Chromebook Churn

U.S. PIRG
Education Fund

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April 2023

Acknowledgments

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Executive summary

Especially since the onset of the COVID-19 pandemic and the widespread implementation of remote learning, school districts have looked for a budget laptop that they can buy en masse and then distribute to students to complete their work. In many cases, they have turned to Chromebooks. However, three years after this huge spike in purchases, schools are beginning to see their Chromebook fleets fail, creating piles of electronic waste and saddling schools with additional costs.

The 31 million Chromebooks sold globally in the first year of the pandemic represent approximately 9 million tons of CO_2e emissions.[1] Doubling the life of just Chromebooks sold in 2020 could cut emissions equivalent to taking 900 thousand cars off the road for a year, more than the number of cars registered in Mississippi. Assuming no additional maintenance costs, in the U.S., longer lasting Chromebooks could save taxpayers $1.8 billion dollars across all K-12 students.[2]

This report examines why Chromebooks fail, and why it matters.

Those who maintain Chromebooks point to several factors that lead to the churn:

1. Manufacturers typically do not sell new spare parts or otherwise support repair.
2. Computers have a built-in "death date," after which software support ends.
3. Design choices frustrate repair and reuse.

In order to address these issues, Google, which provides the operating system for Chromebooks, should extend software support beyond their expiration date to prolong their lifespan. Manufacturers such as HP, Acer, and Asus should supply commonly needed spare parts and design products to improve repair access. Moving forward, these companies should design Chromebooks to last by improving device durability, repairability and sustainability.

Figure 1. A school system's Chromebooks that are no longer usable. Image credit: Peter Mui

Introduction

As schools got ready for a new year in the fall of 2020, they had to teach students remotely in the midst of the COVID-19 pandemic. Increasingly, schools turned to Google Chromebooks as lightweight, affordable options for making sure students had a device capable of supporting remote learning.

This trend created a huge boom for Chromebook makers, as sales rose 87% from 2019 to 2020.[3] The last quarter of 2020 saw a more pronounced spike, as Chromebooks sales were 287% higher than the same period in 2019.[4] In March 2020, Congress passed the Coronavirus Aid, Relief, and Economic Security (CARES) Act which granted $30.75 billion to states for education.[5] The Department of Education's initial grant award letters to elementary and secondary schools urged them to "focus on investing in the technology infrastructure and professional development and training that will help all students continue to learn through some form of remote learning."[6] States such as California authorized additional grants of millions of taxpayer dollars to purchase laptops for students.[7] It wasn't just taxpayers that bought Chromebooks for classrooms. "10 percent [of teachers] say they paid for a device such as a Chromebook or iPad that they use regularly in the classroom," according to a nationally representative survey by EdWeek Market Brief.[8]

The growing trend for "1:1" policies, that aim to give every student their own device, had started before the pandemic and became a necessity with remote learning. According to a survey by the EdWeek Research Center, by "March of 2021, 90 percent of district leaders surveyed said they

were providing a device for every middle and high school student, and 84 percent said they were doing the same for elementary school students."[9]

Google claims that "50 million students and teachers [use] Chromebooks."[10] The International Data Corporation (IDC) reported in 2020 that Chromebook sales surpassed Apple as the second most popular operating system in market share.[11] Clearly, Google has benefited from the tide of public funds that were used to purchase Chromebooks.

Now, some three years after that huge spike in Chromebook sales — over 31 million units sold in that first year of the pandemic[12] — schools are beginning to see their Chromebook fleets fail. This is the dark side to Chromebooks: they don't last as long as they should, and have unique challenges to fixing them.

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NEWS

SKSD needs $2.8 million in 2026 to replace Chromebooks

By Elisha Meyer Port Orchard Independent • January 25, 2023 1:30 am

Figure 2. Headline from Kitsap Daily News

While most consider the devices an affordable option, Washington's South Kitsap School District IT Director Derry Lyons warns, "Chromebooks have what I would call a hard stop expiration on them…So, Chrome and the ChromeOS says, as of 'this date', this device will no longer work." The expiration date for 9,483 of the school's Chromebooks will pass in the summer 2026, leaving the district stuck with a multi-million dollar bill before the next school year. "'I feel bad about this because I really wish this could be spread' out over a longer period of time," Lyons told the Kitsap Daily News. The paper also added that inflation and the need for replacement parts could raise the cost to taxpayers.[13]

South Kitsap is one of many schools facing the Chromebook Churn. To research this issue, we interviewed K-12 school IT directors and repair technicians to understand the challenges they confronted trying to repair Chromebooks and how these affect their schools and students.

