usage of recycled materials throughout their products. Since the number of products sold compared to number of products recycled is so enormous, Apple has a long way to go. All in all, the most sustainable way to produce technology is to make it last and easily fixable, so consumers can continue to keep their phones for as long as possible, hoping one day that this can be forever.

3. POLICY #2 - Elimination of Plastics in Packaging

3.1 Origin of this Policy

Apple has developed an Environmental Progress Report filled with many goals the company would like to achieve to ultimately, "one day make our products without taking from the earth, and to be a force for equity in the world around us" (Apple 3). Apple has decided to take a look at where every part of their supply chain is sourced to see how they can change or modify these sources to be greener and more sustainable. This Environmental Progress Report lays out each of Apple's goals, and details how they are currently fulfilling them; all the information accessed for this policy is for the fiscal year 2021.

3.2 Overview

Apple's policy is to "eliminate plastics in our packaging by 2025" (Apple 6). In the past year of 2021, plastics only accounted for 4 percent of their packaging, and 63 percent of their packaging was from recycled fiber (Apple 43). However, to make that possible Apple needed to think of a replacement to protect the box from damage and tampering that the polypropylene wrap around each box has served to do since the launch of the iPhone 8 (Apple 42). For the iPhone 13 and iPhone 13 Pro to be the first iPhone shipped without any plastic packaging they designed something completely different; this alternative relies on two small fiber-based pull-tabs which provides a tamper seal while avoiding an estimated 600 metric tons of plastic waste, as shown in Figure 10 (Apple 42).

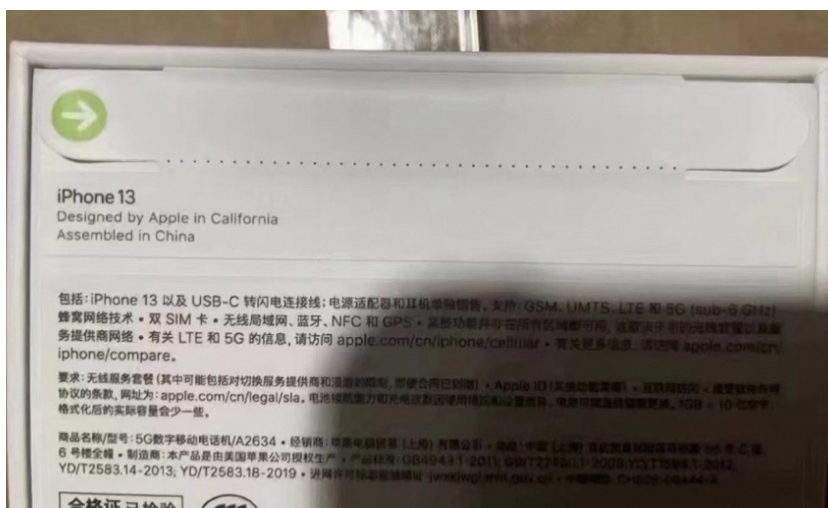


Figure 30: Apple's new fiber-based pull-tab, Sam, Sept. 2021.

The iPhone is just one of Apple's many products, they also made improvements to the packaging of their iMac. There used to be plastic foam that would protect each iMac during shipping, yet their team decided to create an alternative that "absorbs energy while maintaining resilience and structure" (Apple



Figure 11: The iMac's new packaging using corrugated cardboard, Apple, Apr. 2022.

42). The alternative that was developed was an origami-inspired technique that uses corrugated cardboard, a widely used packaging material, allowing them to still work with their current suppliers, as shown in Figure 11. This packaging alternative saved 400 metric tons of plastic from reaching landfills and reduced plastic waste by 72 percent (Apple 42).

Apple's decision to use less plastic in their packaging should inspire other technology companies to stop using plastic in their own packaging because of the harmful effects that plastic has when it is used and "disposed of". The polypropylene wrap also known as cling film, food wrap, or saran wrap, that Apple once used to cover their iPhone is single use and must be disposed of directly after use (Pizza). This plastic cling wrap contains PVC and is clingy, causing it to not be able to be reused and sending this wrap to a landfill to decompose in 450 years. In addition, when disposing of this cling wrap it may unknowingly contaminate other items in the trash by sticking to them (Pizza). The Environmental Protection Agency (EPA) stated that landfills received **27 million tons of plastic in just 2018**. National Geographic claimed that about 91% of plastics are not recycled; when these plastics are not recycled correctly, they will not properly biodegrade, harming wildlife by polluting the atmosphere and ocean ecosystems due to the toxic chemicals and greenhouse gases released (Pizza). Ultimately, plastic provides no benefits other than being a cheap product for businesses.

