1330 Monterey St.
San Luis Obispo, CA 9340

Re: Energy Labeling Rule (16 CFR Part 305) (Matter No. R611004)

January 31, 2023

Dear Chair Khan, Secretary Tabor, and the FTC Commissioners,

As members of the Digital Right to Repair Coalition, we write in strong support of these proposed Energy Guide regulations. Enclosed, we offer evidence from published literature and our own two studies of repair information availability. For instance, we found that 86% of appliance manufacturers refuse to provide consumers with more than a user manual, which provides very little repair information. Even appliance professionals struggle to find the repair information they need—and more than half the technicians we surveyed were concerned that information and parts restrictions might put them out of business.

Our findings lead us to suggest two major emendations to the ruling:

1. We would like the requirement for manufacturers to provide repair information at the point of sale to specify the categories that are most vital for repair: Full service manuals (not just user manuals), schematics, wiring and parts diagrams, diagnostic codes, error codes, firmware updates, reset codes, and service bulletins (also sometimes called fast track or mini manuals)—all in the most recent versions.
2. If manufacturers remain allowed to restrict any of this necessary repair information, we propose that they might be encouraged toward less exorbitant pricing by adding the cost of access to this repair information to the Energy Guide label.

Working to protect consumers from anticompetitive repair practices will also require making parts and tools available—but these things, we understand, are out of the scope of the Energy Guide program. We will continue to advocate for their availability in legislation.

Many thanks to the FTC for its other Right to Repair work, protecting consumers' rights by enforcing the Magnuson-Moss Act and working with state legislators on repair-protective legislation.

Sincerely,
Dr. Elizabeth Chamberlain
Director of Sustainability
iFixit

RIGHT TO REPAIR COALITION

January 31, 2023

Investigation of Barriers to Appliance Service Information Access

A Report to the FTC Re: Energy Labeling Rule (16 CFR Part 305) (Matter No. R611004)

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Executive Summary

We investigated the availability of appliance repair information in the United States, by two primary methods: We surveyed and interviewed appliance repair professionals, and we attempted to acquire service manuals from 50 appliance manufacturers. We found that appliance repair in the United States suffers from a lack of access to the information necessary to complete repairs.

Of the 50 appliance manufacturers we examined, just 7 made service manuals available: Two were found posted publicly, and another five were provided to us upon request. In other words, **86% of the companies we surveyed did not provide full repair instructions**.

Even for appliance repair professionals, accessing necessary information can be difficult. **89.1% of technicians reported having trouble accessing service manuals**. Even more (93.5%) reported difficulty finding necessary schematics. When technicians do find manuals and schematics, they often have to use informal sources. Such manuals may not be current which increases the difficulty of making efficient and timely repairs.

Technicians rely on these backchannel services because manufacturers often refuse to make repair information available. Some information is available to in-network or authorized servicers exclusively; other information is only available via software that is prohibitively expensive for small shops. Many appliance companies charge hundreds of dollars annually for access to diagnostics and service information that they give to their in-network or official servicers for free; 30% of shops are paying more than $1000/year for access to manufacturer software, but this may only grant them access to one or two subscriptions. **GE, for example, charges $919/year**. This access is obviously out of reach for an individual consumer repairing a single appliance in their home. It is also, however, out of reach for many servicers that are small businesses and that perform repairs on many different appliance brands. One group of **repair technicians services 143 brands**; individual subscriptions to all the manufacturers' own service networks would be prohibitively expensive. Ultimately, consumers bear the burden of these expenses and limitations, subject to increased risk, cost, and downtime of their broken devices.

Failing to subscribe to these services may mean that technicians miss out on crucial information, such as service bulletins that inform them about counterintuitive fault codes or recalls for entire runs of parts. Missing this information often leads to a failed repair for something that is fixable.

Even when technicians do subscribe to these services, however, they frequently find that their **service manuals are less comprehensive** than would be ideal. Manuals may not have lists of parts, or parts may be absent from diagrams. They may not have schematics or wiring diagrams. They may be missing pinout information or other important details for performing component-level repairs, not just swapping large expensive parts.

Consumers ultimately bear the financial burden of these anti-competitive repair information restrictions. When repairs are more expensive, consumers may choose to replace their appliances prematurely. This choice has an associated environmental burden; appliance repair is nearly always environmentally preferable over replacement. Many commonly replaced components account for **less than 3% of an appliance's overall environmental impact**.

Manufacturers' counter-arguments are generally unsound. For instance, they tend to raise unfounded concerns about safety, despite the fact that **the majority of appliance repair is already performed by consumers or independent shops**, without major incident. Professional appliance repair is safer than the average job, nationally.

We call on the FTC's Energy Guide repair information requirement to include circuit schematics, wiring diagrams, pinouts, and part diagrams; diagnostic and calibration software; service bulletins; and computer-aided design files at the end of the appliance's expected service life. To enable the widest potential for repair and give consumers the opportunity to consult repair documentation at the point of sale, we propose that this information be made available at **no charge to the consumer**.

The FTC would do well to include access to repair information directly on the Energy Guide label, through QR codes, URLs, or both. Wider public access to appliance repair information would boost the feasibility of do-it-yourself repair, increase competition in the repair market, and ultimately benefit both the environment and consumers' wallets.

Statement of Interest

We are members of the Digital Right to Repair coalition; for years, we have been advocating for Right to Repair legislation and regulation around the country. Briefly, a summary of our organizations:

iFixit is an international, open-source, online repair manual for everything. Our mission is to provide people with the knowledge they need to make their things work for as long as possible. We represent a global community of makers, tinkerers, fixers, and repair professionals. Together, we have published over 90,000 repair guides for everything from tractors to washing machines to smartphones. We also take apart new electronics and score them on a 10-point repairability scale that measures how difficult they are to fix. To fund these efforts, we sell parts and tools, and we support Google, Samsung, and other electronics manufacturers in making repair guides and kits available directly to consumers.

PIRG is an advocate for the public interest. We speak out for a healthier, safer world in which we're freer to pursue our own individual well-being and the common good. PIRG is a federation of independent, state-based, citizen-funded Public Interest Research Groups, with a track record of nearly 50 years of working to protect consumers, democracy, public health and the environment across the country.

Repair.org, also known as the Digital Right to Repair Coalition, is a membership-driven non-profit 501(c)(6) Trade Association representing over 500 member organizations and businesses with common interests in secondary market uses of high-tech equipment, including appliance repair shops and ranging from agriculture to consumer electronics. Our mission is to fight for repair-friendly legislation, regulations and standards wherever possible for owners, because if owners cannot fix their stuff, repair businesses cannot form to help them. Ours is a big and growing umbrella—our members do everything that supports the equipment owner from the point of sale to the final shred.

Together, we work to ensure that the interests of do-it-yourself repair people, electronics consumers, professional repair shops, recyclers, and refurbishers are represented in proposed legislation.

Introduction

The purpose of this report is to provide evidence to answer questions posed in the Federal Trade Commission's Advance Notice of Proposed Rulemaking (ANPR) regarding Energy Labeling Rule (16 CFR Part 305) (Matter No. R611004).

This report is divided into six major sections, each animated by a specific ANPR request:

1. **Section One: Repairing Instead of Replacing Appliances Results in Significant Energy Savings**

   Section One summarizes published research on the energy savings that result from repairing instead of replacing home appliances. Research broadly supports the FTC's suggestion that providing consumers with repair instructions would result in national energy savings. We find repair information to be well within the scope of the Energy Guide labeling system.

2. **Section Two: Appliance Repair Saves Consumers Money**

   Section Two addresses the ANPR request for comment on the notion that wider availability of repair information will result in lower-cost repair options for consumers. We present evidence that consumers can save money by repairing appliances, that consumers nevertheless often are discouraged from repair by high repair prices, and that repair information restrictions hurt the ability of independent repair shops to compete in the marketplace.

3. **Section Three: Appliance Repair Requires Information That Is Often Unavailable**

   Section Three reports the results of our two studies of repair information availability: One study that examines whether manufacturers make full service manuals available either of their own accord or upon request (86% do not), and one study that examines the extent and impact of repair restrictions on appliance repair technicians (more than half fear that it will put them out of business).

4. **Section Four: "Repair Information" Should Go Beyond Manuals**

   Section Four describes the information that ought to be included in the "repair information" required by the FTC's rulemaking. "Information" cannot simply be

limited to user manuals; even service manuals do not necessarily include all the necessary information. Schematics, diagrams, bulletins, software diagnostics, and reset codes are all necessary forms of repair information.

5. **Section Five: Manufacturers' Counter-Arguments Do Not Hold Water**

   Section Five addresses the ANPR request for evidence that these requirements would not be too burdensome for manufacturers. We consider manufacturers' counter-arguments as expressed in letters delivered to Illinois state lawmakers considering appliance Right to Repair legislation that would have made much of this information available, as well as counter-arguments represented in the FTC's own "Nixing the Fix" investigation. We demonstrate how those counter-arguments rest on faulty assumptions, falsehoods, and misconstrued information.

6. **Section Six: Recommendations for Label Content**

   Finally, Section Six addresses the ANPR request for comment on the content of Energy Guide labeling. Using current and proposed European Union ecodesign labels as examples, we recommend that the FTC consider adopting a repairability rating system; we also consider benefits and drawbacks of the use of QR codes in energy labeling. We close by reiterating our call for specific forms of repair information, addressing the needs of consumers and the independent appliance repair industry.

Methodology

Methodology for Determining Service Manual Availability

In order to determine whether a manufacturer makes repair documentation available to a customer (or potential customer), we conducted a survey of 50 appliance manufacturers. Our aim was to recreate the reasonable steps a consumer would be expected to take in order to access service materials.

We decided to use the same 50 appliance manufacturers that U.S. PIRG Education Fund had previously surveyed in research on warranty terms for its report "Warranties in the Void." The methodology section of that report explains how the 50 companies, all members of the trade group the Association of Home Appliance Manufacturers (AHAM), were selected:

> *We chose to examine AHAM because they are a large manufacturer association with an array of companies as members. The products offered by these companies range from refrigerators to lawnmowers to personal care appliances. We wanted a diverse pool of manufacturers to see how warranty language and stance on repair restrictions may vary in the industry.*
>
> *From the full list of AHAM members, we narrowed to a smaller group for the study. First, we only considered manufacturers which make appliances and electronics. A few AHAM members are not U.S. manufacturers or do not provide products to the U.S. market, or do not have any retail sales operations, and were not considered in our inquiry. Second, some companies are part of large conglomerates with several brands, and in these instances, we examined a sample brand chosen at random.*

After we selected the companies, we used the following process to attempt to access a service manual.

1) We entered the company name into a Google shopping search and selected the product which came first in the results.
2) We looked at the documentation available on the website, which was frequently a third party merchant such as Home Depot or Walmart.
3) If no service instructions were available on this page, we also checked the manufacturer's own website if not already directed there by Google search.
4) Finally, we asked customer service if we could have the service manual if we could not access it by a review of the website.

We note in the table, found in Appendix C, where the manual was found easily on the main page associated with the product on either the manufacturer's website or the vendor selling the product. In cases where we were directed to a user manual, we made a determination whether that manual could be described as a service manual, by reviewing repair instructions found within.

Methodology for Surveying/Interviewing Repair Professionals

To understand what kind of service information is available to repair professionals and where their pain points may be, we conducted a survey and semi-structured follow-up interviews, asking respondents to elaborate on their survey responses.

The questions were developed following interviews with two appliance repair professionals in the Digital Repair Coalition, Matt Zieminski of Nana Appliance Repair and Dean Landers of Landers Appliance in Maryland, as well as an anonymous representative of a large home warranty network. They described their own processes of acquiring service information, provided feedback on the 11-question survey, and shared the survey with their own networks.

The anonymous survey featured 6 four-point Likert scale (often, sometimes, seldom, never) questions about how often repairers encountered particular barriers, 3 multiple-choice questions about their companies and costs, 1 open-response question, and an optional opportunity to sign up for a follow-up interview.

We shared the survey:

1) with appliance repair technicians in the coalition
2) on Twitter
3) on the Reddit communities DIY, fixit, appliancerepair, and thereifixedit
4) in the Facebook group "Appliance repair help and questions" (other more appliance technician-focused groups denied our application)

Ultimately, we received 37 legitimate responses to the survey: 9 technicians who work alone, 14 technicians from companies with 2–5 technicians, 5 technicians from companies with 6–10 technicians, and 9 technicians from companies with more than 10 technicians. We also conducted 3 follow-up interviews. Each of those interviews lasted between 30–45 minutes and followed the same basic structure, beginning with a brief history of the respondent's experience in appliance repair and then discussing their survey responses, asking for context and detail.

SECTION ONE

Repairing Instead of Replacing Appliances Results in Significant Energy Savings

Summary of Key Findings from Section One:

- Before appliances arrive on the showroom floor, they have already consumed a significant chunk of the energy they will ever use—and contributed as much as **50% of their lifetime greenhouse gas emissions**.
- Replacing individual components in an appliance is far more energy efficient than replacing the entire unit. Many commonly replaced components account for **less than 3% of an appliance's overall environmental impact**.
- As the world moves toward renewable energy sources, device-level efficiency matters less. With fully renewable energy, **dishwashers would need to last 34 years for replacement to offset the costs of their manufacturing energy**.

The above photograph is from an iFixit teardown of an LG smart fridge.

Animating call from the FTC Advance Notice of Proposed Rulemaking

"Accordingly, the FTC is seeking comment on whether the Commission should require manufacturers to include information on how consumers can repair their products. Access to this information [...] ***could help protect our environment by allowing consumers to repair rather than replace damaged appliances****."*

Before appliances arrive on the showroom floor, they have already consumed a significant chunk of the energy they will ever use. To reduce the lifetime energy consumption of appliances, regulators need to start long before consumers truck those appliances into their homes.

A washing machine, for example, contains 23 kg of mild steel, 3.8 kg of cast iron, 1.9 kg of aluminum, 1.8 kg of copper, and so on.[1] Each of these materials requires a significant energy and resource investment to mine; one tonne of copper ore contains 6–10 kg of copper—or about the amount required by 3–5 washing machines.[2]

"The total weight of resources required to produce a household appliance is **15 to 100 times greater than its final mass**," a 2022 investigation into the consequences of appliance manufacturing by Canadian environmental research group Équiterre found.[3] "The extraction and processing of these resources...account for between **25% and 50% of all greenhouse gasses** (GHGs) emitted during the life cycle of a household appliance."

This embodied energy—a term lifecycle analysts use to describe the energy impact of manufacturing—means that even a new appliance has a deeply sunk energy cost. Appliances must be used for many years before replacing them with a more-efficient appliance actually represents an energy savings. This finding has been quantified in a recent publication addressing product lifetime extension. One of the studies[4] concludes:

[1] Ashby, M.F. (2012) Materials and the environment: Eco-informed material choice. Butterworth Heinemann, p. 204.
[2] Maribus, GmbH. (2014). Wor 3: Marine resources opportunities and risks. Sea-floor mining. https://worldoceanreview.com/en/wor-3/mineral-resources/
[3] Côté, A., Denoncourt, J., and Girard, A. (2022). Working toward repairable appliances and electronics in Canada: Diagnosis, issues, and solutions. Équiterre. https://cms.equiterre.org/uploads/EQT_rapport_reparation_EN_final2.pdf
[4] Bakker, et al. (2014). Products that go round: exploring product life extension through design. *Journal of Cleaner Production 69*: 10–16.

> "While the energy consumption of laptops and refrigerators has decreased substantially over time, so has their lifespan. The overall effect is negative, for it results in premature replacements where the environmental impacts of production have not been fully offset by the energy efficiency improvements in newer models. The results suggest that fridge–freezers and laptops bought in 2011 should be used for longer than their current median lifespans of approximately 14 and 4 years respectively"

A Joint Research Centre (JRC) lifecycle analysis of a washing machine found that prolonging its lifetime by six years **reduces its overall environmental impact by 46%.**[5] Lifecycle analysis considers a range of potential categories of environmental impact; in terms of material consumption, extending a product's lifespan beats out replacement across the board.