How the Chromebook Churn affects schools

Chromebooks present both hardware and software challenges for schools. The relatively short lives of Chromebooks creates costs for schools. For example, Google only provides support until each model's "death date," which could be just a few years after purchase.[14] The Ethical Culture

Fieldston School, which shared its data with this report's authors, projects only a four-year lifespan for its Chromebooks. The school incurs significant costs in part due to the short useful lives of Chrombooks, averaging $75 per student every year. [15] If Google and manufacturers took action to extend the life of Chromebooks to eight years, this would cut costs to $37.50 per student per year.

Across the 48.1 million K-12 public school students in the U.S., doubling the lifespan of Chromebooks could result in $1.8 billion dollars in savings for taxpayers, assuming no additional maintenance costs.[16]

Chromebooks take a heavy toll on the environment

Google claims that, "switching 1,000 devices to ChromeOS can reduce greenhouse gas emissions by 90%."[17] Experts dispute the relevance of this claim. Dr. Elizabeth Chamberlain Director of Sustainability at iFixit explained, "Google's claims about energy consumption of already-manufactured devices miss the point: The vast majority of a laptop's environmental impact happens in manufacturing. Keeping our stuff around for longer is the most sustainable electronics choice we can make."

Manufacturing a computer consumes a great deal of resources. In order to end up with tiny computer components, you have to mine and smelt a large amount of raw materials, build tiny components and assemble them — all of which takes a lot of energy. In fact, some estimate that the information technology sector is responsible for about as much greenhouse gas emissions as the airline industry.[18]

Manufacturing a laptop will result in the equivalent of 580 pounds of carbon dioxide being released into the atmosphere, which is 77% of the total carbon cost across the lifespan of these devices.[19] Therefore, the over 31 million Chromebooks sold in the first year of the pandemic represent approximately 8.9 million tons of CO2e emissions.

In addition, because of the limited software support and various barriers to repair, many of those Chromebooks will have fairly short useful lives, needing to be replaced quickly and contributing to our growing electronic waste issues. Unrepairable devices are a disaster for the environment and fuel the e-waste crisis, in which we globally trash 59 million tons[20] of used electronics, equivalent to the weight of 161 Empire State Buildings, each year.[21] Electronic waste is the fastest growing waste stream in the world[22], and the U.S. The Environmental Protection Agency (EPA) reports that it is now the fastest growing part of our domestic municipal waste stream.[23]

If Google followed our recommendation and doubled the average lifespan of Chromebooks in schools, it could result in cutting emissions from manufacturing by half. Doubling the lifespan of the 31.8 million Chromebooks sold in 2020 could cut emissions by 4.6 million tons CO2e, equivalent to taking 900 thousand cars off the road for a year, more than the number of cars registered in Mississippi.[24]

Findings

Why Chromebooks don't last

We identified three key drivers of the Chromebook Churn:

1. Manufacturers typically do not sell new spare parts or otherwise support repair.
2. Computers have a built-in "death date," after which software support ends.
3. Design choices frustrate repair and reuse.

1. Manufacturers typically do not sell new spare parts or otherwise support repair.

For many common products, manufacturers produce a stock of spare parts when they are made, knowing that these parts will be needed by users. However, the technicians we spoke with told us it was challenging to find spare parts to repair Chromebooks.[25]

As part of the U.S. PIRG Education Fund report, "Failing the Fix," we evaluated the detailed repairability information required from manufacturers in France. There were 11 Chromebooks where we could find this repairability information, which the French turn into a "Repair Score" on a 0-10 scale, posted for consumers at the point of sale, like an EnergyStar label for repair. The 11 Chromebooks which we reviewed had lower repairability scores than the average scores of the non-Chromebook laptops reviewed. In the detailed breakdown of these scores, there are sub scores that assign a number out of 20 measuring repairability across five categories: documentation, disassembly, availability of spare parts, price of spare parts, and laptop-specific criteria. Technicians' complaints about parts access is clearly visible in the parts availability score provided by the manufacturers: the Chromebooks we reviewed had an average parts availability rating of 3.3 out of 20, much lower than the average non-Chromebook laptop, which averaged out to 9 out of 20.[26]

