

Electronics Hibernation

Understanding Barriers to Consumer Participation in Electronics Recycling Services



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Introduction

Understanding the hibernation of consumer electronics

The circular economy concept provides a model for renewal aimed at changing the relationship between the use of materials and the resulting impacts on human and environmental systems. As outlined in the 2019 whitepaper, [A Circular Google](#), Google is committed to accelerating the transition to a circular economy through three circular principles:

1. Design out waste and pollution
2. Keep products and materials in use
3. Promote healthy materials and safe chemistry

This whitepaper focuses on Google's second circular principle as it pertains to consumer electronics products and summarizes research commissioned by Google's Consumer Hardware sustainability team to better understand the phenomenon of product hibernation. Hibernation is defined as the storage period when a product is still retained by a user, but is no longer in use.¹ This paper contains actionable insights for any party wishing to develop services to avoid hibernation and drive recirculation of unused consumer electronics products and their materials.

The impact of hibernation

Hibernation is not a new concept; nor is it uncommon. One research paper from 2016 revealed that 75% of the consumers in Nordic countries have a hibernating phone in their home;² other studies have also found similar trends in other countries where consumers store mobile phones and other electronics that are no longer in use.

The phenomenon of electronics hibernation keeps products (and the materials contained in them) out of circulation. That means that more new products need to be manufactured and that a greater quantity of raw materials need to be extracted from mining sources to support new product production. A successful circular economy is realized when all previously mined materials are actively utilized and displace demand for newly mined materials to the maximum extent possible and hibernation is a formidable challenge to overcome in that pursuit.

¹ Adapted from Wilson, G. T., Smalley, G., Suckling, J. R., Lilley, D., Lee, J., and Mawle, R. (2017). The hibernating mobile phone: Dead storage as a barrier to efficient electronic waste recovery. *Waste Management*, 60, 521–533. <https://doi.org/10.1016/j.wasman.2016.12.023>

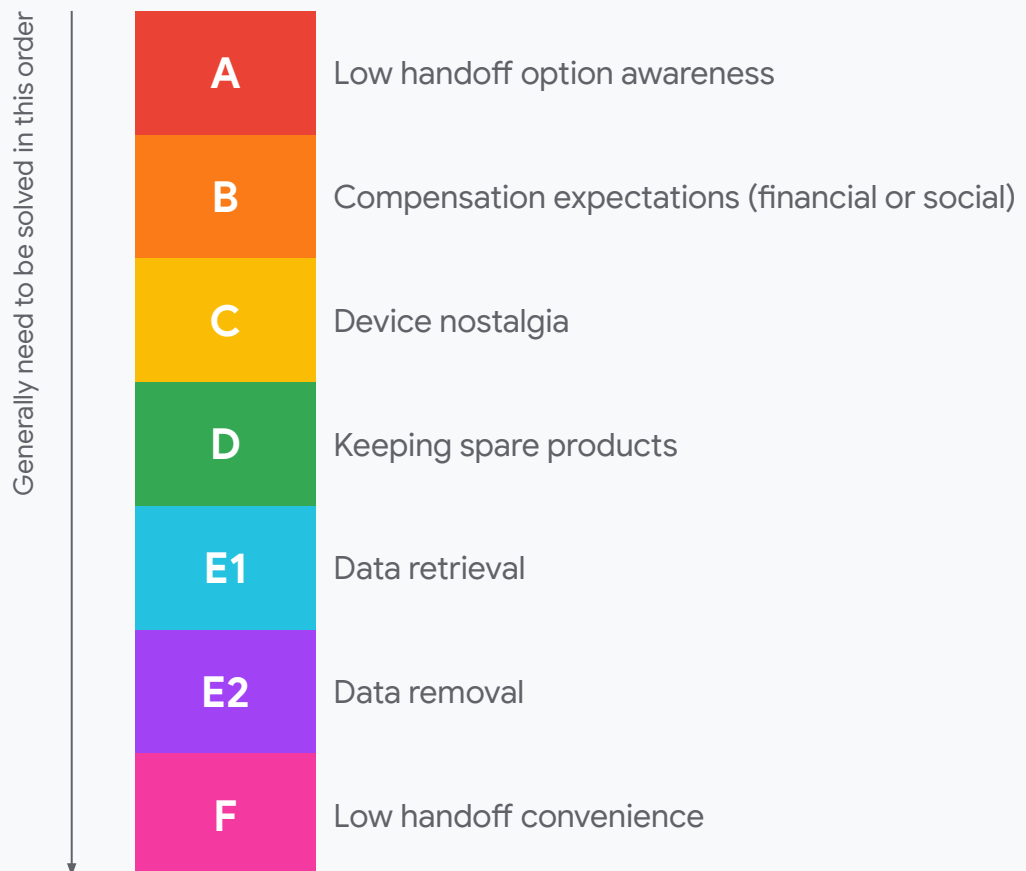
² Baxter, J., and Gram-Hanssen, I. (2016). Environmental message framing: Enhancing consumer recycling of mobile phones. *Resources, Conservation and Recycling*, 109, 96–101. <https://doi.org/10.1016/j.resconrec.2016.02.012>