Ultimately, the JRC report concludes that extending the lifespan of dishwashers and washing machines is "environmentally convenient in the majority of the scenarios considered. Product policies should encourage the design of durable products."

Similarly, the Équiterre report concludes:

> "The manufacturing of these products requires a vast amount of resources and their short lifespan is problematic. Repairing them can extend their lifespan and thus limit the environmental and socio-economic impacts of their manufacture."

Thus, when addressing the energy consumption of household appliances, regulators should not focus solely on the power that machines draw from the wall but also address their embodied energy.

What About the Energy Used in Making Spare Parts?

Readers might reasonably wonder: Doesn't making spare parts also consume energy? Might that undercut some of the benefits of extending the lifespan of a product?

Most spare parts account for a tiny portion of a product's overall environmental impact; replacing a part rather than an entire device represents a significant reduction in environmental impact.

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[5] Tecchio P., Ardente F., Mathieux F. (2016). Analysis of durability, reusability and reparability: Application to washing machines and dishwashers. JRC technical reports. Joint Research Council. https://publications.jrc.ec.europa.eu/repository/handle/JRC102632

A recent lifecycle analysis of repair parts[6] for several products, including washing machines and televisions, determined that many commonly replaced components have quite low contributions to the product's overall environmental impact. In a washing machine, for example, commonly replaced components[7] including the bearing, pump, and belt pulley each account for less than 3% of the washing machine's overall environmental impact.

Comparatively, the printed circuit board (PCB) "has a high environmental impact compared to its weight proportion. Thus, the PCB accounts for 38%, or 24% of the resources used, but its mass fraction is well below 1%."[8] Similarly, for televisions, all the housing parts—including the backlight, a common point of failure—account for 4% of total materials and 6% of raw materials. The liquid crystal display (LCD) and all PCBs for a television together make up 93% of total materials and 89% of raw materials, despite accounting for just 15% of the television's overall mass.

Thus, when repair entails replacing an entire part, the energy savings of repair depend on the environmental impact of that part. For those parts, repairers can maximize energy savings by completing the repair without replacing the entire part: A PCB, for example, can often be fixed via replacement of very small components on the board, such as capacitors, or by resoldering corroded joints. An LCD can sometimes be fixed by manual manipulation of stuck pixels or by using heat to renew ribbon cable connections. For these sorts of repairs, consumers and technicians often need information beyond instructions for how to replace an entire LCD or PCB—they may need wiring diagrams, schematics, and pinout information, for instance. The vast majority of commonly failing components are far less environmentally costly to manufacture than an entire new appliance.

Additionally, often, the environmental cost of spare parts production has already been spent—whether as initial parts overrun in the process of manufacturing, in the case of new spare parts; or during the manufacturing of another device, in the case of used spare parts.

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[6] von Gries, N., & Bringezu, S. (2022). Using new spare parts for repair of waste electrical and electronic equipment? The material footprint of individual components. *Resources, 11*(2), 24.
[7] Commonly replaced components in washing machines are identified in Pozo Arcos, B. (2022). Fault Diagnosis in Household Appliances: A Design Perspective. [Doctoral dissertation, TU Delft]. TU Delft Research Repository. https://repository.tudelft.nl/islandora/object/uuid:b9fef4c4-c52d-4155-875c-bda9bc985f0d
[8] von Gries, N., & Bringezu, S. (2022). Using new spare parts for repair of waste electrical and electronic equipment? The material footprint of individual components. *Resources, 11*(2), 24.

As long as manufacturers have enough parts to meet the repair need, they may not order another parts production run.[9]

How Does Energy Mix Affect Ideal Product Lifespans?

Another study comparing the environmental impact of repairing and replacing washing machines, dishwashers, and microwaves[10] concludes that as we move toward renewable energy sources, lifespan extension becomes increasingly more important than per-device energy efficiency. When fed with renewable energy, researchers found, these products' "**lifespans need to be extended up to 30, 26 and 34 years** (from current average of 8, 12.5 and 10) for MW [microwaves], DW [dishwashers] and WM [washing machines], respectively (increasing current operating lifespans by 375%, 208% and 340%)."

In their concluding remarks, these researchers make the following policy recommendation:

> "As progress is being made regarding the decarbonisation of the energy mix and the implementation of energy originating from renewable sources within the current scenario to reach the climate objectives, policymakers and manufacturers should **focus on the extension of the lifetime rather than developing new technologies which reduce the energy consumption**."

Recent research demonstrates that repairing appliances instead of replacing them represents significant savings in energy efficiency and reductions in other environmental impacts including greenhouse gas emissions and material use. However, in order to reap these environmental benefits, repairers need access to repair information, as detailed in Section 3 and following. Before we examine that information in detail, we explore a major way in which consumers benefit immediately and materially from a more-open repair ecosystem: Repair saves them money.

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[9] This may be less true in jurisdictions that require spare parts availability for a period of time, such as the California Song-Beverly Warranty Act, which requires that manufacturers of products worth >$100 make parts available for 7 years, or the European ecodesign regulation that requires refrigerator manufacturers to make parts available for 7 years and other white goods manufacturers to make parts available for 10 years.

[10] Alejandre, C., Akizu-Gardoki, O., & Lizundia, E. (2022). Optimum operational lifespan of household appliances considering manufacturing and use stage improvements via life cycle assessment. *Sustainable Production and Consumption, 32*, 52-65.

SECTION TWO

Appliance Repair Saves Consumers Money

Summary of Key Findings from Section Two:

- Consumer Reports found that it often makes financial sense to **repair even 10-year-old refrigerators**.
- Still, rising costs are making repair less appealing. **50%** of consumers who replaced rather than repaired their broken appliance chose to do so because **repair was too expensive**.
- People who choose to repair appliances **select do-it-yourself repair** and other less-expensive repair options more often than manufacturer repair. **69.3%** of appliance repairs are performed by someone other than the manufacturer or a manufacturer's authorized repair center.

FTC Advance Notice of Proposed Rulemaking	*"Accordingly, the FTC is seeking comment on whether the Commission should require manufacturers to include information on how consumers can repair their products. Access to this information will strengthen consumers' right to repair damaged products, without the need to go back to the manufacturer, providing them with* ***potentially lower-cost repair options****."*

Appliances are particularly costly objects in people's homes, and their points of failure tend to be replaceable components. With repair, consumers can gain years of use and save large amounts of money.

A Consumer Reports study determined[11] that it makes financial sense for consumers to repair rather than replace the vast majority of refrigerators: "**Considering the cost of many refrigerators, it often pays to invest in a repair even when you've had yours for as long as 10 years.**" For clothes dryers, models that cost between $700-$899 nearly always make financial sense to repair within 5 years of ownership; for models that cost $900 or more, repair is worth the financial investment for at least 9 years.[12] Dishwashers have a higher average repair cost than refrigerators or clothes dryers, so their recommended replacement time is lower—still, Consumer Reports encourages consumers with dishwashers that cost $900 or more to consider repair up through 7.5 years of ownership.[13]

Nevertheless, **rising costs are driving many consumers away from repair**. In 2021, Consumer Reports conducted a nationally representative survey[14] that found that 55% of Americans had a large home appliance such as a dishwasher or clothes dryer stop working in the previous 5 years. Of those who experienced a broken appliance, 33% successfully had the appliance repaired, and 26% tried to get the appliance repaired but ended up

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[11] Wroclawski, D. (2022). Should you repair or replace your broken refrigerator? Consumer Reports. https://www.consumerreports.org/refrigerators/should-you-repair-or-replace-your-broken-refrigerator-a3570195924/

[12] Flamer, K. (2022). Should you repair or replace your broken clothes dryer? Consumer Reports. https://www.consumerreports.org/clothes-dryers/should-you-repair-or-replace-your-broken-clothes-dryer-a1037372822/

[13] McCabe, L. (2022). Should you repair or replace your broken dishwasher? Consumer Reports. https://www.consumerreports.org/dishwasher/should-you-repair-or-replace-your-broken-dishwasher-a9394720998/

[14] CR Survey Research Department. (2022). Right to repair: A nationally representative multi-mode survey. Consumer Reports. https://article.images.consumerreports.org/prod/content/dam/surveys/Consumer_Reports_Right_to_Repair_Survey_2021

replacing it. Half of consumers who replaced rather than repaired their broken appliance chose to do so because repair was too expensive.

These findings align with other consumer research. A report in the *Journal of Consumer Policy* explored reasons why consumers chose not to repair broken home appliances,[15] and over two-thirds of respondents identified the high cost of repair as the most significant discouraging factor.

Competition in repair markets is necessary for keeping costs under control. When consumers do choose to repair appliances, they often choose the lowest-cost option available to them. The Équiterre Canadian appliance repair survey[16] found that of people who do choose to get appliances repaired, **the plurality of them (29.2%) select do-it-yourself (DIY) repair**, purchasing the parts and performing replacements themselves (See Figure 1). Another 24.6% choose independent repair repairers. Altogether, 69.3% of respondents chose repair methods other than manufacturer, retailer, and authorized repair services.

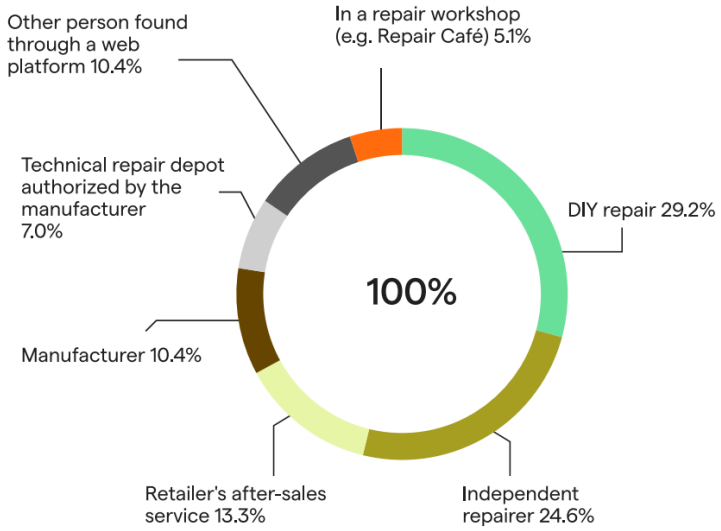


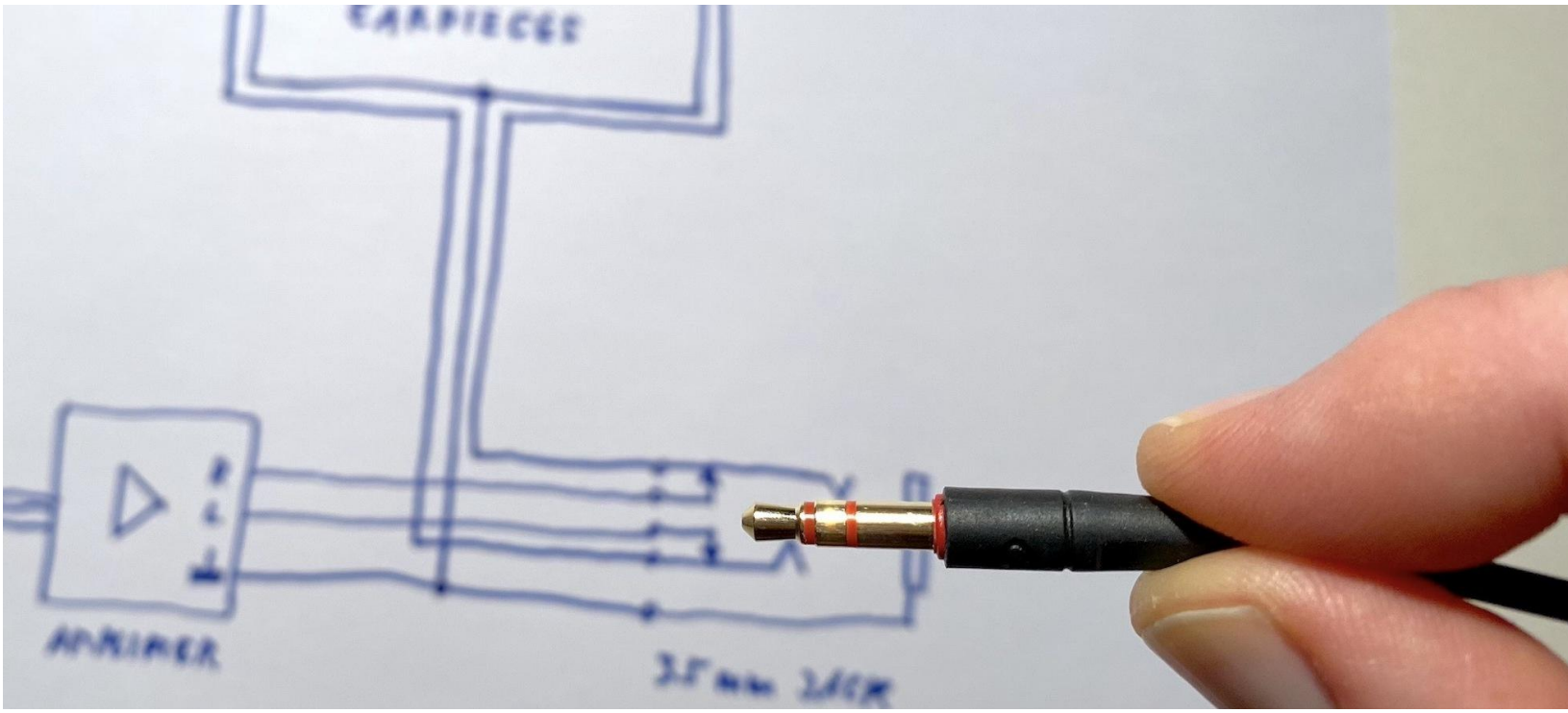
***Figure 1**: The Équiterre appliance survey found that a strong majority of respondents preferred DIY or independent repair.*

[15] Cooper, T. (2004). Inadequate life? Evidence of consumer attitudes to product obsolescence. *Journal of Consumer Policy, 27*(4), 421-449.
[16] Côté, A., Denoncourt, J., and Girard, A. (2022). Working toward repairable appliances and electronics in Canada: Diagnosis, issues, and solutions. Équiterre. https://cms.equiterre.org/uploads/EQT_rapport_reparation_EN_final2.pdf

However, manufacturer repair services aim to capture more of the market, engaging in practices that threaten to edge out independent repair shops. They control parts sales and restrict access to service information and software. For instance, Dean Landers of Landers Appliance in Maryland reports that some manufacturers require him to buy parts through specific dealers or parts distributors, demand that he provide his customers' personal information, and then try to poach his customers:

> "I have to give them the model and serial number of units, tell them what's wrong and what I need. Then they actually sent letters to the consumer, doing an end-around to the independent service company, saying, 'We're authorized and have parts; you should call us.'"

If appliance manufacturers are allowed to continue these anti-competitive practices, many consumers may be priced out of repair altogether. One major key to restoring an affordable repair marketplace is increasing consumer and independent repairers' access to repair information—and not just user manuals, as we detail in the next section.



SECTION THREE

Appliance Repair Requires Information That Is Often Unavailable

Summary of Key Findings from Section Three:

- 89.1% of appliance repair professionals are at least occasionally **unable to access repair manuals for appliances** and even more (93.5%) struggle to find schematics.
- Customers have even more trouble accessing repair information. **Only 14% of the companies we surveyed made repair documentation available** on their website or by asking customer service.
- A study of 150 appliance user manuals found that they do not provide the information necessary for diagnosis. Consumers need full service manuals.
- **Over half** of the technicians we surveyed were worried that systems that favor manufacturers' authorized repair centers **might put them out of business**.

The above photograph is from a user-written iFixit repair guide for headphones, featuring a hand-drawn wiring diagram because the user could not find an official one.

III.C. Repair Instructions

FTC Advance Notice of Proposed Rulemaking

"Specifically, comments should address whether lack of access to repair instructions for covered products is an existing problem for consumers; whether providing such information would assist consumers in their purchasing decisions or product use; whether providing such information would be unduly burdensome to manufacturers; and any other relevant issues."