Company	Device	French Repair Score (out of 10)	Disassembly score	Parts availability	Parts pricing
Acer	Chromebook 14b-nb0041nf	5.5	15.5	2.8	0
Acer	Chromebook 15a-na0003nf	5.2	11.5	2.8	0
Acer	Chromebook 317 (CB317-1H)	5.4	12	7.2	0
Asus	Chromebook CM3200FVA-HW0054	6.1	14.8	1.7	20
Asus	Chromebook CM5500FDA-E60009	6.2	19.5	3.3	13
Asus	Chromebook CX1500CKA-EJ0075	6.1	19.5	3.3	12
Asus	Chromebook CX1500CNA-EJ0059 Gris	6.1	19.5	3.3	12
Asus	Chromebook CX1700CKA-AU0043	6.6	19.5	1.7	11
Asus	Chromebook Pack C433TA	5.3	13.1	1.7	14
Asus	Chromebook Spin 513 (CP513-1H)	5.4	12	7.2	0
HP	Chromebook tactile CM1400FXA-EC0013	6.1	19.5	1.7	6
	Chromebook average	5.8	16.0	3.3	8.0
	Average of all non-Chromebook laptops	6.9	16.5	9.0	8.0

Table 1. Chromebooks with repair scores and category scores. Source: Failing the Fix.

Justin Millman is the co-owner of Cell Mechanic in Westbury, New York, which Millman estimates repairs 5,000 devices for schools on Long Island per month, mostly Chromebooks and iPads. He shared that the authorized parts sellers he works with aren't able to fulfill the quantity of parts needed to maintain huge school fleets. He reported that one of the parts sellers told him, "if I put in an order for 100 parts, the manufacturer would just cancel it," because of their inability to fulfill the order.[27]

We reviewed the process to purchase spare parts from three popular manufacturers of Chromebooks: Acer, HP, and Asus. Acer does not directly sell spare parts for their devices, although at the time of writing this report they provided a single "Acer USA Parts Partners," Capital Data.[28] This company has no way to order parts online. We also could not assess if parts for several specific Acer Chromebooks were available.[29]

Figure 2. Form from Capital Data, Acer USA Parts Partner, to request parts and repair.

HP claims to offer parts for Chromebooks at parts.hp.com, but searching reveals huge gaps in its practical use. For example, the only two parts available for the $250 Chromebook 11a were an AC Adaptor and Power Cord. These are necessary accessories that schools often need to replace, but do nothing to address common issues around broken screens, hinges, and keyboards. These common accessories are also expensive. The combined price of these parts is more than half the cost of a new laptop.[30] These high costs may make schools reconsider Chromebooks as a cost-saving strategy.

Figure 3. Parts available from parts.hp.com for Chromebook 11a

Asus offers a "Customer Self Repair" program which claims to offer, "speedy, convenient option for notebook repair."[31] While the program provides an option for DIY repair, it isn't much use for schools or institutions which need to maintain hundreds of Chromebook. It's burdensome for schools to follow a five-step process of diagnostics, forms, and waiting to receive a single part for every repair they perform. This process comes at the cost of the availability of each broken device.
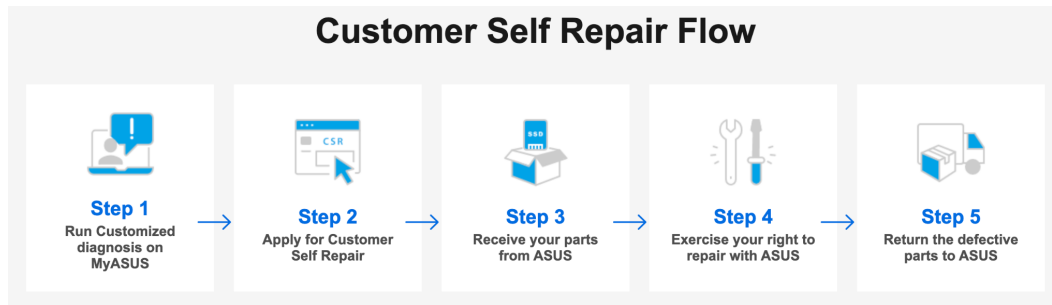

Customer Self Repair Flow

Step 1	Step 2	Step 3	Step 4	Step 5
Run Customized diagnosis on MyASUS	Apply for Customer Self Repair	Receive your parts from ASUS	Exercise your right to repair with ASUS	Return the defective parts to ASUS

Figure 4. Asus Customer Self Repair program diagram

Jeannie Crowley, the Director of Technology and Innovation for the Scarsdale, NY Public School district explained how for her, it was "hard to source parts," and the brand-name parts she did buy, "raises prices so [the devices] are running closer to the $400 range," for their lifetime costs compared to the $300 purchase price. An Oakland, California school district official explained that fixing a cracked screen can cost around half the price of a new device. These high prices can make repairs challenging for schools.