Electronics are prone to hibernation

When consumers are asked why they hold on to unused (hibernating) products in their homes, they state several reasons, including not knowing what to do with the products, keeping them as a spare, or needing to transfer data and more. This highlights how consumer electronics (and other durable goods) are treated differently from household recyclable packaging items, such as aluminum cans or cardboard boxes. When consumers are done using an orange juice carton or a soda can, it becomes waste to them and they immediately make decisions about how to dispose of it (e.g., in the trash, in recycling, or even in the open environment). They do not, however, store the empty cartons or cans indefinitely in a drawer or closet, as is often the case with electronics.

Consumer Barriers to Recycling Electronics

Through our research,³ we identified seven categorical barriers consumers contend with when they consider handing off their electronic devices (e.g., through sale, reuse, gifts, donation, or recycling), as outlined in this graphic:



While any one barrier can deter a consumer from handing off their device for reuse or recycling, it is most common for a consumer to encounter

³ The research is based on 50 approximately one-hour video conversations with consumers across the US, roughly matching current US demographics in the categories of age, gender, ethnicity, education, employment status, family composition, income level, home ownership, US region, urban/suburban/rural, and environmental attitudes. While this research was US only, it aligns generally with previous (publicly available) academic research on electronics hibernation with European consumers.

multiple barriers, creating more obstacles to action. For example, while addressing low handoff convenience seems like a straightforward opportunity, if the consumer’s data retrieval and removal needs aren’t already solved for that device, a convenient handoff option will not be sufficient to drive consumer action.

Our research was not designed to be a quantitative study. It focuses qualitatively on a deeper understanding of consumers’ experiences, feelings, and perspectives. Nonetheless, we did find an average of about six hibernating devices per household across the 50 consumers we individually interviewed. Just over half of the 308 products discussed were phones, laptops, or tablets. Based on interviewee responses, we documented whether a barrier was present (“yes”), not present (“no”), or whether the response was contradictory (“maybe”) for the product. About one-third of the time, a potential product-barrier combination was discussed during the interview, leaving the remaining two-thirds as “unknown.” See an example for one specific interviewee below:

Product barriers

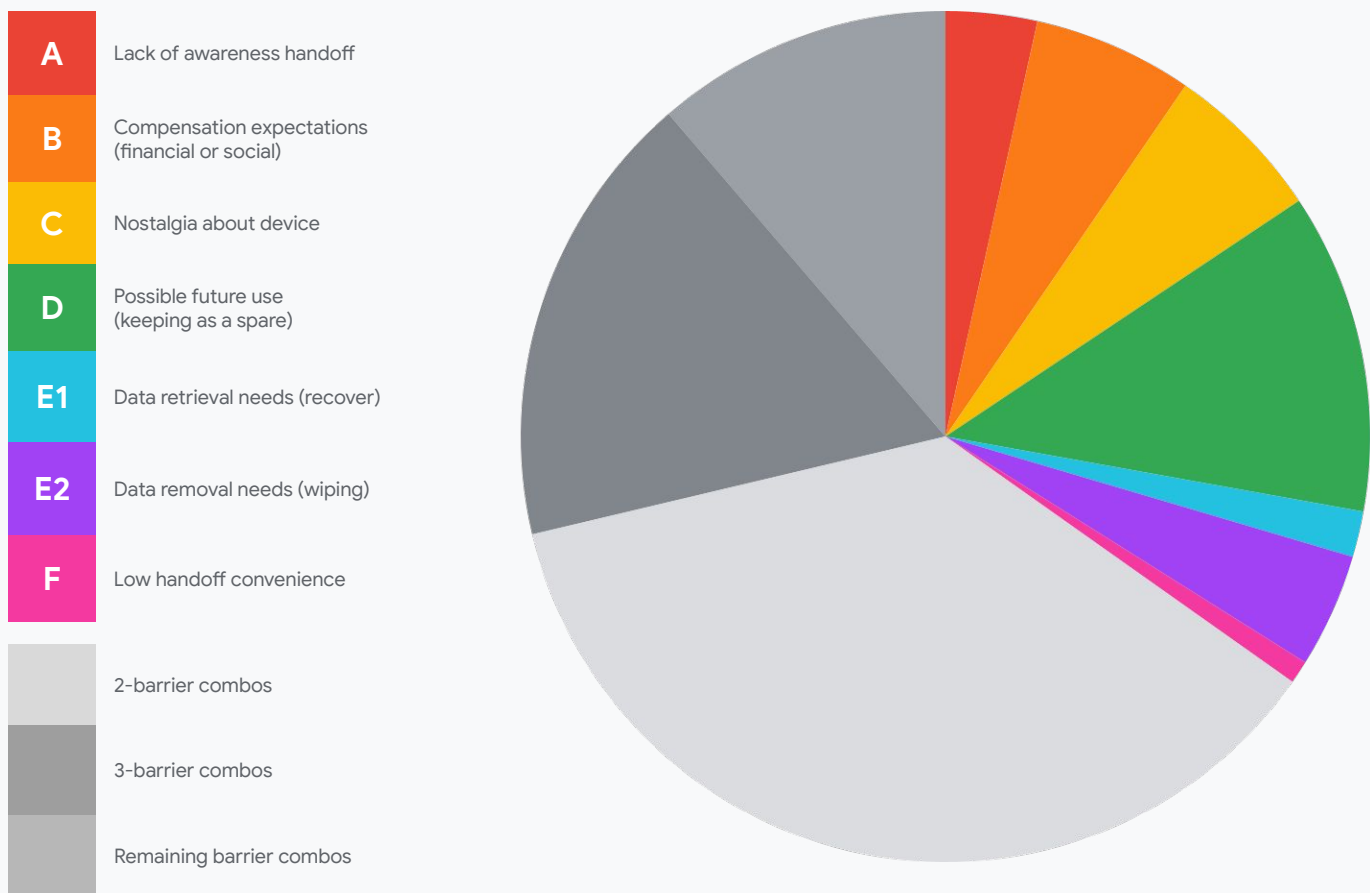
Example individual interviewee

Y — Yes
 N — No
 M — Maybe
 U — Unknown
 (not discussed)

	5-year-old smartphone	4-year-old smartphone	Tablet	Laptop	Bluetooth speaker	Smart speaker
Low handoff option awareness	Y	Y	Y	U	U	U
Compensation expectations (financial or social)	Y	Y	Y	U	U	Y
Device nostalgia	U	U	U	U	U	U
Keeping spare products	U	U	U	Y	Y	N
Data retrieval	N	N	U	N	U	N
Data removal	U	Y	Y	Y	U	N
Low handoff convenience	U	U	Y	U	U	U

That example illustrates a consumer confronted with different barriers for different products. As such, they do not perceive their hibernating electronics as one group to be disposed of collectively. Instead, consumers generally perceive each hibernating product as a unique item with distinct requirements that need to be addressed before they actually take the action of handing off the device for reuse or recycling. Because not all barrier-product combinations were explored in these interviews, the following chart can be seen as a best-case scenario, where one barrier was present for an individual product only about a third of the time.⁴

Barrier frequency



While a dedicated quantitative assessment of hibernating devices would provide a clearer view, this chart illustrates the relative frequency of each barrier occurrence in our research, either alone or in combination with one or more other barriers.