Repair Requires Service Manuals (Not Just User Manuals)

Within recent memory, providing circuit schematics and repair instructions was common practice for home appliance manufacturers; a TV cabinet was likely to have a circuit schematic sticker inside the cabinet, and a washing machine probably had repair instructions taped to the inside.

Today, however, the vast majority of appliance manufacturers no longer provide repair documentation at the point of sale. Our analysis of 50 manufacturers, targeting a popular model of appliance from each, found that **just 7 manufacturers made service manuals available** — while the remaining 86% did not. Of the 7 products for which we did access service documentation, two were available from the website, the other five we received after requesting it from the customer service.

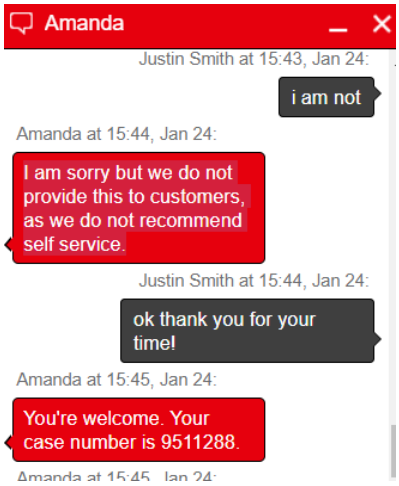


***Figure 2**: Sharp customer service was explicit that they do not provide service manuals to customers because they discourage self-service.*

Some customer service representatives refused our request outright, explaining that they do not recommend self service (see Figure 2 above). Others expressed bafflement at the request, reminding us that the user manual or a troubleshooting guide was available on the product website. User manuals, however, are typically inadequate to complete a repair. Meanwhile, troubleshooting guides are often framed as a way to avoid repairs, not conduct them.

For example, in the AB Electrolux "Use & Care Manual," posted with washing machine model EPWD257UTT,[17] the troubleshooting section makes the following recommendation:

> "Before calling for service, review this list. It may save both time and expense. The list includes common occurrences that are not the result of defective workmanship or materials in this washer."

While most manufacturers do not make their service materials easily accessible, others do. For example, we quickly found a service manual for Friedrich's air conditioning units (Figure 3, below). The market presence of these manufacturers—who are successful despite continuing to publish public manuals with detailed electrical repair information—suggests that other manufacturers' reluctance to publish is unfounded.

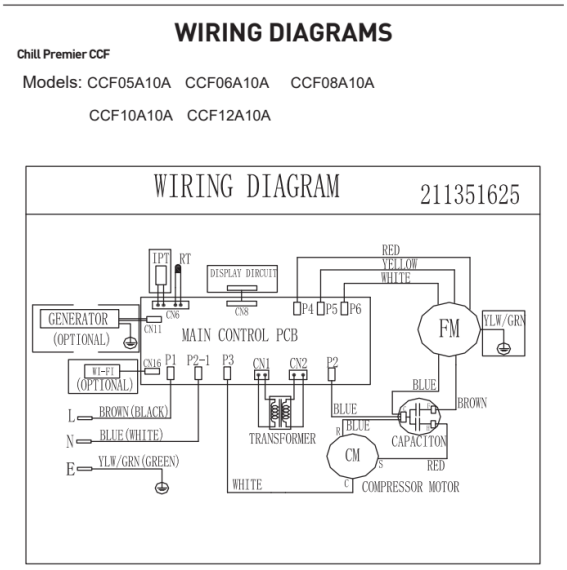


***Figure 3**: A sample wiring diagram from the Friedrich "Chill Premiere Series Models" service manual.*

[17] Electrolux. (2021). Use & care manual: washing machine. https://images.thdstatic.com/catalog/pdfImages/9f/9f89d27c-1448-4c01-8c07-a230e4051231.pdf

Consumers and repair professionals come to service manuals for a variety of reasons:

- Learning how to open up a device
- Performing basic troubleshooting
- Performing cleaning or maintenance
- Diagnosing faults, including understanding error codes and identifying bad components
- Determining the complexity of a potential repair, for use in deciding whether or not to attempt it, hire a more experienced technician, or replace the device
- Gathering information about a needed repair to ensure a reasonable quote from a potential service provider
- Replacing faulty components, including knowing which parts may be substitutable in the event that preferred parts are unavailable
- Calibrating new parts to manufacturer tolerances
- Updating firmware
- Resetting/removing error codes

Without access to any one of these functions, a repairer may be stymied, or consumers might end up paying more in service charges than are necessary or appropriate.

A TU Delft doctoral dissertation examined 150 household appliance user manuals of 48 brands,[18] coming to the conclusion that user manuals rarely instruct users in effective fault diagnosis:

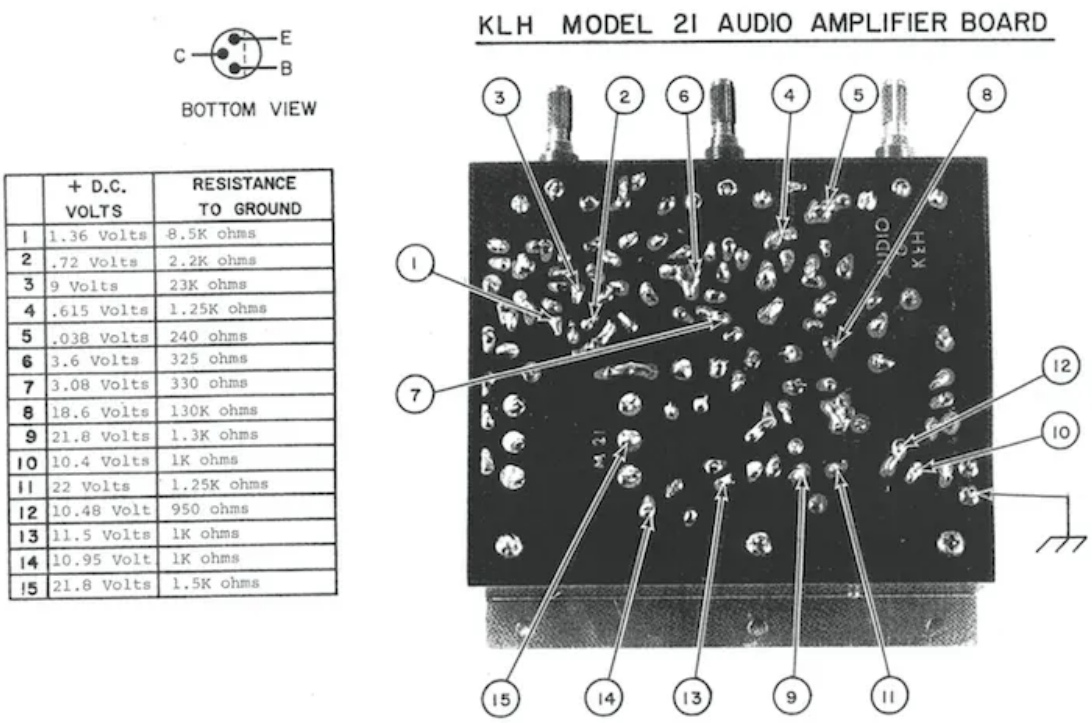
> "User manuals only facilitate the diagnosis and correction of faults caused by a lack of maintenance, or that are due to an internal state failure of electronic components. We conclude that manuals do not provide support for users to diagnose frequent faults such as a broken pump or a defective magnet in a coffee maker, a motor failure in a vacuum cleaner, or a short circuit in electronic components. In such cases, the user receives no guidance, but is simply referred to customer support or a service centre."

A consumer that would like to perform a repair themselves is likely to be frustrated with the status quo in appliance repair information: a user manual that does not provide repair instructions, and a customer support helpline that refuses to provide instructions beyond that user manual.

[18] Pozo Arcos, B. (2022). Fault diagnosis in household appliances: A design perspective. [Doctoral dissertation, TU Delft]. TU Delft Research Repository. https://repository.tudelft.nl/islandora/object/uuid:b9fef4c4-c52d-4155-875c-bda9bc985f0d

Repair in the 1960s vs. the 2020s

As a strong representative example of the changed availability of service information, SecuRepairs founder Paul Roberts took apart a 1965 KLH Model 21 radio and a 2020 FitBit Charge 4 in the same week and compared the experiences.[19] The KLH came with a detailed service manual, including schematics and wiring diagrams, detailed diagrams with expected resistance (see Figure 4, below) and plenty of information for Roberts to replace the broken power cord and fuse that he needed to get the radio running again.



	+ D.C. VOLTS	RESISTANCE TO GROUND
1	1.36 Volts	8.5K ohms
2	.72 Volts	2.2K ohms
3	9 Volts	23K ohms
4	.615 Volts	1.25K ohms
5	.038 Volts	240 ohms
6	3.6 Volts	325 ohms
7	3.08 Volts	330 ohms
8	18.6 Volts	130K ohms
9	21.8 Volts	1.3K ohms
10	10.4 Volts	1K ohms
11	22 Volts	1.25K ohms
12	10.48 Volt	950 ohms
13	11.5 Volts	1K ohms
14	10.95 Volt	1K ohms
15	21.8 Volts	1.5K ohms

***Figure 4**: A diagram showing expected resistance of solder joints from the 1965 KLH Model 21 Service manual.*

By the 1980s, appliance manufacturers were actively promoting their DIY repair-friendliness. The New York Times reported[20] in 1983 that GE and Whirlpool both had

[19] Roberts, P. (2021). Repair-off: 10 month old fitness tracker vs. 55 year-old radio. Fight to repair substack. https://fighttorepair.substack.com/p/repair-off-10-month-old-fitness-tracker

[20] Hinds, M.D. (1983). A fix-it-yourself trend for appliances. The New York Times. https://www.nytimes.com/1983/02/19/style/a-fix-it-yourself-trend-for-appliances.html

customer support lines for do-it-yourselfers; in 1981, GE “introduced a Quick Fix System” that sold spare parts and manuals out of dealer showrooms.

Times, however, have changed. For the FitBit Charge produced in 2020, Roberts was able to find only a user manual, no service manual. Although he was easily able to diagnose the problem—a broken clasp, a purely mechanical plastic part on the outside of the watch that did not hinder the functioning of its electronics at all—he could not acquire any repair information or parts. FitBit simply replaced the broken device and collected the (still electronically intact) watch for recycling, a solution that they proposed when Roberts declined the offer to receive a discount on a new, upgraded unit.

The same problems play out across the appliance industry: True manuals are difficult to find or not available at all. Even relatively easy fixes may be made difficult or impossible by a lack of information and parts. Manufacturers do not encourage repair as in the past—and in fact, in some cases, even discourage it.

Appliance Pros Also Struggle to Find Service Information

This frustration is not limited to consumers; service technicians also report difficulties getting the service information they need to do their work.

In addition to the repair instructions for part replacement provided in service manuals, technicians emphasized the importance of being able to access wiring diagrams, pinouts, and circuit schematics. This information, which documents the organization of electrical circuits within a device, is necessary for diagnosing and troubleshooting electrical failures.

Whereas appliances frequently used to come with schematics printed on stickers attached to the unit itself (see Figure 5, a sticker on a 2008 refrigerator), technicians today report that such stickers have become less common.

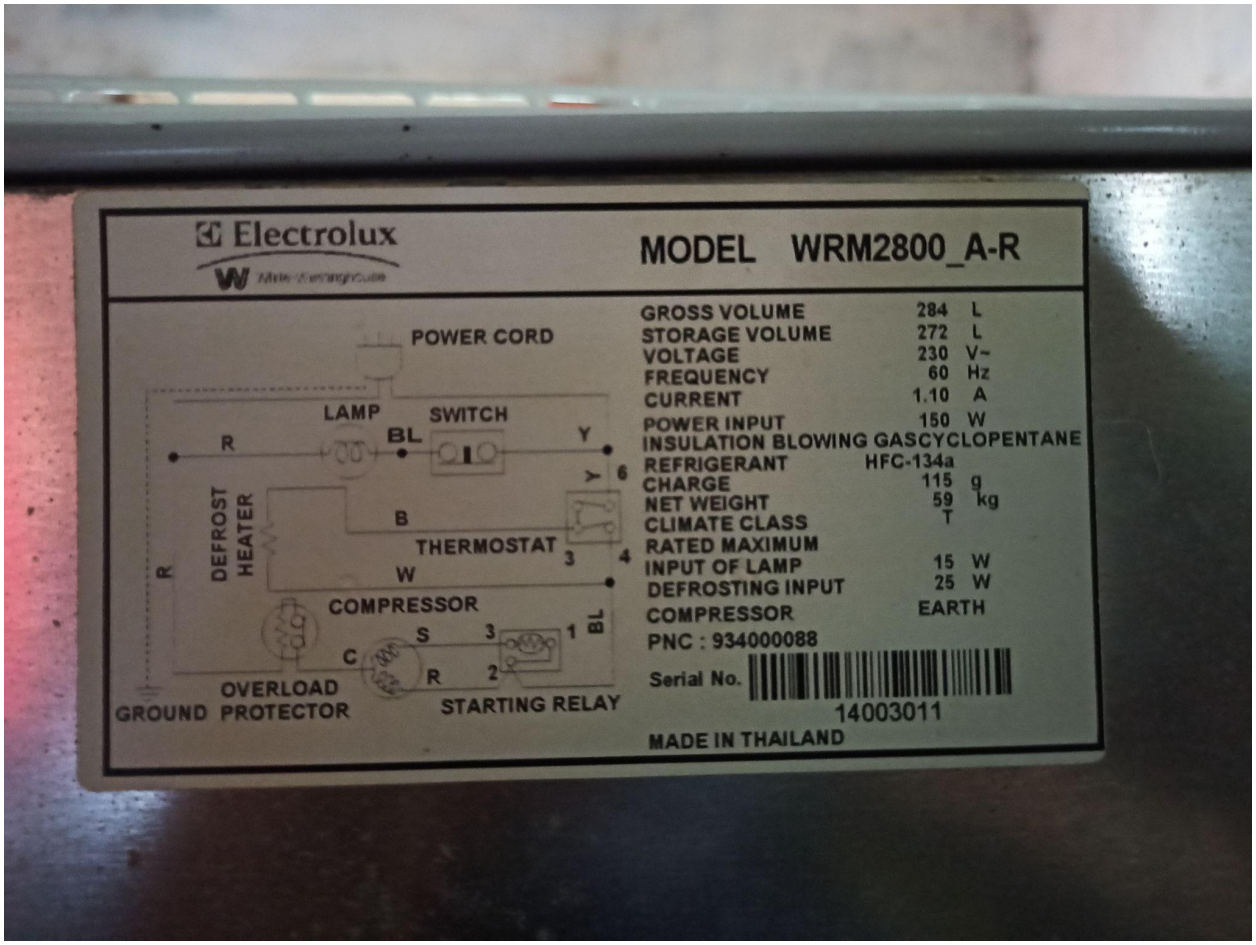


***Figure 5**: This 2008 model year Westinghouse refrigerator came with a wiring diagram printed on a sticker.*[21]

As an increasing percentage of functions of appliances are routed through electrical control boards, the importance and complexity of printed circuit board (PCB) schematics has also increased. A wiring diagram shows the connections between physically separate parts in the appliance, while a circuit schematic shows the connections between components on a PCB.

[21] Gragasin, J. (2020). I got a white Westinghouse refrigerator, unable to find pinout. iFixit Answers. https://www.ifixit.com/Answers/View/670957/Hey.+I+got+a+White+westinghouse+refrigerator,+unable+to+find+pinout.