The lack of spare parts produced by manufacturers makes them hard to source and expensive. Currently, schools need to purchase parts from third-parties or scavenge from broken machines. While there are parts suppliers such as chromebookparts.com and Edu-Parts, popular parts are often out of stock. We found nearly half—14 of 29—Acer replacement keyboards listed on chromebookparts.com out of stock, with backorders estimated at 28 days or more. This scarcity can contribute to the high price for parts, making repair uneconomical. 10 of the 29 keyboards we reviewed cost $89.99 or more, which is nearly half the cost of a typical $200 Chromebook.[32]

Due to these issues, respondents told us that to have a source for spare parts, they increased their orders of Chromebooks to above what's needed for their students. The rate of churn is so constant, they also maintain extra devices in order to provide loaners or create a revolving bank to swap out with devices being repaired. In fact, buying and maintaining extra Chromebooks is exactly what Google recommends to schools in their guide on repair programs.[33] The guide also tells schools to scavenge parts: "if there are Chromebooks you own that are damaged beyond repair, there may be an opportunity to reuse some of the non-damaged parts (e.g. display, keyboard)."[34]

Manufacturers can reduce sourcing and inflated costs by producing a stock of spare parts along with the production of new notebooks, a typical process for other devices. Being able to purchase

repair parts with orders of new laptops would lessen the burden on school staff to source parts while reducing repair turnaround time.

2. Chromebooks have a built-in "death date" after which software support ends.

If you bought a laptop 20 years ago, it likely came with Windows XP. Microsoft supported XP until 2014—12 years after the operating system's release. [35] When support ended, many users were able to upgrade their devices to the newer Microsoft operating systems Windows 7, 8 or 10.

Chromebooks are a different story. These devices come with a built-in expiration date from the beginning, limiting the useful life of a Chromebook.

Figure 5. Message that appears on Chromebooks when they reach their AUE date.

Many major manufacturers typically offer operating system updates to their devices until they no longer meet minimum hardware requirements, such as CPU generation, RAM size, and storage to successfully install the update. [36] Google, on the other hand, assigns each model of Chromebook an expiration date at the outset. After that date, these devices no longer receive updates for ChromeOS—the operating system for Chromebooks. [37] This predetermined expiration date likely means that some Chromebooks are denied software updates before the hardware reaches the end of its useful life.

The exact reasons for these expiration dates—which Google calls Automatic Update Expiration (AUE) dates—are not transparent to consumers. For example, Google has a version of its operating system—ChromeOS Flex—that allows users to install a version of Chromebook software on "Windows, Mac, or Linux devices, [and] get most of the features and benefits of ChromeOS." [38] This version of Google's operating system has clear device requirements, requiring "4 GBs of RAM, and at least 16 GB of storage." [39] By contrast, this report's authors were unable to find published hardware requirements for the ChromeOS that runs on Chromebooks. [40]

Some technicians are skeptical of Chromebooks' AUE dates. As Justin Millman, a repair technician who estimates he services 5,000 devices for schools a month, told PIRG in an interview, "the hardware hasn't changed all that much in seven years, the AUE dates are arbitrary." [41]

What is clear is that the AUE dates can take consumers by surprise. When consumers or schools buy a used or refurbished Chromebook thinking they're getting a great deal, they can be surprised

to learn their new laptop expires after a year.[42] As one school official in California shared with PIRG, while the expiration date for a given model might be set for seven years, by the time his school buys their laptops, expiration is only four to five years away.[43] Similarly, the Ethical Culture Fieldston School budgets with the assumption that Chromebooks last a short four years.[44] As of this report's release, Google's AUE information page lists the average expiration date for all devices as four years away.[45]

When a Chromebook hits its AUE date, Google stops providing software updates to the device[46] which makes it more vulnerable to viruses and attacks over time.[47] For schools, this can have significant implications. Chromebooks can no longer access services which require the device to pass a security check. [48] Instructors have reported that expired laptops can't access online state testing websites.[49]