Qualitative Insights

Barrier A: Low Handoff Option Awareness

Barrier A describes when the consumer wasn't clearly aware of the options they could use to dispose of their device (besides throwing it in a landfill-bound trash bin).

Barrier A categories

Consumers indicate several types of knowledge gaps in choosing a recycling or reuse service. While satisfactory answers to their concerns exist, this barrier specifically represents a lack of awareness of that answer, and by extension, the effort required to discover it.

Choice overload – When a consumer performs an internet search, there are so many options to evaluate that it becomes overwhelming to decide which is best. While consumers are broadly aware that formal recycling options exist, urban dwellers are often also aware of informal options in their neighborhoods and become indecisive in considering these options.

Social good optimization – Many consumers would prefer to see their unused product used again by someone who needs it. Their challenge is determining whether their product is actually still useful and what donation option would make the best use of it.

Device eligibility uncertainty – Consumers aren't clear on which items each service will accept.

Process integrity uncertainty – Consumers wonder if the service they are handing the product off to will responsibly follow through on what they claim.

Beneficiary skepticism – While consumers want their unused products to benefit an individual, they don't want to “make a donation” to a program that enhances corporate profitability.

Logistical uncertainty – Sometimes basic awareness of location and hours of operation for recycling is the difference between action and inaction. While a quick search could provide an answer, consumers almost always have higher-priority tasks on any given day.

Cost uncertainty – Unexpected expenses are never a welcome surprise. Consumers know that in some contexts for some products, there is a cost to recycle, and that vague knowledge becomes a major detractor for consumers. The mere possibility of a fee is a disincentive for consumers to invest time in recycling products that might actually be free to recycle.

Selected quotes from interviewees

“Then something like this, I’m not really sure what to do with it. I think you’re not supposed to throw it away in the trash, being electronic. I don’t really know how to dispose of it or I haven’t looked into how to dispose of it.”

“I know our city sends us a little brochure a few times a year about what you’re supposed to put in each bin—what’s recyclable, what’s not. Then I know they have a dump somewhere in town, then they list items like latex paint and corrosive—like batteries, you’re not supposed to throw away. I don’t remember where I originally heard about electronics, and then, I don’t know. I would assume this would qualify as an electronic, even though it’s tiny. I don’t even know where the city dump is, so I wouldn’t know where to take it. Again, I haven’t prioritized researching that information.”

“Why don’t I just leave it in the laundry room, beside a dumpster instead? Things disappear when I do that, supposedly benefiting someone in need.”

“Every option seems to have different guidelines. Are my items too large? Too small? Too broken?”

“What happens to the materials I drop off? Should I put things in an unattended bin?”

“I don’t want this to make money for the corporations who charged me a bunch for the product in the first place.”

Many interviewees instinctively knew that throwing electronic devices in the trash was not appropriate, but they also admit they haven’t prioritized finding options for handing off their devices and then following through with action. There is clear confusion as to what option to pursue given the diversity of device types and sizes, device conditions, and service offerings.

Qualitative Insights

Barrier B: Financial or Social Compensation Expectations

Barrier B describes when an interviewee indicated that they would like a form of financial or social compensation before it would be worth it for them to hand off the device to a third party. While financial compensation is straightforward, social compensation needs to create the feeling the consumer is helping someone in need or contributing to a larger movement or campaign.

Barrier B categories

Product value disillusionment – Electronics lose value primarily through obsolescence, not wear and tear. Additionally, that loss of value can occur over a shorter time than it does for other durable goods. Both dimensions of value loss can be hard for consumers to accept.