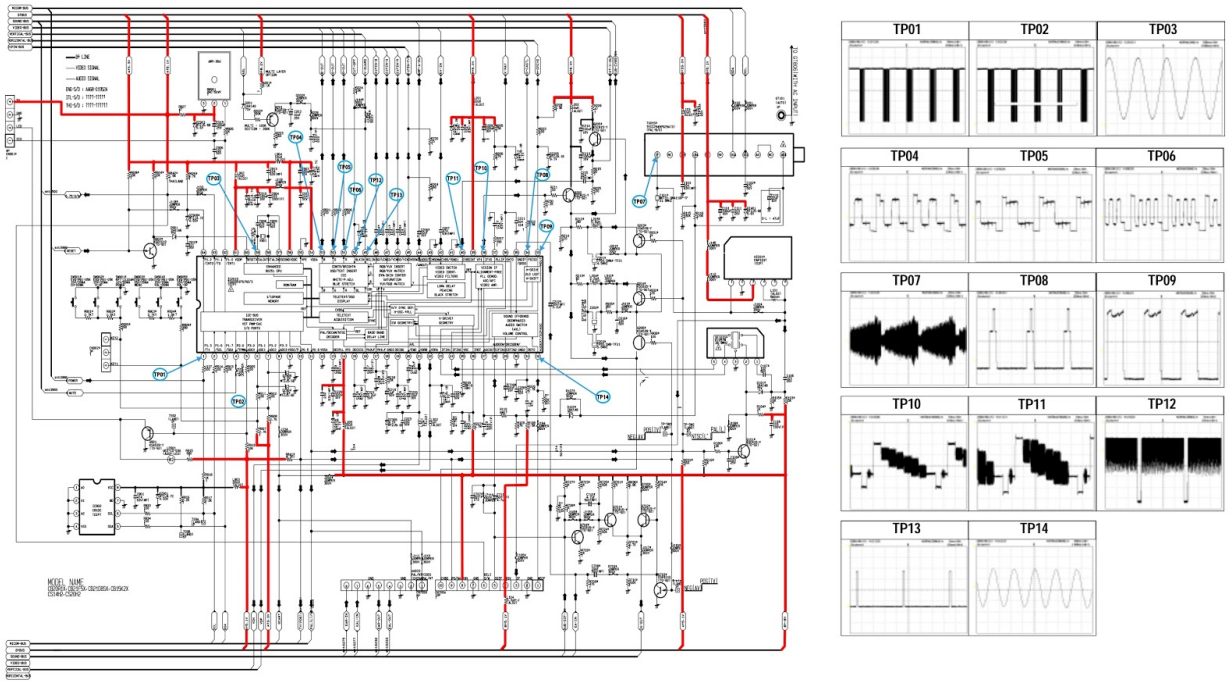


***Figure 6**: A 2017 Samsung TV circuit schematic.*[22]

In a modern electronic appliance, the PCB schematic provides the same function that wiring diagrams have in the past: informing the technician about the flow of current from one subcomponent to another. As components have shrunk in size, elements such as fuses and resistors are mounted directly on the PCB rather than as discrete components. In Figure 6, the integrated paths from the central microcontroller are clearly labeled. This information is essential for modern repairs where a single failed surface-mount resistor worth one cent can stop an entire appliance in its tracks.

Whereas appliances from a decade ago might only have one PCB, many contemporary appliances, particularly "smart" ones, will have a control board for every major system of the device. For instance, iFixit's teardown of a 2022 smart fridge found several control boards, including one above the ice maker.[23]

Technicians report that not only are wiring diagrams less common on-unit, but sometimes wiring diagrams can't even be found in service manuals. When we surveyed appliance

[22] Gopalan, G. (2017). Samsung CS21M16MJZXNWT CRT TV: how to enter the service mode, circuit diagram. Schematic diagrams. https://schematicscom.blogspot.com/2017/07/samsung-cs21m16mjzxnwt-crt-tv-how-to.html

[23] iFixit. (2022). Modern smart fridges: Can you fix one at home? iFixitYourself. YouTube. https://www.youtube.com/watch?v=eDVbkPIaLpE

repair technicians, the vast majority (**89.1%**) reported that they are at least occasionally **unable to access repair manuals** for appliances and even more (**93.5%**) reported at least occasionally having **trouble accessing schematic diagrams**. (See Figure 7, below.)

In comments and interviews, several technicians who answered that they "seldom" failed to access manuals or schematics explained that their success at acquiring service information relied on informal information sharing networks (more on this later).

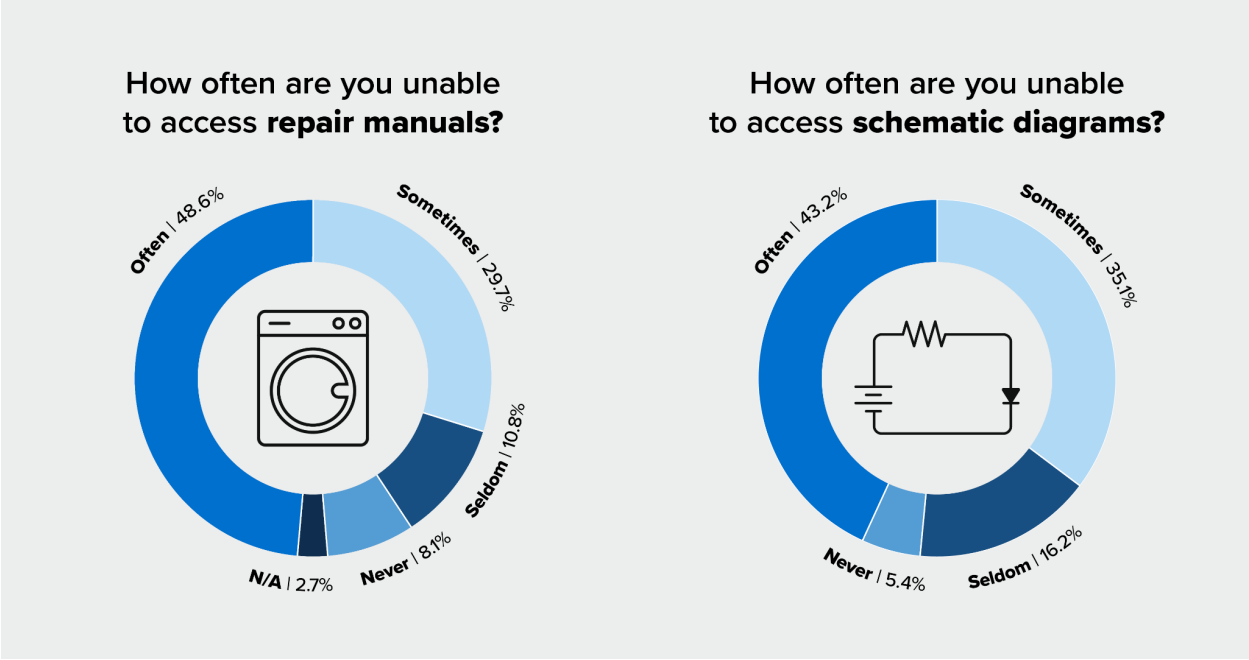


***Figure 7**: Surveyed appliance repair professionals report difficulties accessing service manuals and schematics.*

The Équiterre study of Quebecois appliance professionals[24] reported similar findings:

> "Quebec repairers, especially those without manufacturer certification, indicated that product manuals are difficult to access. Nevertheless, online platforms and support from colleagues can enable them to get around this lack of information. For their part, customers receive little if any information on their product's repairability, maintenance and intended use at the time of purchase."

Like the Équiterre researchers, we found that appliance technicians reported relying heavily on information sharing networks to acquire service information when it was

[24] Côté, A., Denoncourt, J., and Girard, A. (2022). Working toward repairable appliances and electronics in Canada: Diagnosis, issues, and solutions. Équiterre. https://cms.equiterre.org/uploads/EQT_rapport_reparation_EN_final2.pdf

unavailable via official channels. These networks come in two primary varieties: Formal and informal.

- **Formal information sharing networks:** Several parts sales services host repair information, such Marcone and Service Matters; Marcone's database is reported to be particularly robust, though it is only available to members of the Marcone Servicers Association.
- **Informal information sharing networks:** All of the appliance technicians we interviewed described swapping USB sticks and using Facebook groups to find otherwise-unavailable manuals and other service information. We tried to join these groups to share our technician survey, but they are primarily limited to service technicians only.

Technicians' reliance on these information sharing networks reflects the general unavailability of service information through formal means. Importantly, individual consumers would be unlikely to be aware of these options for acquiring service information when it is not otherwise available through the manufacturer directly. Even if a consumer aiming to complete an individual appliance repair themselves wanted access to these information sharing networks, they might be unable, since both the formal and informal networks are limited to professional servicers only.

Several technicians were slightly cagey about their participation in these sharing networks; many of them had some level of formal association with at least one manufacturer, in order to gain access to their gated parts and service information, and they were concerned about being perceived as in violation of their non-disclosure agreements. Even technicians with one manufacturer association, however, tended to rely on these networks to get information about other manufacturers' products.

Repairers describe many levels of gating of manufacturers' appliance repair information (see Table 1, below).

Table 1: Appliance manufacturers' gated levels of service information access

Service information user	Description	Level of service information access
Consumer	An individual owner of an appliance, attempting to perform a repair.	Only rarely can consumers find repair information through manufacturers' websites or helpline services. For smart appliances, they may be able to download a diagnostic app that will read error codes and connect them with a preferred service provider. Some service manuals may be available through third-party sales sites.
Independent repair technician	A repair technician who has no formal association with an appliance manufacturer. Independents may (and often do) perform contract work for manufacturers or home warranty companies; they may or may not have manufacturer-specific certifications and training.	Independent technicians, by default, have nothing more than consumers' level of access to repair information. Some independents pay for access to individual appliance manufacturers' online systems, such as GE's $919 SmartHQ service; those systems may give them manuals, schematics, and parts diagrams, though for some models this information may still be unavailable. Some independents pay for third-party manual aggregation services such as Marcone (a parts sales site that also offers training and access to a manual/schematic database). Often, independent technicians rely on informal networks of repair information sharing through Facebook, especially for service bulletins and recall information.
Authorized service technician	Manufacturers typically have a network of repair professionals whom they assign warranty service repairs. Often, becoming a	Authorized technicians typically have full access to whatever repair information manufacturers make available, including schematics, manuals, and diagnostic software.

	part of that network requires paying for manufacturer-specific training and software, plus agreeing to manufacturers' requirements, such as only using parts from manufacturers' own dealers. Technician-level access to software can cost hundreds of dollars per year. Authorized service technicians may or may not work exclusively with one manufacturer.	Their status often grants them significantly discounted pricing for tools and parts. In both that pricing structure and their level of access to manufacturer support, however, they are second to preferred service providers. Authorized technicians report waiting hours on hold for callbacks from manufacturers; they also report manufacturers' dealers requiring customers' personally identifiable information and then trying to poach those customers.
Preferred service provider	Within their authorized network, some manufacturers also have a "preferred" designation; preferred servicers have generally been through the manufacturer's highest level of training, pay for their highest level of access to software and information, and in exchange, are called first for warranty repair. These servicers tend to work exclusively with one manufacturer.	Preferred service providers receive full access to service information. They also have priority in their interactions with manufacturers, including even greater discounts on parts and software, as well as phone support queue-jumping.

FTC Advance Notice of Proposed Rulemaking	*"Accordingly, the FTC is seeking comment on whether the Commission should require manufacturers to include information on how consumers can repair their products. Access to this information [...]* ***could also help ensure that independent repairers have a chance to compete with manufacturers and licensed dealers.***

Manufacturer Service Software Is Prohibitively Expensive for Small Repair Businesses

Many companies limit access to all the documentation appliance repairers need behind manufacturer-specific servicer software. Subscriptions for this software often cost companies hundreds of dollars per year, per manufacturer. This cost makes access impractical for consumers completing a single repair, of course, but it also prices out many small and independent repair technicians.

A source within a home warranty company told us that their technicians service **143 different appliance brands**. Since many of these brands have their own gated information networks, it is infeasible for small appliance repair companies to purchase access to networks for all the brands they service. The vast majority of the home warranty company's appliance service providers are small operations, with just one or two technicians.

This predominance of small repair outfits accords with our survey results; 62% of our respondents worked for companies with **fewer than 6 technicians**. For an appliance repair company of that size, paying annual subscription fees for multiple appliance manufacturers' diagnostic software could prove prohibitively expensive. See Table 2 for publicly available costs for manufacturers' servicer diagnostic software.

Table 2: Cost for technician-level access to appliance manufacturers' diagnostic software

Company	Software	Cost	Price Source URL
GE	GE SmartHQ	$919/year	https://smarthqservice.com/
	GE Technical Assistance Group	$550/year, 1-4 users $660/year, 5-9 users $825/year, 10+ users	
Whirlpool	Service Matters	$270/year, 1-3 users $360/year, 4-6 users $460/year, 7-10 users $46/user/year, 11+ users	https://servicematters.com/en_US
Samsung	Samsung Tech Guide	$299/year	https://support-us.samsung.com/stg/login
	Samsung Home Assistant	$599/year	https://www.samsung.com/us/business/builder/service-and-support/
Electrolux	Electrolux Service Tips	$349.99/year	https://electroluxservicetips.com/cc/showPage.html?pageName=subscriptionPage&&headerLess=true
Miele	Miele Service Documentation	400€/year	https://www.miele.com/en/com/spare-parts-iceland-professional-repairer-6642.htm

Even with Software, Not All Necessary Information Is Available

Manuals do not have standard sets of information, and technicians tell us that manuals are frequently missing the most important pieces for repair, such as parts lists and diagrams.

Justin Nunn, a repair technician with Nana Appliance Repair, explains that even in the case of a brand for which he has access to official manufacturer service software and manuals, those manuals often lack a parts diagram. Even if he is able to diagnose the fault, identify a broken component, and extract it from the device, **without a parts diagram, he may struggle to order a replacement part**. Different manufacturers have different names for parts, and without that list, technicians have to go through a frustrating, time-consuming guessing game. Nunn gives the example of door shims:

> "On one model they call it a 'step up.' On another, they call it a 'support.' On another, there's no callout for it on the diagram, [and I] can't find it on the schematic. So I'm going through 100–150 diagrams, looking for what to call it."

In other cases, units begin to require support before the manufacturer's service manual has made it to third-party manual aggregation services and Facebook groups. When servicers do not have manufacturer-specific software, they often turn to service manual aggregation services such as Marcone and Facebook groups—but those groups have spotty coverage, especially for newer appliances. Nunn points to the LG Laundry Center:

> "There's a control panel in the middle. For the longest time, no one knew how to work on it. It was a joke on the Facebook groups. Even with some of the newer LG washers and dryers, we can't find documentation to order parts, match up parts. So then we have to call the manufacturer people, but we need an account to get any help from them."

This restriction of appliance repair information was a serious concern for the technicians we surveyed. Slow access to manuals, software, parts diagrams, and schematics balloons their time spent on each service call, which eats into their already thin margins and artificially impairs their ability to compete with manufacturers' own service networks. When that information is incomplete or inaccurate, it can result in failed repairs—not simply slowing their work but making it truly impossible, even for relatively simple problems.

Former appliance technician Joe Guertin described working for a medium-sized appliance repair company in Boston for 5 years. Their company subscribed to several manufacturer information networks. However, technicians out in the field were not given direct access to those networks, because each individual log-in was so expensive. Instead, Guertin and his fellow technicians had to call into headquarters, relay what they were seeing to a technical support person, and try to pass information from schematics verbally. Sometimes, the technician would take a cell phone photo of their computer screen and text that to him. Guertin says, "It was literally playing a game of telephone with complicated instructions. For older technicians who weren't computer savvy, this was really, really tricky."

This convoluted system sometimes resulted in expensive mistakes. One time, through Guertin's company's complicated game of telephone, he requested a wiring diagram. He was meant to jump out two wires—but it turned out that the diagram was wrong, and the two wires he jumped were live. He burnt out the motor, the customer was angry, and the repair ended up being a lot more complicated and expensive than it would've been otherwise. These sorts of frustrations led to Guertin leaving the appliance repair business.

Over half of the technicians we surveyed (56.8%) were at least somewhat worried that software network fees and tiered pricing might put them out of business (see Figure 8,

below). Some (8.1%) reported that those things already were creating a strain on their ability to succeed in the marketplace.