AUE dates are a choice. In 2016, a Google spokesperson told PCWorld that the end-of-life dates are "not a firm cut-off"[50] and in 2019, Google extended the life of many of its Chromebooks.[51]

When the software expires just a few years into a device's use, schools are left with boxes of computers with working components that end up as electronic waste, and the need to buy even more Chromebooks.[52]

Why software needs updating
Every internet-connected computer that we use requires software updates. Updates don't necessarily add new features, but they can be critical to maintain functionality and security. Software like ChromeOS and Google Classroom depends on an ecosystem of software packages written by other developers to run. Bugs and security vulnerabilities are inevitable in these complex systems, which means fixes are required.[53] Operating system developers like Google release patches to fix bugs which can be found years after the code was initially written.[54] Changes in the complex dependencies can require updates to maintain functionality. Finally, the other software a user uses, for example Google Docs, is evolving as well and updates might be required to maintain compatibility. Without necessary software updates, an operating system can't meet users' needs for functionality.

3. Design choices frustrate repair and reuse.

Chromebooks do not vary in computing power or other core features as much as other computers. Because Chromebooks function as terminals to access much more powerful cloud computing services over the internet, they don't require much processing or storage capacity, which makes them much less expensive.

It would be easy, therefore, to make these less-powerful laptops highly modular, allowing commonly used parts to be shared across a range of models. Parts that wear down over time or frequently break—such as the battery, screen and keyboard—could be taken from older or broken devices and used to fix newer devices. However, school technicians point out that updates to popular models often include arbitrary changes that frustrate repair and use.

For example, in the past Chromebook chargers varied across makes and models. Crowley described how her previous institution, "had to throw out boxes [of chargers], the waste was monumental." Newer Chromebook models use USB-C chargers, which have variations in wattage but are largely compatible across models. While charger incompatibility used to be an issue, Google's move to standardize chargers has been a strong step in the right direction. More of these standard parts and accessories would alleviate repair issues.

Peter Mui, founder of Fixit Clinic, explained to us how models slightly change batteries and arbitrarily change plastic bezels on the screen, which foil repair. To test this, we reviewed the six manufacturers on edu-parts.com, a popular parts reseller, to assess if the plastic bezel that surrounds the laptop's screen were compatible from one sequentially released model to the next. All six of the manufacturers we surveyed made non-functional changes to the bezels of their Chromebook 11 sequentially released models that made these parts incompatible from one model to the next. For example, from the Samsung Chromebook 11 XE500C12 to XE500C13 the cutout in the bezel for the camera changed from a square to a circle. This cosmetic change rendered replacement parts incompatible across models. From the Dell 11 3100 to the Dell 11 3110 the bezel is not compatible across models, the only visible changes to the user between them being the addition of small notches on the bottom of the newer model. On the back of the bezels the 3110 version has missing or less pronounced clips which renders them incompatible.

Figure 7. Can you spot the difference? From left to right, on top the front and on the bottom the back of the Dell 11 3100 Non-touch Chromebook Bezel and Dell 11 3110 Non-Touch Chromebook Bezel. These parts are not compatible across models, the only external changes between them being the addition of small notches on the bottom of the newer model. On the bottom row from left to right, on the back of the bezels we can see that 3110 has missing or less pronounced clips which renders them incompatible. Image credit: edu-parts.com

Crowley explained that, "repair is a risk for Chromebooks. In order to make a typical repair you need to replace 50% of the device and chuck it." This was a concern raised by our other interviewees who shared their frustration with typical repairs, such as replacing broken keyboard buttons. They explained that for the models they used, rather than replacing a single key, they often needed to replace the entire keyboard.

All of our surveyed technicians described how most of the parts they used were from broken Chromebooks kept on hand. And yet, the unique repair challenges of these devices still frustrated attempts to keep repair costs down by reusing parts. "We have piles, hundreds of Chromebooks, and it's so frustrating because I can't just take a key off one," described Crowley.

Some schools have started repair internship programs to teach students skills while maintaining their devices. These programs have resulted in lowered maintenance costs, increased sustainability, and students who have gone on to technology careers due to their participation. We spoke with a coordinator who over two summers ran an internship program that worked at 50 schools, trained 23 students, and repaired 590 computers. Unfortunately, the program also needed to replace 4,156 Chromebooks, most of which still worked but had reached their software expiration date.[55]

Disposable design even frustrates attempts to recycle Chromebooks once they're no longer in use. Most schools are able to recoup some of the costs of maintaining their devices by selling previous fleets to refurbishers and resellers. Due to Chromebooks' expiration dates and fragility, our respondents told us they often have no resale value. In fact, some mentioned they had to pay for e-waste recycling of these devices.