Product brand relationship trust – Some consumers describe being in an “abusive relationship” with the manufacturers whereby they are continuously purchasing new products to “stay current,” only to see their value rapidly decline.

Value recovery hierarchy – Some consumers have specific notions for how the value of an unused product should be recognized socially or financially in order to part with it. Determining those values in multiple contexts is complex and can lead to inaction. Some consumers also expect a tax deduction benefit for donations, which isn’t always possible.

Unrealistic social good aspirations – Many consumers want to see their product do social good. However, some will only consider donation when a product has low or no resale value, and these are usually too old to be useful even in charitable contexts.

Selected quotes from interviewees

“Ideally, you would turn it into money and if not into money, you would have it doing something useful in the world.”

“For it to be socially useful and not end up in a landfill, that’s beautiful.”

“My phone doesn’t flip open—it should be worth more than \$5.”

“Trading in feels like a loss” and “I don’t trust the trade-in values, especially after all that I paid in the first place.”

“First, get money/product value for it; if not, do social good; if not, recycle it—and don’t make me find three different places for all that.”

“I won’t recycle this if I suspect it could benefit someone through donation. Recycling is only for waste.”

“If it’s really and truly not worth more than \$20, then I’ll donate it.”

Consumers still perceive many of their older electronic devices as having some financial value. For items like phones, laptops, and tablets for which trade-in programs exist, if the value offered for a device is not high enough, the consumer may just choose to keep it. While they may have the intention to later sell it themselves on a resale site, they often don’t follow through on that action.

Fortunately, there are options besides paying consumers in these situations: we found that consumers’ perceived financial value for their devices can often be substituted with an offer of social value. If the consumer believes that their device will go to someone else who would value it and use it, then many are willing to donate the item (as long as there is a high level of trust and transparency in the donation process and they aren’t losing too much financial value).

Most importantly, we found that consumers do not usually see their hibernating products as “waste,” especially if the product is not broken. When consumers hear terms like “e-waste,” they don’t naturally associate it with their hibernating products. For them, recycling is just a better way to dispose of waste and is for items that no longer have value. Therefore, recycling programs that advertise using the term “e-waste” might be missing potential opportunities to collect products that still work (even if in a diminished capacity) or are seen by the owner as still having some form of value.

Qualitative Insights

Barrier C: Device Nostalgia

Barrier C describes when the consumer indicated feeling some amount of nostalgia associated with the device itself and being reluctant to part with it. (Nostalgia about the data on their device is covered separately, in barriers E1 and E2.)

Barrier C categories

Iconic design – Products with novel and memorable design innovations continue to fascinate consumers even after their utility has become obsolete. Even without data present or functioning at all, a physical device can evoke emotional value.

High quality – Products that functioned well with high reliability or durability earn a place of respect with their users.

Life events – Products can represent companions or significant points in consumers' lives.

Remembrances – Some products belonged to a friend or loved one who has passed and become a way to keep their memory alive.

Historical artifacts – Products can be shared with different generations as a way of sharing a lived experience or to describe a cultural era.

Selected quotes from interviewees

“This is my oldest laptop. Well, no, I had one in high school that went away a long time ago. This is the first one that I bought myself, and this was my college laptop, and I loved it. Wore it into the ground and covered it with stickers. Then wore the stickers off, too.”

“It reminds me of the times I had beyond just using the phone. The experiences I had with my new friends and things like that. It is in a way just something that triggers memories of good times and bad times, whatever it may be, because your phone is something—I read somewhere—the phone is the most personal device you’ll ever own. It always went places with me. In a way, it’s seen the things that I’ve seen, and done the things that I’ve done, and it’s hard to let that go because it feels like my phone’s always an extension of myself.”

“It was from a time in your life. We’ve all done that. I mean, do you remember—I’m sure you’ve gone through a box of your parents’ old stuff, whether it’s valuable or not. It was just sort of like, wow. And they had stories to tell you.”

“My dad passed away seven weeks after my husband, and I wanted his stereo ‘cause I had memories of him playing [it].”