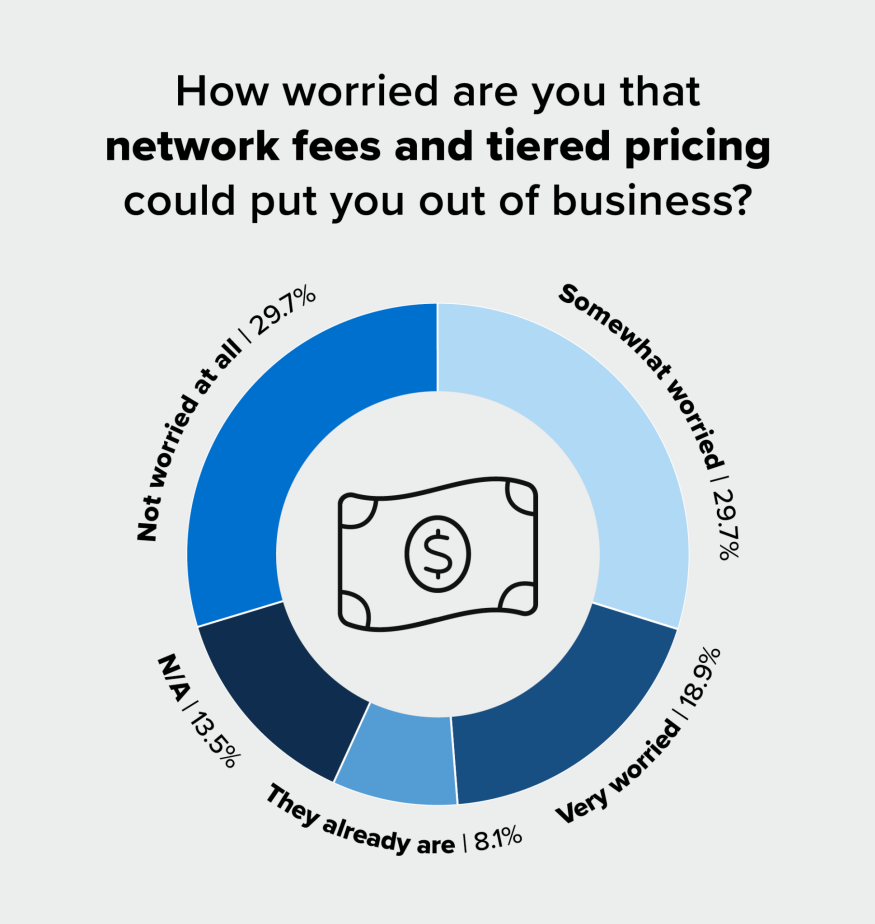


***Figure 8**: More than half of surveyed appliance professionals are at least somewhat worried that this information gating might put them out of business.*

Spotty Documentation Also Thwarts Community-Assisted Repairs

The Equiterre survey found that over 5% of consumers chose community-assisted repair organizations for their appliance repairs. These organizations also suffer from a lack of access to repair information. To understand the extent of this lack of access, we interviewed Peter Mui, founder of the non-profit organization Fixit Clinic.

Fixit Clinic runs free community repair events across the county. At these clinics, community members can bring items needing repair—everything from clothing to appliances to furniture—and receive coaching from an expert on how to diagnose and fix

these products. According to Mui, as of January 2023, Fixic Clinic has held 814 free clinics. The range of attendance is between 20 and 100 people seeking assistance, and Fixit Clinics have attempted tens of thousands of repairs.

When it comes to appliances, Mui says people bring a wide range of products, “anything you see for sale at a Best Buy,” including small kitchen appliances, vacuums, space heaters and more. During the pandemic, the organization began to offer Zoom clinics and has seen a considerable increase in the number of large appliance repair requests fielded by the volunteer repair coaches, since there is now no need to transport the appliance. Given his experience attempting repair on such a great variety of appliances, we interviewed Mr. Mui about his perspective.

Mui is quick to point to a decline in overall engineering quality for devices as a key barrier to successful repair, as well as the role that contract manufacturing plays in that decline. When you see a brand label on the outside of a product, says Mui, all you are really seeing is the brand that commissioned its construction “done to spec” from a manufacturing facility that makes all manner of products for a wide variety of brands. Often there is little attention paid by that brand on the many internal design and component decisions made by the contract manufacturer.

“The companies don’t share schematics because they don’t have them; they didn’t build the device,” explained Mui. Products built in the 1950s through the 1980s, Mui says, mostly came with that documentation and manuals, and most of those devices remain able to be repaired. Manufacturers that contract their factory work to other companies might not request schematics, if their own repair networks are not doing component- and board-level repairs.

“Access to manuals greatly increases the likelihood that the product will be fixed” at a Fixit Clinic event, explained Mui. Even for products that are not fixed that day, the owner knows what parts are needed and can typically find them and finish the repair.

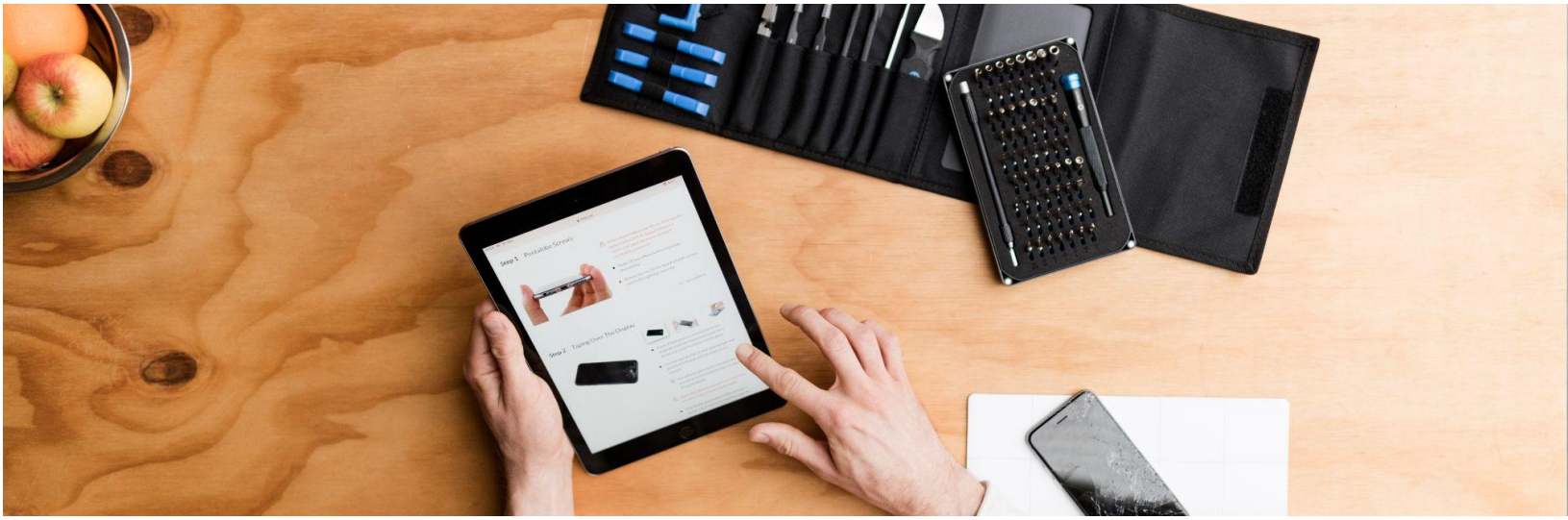
Easily accessible repair information helps coaches and community members fix products, and also indicates which products are more carefully designed to last, something that consumers often struggle to determine at the point of purchase. For example, Mui pointed to a popular item at Fixic Clinics, KitchenAid stand mixers. “We’re always happy when someone brings one of those in, because we know we have a pretty good chance of fixing it,” explained Mui. The design has been fairly consistent for many years, and full repair documentation, including exploded diagrams, are easily accessible.

Another common fault that dooms many products is blown thermal fuses, present in most products with heating elements, including most appliances. Documentation is essential to replace that fuse. “Knowing what that fuse is, where it is, can mean the difference between something being junked or fixed,” said Mui, noting that these fuses are usually less than a dollar in cost.

Outside of Manufacturers’ Authorized Repair Shops, Repair Information Can Be Difficult to Find

The results of our studies of appliance repair information availability come to the conclusion that adequate repair information is difficult to come by outside of manufacturers’ authorized repair shops.

In consequence, the market for service providers has become increasingly anticompetitive; these repair restrictions threaten independent shops’ ability to conduct business. Consumers, meanwhile, are discouraged from repair by service prices driven higher via this anticompetitiveness, and by a lack of information necessary to complete repairs at home. Ultimately, these practices result in severe negative environmental consequences, due to quicker appliance replacement cycles demanding more materials, energy, and greenhouse gas emissions in manufacturing.



SECTION FOUR

“Repair Information” Should Go Beyond Manuals

“Information” Should Include Circuit Schematics, Wiring Diagrams, Pinouts, and Parts Diagrams

Although most technicians we interviewed reported usually being able to find some amount of the repair information they needed, the circuitous pathways to that information create ridiculous headaches for technicians—and would completely stymie most consumer DIY repairs.

Speaking of circuitous pathways, literal circuits in appliances are rarely as well documented in service manuals as in the past; manuals only occasionally include all the information a repair technician would need to perform component-level repairs, from PCB schematics to wiring diagrams to charts of expected resistance.

One iFixit user with a 2008 Westinghouse refrigerator, for instance, tried to replace some corroded wires in a thermostat connector.[25] Although the refrigerator had the unusual

[25] Gragasin, J. (2020). I got a white Westinghouse refrigerator, unable to find pinout. iFixit Answers. https://www.ifixit.com/Answers/View/670957/Hey.+I+got+a+White+westinghouse+refrigerator,+unable+to+find+pinout

boon of a wiring diagram sticker (see Figure 5 above), the pinout information was ambiguous and left the user and other commenters guessing.

More granular and in-depth component-level repair information enables more precise repairs. Replacing the individual failed component rather than a large assembly is environmentally preferable; smaller components almost universally have lower overall environmental impacts than assemblies of components.

As more electronics are integrated into home appliances, the need for component-level repair information increases. Failure of embedded electronics due to humidity is often more common than mechanical fatigue in electromechanical systems; a Fraunhofer study of wind turbines, for instance, concluded that humidity was the "critical stressor and likely driver of converter failure" in a study of 31 wind turbines across 3 continents.[26] Home appliances are particularly likely to be used in humid conditions with high temperature fluctuations—far from ideal operating conditions for electronics.

"Information" Should Include Software

Software is an increasingly important part of appliance repair and maintenance. Not only do manufacturers often limit access to manuals and other repair information inside dealer-only software; increasingly, software is also required to diagnose faults and complete repairs.

Instead of directly displaying the error to the user, many appliances now require software to interface with the device to access full error codes and associate those codes with diagnostic descriptions. Parts sometimes need to be calibrated via a firmware update after installation. Other times, parts are paired via serial numbers with the device motherboard and require hidden routines or other codes to activate. Repairers report encountering parts pairing in televisions and washing machines.[27]

Some repairs require servicer codes to complete; those codes may stay the same over the course of months or years, and most technicians reported being able to get them through friends or informal information-sharing networks when they did not have a code personally. However, Facebook groups do not make for a particularly reliable or robust system of repair.

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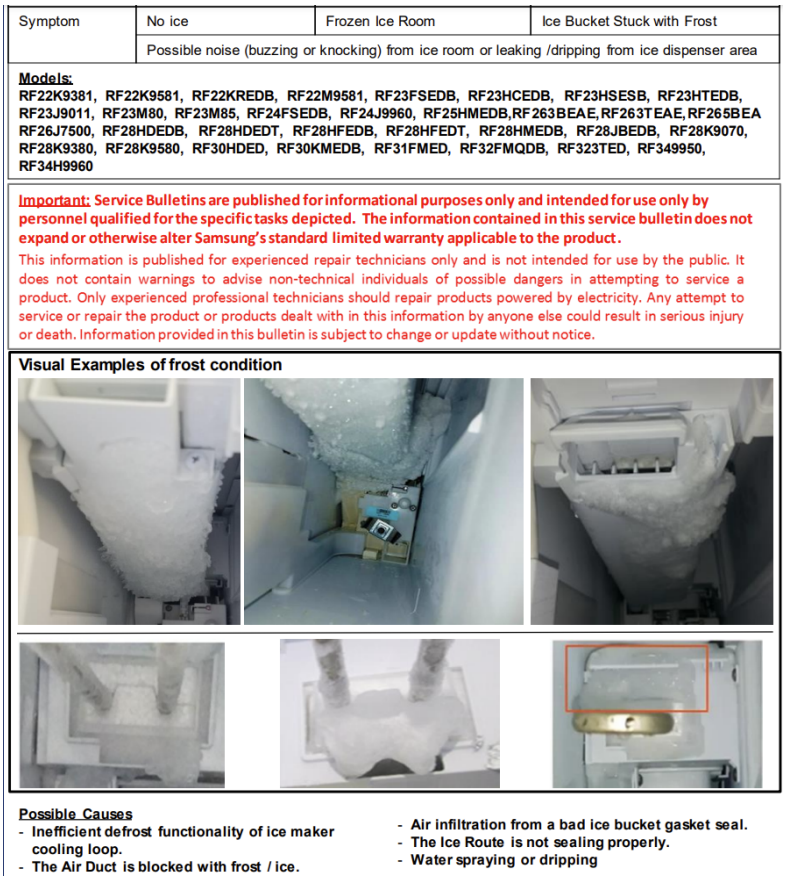
[26] Fischer, K. (2023). Humidity in power converters of wind turbines: Field conditions and their relation with failures. *Energies 14*(7): 1919. https://www.mdpi.com/1996-1073/14/7/1919

[27] Greenlee, L. (2023). How parts pairing kills independent repairs. iFixit. https://www.ifixit.com/News/69320/how-parts-pairing-kills-independent-repair

“Information” Should Include Service Bulletins

After a product is shipped to customers, warranty claims provide rich information about failure modes to manufacturers. Rather than updating the service manual, most manufacturers issue “service bulletins” to their authorized warranty network (see Figure 9, below, for an example). This essential information is rarely shared outside this network.

Some manufacturers restrict service bulletins to their authorized repair centers. This practice can lead to inaccurate diagnosis; even if a servicer is able to read a fault code, associate it with a diagnostic description, and perform a repair, the code may be obscuring a deeper known issue.



Symptom	No ice	Frozen Ice Room	Ice Bucket Stuck with Frost
	Possible noise (buzzing or knocking) from ice room or leaking /dripping from ice dispenser area		

Models:
RF22K9381, RF22K9581, RF22KREDB, RF22M9581, RF23FSEDB, RF23HCEDB, RF23HSESB, RF23HTEDB, RF23J9011, RF23M80, RF23M85, RF24FSEDB, RF24J9960, RF25HMEDB,RF263BEAE,RF263TEAE,RF265BEA RF26J7500, RF28HDEDB, RF28HDEDT, RF28HFEDB, RF28HFEDT, RF28HMEDB, RF28JBEDB, RF28K9070, RF28K9380, RF28K9580, RF30HDED, RF30KMEDB, RF31FMED, RF32FMQDB, RF323TED, RF349950, RF34H9960

Important: Service Bulletins are published for informational purposes only and intended for use only by personnel qualified for the specific tasks depicted. The information contained in this service bulletin does not expand or otherwise alter Samsung’s standard limited warranty applicable to the product.

This information is published for experienced repair technicians only and is not intended for use by the public. It does not contain warnings to advise non-technical individuals of possible dangers in attempting to service a product. Only experienced professional technicians should repair products powered by electricity. Any attempt to service or repair the product or products dealt with in this information by anyone else could result in serious injury or death. Information provided in this bulletin is subject to change or update without notice.

Visual Examples of frost condition

***Figure 9**: A service bulletin noting a common problem with ice makers freezing over.*[28]

One technician reported the example of a malfunctioning ice maker that could be fixed with a software update. Technicians who were unaware of the larger problem might

[28] Samsung. (2017). Service bulletin: French door direct cool ice maker frozen. ClassAction.org. https://www.classaction.org/media/samsung-service-bulletin-ice-maker.pdf

correctly diagnose that there was a problem with an icemaker, replace the whole part, and seal it up—only to have the icemaker shake itself apart again within a few months.

"Information" Should Include CAD Files at End of Service Life

Several technicians expressed concern about parts that stop being available—when there is outsized demand for the part, when there is a large-scale defect or recall, or when a device and its parts leave service life.