Recommendations

Chromebooks aren't designed to last, but Google has the power to change that. The company can set hardware and software standards that third-party manufacturers such as Dell, Asus, Acer, and HP must follow. Manufacturers should publicly set a goal of Chromebooks lasting at least eight years in actual use by schools. To stop the Chromebook Churn we recommend the following:

1. Extend expiration dates for Chromebooks. Laptops shouldn't be disposable. Chromebooks should last at least as long as other laptops, especially since they're being purchased with taxpayer funds in such large quantities by schools. Ultimately, software shouldn't be the reason we toss perfectly functional laptops, and the Automatic Update Expiration (AUE) should be eliminated entirely. As a first step, Google should extend the AUE to 10 years after the model's launch date for existing models. This would allow school districts to greatly extend use, potentially allowing students to use the same Chromebook throughout the majority of their K-12 attendance. Decommissioned laptops could also be resold or refurbished to extend their life.

Extending the AUE or providing security updates for longer is plainly technically feasible given Google extended these dates in 2019 for over 130 devices.[56] If Google extended AUE dates before, why not extend them for all Chromebooks? This would allow secure browsing and access to web applications such as state tests for much longer. Technical details aside, it's clearly possible for highly profitable technology companies to act on their responsibilities to security and longevity. Apple recently provided a security update for the nearly decade-old iPhone 5s, five years after it had reached its OS end of life.[57] Google can and should act similarly on Chromebooks.

2. Manufacturers should produce spare parts based on 10% of their stock. Repairable laptops are worthless if technicians don't have access to the parts needed. In order to produce longer-lasting Chromebooks, manufacturers should produce a minimum 10% overstock of spare parts available for purchase at reasonable prices. This will increase availability and keep prices low for institutions buying common parts in bulk such as keyboards, screens, and chargers.

3. Parts should be standardized across models and manufacturers. Manufacturers should prioritize standardizing batteries, screens, keyboard, and other components across models to allow reuse and enable repair. Several battery capacities, screen sizes, and keys could be standardized to allow a range of performance specifications and price-points while still supporting modularity. This will allow parts from a broken device to be used to maintain other Chromebooks still in rotation. It will also allow schools to use various Chromebook models from various manufacturers without sacrificing repairability.

4. Refurbishers should be able to unenroll devices from remote management. Right now, refurbishers who receive computers might be locked out of use because the device is still tied to an earlier user. Google should create a process, which maintains security, but makes it easier to unenroll such computers and free them up for another user.

5. **Google should make it easy to install alternative operating systems.** Users should be able to tinker, repair, and modify devices they purchased—including the operating system. Whether because the laptop has reached its expiration date and Chrome OS is no longer eligible for security updates, or for any reason at all, owners should be able to install alternative operating systems such as Linux. Not only is the choice of operating system a consumer right, it would extend the resale and reuse value of the laptop by years.

Conclusion

We have a massive stuff problem. We don't need most of it and too much of it is built to be disposable, which keeps us buying more things all the time.

Ultimately, all companies should do more to design their products to last with flexible and durable software and hardware to enable repair and repurposing. While Chromebooks follow some damaging industry trends, Google has the power to lead the industry towards a durable future. Google, Acer, Asus, Dell, HP and others can make their products easy to fix, private, secure, modular and upgradable.

Our planet can't afford to produce disposable technology at this rate. Electronic waste is less than two percent of the world's waste stream by volume, but causes over 70 percent of the waste stream's harmful and toxic environmental effects.[58] This waste releases toxic metals such as lead.[59] The energy required to produce these complex devices is contributing to climate emissions.[60] The annual consumption of laptops in the United States alone emits 150.6 billion lbs of carbon dioxide equivalent — or the same amount of emissions generated from 17 coal plants in a year.[61] We can't recycle our way out of the problem. When technology like Chromebooks reach their expiration date, only one-third of this electronic waste is properly recycled.[62] If it isn't designed to last, our environment shouldn't pay the price.