3.3 Pros

- **Only 4% of Apple's Packaging in 2019 was Plastic** - Apple reducing their plastic in their packaging by 75% since 2015 to end up only having a total of 4% of plastic is an impressive reduction that many competitors should be impressed about and looking to follow in their footsteps (Apple 42). As previously mentioned, there are no benefits to the use of plastic in products to the environment, and although plastic can be recycled it is not a high percentage of the time, sending even more waste to landfills when consumers buy a new phone. Therefore, Apple choosing to use less of this resource is beneficial to reducing Apple's total waste.
- **50% Less Packaging Overall** - Apple has decided to remove the charger and headphones that usually come in the iPhone packaging along with the phone. The reasoning behind this is that there is already an abundance of chargers created and in use, so Apple decided that manufacturing more chargers would not be an environmentally friendly business decision (Forbes). Figure 12 shows what this 50% reduction in packaging looks like. Also, Apple found that many consumers

preferred to use aftermarket headphones, so the headphones that were once included in the packaging with the iPhone were often not used (Forbes). Deciding not to include headphones with the purchase of an iPhone leads to less e-waste and more revenue for Apple because they are now only



Figure 12: The 50% decrease in box size in the iPhone 13 compared to older models, Splaznot, 2021.

sold as a complementary product. In addition, smaller packaging allows Apple to fit more products into the same number of pallets, resulting in fewer emissions but equal product delivery.

- **Setting a Precedence** - Competitors of Apple should start to realize that eliminating plastics in their packaging is doable if they commit enough time and resources to developing new solutions. Apple has already shown other companies firsthand how to start by cutting down on plastic through being transparent about how they omitted plastic from their products and what they replaced it with in their Environmental Progress Report. Cutting down on any material in the packaging of electronics will overtime add up to a large decrease in the waste that results from the sale of electronics.

3.4 Cons

- **No Credible Certifications** - Apple has decided one way to eliminate plastic in their packaging is to use recycled wood fiber (or paper pulp) instead (Forbes). Although, using this type of material as a “recycled” source is only as credible as the certifications that back it up. Apple claims that all their wood fiber used is derived from responsibly managed forests, and Apple states that they have "protected or created enough responsibly-managed forests to cover all the virgin wood fiber we use in our packaging" (Forbes). However, when Apple's new supply chain expert and packaging engineer Artur Obolenski was asked about an indication of this wood fiber resource being certified, "he was unable to find any form or logo or indication of there being a certification" (Forbes). There being no indication of this certification on the package is strange since Apple specifically mentions that this resource is sourced from “responsibly-managed forests”.

- Waste is Still Created** - If consumers do not dispose of their packaging properly then it will not be recycled and reused, the waste will become contaminated and end up in a landfill somewhere. In the entire year of 2022, 224.7 million iPhone units were sold globally (Susic). This means there were 224.7 million boxes opened by individual consumers, and it was left to the consumer to decide if they would recycle it properly regarding their town and state guidelines; Figure 13 shows what a contaminated recycling pile looks like. Also, the 224.7 million boxes are only the number for iPhone boxes sold, it does not even include the other products that Apple sold with packaging throughout 2022.



Figure 13: A contaminated recycling pile, Vendel, Feb. 2017

- Forced Obsolescence** - Apple continues to force consumers to buy a new phone or computer because they make it too difficult to fix the product they currently have, so buying a new one is perceived as the easier and cheaper option. Veksler explains this best through a frustrated first-hand customer perspective, "Apple choses to build its products in a way that makes upgrading them impossible, even though it could easily, and in fact used to be far more accommodating to customers who prefer to upgrade their electronics rather than replace them wholesale". Instead, Apple builds their computers with a "non-upgradable solid-state drive and memory that is soldered to the mainboard", "the display assembly is bonded to a single unit", and "the battery is firmly glued in place" (Veksler). This makes it almost impossible to fix one's device and usually leads consumers to buy a new piece of technology, so while there is no plastic in the packaging, Apple is still leading consumers to buy products from them in packaging that will ultimately be thrown away.