“Yes, I can transfer over my old playlists from this device. But for me, it’s still about remembering how cool it was when it was first released and how good it feels to hold in my hand.”

“I was excited when I got this flip phone because it had color and a front screen with picture. It made noise when it opened; it made noise when it closed. It was great.”

“It always operated really great. It was just a real good machine.”

“I ran my first marathon with this MP3 player.”

“I want to share how neat this older device is with others, like my kids, and nieces and nephews.”

With this barrier, the device hardware itself prompts nostalgia for the consumer. Specific design elements or physical features, like a hidden keyboard on flip phones, function as a kind of memory recall to times in the consumer’s past. Given the deep emotional connection that can be present with this barrier, these instances are harder to address. It may be the case that characterizing some devices with nostalgic value as “unused” would be inaccurate. In some scenarios, a product’s use and utility may be very active but simply different from its original use case.

Qualitative Insights

Barrier D: Keeping Spare Products

Barrier D describes scenarios where consumers indicated they keep a currently unused device as a backup (spare) or for another possible future use.

Barrier D categories

Indispensable product type – A type of device a user has a constant need for, especially while waiting for repair of a primary device.

Friends and family potential – Someone in their network might be able to make good use of the device.

Social obligations – Some products given as gifts might be unused and potentially useless to the recipient, but are nonetheless kept out of a sense of obligation or appreciation to the person who gave it to them.

Unique legacy features – Some products have hardware features that are obsolete but still useful in some potential contexts, such as accessing older media types (e.g., CDs and DVDs) or connecting older accessories.

Potential utility recovery – Devices that need repair and, if repaired, have potential uses.

Services attachment – Products that have software or content services attached to specific hardware that would be inaccessible without it (e.g., a content streaming subscription). In these situations, the services are not actively used but still represent value consumers don't want to lose.

New or dedicated uses – Products that can become a dedicated device for a particular function or user need. Even if the function can be accomplished with a newer device they own, some consumers see a potential convenience or utility in having a dedicated device for a task.

Common examples include devices repurposed for additional data storage or as a camera monitoring device. In many cases, the consumer has not actually repurposed the device but is interested in that possibility.

Selected quotes from interviewees

“I just have kept this around ’cause technically, it still works. Technically, and what if I need a backup, you know what I mean?”

“The intent of that was to trade it out at some point, and then it just sat there, and so then we thought it probably doesn’t have much value anymore to trade out, but we’ll hold on to it and see if maybe we can put it to use.”

“My mom or one of their friends might be able to use this” and “We pass down old phones to our kids when they need one.”

“This phone has a headphone jack” and “This laptop has a USB port and a CD-ROM drive.”

“If I take the data off of this, I’ll have to pay for cloud storage or an external hard drive.”

“I can use my phone as a security camera or a remote” and “I can use this laptop as a streaming device.”

“I got a lifetime subscription with this device.”

“If it breaks, then I need something to use while I wait for a repair or the insurance replacement.”

“I need to have it in case Mom asks me about it—she gave it to me as a gift.”

Consumers expounded on scenarios that justify holding on to unused devices, including broken devices they might someday fix. The belief that the devices have value is powerful. Having a backup also invokes a sense of safety, especially for frequently used device types. Often though, the backup devices are already too obsolete to fulfill their intended purpose.

Like Barrier C (device nostalgia), this is a challenging barrier to address directly. Offering forms of social compensation, such as the prospect of another person being able to make use of the hibernating device, could help overcome this barrier, especially when the user has more than one spare of a particular product type.

Qualitative Insights

Barrier E1: Data Retrieval

Barrier E1 describes when the consumer needs to transfer data off their hibernating device before they would be willing to hand off the device. Usually consumers have specific data they need to transfer, which might include photos, documents, or text messages. They also have lingering concerns about data they might be forgetting. Beyond that, however, they are not usually seeking a full backup of their device's applications and operating system.

Barrier E1 categories

Process complexity – Some users are willing to do the work themselves but lack the technical expertise or confidence.