Furthermore, schools with tight budgets shouldn't face multi-million dollar expenses every few years to replace computers that still work. Chromebooks' expiration dates and poor repairability mean millions of taxpayer funds are being spent on devices that don't last. By committing to longevity in real use, Google has the power to lighten the load on struggling schools. We shouldn't have to choose between students empowered with educational technology and underfunded priorities such as arts programs or school building upgrades.

Tech companies can do better. The good news is more companies are taking seriously their mandate to improve society. Our "Failing the Fix" report found increased repairability in phones and laptops in 2023.[63] Our reporting at industry trade show CES found more devices offering replaceable batteries and reusable components.[64]

There's a long road ahead, but more tech companies are realizing they can improve and help people's lives with their innovations. Google and other companies making Chromebooks can lead the way by stopping the Chromebook Churn to protect our planet, our wallets, and the 48.1 million K-12 students who need access to technology in order to build our future.

Methodology

This report's findings result from interviews we conducted with school IT directors, technicians, journalists, repair shop owners, parts suppliers, and teachers about their experiences using Chromebooks. Our respondents told us the manufacturers and models they used and the top problems they identified. We conducted a five-question survey with 13 school IT administrators and technicians. The results broadly confirmed the trends reported by our interviewees. For example, 9 of 13 reported they had, "stopped using a Chromebook because its software expired (Automatic Update Expiration), although it was otherwise functional." 2 described Chromebooks as "very durable and repairable," 9 as, "somewhat durable and repairable," and 2 as "durability and repairability are unsatisfactory." Respondents shared concerns such as wanting to "keep support going a few more years so that software lasts as long as the hardware," and "keyboards are essentially unrepairable."

From the Ethical Culture Fieldston School in New York City we were able to review the total costs spent on machines from 2010 to 2020. This dataset included all devices purchased for student use with the intended program, device, number of procured devices, grade, school division, purchase year, projected replacement year, device cost, and total purchase price. Using this dataset we identified Chromebooks purchased which were all priced at $300 per device. To calculate the projected device cost per student per year we assumed a one-to-one Chromebook to student policy and divided the $300 device cost by four years, which was the school's projected time before replacement for all the Chromebook initiatives in the dataset.

We also reviewed purchasing information from the Los Angeles Unified School District for Chromebooks and related costs from July 1, 2021 to February 3, 2023. In total the district spent $130,714,870 on devices and closely related fees such as warranty replacements, e-waste fees, and laptop carts. We calculate an approximate cost of $229 spent per student ($130,714,870 costs / 571,002 total enrolled students in the district[65]). Assuming additional repair and upkeep costs from this figure then seems consistent with our $300 estimate of cost-per-student per year.

We calculated the emission to manufacture all 2020 Chromebooks sold by multiplying the emissions required to manufacture the average laptop from the Restart Project[66] by the 31.8 million Chromebooks sold.[67] We then calculated the car CO_2e savings of an 8 year lifespan compared to a 4 year lifespan by dividing the total manufacturing emissions by the average CO_2 emitted by a typical passenger vehicle per year: 4,600 kg.[68] In notation: (31.8 million * 263.084 CO2e kg) / 4600 kg per car-year / (8 years / 4 years) = 909,000 reduction in CO_2e in cars over a year. We compared this to the list of vehicles registered in each state in 2021 to determine this was more cars than the 893,598 registered in Mississippi.[69] To create an equivalent car savings per state we used 2020 U.S. Department of Education statistics and multiplied the total CO_2e savings by the percentage of the total U.S. K-12 students who lived in the given state.[70]

To calculate the potential savings of longer-lasting Chromebooks for schools in the U.S. we calculated the total number of students enrolled in public Kindergarten to twelfth-grade (K-12) multiplied by the four-year cost per student per year of $75. We subtracted the projected cost of using Chromebooks for eight years calculated by multiplying all K-12 students by the eight year cost of Chromebooks of $37.50 (device cost of $300 divided by eight) from the above total cost savings. We calculated the total number of K-12 students by taking the fall 2021 public Pre-Kindergarten-12 enrollment of 49.5 million and subtracting the 1.4 million Pre-Kindergarten enrollment to arrive at 48.1 million K-12 students.[71] In notation: 48.1 million * ($300/4) - 48.1 million * ($300/8) = $1,803,750,000 saved by schools. We assumed no additional maintenance costs for longer lasting Chromebooks due to the lack of available data. We assume a national one to one (1:1) device to student ratio due to the prevalence of these programs.[72] According to an Education Week survey, "by March of 2021, 90 percent of district leaders surveyed said they were providing a device for every middle and high school student, and 84 percent said they were doing the same for elementary school students."[73] Current trends indicate an upward trend of 1:1 programs in K-12.[74]