3.5 Assessment

In conclusion, this policy is moving Apple in a better direction with more creative and sustainable packaging. It opens their mind to changing their packaging by doing research on materials that take less time to decompose when put in landfills and can be recycled easier than most plastics. They made a smart move with the 50% reduction of their iPhone package size by removing the plastic within them, such as the charging cord and headphones that were once included. Similar to Policy 1, it is apparent that the most environmentally friendly way to eliminate e-waste is to make their products easily fixable and last for many years. Although the packaging may be sourced from recycled wood fiber, at least 224.7 million boxes would have to be correctly recycled for Apple to move towards closing their supply chain. Realistically, it is hard to expect that these many busy consumers will dispose of their packages properly or that if they do, they will not become contaminated in the recycling process.

4. POLICY #3 - Product Longevity

4.1 Origin of this Policy

Throughout the history of Apple, they have done a tremendous job changing their technology to meet the needs of their consumers. For example, they changed the first models of their computer from initially being self-assembly/DIY to instead being manufactured already put together, so it can work right out of the box. Their technology is easy to work and easily understood by many throughout the world. Currently, Apple understands that "Designing and building durable hardware is core to delivering this customer experience" (Apple 44). The less frustrated the consumer is with the product and process of owning a device from a company, the happier they will be with the company, hopefully resulting in future sales of more products. Apple consumers want to see their phones last longer than they currently do to benefit both the consumer's pockets and the environment. This has caused Apple to investigate their technology and processes, which Apple accesses in their Environmental Progress Report by looking at their business processes up until the fiscal year 2021.

4.2 Overview

Apple's policy states, "We believe long-lasting products are best for the environment. We also believe products that minimize the need for repair or replacement encourage our customers to come back to Apple. We design our products with this goal in mind" (Apple 44). It can be seen that Apple has done better than most companies with completing this goal because in a report by BankMyCell, which tracks trade-in and sale value of technology products, the iPhone depreciation rate is the lowest among the nine leading smartphone manufacturers (Apple 44). There are different aspects that compile the durability of Apple's products; how they are made, how easily they can be fixed, and how accessible these repair centers are.

If products are made for longevity, this will benefit the consumer because the value paid for within the product will remain longer. Therefore, Apple thinks it is important to build longevity into their products by "designing durable hardware, developing access to safe and convenient repair services that meet our customers' needs, and providing software support for years so that more customers can unlock new features and functionality" (Apple 44). Water resistance has been the most recent focus to Apple's product design to make them more durable and last longer. In addition, the availability of software

updates allows consumers to enjoy new features on a device that may be a few generations older (Apple 44). In addition, the Apple Authorized Service Providers, the Independent Repair Provider program, and the upcoming Self Service Repair option, allow customers to acquire the repair services they need for their devices

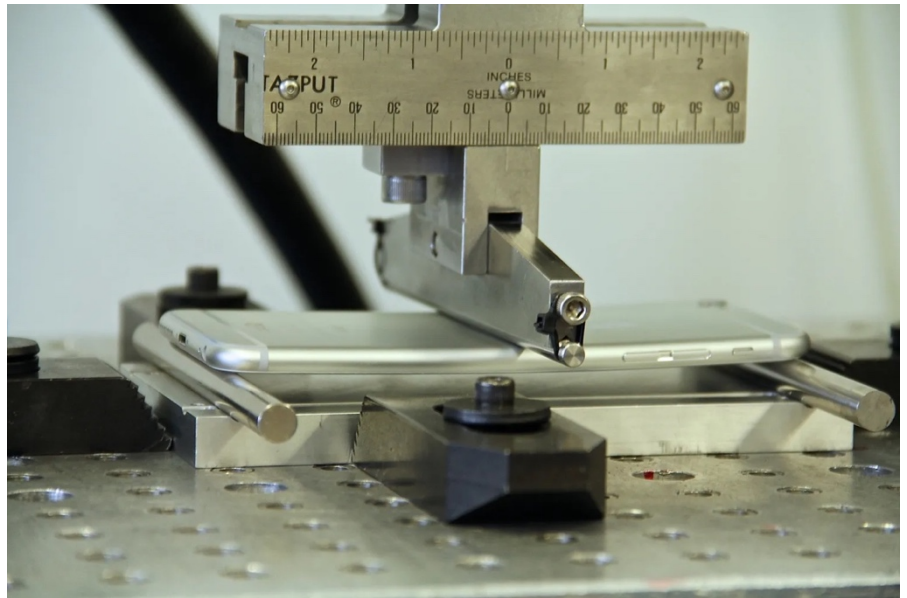


Figure 44: A sneak peek into Apple's Reliability Testing Lab, Goode, Sept. 2014.

to keep them running for longer with no need to buy a whole new product. Also, before all products are put on the market, every feature is tested in Apple's Reliability Testing Lab, shown in Figure 14. This means that tests are performed that mimic the day-to-day experiences one of their products may go through: scratched by coins, taking a tumble on rocks, or an arm swinging into an object (Apple 44).