Ben Schlichter, an appliance technician in central Ohio who also runs a popular appliance repair YouTube channel,[29] expressed the hope that manufacturers might make computer-aided design (CAD) files for parts when they stop making an appliance. He explains, "I get constant emails from people asking for specific parts that I have no possible way of finding save for getting the part, reverse engineering it, and hiring a factory to make it."

In a few situations, Schlichter has actually taken up these calls, reverse engineering parts that had become unavailable for one reason or another: A door panel for a 3-year-old washing machine that was not being sold directly from Samsung or through Marcone, for no obvious reason. A refrigerator evaporator panel that had a systemic issue, and for 6 months there were no such panels available in the US. Drain tubes and drain clips for washing machines that have reached their end of service life.

Asked what would help, Schlichter proposed "some sort of open-source rendering. If a part is unavailable, the company has to at least make the designs available. You'd still have to pay the die fee and pay for the manufacturing, but at least you could get the part."

[29] Schlichter, B. (2022). Ben's appliances and junk. YouTube. https://www.youtube.com/channel/UC1sWwB45heL1CfLHLBXCXow

Required Repair Information in European Ecodesign Regulation

The material efficiency requirements from European Ecodesign Regulations on dishwashers[30], washing machines[31] and TVs[32] include a specific set of information that regulators have determined to be necessary to enable repair of these home appliances, and the requirements reinforce the testimonies here.

The regulations, which apply to products on the European market, establish that manufacturers must provide professional repairers with the following repair information:

1) unequivocal appliance identification;
2) a disassembly map or exploded view;
3) list of necessary repair and test equipment;
4) component and diagnosis information (such as minimum and maximum theoretical values for measurements);
5) wiring and connection diagrams;
6) diagnostic fault and error codes (including manufacturer-specific codes, where applicable);
7) instructions for installation of relevant software and firmware including reset software; and
8) information on how to access data records of reported failure incidents stored on the products (where applicable);

Product manufacturers are allowed to charge a fee for access to that information, as long as it is reasonable. The term “reasonable fee” is defined in the regulation as a fee that “does not discourage access by failing to take into account the extent to which the professional repairer uses the information.” While current EU legislation considers this fee-limited option as adequate for professional repairers, our findings suggest that fees of any kind limit the potential usefulness of repair information. For small repair businesses, subscriptions to a variety of brands quite quickly become prohibitively expensive. Plus,

[30] European Commission. (2019/2022). Commission Regulation (EU) 2019/2022 of 1 October 2019 laying down ecodesign requirements for household dishwashers pursuant to Directive 2009/125/EC of the European Parliament and of the Council. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02019R2022-20210501&from=EN

[31] European Commission. (2019/2023). Commission Regulation (EU) 2019/2023 of 1 October 2019 laying down ecodesign requirements for household washing machines and household washer-dryers pursuant to Directive 2009/125/EC of the European Parliament and of the Council. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02019R2023-20210501

[32] European Commission. (2019/2021). Commission Regulation (EU) 2019/2021 of 1 October 2019 laying down ecodesign requirements for electronic displays pursuant to Directive 2009/125/EC of the European Parliament and of the Council. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R2021&from=EN

when products exit their expected service life and manufacturer support ends, fee-limited repair information rarely makes it to the public. Repair information should be freely available to open the repair market to enable consumer repairs and trigger innovation in the marketplace.

For consumers, the EU repair information requirements differ: Information must be free and made available online at the product manufacturer site. However, consumers are entitled only to a subset of the information that professional repairers get. At minimum, consumers must have access to instructions for installation, use, maintenance, product identification, diagnosis (e.g., identification of errors, the meaning of the errors, and the action required, including identification of errors requiring professional assistance), and how to access professional repairers.

Some member countries in the EU have addressed the disparity of information between consumers and professional repairers. France, for instance, has strengthened its support for do-it-yourself repair, increasing the repair information required to be provided to consumers for free.

The French Repairability Index[33], a label of mandatory application in the French Region for products put on the French market, describes the repair information that should be made available to facilitate a repair:

A	The unequivocal identification of the product (type of product, trademark, trade name, model, and possibly, serial number)
B	A disassembly map or exploded view
C	Wiring and connection diagrams
D	Electronic boards diagrams
E	List of necessary repair and test equipment
F	Technical manual of instructions for repair
G	Diagnostic fault and error codes
H	Component and diagnosis information
I	Instructions for software and firmware (including reset software)
J	Information on how to access data records of reported failure incidents stored on

[33] Gouvernement. (2022). Indice de réparabilité. Ministère de la Transition écologique et de la Cohésion des territoires, and ministère de la Transition énergétique. https://www.ecologie.gouv.fr/indice-reparabilite#scroll-nav__6

	the product
K	Technical bulletins
L	Specific guidance for self-repair (recommended operations, safety and repair instructions, any implications for the guarantee)*
M	How to get access to professional repairers
N	Failures detection and required action (consumers approach)
O	User and maintenance instructions

The information in points A to K should be provided for both professional repairers and consumers. The information on points L to O is specifically targeted to consumers.

The minimum requirements set out in Ecodesign Legislation show that to successfully carry out repairs, repairers need more information than what is currently presented in user manuals. The content of the legislation corresponds very well with our interviews indicating that broad consensus exists defining the bare minimum of repair information required to support the marketplace. Regulatory intervention is clearly needed to restore competition.

Information Should Be Widely Distributed and Free

Any barrier to repair information will reduce repair activities in the market. To enable the greatest amount of economically beneficial repair activity, the FTC should require that manufacturers make access to repair information free of all encumbrances—that is, without fees and without the requirement to purchase special software.

As iFixit has been making repair information freely available around the world for 20 years, we have heard from many users in situations where their success at repair depended on that free availability: For instance, we have users relying on this information in rural Alaskan villages, in Ugandan refugee camps, and aboard volunteer hospital ships. For such consumers, **any cost, even $1, is an impediment to repair**.

When manufacturers go out of business, their documentation and support networks also shut down. Appliances, with the right care, may last decades. Requiring repair information to be made freely and publicly available at the point of sale will prevent consumers whose appliances have outlasted their manufacturers from getting stuck without access to documentation.

Manufacturers have historically used copyright law as a cudgel to limit distribution of service documentation. Toshiba famously used legal threats to shut down a popular resource of repair information for their laptops.[34] Appliance repair technicians have confidentially shared with us threats that they have received from appliance manufacturers for posting service bulletins online.

Furthermore, repair documentation freely available before sale enables consumers to compare the ease and potential cost of repair across models. Any limitation to service manual availability that requires consumers to input a serial number or other proof of purchase would preclude that kind of pre-sale consumer comparison. It would also preclude third parties from improving the accessibility of repair manuals, for instance, by translating them into other languages or by creating large-print or audio versions of repair manuals for the visually impaired.[35]

[34] Hicks, T. (2012). Toshiba laptop service manuals and the sorry state of copyright law. Future proof. https://tim.id.au/blog/2012/11/10/toshiba-laptop-service-manuals-and-the-sorry-state-of-copyright-law/

[35] ClickHelp (2018). Technical documentation for the visually impaired. https://clickhelp.com/clickhelp-technical-writing-blog/technical-documentation-for-visually-impaired/

SECTION FIVE

Manufacturers' Counter-Arguments Do Not Hold Water

We know what concerns manufacturers will raise to proposed Right to Repair reforms because they have sent letters to lawmakers expressing those concerns.[36] [37] Those concerns are generally unsubstantiated, irrelevant, or based on a misrepresentation of facts.

Appliance Repair Is Not Unsafe

An anti-Right to Repair letter from hair clipper manufacturer Wahl argues that they need to be able to "track repairs and defend the company" against liability; however, both

[36] Brown, J. (2018). HB 4747 (Digital Fair Repair Act) – OPPOSE. Dyson. https://www.documentcloud.org/documents/4446373-DYSON-Illinois-Opposition.html
[37] Habben, R. (2018). HB 4747 (Digital Fair Repair Act) – OPPOSE. Wahl. https://www.documentcloud.org/documents/4446374-Wahl-Opposition-Illinois.html

Consumer Reports[38] and Équiterre[39] found that the majority of appliance repairs already take place outside of manufacturers' repair networks. When consumers engage in do-it-yourself (DIY) repairs, manufacturers typically have no ability to track those repairs. Today, this sort of repair accounts for the plurality of repair; if it were a serious safety problem, one might reasonably expect that we would see frequent news reports of DIY appliance repair injuries.

The FTC has already investigated many of these safety concerns, including Wahl's suggestion that increasing the ease of independent and DIY repairs might result in reputational harm to manufacturers, in its "Nixing the Fix" report.[40] Commissioners cited comments submitted by the Association of Home Appliance Manufacturers (AHAM) suggesting that their repair restrictions served to "uphold brand reputation." However, the FTC reported: "Manufacturers provided no empirical evidence to support their concerns about reputational harm or potential liability resulting from faulty third party repairs."

Furthermore, appliance repair as a profession ranks well below the national average for injury and illness. According to the Bureau of Labor Statistics,[41] in 2021, appliance repair professionals (NAICS Code 8114) had a lower rate of injury and illness than new car dealers, women's clothing store workers, and elementary school teachers—with 1.7 cases per 100 workers, compared to 2.6, 2.1, and 2.6 cases, respectively.

Manufacturer arguments fail to mention that they have previously provided this information without experiencing the safety challenges they fear. In the previously cited 1983 *New York Times* article, "A Fix-It-Yourself Trend for Appliances," Whirlpool bragged that "by 1982 a third of the company's 230,000 callers asked about repairing or installing an appliance, said Joy Schrage, a Whirlpool spokesman." The *Times* goes on, "In response to consumer inquiries about washer and dryer repairs, the company published repair manuals for these two appliances last year, and this year will publish manuals on ranges, dishwashers, refrigerators and freezers and trash compactors." This move toward

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[38] CR Survey Research Department. (2022). Right to repair: A nationally representative multi-mode survey. Consumer Reports. https://article.images.consumerreports.org/prod/content/dam/surveys/Consumer_Reports_Right_to_Repair_Survey_2021

[39] Côté, A., Denoncourt, J., and Girard, A. (2022). Working toward repairable appliances and electronics in Canada: Diagnosis, issues, and solutions. Équiterre. https://cms.equiterre.org/uploads/EQT_rapport_reparation_EN_final2.pdf

[40] Federal Trade Commission. (2021). Nixing the fix: An FTC report to Congress on repair restrictions.

[41] U.S. Bureau of Labor Statistics. (2021). Injuries, illnesses, and fatalities. Table 1: Incidence rates of nonfatal occupational injuries and illnesses by industry and case types, 2021. https://www.bls.gov/iif/nonfatal-injuries-and-illnesses-tables/table-1-injury-and-illness-rates-by-industry-2021-national.htm#soii_n17_as_t1.f.5

widespread publication of appliance repair manuals does not seem to have resulted in an accompanying spate of appliance repair injuries; if they had, one might imagine manufacturers would be quick to point to those incidents, instead of pointing to cases, as the Wahl letter does, of "laptops and hoverboards in the news."

Despite this relative safety, of course, there *is* the potential for danger in appliance repair; repairers may encounter large capacitors and live wires. But just as in the 1980s, individual consumers and independent repairers are already doing the majority of appliance repair. Withholding crucial repair information from them makes their work *less* safe, not more.

Repair Does Not Threaten Cybersecurity

Dyson's anti-Right to Repair letter calls third-party repair and cybersecurity "like oil and water," pointing out that many connected appliances now require wi-fi connectivity and could grant repairers access to owners' home networks.

This argument rests on the strange claim that owners should be locked out of their own home appliances. As cybersecurity expert Paul Roberts, founder of the group SecuRepairs, explains in a letter to New York Governor Kathy Hochul:[42]

> "Manufacturers are arguing that they should be free to share repair information with their business partners, but withhold that same information from the actual owner of the device—all in the name of data privacy? That argument defies logic."

Internet-connected devices, Roberts argues, ought to be designed securely, not rest on the promise of obscurity and the goodwill of manufacturers' representatives.

The notion that providing repair documentation results in cybersecurity risks was broached and refuted in the FTC's "Nixing the Fix" report:

> "Providing individuals and independent repair shops with the diagnostic software to fix devices and with firmware patches is fully consistent with Commission staff's 2015 Internet of Things report and its subsequent Start with Security guidance. Manufacturers can provide others with access to the same parts and tools that they provide to their authorized service providers. And, by providing such access to individuals and independent repair shops, manufacturers would have greater confidence in the repair activities that occur outside of their authorized networks."

[42] Roberts, P. (2022). An open letter to Governor Hochul: There is no cyber risk in repair. SecuRepairs. https://securepairs.org/an-open-letter-to-governor-hochul-there-is-no-cyber-risk-in-repair/

This take corresponds with security expert Bruce Schneier's *Click Here to Kill Everybody*,[43] which broadly represents the "Internet of things" reality as deeply, fundamentally insecure—not as a result of publicly available repair documentation but due to flaws in the trust networks. Schneier echoes the FTC's call for *more* availability of diagnostics and firmware updates to help make our things more secure: "We are all more secure when everybody installs updates as quickly as possible."

Independent Repair Does Not Threaten Warranty Repair

Dyson's letter also points out that manufacturers reserve the right to deny warranty claims for "defects or damage caused by the use of unauthorized parts or service," and thus they argue that opening the opportunity for more third-party repair "could lead to a shortening of warranty commitments and protections for the consumer."

This warranty denial language is carefully crafted to avoid violating the Magnuson-Moss Warranty Act. Notably, it does not acknowledge that manufacturers are still legally obligated to retain the warranty for any parts that are not damaged by an individual or third party.

Perhaps more importantly, however, the argument rests on the questionable assumption that consumers are prematurely opting out of warranty repairs because they are misled by independents. Consumer Reports found[44] that the majority of large home appliance repairs happen outside of manufacturers' doors. Other survey responses suggest that this reality comes not from customers' blithely breaking the terms of their own warranties but because they are opting for the least-expensive repair option, largely for devices that are well out of warranty. Consumers seem to think first of manufacturer-provided warranty repair. When asked which repair option consumers would *consider* if a major appliance broke down, the top two responses were "A local repair shop that is 'authorized' or 'certified' by the appliance manufacturer" and "The manufacturer." Asked to compare manufacturer-authorized and independent repair, consumers rated them roughly equivalent on most measures—except that independent repair won out on cost and convenience. This suggests that, given the opportunity to have repairs conducted

[43] Schneier, B. (2018). Click here to kill everybody: Security and survival in a hyper-connected world. W.W. Norton.

[44] CR Survey Research Department. (2022). Right to repair: A nationally representative multi-mode survey. Consumer Reports. https://article.images.consumerreports.org/prod/content/dam/surveys/Consumer_Reports_Right_to_Repair_Survey_2021

inexpensively by a manufacturer while a product is under warranty, consumers will likely choose that less-expensive option.

Manufacturers Should Be Reimbursed During First Sale, Not From Tied Parts and Service

The Wahl letter explains that they have "spent hundreds of thousands of dollars on product research, design, and testing" and fears that repair reforms would require them "to disclose confidential information to people who may allow this information to be obtained by our competitors."

Independent repair technicians already have some means of accessing most repair information—whether by paying exorbitant amounts to manufacturers directly, or through information-sharing networks like Marcone and Facebook groups. If this information were really so sensitive, manufacturers would already be sunk; counterfeiters are not waiting on the wider public availability of repair manuals.

We believe that no repair information is "sensitive." Almost all repair information can be reverse engineered with enough time and effort. The CAD files that Ben Schlichter requested can be created with 3D scans and manual model making,[45] plus a lot of trial and error. Circuit schematics can be painstakingly recreated,[46] as iPhone repair technicians have done. This level of effort is not economically viable for repair technicians.

We ask only for the disclosure of information that would enable a level playing field for independent, DIY, and manufacturer repair options.

[45] iFixit. (2017). Dare to repair: Phase 2a, scanning. https://www.ifixit.com/Wiki/Dare_to_Repair_Scanning

[46] Throbscottle. (2011). How to reverse engineer a schematic from a circuit board. Instructables. https://www.instructables.com/How-to-reverse-engineer-a-schematic-from-a-circuit/

SECTION SIX

Recommendations for Label Content

III.D. General Label Content and Format Requirements

FTC Advance Notice of Proposed Rulemaking

—Are there any improvements the Commission could make to the content of the information on labels (or other locations such as product manuals or websites) to help consumers with their purchasing decisions? [30]

—Is there a role that QR codes may play in conveying useful information to consumers?