Table 1. compares the repairability of Chromebooks to other laptops by referring to the 2023 edition of our "Failing the Fix" report which reviews laptop and cellphone repair scores developed by the French government to help consumers buy repairable devices. The repairability index scores devices on five criteria, with a max score of 20 for each criterion, for a total of 100 points, and then divides the total by 10. Each score is based on a worksheet which shows the breakdown of all five criteria. We collected the full score worksheet for each scored product to better identify and evaluate products according to the different criteria measured by the French repair index. We did not include products for which we could not locate this detailed scoring information. There were a small number of products where there appeared to be a discrepancy in the overall score and the full score breakdown. We elected to use the score suggested by the full repair worksheet in those cases. The average of all non-Chromebook laptops is calculated based on the other devices analyzed, which were all laptops available for sale in the U.S. directly from the reviewed manufacturers in January 2023. We included manufacturer-refurbished devices but not any devices that were only available from third-party or aftermarket retailers.[75]

We analyzed the availability and price of parts by searching for parts in the support sections of the following manufacturer's websites: Asus, Acer, and HP. To access the availability of parts from third party sellers we searched for Acer replacement keyboards because it was the first brand listed alphabetically. We choose to assess keyboards given the frequency in which they were mentioned by the technicians we interviewed.

To assess the compatibility of parts across sequentially released models we reviewed Chromebook 11 bezels from one model to the next sequential model for all manufacturers on edu-parts.com. We searched for bezel replacements with pictures for sequentially released models, if we couldn't find the image for the part we looked at chromebookparts.com. We kept track of the part numbers and which Chromebook models the edu-parts.com listed as compatible. Finally we wrote what

changes we saw between the two replacement parts across the sequentially released models. Staff from Edu Parts confirmed our assessments of incompatibility across parts and provided images.

| Endnotes

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Appendix: Emissions reductions and cost savings by state from doubling the lifespan of Chromebooks from four to eight years

State	Emissions reduction, car equivalent	Cost savings
—United States	909,000	$1,805,000,000
Alabama	14,000	$27,000,000
Alaska	2,000	$5,000,000
Arizona	21,000	$41,000,000
Arkansas	9,000	$18,000,000
California	113,000	$225,000,000
Colorado	16,000	$32,000,000
Connecticut	9,000	$19,000,000
Delaware	3,000	$5,000,000
District of Columbia	1,000	$3,000,000
Florida	52,000	$103,000,000
Georgia	32,000	$63,000,000
Hawaii	3,000	$7,000,000
Idaho	6,000	$11,000,000
Illinois	34,000	$68,000,000
Indiana	19,000	$38,000,000
Iowa	9,000	$18,000,000
Kansas	9,000	$17,000,000
Kentucky	12,000	$24,000,000
Louisiana	13,000	$25,000,000
Maine	3,000	$6,000,000
Maryland	16,000	$32,000,000
Massachusetts	17,000	$34,000,000
Michigan	26,000	$53,000,000
Minnesota	16,000	$32,000,000
Mississippi	8,000	$16,000,000
Missouri	16,000	$32,000,000
Montana	3,000	$5,000,000
Nebraska	6,000	$12,000,000
Nevada	9,000	$18,000,000
New Hampshire	3,000	$6,000,000

New Jersey	25,000	$49,000,000
New Mexico	6,000	$12,000,000
New York	48,000	$95,000,000
North Carolina	28,000	$56,000,000
North Dakota	2,000	$4,000,000
Ohio	31,000	$61,000,000
Oklahoma	12,000	$25,000,000
Oregon	11,000	$21,000,000
Pennsylvania	32,000	$64,000,000
Rhode Island	3,000	$5,000,000
South Carolina	14,000	$28,000,000
South Dakota	3,000	$5,000,000
Tennessee	18,000	$36,000,000
Texas	97,000	$193,000,000
Utah	13,000	$25,000,000
Vermont	1,000	$3,000,000
Virginia	23,000	$46,000,000
Washington	20,000	$40,000,000
West Virginia	5,000	$9,000,000
Wisconsin	15,000	$29,000,000
Wyoming	2,000	$3,000,000