Level of effort – Users who are confident in their technical knowledge of what needs to be done but are deterred by the amount of time needed or how tedious the task is.

Distrust of a process or person – Some users know they will need assistance but are fearful of something intentionally or unintentionally going wrong in the process.

Data retrieval and storage costs – When transferring infrequently used data off a product means incurring additional costs to move it or store it elsewhere, many consumers conclude that it makes more sense to keep their old device indefinitely.

Accessibility challenges – Some consumers are presented with the challenge of wanting to retrieve data but lack the necessary cables or accessories to make that possible, or they are confronted with security

barriers, such as a forgotten password. While they might not have a path to overcome those challenges, they believe that by holding on to the device, they technically haven't lost their data.

Selected quotes from interviewees

"It seems just like a lot of things—steps that I have to figure out how to do it. Then I don't know where does it get backed up to. I don't trust it, so I would rather just copy the information to an external hard drive or something. Really, it's just the pictures I care about. I don't care about anything else on that."

"Some of them, though, I guess that's where I'm stuck. I don't know how to even turn these on and how to get the data off of them."

"It would take a lot of time and it's just not a top priority now. It's kind of funny looking back at old pictures, but it's like—same thing, we have to sit down and take the time to move all the photos off it, wipe clean, and then go recycle it. No use for it anymore."

"All of my data might not get pulled off the device."

"Someone might steal my data when retrieving it for me."

"I know how to retrieve my data, but the device is so slow or the process such a pain, I haven't gone through it."

"I don't want to pay for the cloud storage to store the data I retrieve from the device, especially if I don't need everything."

"I don't remember the password to unlock my device, but hope that someday I will."

When data is difficult or expensive to retrieve from hibernating devices, consumers are sometimes reluctant to hand off their devices. They fear that something important they've forgotten about will be lost and they want to ensure the device truly contains nothing of importance to them. In the case of accessibility challenges when devices no longer work or have security features enabled, this is an extremely difficult barrier to overcome.

Qualitative Insights

Barrier E2: Data Removal

Barrier E2 describes when the consumer wishes to wipe sensitive data off their device before handing it off.

Barrier E2 categories

Process complexity – Some users are willing to do the work themselves but lack the technical expertise or confidence.

Level of effort – Users who are confident in their technical knowledge of what needs to be done but are deterred by the amount of time needed or how tedious the task is.

Distrust of a process or person – Some users know they will need assistance but are fearful of something intentionally or unintentionally going wrong in the process.

Data wiping costs – Wiping data off a product means incurring additional costs. Many consumers conclude that it makes more sense to keep their old devices indefinitely rather than risk it leaving their possession with data still on it.

Accessibility challenges – Some consumers are presented with the challenge of needing to wipe data off a device but lack the necessary cables or accessories to make that possible, or they are confronted with security barriers, such as a forgotten password. While they might not have a path to overcome those challenges, they believe that holding on to the device indefinitely is lower risk than recycling it without wiping the data.

Selected quotes from interviewees

“Honestly, whenever I look at a device, I’m thinking about getting rid of it. The first thing that goes through my head is: What’s on it? Is there anything embarrassing on it? These days, data never dies.”

“What’s on there? But every time I go on it, it’s so slow I can’t even get to those things to get it deleted, so we just sit here with it.”

“I don’t trust that the factory device reset process really erases my data.”

“I don’t know if I really completed the factory device reset process.”

“I don’t trust certain entities/people to really erase the data off my device.”

“I don’t want to erase the data myself at this time, and I’m not willing to pay for someone else to do it.”

If the consumer is unable to erase the data off a device themselves and hands it over to a third party, they must trust that party to securely destroy the data, possibly through physical device destruction. Consumers may be reluctant to hand off devices, even if the data of concern is unknown, because it may still be of a private nature (e.g., financial data).

Qualitative Insights

Barrier F: Low Handoff Convenience

Barrier F describes when the consumer found suitable handoff options, but they are inconvenient enough that they put off taking action.