Content of the Information on Labels

At a bare minimum, we are calling for access to service manuals via Energy Guide labels. We encourage the FTC also to require parts diagrams, wiring diagrams, schematic diagrams, pinout diagrams, diagnostic software, and service bulletins. An additional helpful step would be the release of CAD files at the end of the appliance's official service life.

We also encourage the FTC to consider how the label's "estimated yearly energy cost" feature might integrate some of the expected costs of repair. For instance, the label might include the average cost of a repair to that appliance, or the annual average cost of repairs across the appliance's expected service life; Consumer Reports has collected that information for many categories of appliances. The label should also include the annual cost of access to manuals (if any) and diagnostic software—because whether the customer pays directly or through the repair technician of their choice, it increases the cost of repairs significantly.

The Use of QR Codes for Conveying Repair Information

To provide all the kinds of repair information we have requested above as part of the Energy Guide labeling system, manufacturers will need somewhere to host all their appliance documentation. Although the European Union ecodesign labeling system does not currently require manufacturers to make repair information available to consumers, their label nevertheless offers an example both of a government entity hosting related documentation and of manufacturers hosting their own (see Figure 10, below).

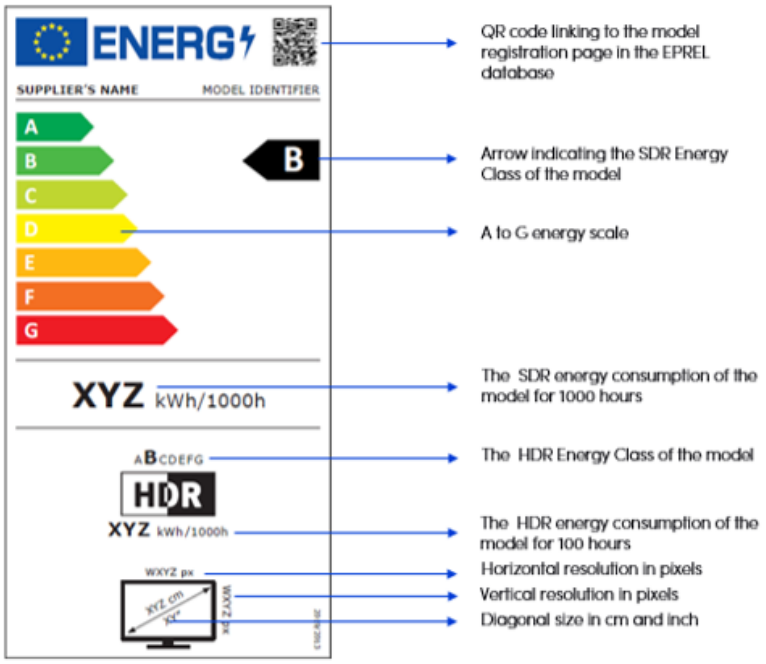


***Figure 10**: The new European ecodesign appliance energy label, including a QR code, via Digital Europe.*[47]

The QR code on the EU energy label points to an entry in the European Product Registry for Energy Labeling (EPREL). That site includes detailed explanations of the abbreviated information on the label, including a "product information sheet," provided as multi-language PDFs; the information sheet by law includes a URL to a place on the manufacturer's website that provides consumers with access to user manuals and spare parts ordering.

Although this system is perhaps more convoluted than necessary, it provides a relatively simple four-click path from product label to detailed energy guide to product information sheet to user manual. The responsibility for hosting is distributed; the government hosts the energy label information, while manufacturers are expected to host the repair information. This system enables manufacturers to present manuals and parts through whatever website and with whatever framing information they deem appropriate, including potentially by linking to third-party parts distributors or manual sites; meanwhile, it enables standardized energy label information and elaboration on the government website. It also **gives manufacturers the power to update repair information** when they find it

[47] Basiulyte, M. (2020). Digitaleurope communication on energy labelling rescaling. Digitaleurope. https://www.digitaleurope.org/resources/digitaleurope-communication-on-energy-labelling-rescaling/

necessary, including providing warnings and potentially even up-to-the-minute service bulletins.

However, the system does have some drawbacks: If manufacturers' websites go down or their site architecture changes, the interlinkages are less robust than the stable product information sheet PDF on the EPREL page.

QR codes themselves also have both benefits and drawbacks. Two of our interviewees independently brought up wishing that appliances had QR codes, to connect servicers to diagnostics, videos, or repair instructions. Both suggested that this practice would speed up their diagnostic process significantly; a QR code increases the convenience of accessing a website, particularly one with a lengthy URL. The Framework laptop notably includes QR codes[48] on each part referencing a repair procedure on the manufacturer website (see Figure 11). However, unlike URLs, which are equally functional with all types of internet-capable devices, **QR codes require servicers to have a smartphone with a charged battery and a working camera**. Although the United States has high smartphone market saturation, still, nearly 15% of Americans do not have a smartphone.[49]

***Figure 11**: Framework's on-component QR codes enable easy repair access.*

[48] Patel, N. (2022). Framework Laptop DIY edition quick start guide. Framework. https://guides.frame.work/Guide/Framework+Laptop+DIY+Edition+Quick+Start+Guide/57#s280

[49] Statista. (2023). Smartphone user penetration as share of population in the United States from 2018 to 2025. https://www.statista.com/statistics/201184/percentage-of-mobile-phone-users-who-use-a-smartphone-in-the-us/

Could Energy Guide Labels Include Repairability Ratings?

The European Union ecodesign labeling system also offers another promising option for energy labeling, when it comes to informing consumers about repair: A recent proposed label presented a design including a repair index, which would score products' repairability on a scale of A–E (see Figure 12).

Although repair activists take issue with many aspects of the proposed repairability index,[50] the draft represents a promising example of how energy labeling might include information to help consumers identify more-repairable products.

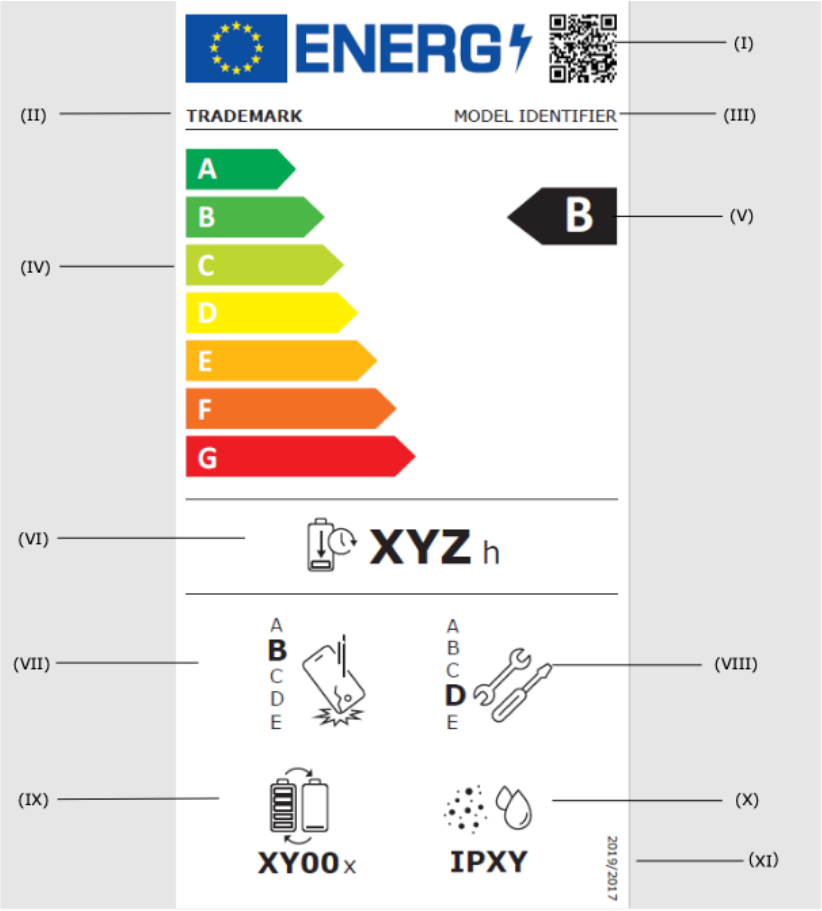


***Figure 12**: The proposed draft ecodesign labeling for smartphones in the EU includes a repairability rating system on an A–E scale (see VIII in the image above).*

[50] Ganapini, C. (2022). A fake right to repair—new EU smartphone rules set to overlook main needs for a real repair revolution. Repair.eu. https://repair.eu/news/a-fake-right-to-repair-new-eu-smartphone-rules-set-to-overlook-main-needs-for-a-real-repair-revolution/

The French repairability scoring system offers another example of how repair education might be represented on a product label. As of January 2021, electronics manufacturers in France have needed to score themselves using a repairability rating system and publish those scores on their websites. At the point of sale, they must display their product scores.

***Figure 13**: The French repairability labeling scores that must be visible at the point of sale, whether online or in person.*

Although manufacturer self-report is not an ideal repair scoring system, it reduces the implementation cost for the French government and keeps the burden on manufacturers relatively low—they need not achieve a specific score, yet the high visibility of the scores and the intuitive ranking and label colors make better scores attractive to consumers.

Consumers Want and Need Repair Information

Consumers are increasingly demanding repair information. Consumer Reports found that 75% of consumers believe that manufacturers should be required to make diagnostic information available to consumers.[51] Similarly, the Équiterre survey reported that 60.8% of consumers supported legislation that would require manufacturers and/or retailers to make available repair information ("on the manufacturer's website, on the product label, etc.").[52]

[51] CR Survey Research Department. (2022). Right to repair: A nationally representative multi-mode survey. Consumer Reports. https://article.images.consumerreports.org/prod/content/dam/surveys/Consumer_Reports_Right_to_Repair_Survey_2021

[52] Côté, A., Denoncourt, J., and Girard, A. (2022). Working toward repairable appliances and electronics in Canada: Diagnosis, issues, and solutions. Équiterre. https://cms.equiterre.org/uploads/EQT_rapport_reparation_EN_final2.pdf

Repair information is not only desired but needed to successfully diagnose and repair an appliance. In a user observation study with 24 participants, almost all the participants without previous repair experience could not have diagnosed the appliance without help.[53] Moreover, diagnosis and repair information cannot only help during a repair, but actually incentivize it. In another recent study into consumer repair behavior, researchers found that fault indications in products increases willingness to repair in consumers.[54] In other words, if consumers know what they need to repair, they will be tempted to do it. Fault indications are "signals appearing of products providing information about the occurring failure." If this information were provided in the repair information given to consumers, they would be similarly incentivized to repair their products. Repair information can incentivize and motivate repairs that would not otherwise happen. The FTC has a golden opportunity to deliver on this glaring consumer need.

[53] Pozo Arcos, et al. (2021). Faults in consumer products are difficult to diagnose, and design is to blame: A user observation study. *Journal of Cleaner Production 319*. https://www.sciencedirect.com/science/article/pii/S0959652621029401

[54] Van den Berge, R. et al. (2022) Enhancing consumers' willingness to repair electronic products: How design can nudge sustainable behavior. DRS Conference Proceedings http://resolver.tudelft.nl/uuid:5aae8710-c439-4165-856e-5733fa5d2398

Appendix A: Repairing a Fridge Costs More Than a Fridge

An article posted on iFixit.com on November 23, 2022
https://www.ifixit.com/News/69391/repairing-a-fridge-costs-more-than-a-fridge

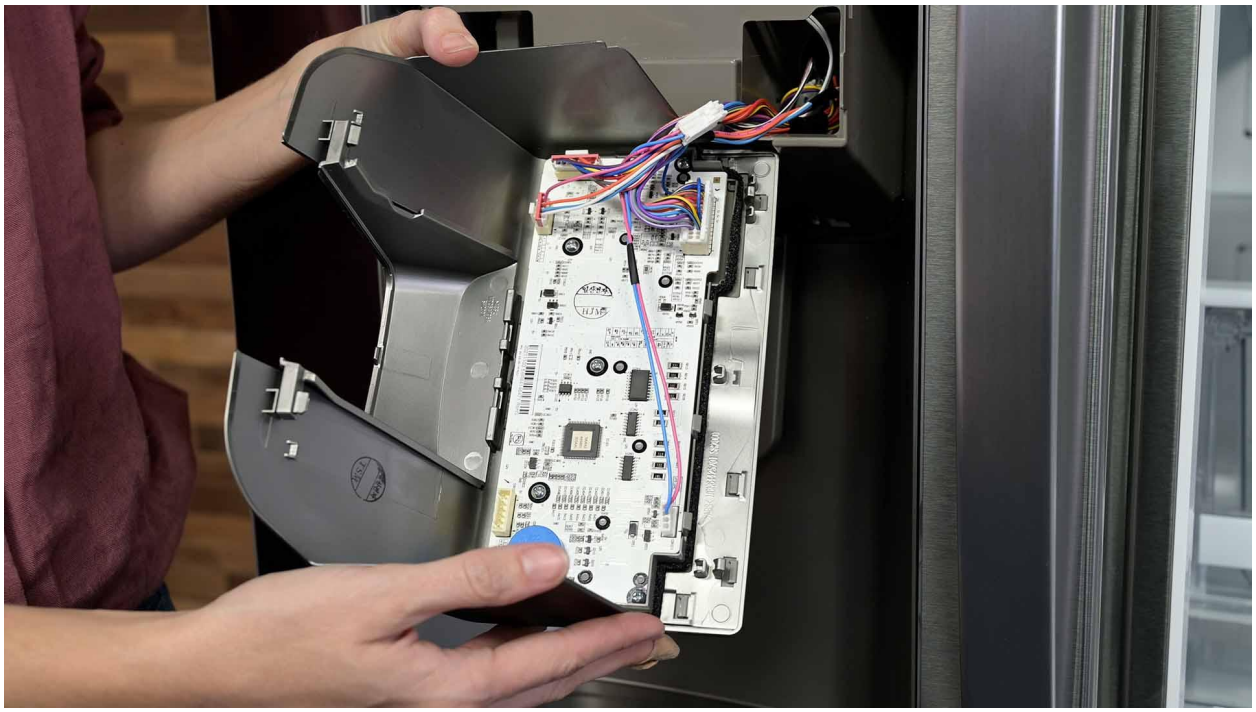
In October, the US Federal Trade Commission announced a new set of rules that would require appliances to ship with repair instructions. The repair community applauded the move—access to manuals is a core part of the Right to Repair. But when we reached out to appliance repair experts to better understand the proposal, they said that repair manuals alone won't truly lead to more appliance repair. That's because fixing modern appliances—so many of which are loaded with "smart" tech—often requires access to software and equipment that prices out independent and DIY repair.

The appliance repair community says that the FTC rules should require access to service bulletins and required board updates: These things alert technicians to recalls, help align parts to required tolerances, and make it possible to complete repairs. Right now, often this data is locked within proprietary manufacturer software, and without it, repair techs say the FTC won't solve the real problems preventing mass appliance repair.

Here's what the holdup looks like in practice:

Let's say one day, the ice maker in your fridge stops making ice. You find the replacement part you need to get it working again online, get it shipped, slot it in—and ice cube cereal is back on the menu. But a few weeks later, the ice maker stops working again. What gives?

The ice maker may have shaken itself to death because you failed to reprogram the motherboard with the correct tolerances using the manufacturer's special software. This sort of unpleasant surprise is all too common for DIY and independent repair technicians, explains Matt Zieminski, Vice President of Repair.org. You want access to the special software that will allow you to calibrate the new part with your fridge? Get ready to shell out hundreds of dollars a year—access to GE's SmartHQ Service costs $919 per year, including $199 for a cable that lets your tablet talk to your fridge. You can buy a whole new fridge for $919.



Sam inspects the control board on top of the ice maker in our LG smart fridge.