4.3 Pros

- **Software Updates** - Apple manufacturers release new software updates to help with security issues and other operating system bugs that may be present in devices (Balasaygun). Software updates, depending on how extensive the update is, can be like buying a new phone without the hassle and the extra trash. That is because they can provide the latest technology on the current

product a consumer already owns (Balasaygun). In addition, delaying updating one's technology with the current software can put users at a higher risk of their information being hacked; this is because when Apple releases a new update, they are indicating that one's current operating system is not the safest anymore (Balasaygun). The people most susceptible to being hacked are those who have not updated their product because updates are usually released after hackers come out with a patch to grab people's information off their device. Therefore, software updates allow consumers to both keep their device for longer and keep their personal information safe.

- **More Repair Options** - There are three repair options for Apple products to prolong the life of them and reduce the need to buy a new device as often. The first is to send your product to Apple, where they will arrange the shipment to one of their Apple Repair Centers for your device (*Apple Repair*). This allows everything to be on the consumer's schedule and does not require an appointment. The second is to locate a convenient Apple Authorized Service Provider, or in some areas an iPhone screen repair technician will travel to the consumer's home or office (*Apple Repair*). The third option is to visit a Genius at an Apple Store. Online there is a place to make a reservation with a Genius to receive the help needed with a hardware repair (*Apple Repair*). All these options are clearly explained and laid out on Apple's Support section of their website.
- **Features that Enhance Durability** - Apple tests every single aspect of their products in their Reliability Testing Lab, here engineers "measure the performance of materials, components, and fully assembled products" (Apple 44). The standards that they test against in this lab are a result of their findings from their in-depth user studies of how customers both use and misuse their products. With every successive product Apple tries to develop innovative designs that can withstand the hardships of everyday use (Apple 44). Figure 15 depicts the journey that the iPhone in particular has taken to make it more durable overtime.

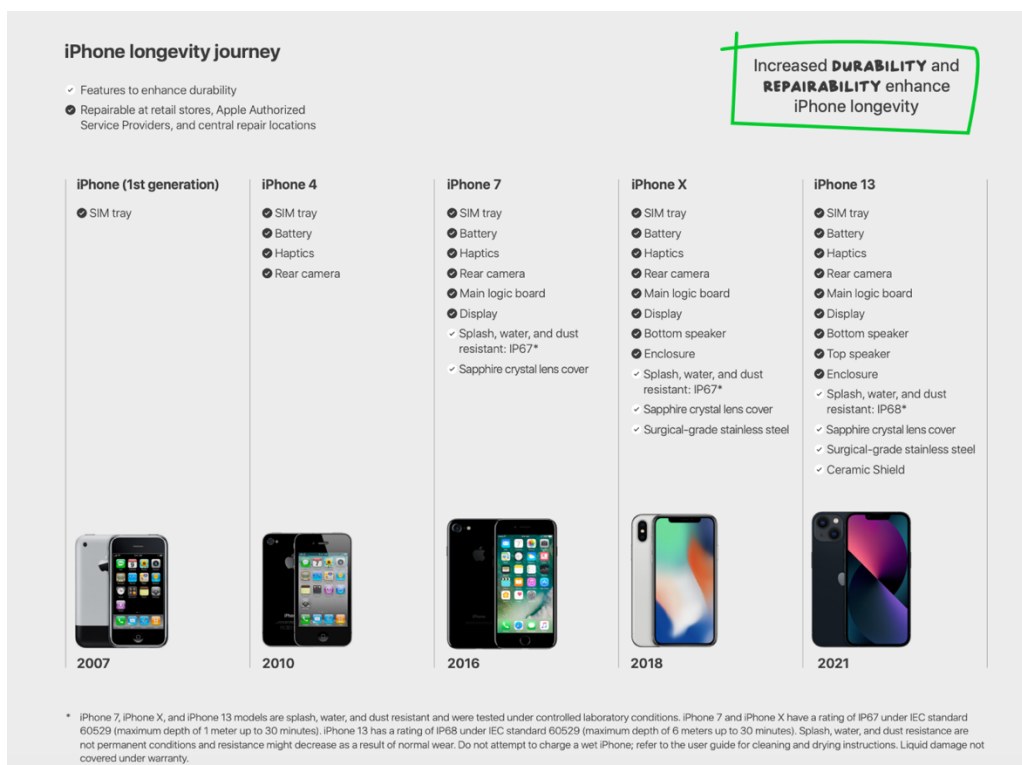


Figure 15: "iPhone Longevity Journey" Apple, Apr. 2022.