Barrier F categories

Infrequent pickups – In areas where e-waste pickup services do exist, they occur infrequently or on an inconvenient schedule.

Unsecured drop-off points – In areas where e-waste drop-off locations exist, they may not provide any security for receptacles.

Proximity – Options exist to drop off e-waste, but they are not hyperlocal to the user.

Low priority/value – The value isn't high enough to hand off the device(s) relative to the effort that is required.

Storage availability – When users have easy options to store unused electronics in their own drawers, closets, garages, or attics, they find keeping unused products to be more convenient than handing them off to a recycling service.

Selected quotes from interviewees

“Nobody wants to go out of their way to just actually properly dispose of something. I live in a condo complex. There are so many times I go out to the dumpster and there’s something in there that should not be in there. People just—they don’t want to have to go out of their way to dispose of something.”

“If I leave items out, they may be stolen before they are picked up.”

“I know that there is a recycling center, but I don’t have a car. It’s just one of those things where I have a big bag of stuff to bring to [a donation center] that I’ve just never done the 30-minute walk. I think if you could come to me, that would make my life a lot easier.”

“If there’s a way to recycle it—electronics recycling that was convenient—I’d probably do it. But it might be headed for the trash heap if I find it inconvenient.”

“My city/apartment building has an electronics drop-off day, but it only happens once a year.”

“I’m not within walking distance of a [store that accepts recycling].”

“I’ll have to drive 15 minutes to make \$15.”

“I’m waiting until I have a big-enough pile of stuff to take action.”

Convenience is essential to consumer participation in almost anything. There’s an impactful nuance for electronics recycling, though. Even if a particular recycling service were as convenient to use as other services that consumers regularly use, a difference in the urgency of the task translates to a difference in the perceived convenience. For most consumers, recycling their unused electronics products is rarely an urgent task.

Addressing the Barriers

This research did not test potential solutions to address hibernation. However, we did speak with consumers about their desires for recycling and reuse services. From these conversations, we see opportunities to prevent hibernation and increase participation in these services:

1. Clearer and more ubiquitous awareness messaging
2. Financial or social incentives for action
3. Terminology that recognizes value instead of “e-waste”
4. Easier data management
5. Increased collection convenience

We hypothesize that public engagement campaigns from a variety of entities—whether they’re brands, donation centers, or local municipalities—will enhance consumer awareness of options for recycling electronics. In addition, collection services that accept a wider range of products will be met with less user confusion.

Consumers still see value in their unused devices, and financial or social incentives could help avoid hibernation. Communications that emphasize the potential value or utility of devices in a social good or commercial context will likely engage consumer interest more than characterizing them as “e-waste.” However, it’s unclear whether this potential value will outweigh a product’s nostalgic value or its perceived utility as a spare.

Data retrieval and data removal are practical challenges that must be addressed for some consumers. Providing clear, easy, and trusted ways to backup and erase data is critical to removing these barriers. In addition, establishing and communicating the chain of custody for data protection and destruction once a device is handed off can help build consumer trust.

Lastly, convenience is an essential component of any successful service. A variety of collection models need to be developed to understand which ones provide the greatest convenience for consumers in a variety of contexts and what resources are needed to support them. In designing these services, ensuring that the level of convenience outweighs the lower priority that recycling typically has among consumers will be critical.

Conclusion

Ensuring the prompt reuse and recycling of consumer hardware devices is an important focus area in making the consumer electronics industry more circular and sustainable. While avoiding improper disposal of electronic devices is important, avoiding indefinite hibernation is also critical to keeping products, parts, and materials in circulation and to reducing the need to mine new materials.

At Google, we recognize that realizing a sustainable world means that we must accelerate the transition to a circular economy, and we are committed to designing our electronic products and the services needed to dispose of them to be circular, too. Consumers have understandable reasons for holding on to their electronics devices after use, but there are actions that can be taken to address the barriers they experience. We hope that sharing these initial insights will inspire public and private sector stakeholders alike to engage consumers in new ways and drive higher circulation of unused electronics products and their materials in reuse and recycling systems.

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