If that sounds like too much for a single repair, well, yeah. That's the point: It's in GE's interest to make you decide it's not worth the effort to fix the fridge yourself and call a technician instead. And they want to make sure the technician you call is from their own service network.

There's nothing necessarily wrong with GE preferring their own technicians, but authorized service isn't always the best option and it certainly shouldn't be the only option. For one thing, some customers live a long way from an official tech. For another, manufacturer networks often get overwhelmed during recalls. After a large batch of LG refrigerator compressors went bad at once, for instance, lots of customers complained about problems getting timely manufacturer service.

One LG fridge owner relates their experience:

> ***Have had an LG refrigerator for less than two years. Compressor went out. They tell me there is only one LG repair center within 100 miles and they can't come for three weeks. Are you kidding me? What family can go three weeks without a fridge…***
> —A CUSTOMER LEFT HANGING

Now, even if you wanted to go with a manufacturer's pro, if the wait time is too long to save your Thanksgiving leftovers, you might call an independent shop. But even if your fridge shows an error code, or even if you've got simple diagnostics via the free version of a manufacturer's app, that often isn't enough to complete a repair. Dean Landers, owner of Landers Appliance Repair in Baltimore, Maryland, says sometimes an error code masks a required board update, available only to techs who have paid the $919 for the app and dongle.

"If you don't have that device and can't do a board update, you're going to think that board is defective," Landers explains. "You're going to tell the customer the repair will be the cost of the board. You won't know it needs an update—and that's all it needs, even though it shows up defective."

Error codes only tell part of the story, and if the tech at the independent repair shop isn't paying $919 per year for the app and dongle, solving your problem might be literally impossible.

Free diagnostics apps, like the one that connects to our LG smart fridge, often don't tell the whole story repair technicians need.

Now, for many repair shops, a single annual fee of $919 might not be such a bad business expense if it were the only equipment they were servicing. But think about how many kitchen appliance brands there are out there, and then multiply.

A source within a home warranty company says their technicians service 143 different appliance brands. If technicians had to pay $919 for every brand they serviced, each would

be paying $131,417 annually for that access. Most of these technicians are one-person shops already operating on thin margins. If GE's model of giving service information access were to keep spreading across the industry, it could quickly put them out of business.

When we push manufacturers to make their documentation more open, they often argue that their products are too complicated for people without fancy manufacturer-provided training to repair. We take apart a lot of complicated gadgets, and we haven't found one that seems beyond the repair powers of someone with the right screwdriver and the right documentation.

But we'd never taken apart a fridge at all, let alone a smart fridge. So we figured we'd tackle one now, with the question in mind: Is there anything about this smart fridge technology that suggests only people with special manufacturer training should attempt a repair?

Short answer: No.

We didn't find anything more dangerous than some big capacitors (no touchy). What we did find: Lots of easily replaceable parts. A handful of control boards, with a much more spacious pin arrangement than we're used to in phones and laptops. And a really buggy diagnostic app that only talked to our fridge about half the time.

The FTC making repair documentation available will be a boon to DIY and independent repairers around the world. But if they *really* want this regulation to make appliance repair more open, they need to include software access as well.

We've found that manufacturers tend to be reluctant to give up their monopolies—so regulators need evidence to push back against them. The FTC is calling for public comment now. Have you ever had an appliance repair gone wrong? Might more documentation or software availability have helped? If so, drop the FTC a line (or comment on this post, and we'll put your thoughts into our own formal comment submission).

Appendix B: Full results from the survey of professional appliance repair technicians

How big is your repair company?		
More than 10 technicians	9	24.32%
Just me	9	24.32%
6-10 technicians	5	13.51%
2-5 technicians	14	37.84%
How often does an appliance you're repairing require you to input a service code to complete the repair?		
Often	9	24.32%
Sometimes	10	27.03%
Seldom	11	29.73%
Never	5	13.51%
n/a	2	5.41%
How often does an appliance you're repairing provide a service failure/fault code that you must find a description of that isn't listed in any of the repair manuals?		
Often	8	21.62%
Sometimes	18	48.65%
Seldom	9	24.32%
Never	2	5.41%
How often are you unable to access schematic diagrams?		
Often	16	43.24%
Sometimes	13	35.14%
Seldom	6	16.22%
Never	2	5.41%
How often are you unable to access repair manuals?		
Often	18	48.65%
Sometimes	11	29.73%
Seldom	4	10.81%
Never	3	8.11%

n/a	1	2.70%
How often are you unable to access spare parts?		
Often	10	27.03%
Sometimes	11	29.73%
Seldom	15	40.54%
Never	1	2.70%
How much would you estimate your company pays each year for access to manufacturers' repair service software?		
Nothing	4	10.81%
$1-$500	5	13.51%
$501-$1000	6	16.22%
Over $1000	10	27.03%
I don't know	12	32.43%
How worried are you that network fees and tiered parts pricing that favors manufacturers' technicians could put you out of business?		
Not worried at all	11	29.73%
Somewhat worried	11	29.73%
Very worried	7	18.92%
Those things are already putting me out of business	3	8.11%
n/a	5	13.51%
Which manufacturers' products do you have the hardest time getting service documentation for?		
LG	19	
GE	10	
Miele	12	
Samsung	19	
Bosch	12	
Thermador	10	
Sub-Zero	8	
Viking	1	
Haier	8	
Whirlpool	7	

Aga	3	
Bertazonni	5	

Anything else you'd like to share about the things that make appliance repair difficult for you?
Repair parts prices have made a large percentage of repairs "too expensive to fix"
Lack of color coding for wiring.
Typically diagnosing would be the most frustrating part. Finding service manuals and wiring diagrams through google would yield extremely mixed results. This would drastically slow me down as you need to be 100% sure in diagnosing and without knowing the specifications it makes testing components extremely difficult.
Part availability. And why do all brands use the same generic parts, but rebrand and mark up the prices 3x(looking at you GE)
Service bulletins for known issues should be public.
manufactures discounting parts after only a few years
The overall ease of access to manuals seems to be under lock and key front thr manufacturers or a "Pay to play" type scheme.
Sparce or flat out incorrect docs/tech sheets. Just had one today: ge fridge tech sheet listed over a hundred tests that could be run in service mode. The software of that same fridge only let you go up to 100.the tests I needed had numbers over 100. I searched online and found a similar tech sheet that correctly matched the fridges list of tests. I frequently come across errors and typos in repair documents.
Manufacturers cannot keep up with the demand of spare parts. It’s becoming more and more difficult for people in my trade to access the parts to complete a repair whether it be by discontinuation of that part, out of stock, and/or back ordered with no ETA date from the manufacturer. LG, Samsung and Whirlpool are the biggest culprits of this.
Diagnostic or service modes with lack of error codes. Diagnostic or service modes with lack of forced operations.
Receiving incorrect parts from manufacturer and warehouses.

Appendix C: Full results from the survey of manual availability

Company Name / Brand Examined	Products:	Product targeted	Model No	Service manual found online?	Did they send service manual after request?
AB Electrolux	Dishwashers, Vacuum Cleaners, Other home appliances	4.5 cu. ft. High-Efficiency Stackable Front Load Washer in Titanium with SmartBoost, ENERGY STAR	EPWD257UTT	No	No
Airgle Corporation	Air Purifiers	Airgle AG900 Clean Room Air Purifier	AG900	No	No
Alticor, Inc. / Amway	Bath, Beauty and Home products	Atmosphere Mini™ Air Treatment System	124746	No	No
BISSELL Inc.	Vacuums	SpotClean Pro™ Portable Carpet Cleaner	3624	No	No
Blueair Inc.	Air Purifiers	Blue Pure 211+	Blue Pure 211+	No	No
Breville USA Inc.	Kitchen Appliances	Breville Barista Touch Brushed Stainless Steel Espresso Machine	BES880BSS1BUS1	No	No
Brown Stove Works, Inc.	Stoves	Summit 24" Single Gas Wall Oven with Oven Window, Electronic Ignition, and Clock with Timer	TTM7212DK	Yes[55]	Yes (sent additional service info)
BSH Home Appliances Corporation / Bosch	Large Appliances	Bosch 24" Built-In Dishwasher with Recessed Handle and Express Wash - Ascenta Series	SHE3AR75UC	No	No
Cleva North America Inc. / Lawnmaster	Lawnmowers	LawnMaster; No-Pull; 17" 26cc 2-Cycle Straight Shaft Electric Start Gas Trimmer	NPTGSP2617A	No	Yes
Danby Products	Home Appliances	Countertop Ice Maker: Nugget Cube Type, 25 lb Ice Production per Day, Up to 200 lb, Ice Scoop	DIM2500WDB	No	No

[55] We determined that the manual posted at the point of sale qualified as a service manual, given its extensive wiring diagrams and exploded diagrams. However, when we asked for more information, there was a more detailed manual which was quickly provided to us.

DeLonghi America, Inc.	Kitchen, Home Appliances	La Specialista Prestigio Espresso Machine	EC9355M	No	No
Dyson Limited	Vacuums	Dyson Pure Hot+Cool™ HP01 purifying heater + fan (Iron/Silver)	Hot+Cool HP01	No	No
Emerson Electric Company	Heating Cooling Systems.	ST75, Sensi Touch Smart Thermostats	ST75	No	No
Essick Air Products	Coolers and Humidifiers	ESSICK AIR Ducted Evaporative Cooler with Motor: 1600 sq ft, 5,500 cfm, 2 in Pad Thick, 1/2 hp HP	2YAD9-2HTK9	No	No
Fellowes Inc.	Shredders	Fellowes Quasar+ 500 Comb Binding Machine	5227201	No	No
Friedrich Air Conditioning Company	Air Conditioners	Friedrich Chill Premier 24000 BTU Smart Through Wall Air Conditioner with 10600 BTU Smart Heater and Remote Control	CEW24B33A	Yes	N/A[56]
Gorenje Group / ASKO	Large Appliances	Front Load Super Rinse W4114CT 24" Energy Star Washer with T411VDT 24" Electric Dryer Laundry Pair in Titanium	916444	No	Yes
Groupe SEB / Krups	Kitchen Appliances	KRUPS Simply Brew Compact Filter Drip Coffee Maker, 5-Cup, Silver	KM202850	No	No
Haier Group / Haier America	Refrigerators, Large Appliances	Haier HRQ16N3BGS	HRQ16N3BGS	No	No
Helen of Troy / Honeywell	Fans, Heaters, Humidifiers	Honeywell Home Wi-Fi Color Touchscreen Programmable Thermostat	RTH9585WF1004/W	No	No
H-P Products, Inc. / Vacuflo	Vacuums	VacuFlo DB7000 Central Vacuum Power Unit	DB7000/9515	No	No
Hisense International Co. Ltd.	TVs	Hisense 58" Class 4K UHD LED LCD Roku Smart TV HDR R6 Series 58R6E3	58R6E3	No	No

[56] The manual we accessed was clearly the full service manual, so we did not request more information.

Keurig Green Mountain, Inc.	Coffee Makers	Keurig K-Duo Essentials Single Serve K-Cup Pod & Carafe Coffee Maker, Black	5000204976	No	No
Koblenz Electrica, S.A. DE C.V.	Vacuums	Endurance Commercial Upright Vacuum Cleaner	U-80	No	Yes
Lasko Products, Inc.	Air Purifiers, Fans	Ceramic Tower Heater w/ Remote - Black	5790	No	No
LG Electronics	TVs, Monitors, Refrigerators	33 in. W 25 cu. ft. French Door Refrigerator with Ice Maker in PrintProof Stainless Steel	LRFCS2503	No	No
Liebherr Export AG	Refrigerators	24 Inch Counter Depth Bottom Freezer Refrigerator with DuoCooling, 11.0 cu. ft. Capacity: Right Hinge	CBS 1660	No	N/A[57]
Lindsay Manufacturing, Inc. / Vacumaid	Vacuums	Wall Mounted Utility Vacuum with 50 ft. Hose and Attachments	GV50PRO	No	No
Midea Group	Refrigerators, Coolers	Smart Window Air Conditioner with 8000 Cooling BTU	MAW08V1QWT	No	No
Miele, Inc.	Refrigerators	Miele G5000 Series 24 Inch Wide 16 Place Setting Energy Star Certified Built-In Fully Integrated Dishwasher with QuickIntenseWash	G5056SCVISF	No	No
National Presto Industries, Inc.	Kitchen Appliances	12-Cup Stainless Steel Percolator	2811	No	No
Newell Brands Inc. / Mr. Coffee	Kitchen Appliances	Mr. Coffee Coffee Maker with Auto Pause and Glass Carafe, 12 Cups, Black	SK13-RB	No	No
Oransi	Air Purifiers	mod HEPA Air Purifier	mod HEPA Air Purifier	No	No
Panasonic Corporation of North America	Various Products	Panasonic - LUMIX G7 Mirrorless 4K Photo Digital Camera Body	DMC-G7KK	No	No

[57] We were unable to reach Liebherr.

		with 14-42mm f3.5-5.6 II Lens - DMC-G7KK - Black			
Perlick Corporation	Refrigerator	Perlick 24-Inch Signature Series Stainless Steel Glass Door Outdoor Refrigerator - Right Hinged - HP24RO-4-3R	HP24RO-4-3R	No	No
Philips Electronics	TVs, AV Tools	Philips 50" Class 4K Ultra HD (2160p) Android Smart LED TV with Google Assistant (50PFL5766/F7)	50PFL5766/F7	No	Yes
Samsung Electronics America, Inc.	Phones, TVs, Cameras, Home Appliances	43" Class TU690T Series LED 4K UHD Smart Tizen TV	UN43TU690TFXZA	No	Yes (for purchase at $12)
Scott Fetzer Company / Kirby	Vacuums	Avalir 2 Vacuum, Avalir 2 Home Cleaning System, Avalir 2 – Ultimate Home Cleaning System	G10D	No	No
SharkNinja Operating, LLC	Vacuums, Blenders and Kitchen Appliances	Shark - HyperAir Hair Blow Dryer with IQ 2-in-1 Concentrator & Styling Brush Attachments - Stone	HD112BRN	No	N/A[58]
Sharp Electronics Corporation	Kitchen Appliances	Sharp 24 Inch Wide 1.2 Cu. Ft. Microwave Drawer with Push Button Opening	SMD2470ASY	No	No
Smeg USA	Refrigerators, Large Appliances	Smeg Cream Retro Electric Tea Kettle	KLF03CRUS	No	No
Spectrum Brands, Inc. / Black & Decker	Kitchen Appliances	BLACK+DECKER Easy Assembly 8-Cup Food Processor, Black, FP4200B	FP4200B	No	No
Stanley Black & Decker / Stanley	Hand Tools	8-Volt MAX Lithium-Ion Cordless Rechargeable 3/8 in. Drill with Charger	BDCD8C	No	No
Sub-Zero Wolf Inc.	Refrigerators	36" Classic Refrigerator with Internal Dispenser - Panel Ready	CL3650RID/O	No	No[59]

[58] We were unable to reach SharkNinja.

[59] They would not let us proceed with our request without a purchased product number.

The Middleby Corporation / Viking Range	Ovens / Ranges	5 Series 30 Inch Freestanding All Gas Range with Natural Gas	VGIC53024BSS	No	No
Vornado Air LLC	Fans	Vornado MVH Vortex Heater with 3 Heat Settings, Adjustable Thermostat, Tip-Over Protection, Auto Safety Shut-Off System, Whole Room, Black	MVH	No	No
Wahl Clipper Corporation	Clippers, Personal Care	Wahl Color Pro Cordless Rechargeable Hair Clipper & Trimmer – Easy Color-Coded Guide Combs - for Men, Women, & Children – Model 9649P	9649P	No	No
Waterpik, Inc.	Dental Care	Waterpik Cordless Water Flosser, Battery Operated & Portable for Travel & Home, ADA Accepted Cordless Express, White WF-02	WF-02W010	No	No
Whirlpool Corporation	Large Appliances	Whirlpool WRX735SDHZ 25 Cu. Ft. 4-Door French Door Refrigerator - Stainless steel	WRX735SDHZ	No	No
Winix Inc.	Dehumidifiers	C535 3-Stage True HEPA Air Purifier with PlasmaWave® Technology	C535	No	No