4.4 Cons

- Trade-in Incentives Offered by Data Carriers** - Many data carriers entice consumers to switch carrier companies with a new phone or a great price to trade in their old phone. In addition to offering a great price for a new phone, this sale of a new phone helps the company boost sales by selling more frequent upgrades, a new upgrade also lures customers into long contracts with carrier companies, and lastly it provides raw materials for companies to reuse to make new phones in a more environmentally friendly way (Iyengar). This idea goes against the most sustainable way to own a phone which is to keep it for as long as possible. On the other hand, mobile phone carrier companies are starting to see a shift in consumers choosing to keep their devices for longer, and many consumers are skipping over models before they upgrade; this is because even though companies try to reel in consumers with great deals, many consumers are starting to realize that there is "very little differentiation" with their current model from the new

ones that are being put on the market (Iyengar). Although, this does not stop carrier companies from creating new marketing promotions to entice consumers with a great phone price to prematurely trade-in their current phone (shown in Figure 16), because ultimately these companies are in the business to create a profit.

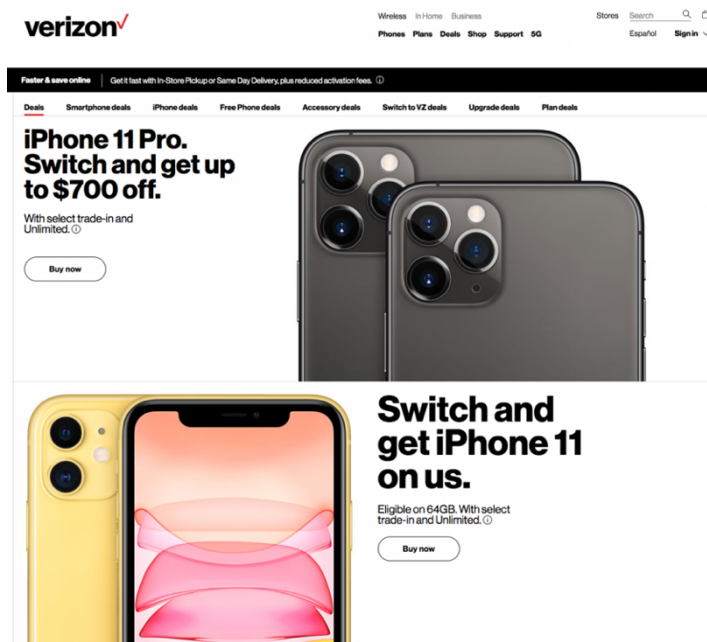


Figure 16: An example of a Verizon Trade-In Incentive Advertisement, Buyback Boss, n.d.

- **Bugs Hidden in Software Updates (Built in Obsolescence)** - There has been much recent talk that when Apple comes out with new updates it puts bugs on older phones causing consumers to need to purchase a new phone sooner than they really need to. However, there is not much information out there on this top, or if there is it is hidden. The only valuable piece of information is that when a consumer downloads the latest software on their device it may become slower because this new software is written for the latest device, and it cannot help but run slower on old hardware (Cowling and Johnson).

4.5 Assessment

It appears Apple has stepped up their product development in the past few devices to make them last longer. They seem to care what resources they are putting into their products because if they hope to accomplish their goal, which was described in Policy 1, of 100% renewable products one day then it is important that these products are made to last, and the resources within their products are made to be recycled into new phones/devices. Carrier companies seem to play a big role in the premature purchase of new products because they are in the business to make a profit just like Apple. Apple's website also

provides helpful information with how to fix their products, and they even try to make it convenient for the consumer by having different options. Overall, Apple has done a good job with following this policy they have put in place for themselves, yet that does not mean it is perfect and they could fix the slowing of new software on old devices by writing different software for every device that is out there.

5. CONCLUSION

5.1 Overview

Electronic waste, not just Apple's alone, is an enormous issue that is not expected to stop anytime soon. It is projected that at the end of this year, 2023, the worldwide generation of electronic waste will be 61.3 million metric tons (Statista). The reason why this issue is not projected to stop anytime soon is because it is a booming industry for many countries, but especially the United States in particular. The most recent data shows that in 2021 "computer and electronic products" was the largest manufacturing subsector in the United States, which was followed by chemical manufacturing, food products, beverage products, and tobacco products (NIST). Figure 17

depicts how much larger the manufacturing of computer and electronic products is in comparison to the other subsectors in US manufacturing. However, the United States is just one of the leading countries

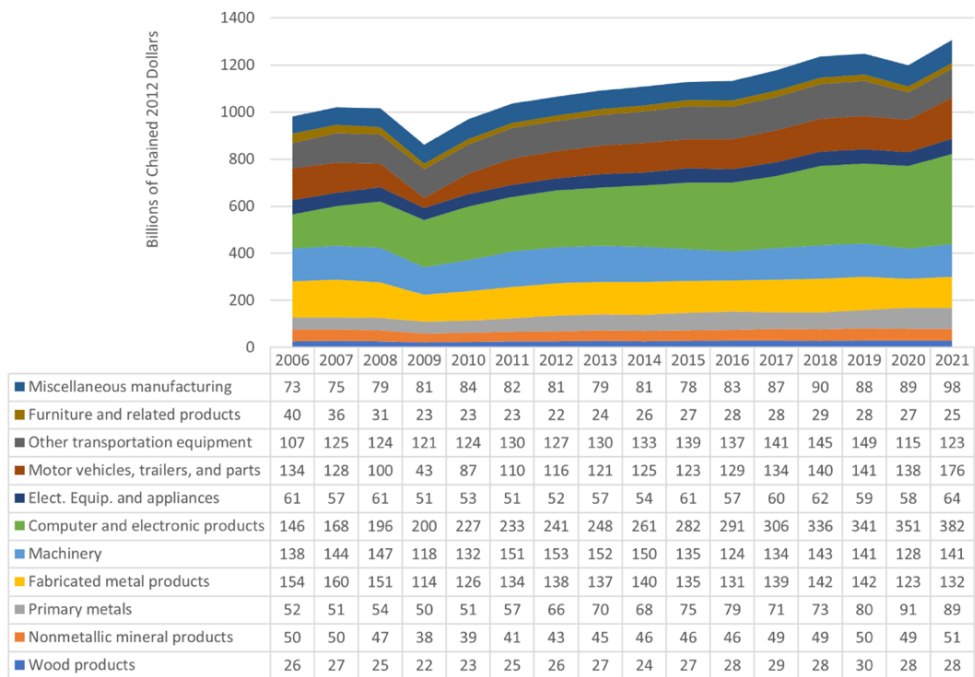


Figure 57: Computer and Electronic Products was the Largest Manufacturing Subsector in 2021

in technology production along with Hong Kong and China (Mansa and Velasquez).

The reason why electronic pollution is a large global issue and not just a result of the consumerism culture of the United States, is because many of the largest technology companies are worldwide companies. Apple leads the Consumer Electronic (CE) companies worldwide by having the leading number of sales with \$378.7 billion (Laricchia). Figure 18 illustrates just how large Apple's sales are in comparison to its competitors out of the CE companies. Apple's sales in

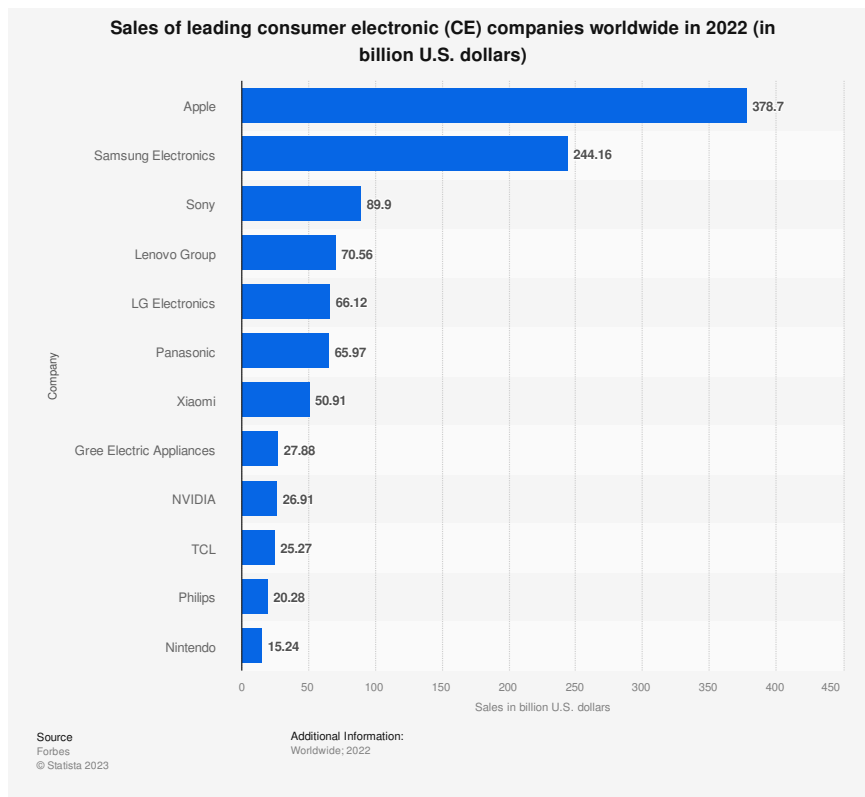


Figure 18: Apple is the Leading Producer out of the Consumer Electronic (CE) Companies, Forbes, May 2022.

Figure 18 are a larger overview of how they match up with other multinational corporations, but to understand in more detail how many worldwide users there are of Apple products, and how they are dispersed by country, Figure 19 breaks this down.

Apple's products are being sold and used in more parts of the world, which is great from a business and revenue perspective for this company. However, from the sustainability side this is not great. The larger

the number of products that Apple sells the more they will ultimately have to recycle down the line. With their current recycling capabilities, they cannot keep up with the influx number of technology that needs to be recycled.

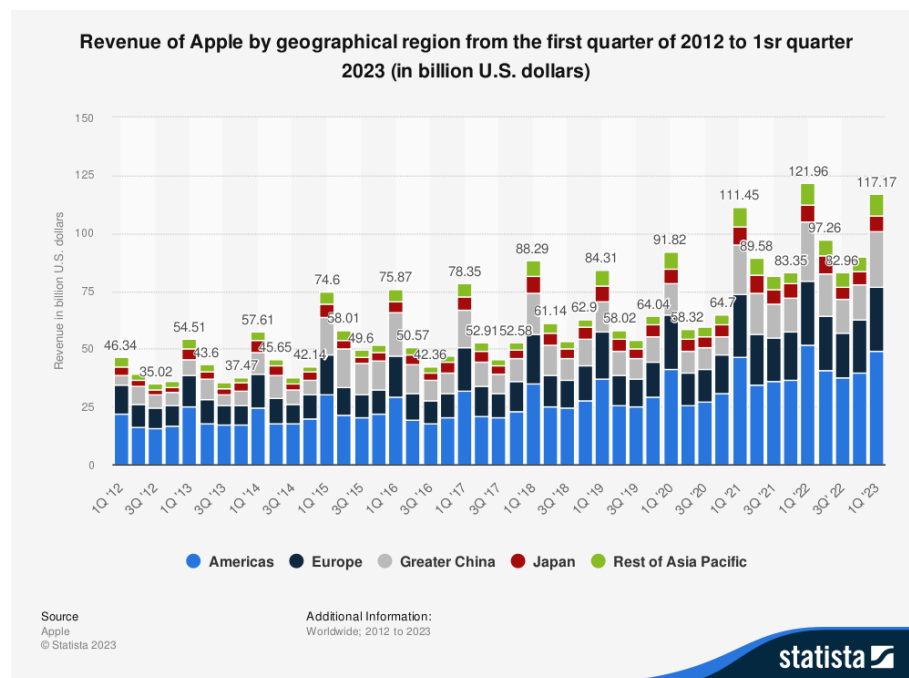


Figure 19: Apple's Revenue by Geographical Location from Q1 2021 until Q1 2023, Apple, Feb. 2023.

Apple seems to promote that recycled parts make up a larger part of their products than they really do; in 2021 they reached their highest-ever use of recycled content which was almost 20% in the products for that year (*Apple Newsroom*). With the ginormous quantity of products that Apple manufactures sells every year this does not add up to much, but it is a start. This reiterates the idea that Apple currently does not have a 100% renewable manufacturing process, and they have a long way to go before reaching that. In addition, Apple is not claiming to use only old and recycled Apple products to produce their goods, they are claiming to use recycled materials in general to make their new products.

As a result of the problem that Apple is producing more products than they can recycle, and all consumers still do not understand the proper way to dispose of their products, many technological goods are sent to landfills becoming e-waste, rendering the precious metals and materials within not to be recycled for future use. In 2019, only a little over than 17% of

electronics were known to be properly recycled, and considering Apple is the largest technology company many of those products that were not recycled must have been Apple products. This is not a great look for Apple as a company for educating their consumers on the proper disposal and recycling process of their devices. Also, this hurts Apple's goal of one day wanting to have complete circularity for all their products, because it reduces the materials and valuable resources that could be recycled into newer products one day in the future.

5.2 Recommendations

1. The United States must pass a federal law to facilitate the management and safe disposal of E-Waste. Passing a federal law would push companies producing electronics in the United States to fix their manufacturing process to make products that are easier to dispose of once that time has come. Also, it would increase companies' efforts to recycle the materials in their products because recycling is the easiest way to completely reuse and repurpose these materials because electronics cannot break down in landfills like other types of waste. In addition, this would mean that companies cannot send this waste overseas to make it another country and their citizens problem. This would reduce the negative health effects that people experience as a result of burning and living near the rotting e-waste from other countries.

2. Apple needs to set up more recycle centers to support the massive number of phones they sell. Apple claims to have more than one recycling center, yet they do not disclose their total number of recycling centers and Daisies that can refurbish and recycle the products within iPhones. Also, Apple does not disclose where these recycling centers are located; they only state where you can mail or drop off your products for them to reach the undisclosed location of these centers. The only one that is talked about is the new 9,000 square foot facility that will be opening in Austin, Texas (*Apple Newsroom*). In addition, Daisy currently can only recycle 15

specific iPhone models, which does not account for the many other electronic products that Apple sells. Apple needs to be more transparent with what is happening with these other products that cannot be recycled and starting to investigate new processes towards being able to recycle them. There is nothing that states that there are these recycling centers in other countries which would be another important step for Apple to start to implement.

3. Apple needs to make different software updates for specific older models that they can handle on their technology. This would allow consumers to enjoy the new technology and software on their older devices without feeling the need to upgrade because their phone is acting slower with software that their current phone generation cannot handle. Also, consumers would not need to buy a phone as often if their device continued to work as well as the first day that they bought it. This would lead to less consumer complaints about Apple's products and decrease some of the negative perceptions that consumers have about Apple as a company. Business's do not like negative publicity because it tends to hurt their business, and solving one of their software issues would lead to more positive consumer perceptions and a larger profit in the long run. The most sustainable way to own a device is to use it for as long as possible, and Apple following this recommendation would allow consumers to do just that.

4. Apple needs to remove the built in obsolescence that is a part of their products. While Apple claims to be able to fix their products easily and offer many helpful options when the consumer needs it, they instead tend to sell consumers on the idea that buying a new product will ultimately be cheaper than fixing their current one; this leads many consumers to purchase a new product, rendering more e-waste in the environment. If Apple produces their products with the ability to easily fix them, it will result in the production of less waste, and happier customers from hearing that their problem is easily fixable. In addition, Apple will still be able to generate a

revenue from the cost of performing these services. Also, if Apple followed Recommendation 3, the software on many of their products would not slow down because the new software would be made for that model, and consumers would not need to purchase a new product due to the built in obsolescence aspect of the way Apple currently produces their software updates.

5.3 Concluding Remarks

The United States government could be doing more and putting more restrictions in place to make electronic companies, especially Apple, more responsible of their waste. This will lead to more incentive for companies to implement more sustainable practices if they want to continue to sell and produce products for the United States consumers. Also, other countries' governments can become more involved by rejecting the waste that the United States and other countries want to send over to their country. This would force these larger companies to start to look at their manufacturing and disposal processes with a more discernible eye.

Apple's sustainability policies show that they are on the right track to understanding how to produce more environmentally friendly products, yet they need to work on speeding up achieving these processes if they want to achieve the goals that they have set for themselves by 2030. Implementing these previously stated recommendations will allow Apple to slow down their production of new products, so they can focus on the recycling side of them more than they have been. Overall, these recommendations will force them and their other technology competitors to find even more ways to recycle the materials they use to produce their products, instead of taking the easy option, sending their trash over to other countries for it to rot.

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