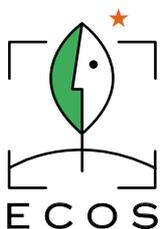


LONG LIVE THE MACHINE

How ecodesign & energy labelling can
prevent premature obsolescence of laptops





Authors

Ernestas Oldyrevas, Programme Manager, ECOS

Catriona McAlister, Independent Consultant & ECOS Expert

ECOS is an international network of members sharing a vision of a clean and healthy environment where people live in respect of the planet and its natural resources, preserving them for future generations.

We aim to influence the development of ambitious standardisation, legislation and political strategies to promote the transition to a clean and circular economy that respects planetary boundaries.

We promote and defend environmental interests in the development of standards at European and international level, as well as in the development of environmental product policies.

ECOS, together with the EEB, co-leads the [Coolproducts campaign](#), working to ensure that ecodesign and energy labelling truly work for Europeans and the environment. We are also co-founders of the [European Right to Repair campaign](#), launched in 2019 by ECOS, EEB, iFixit Europe, Runder Tisch Reparatur and The Restart Project.



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Contents

1

Executive Summary

4

2

What the consumer wants, they don't (always) get

5

3

Addressing the climate crisis requires laptops that are around for longer

7

4

Reasons for laptops retiring early

9

5

Setting sights on new horizons for laptops

13

6

Using existing policy tools can make change happen

20

7

Notes and References

28

Executive Summary

The proliferation of electronic devices which are difficult to repair and whose lifespans are shortening, contributes to one of the fastest growing waste streams in the EU.¹ This not only puts enormous pressure on the environment in terms of pollution and resource depletion, but also results in higher consumer costs and contributes to the climate emergency. Although successful reuse, repair or refurbishment can extend the lifespan of electronic devices and bring benefits to both the environment and consumers, a number of critical obstacles persist that have so far received limited attention from policymakers.

The purpose of this paper is to shed light on these obstacles and to stimulate debate by focusing on measures necessary to enable longer lifetimes for our laptop computers. It is time to put an end to premature obsolescence of electronics, and timing could not be better: the 2020 Circular Economy Action Plan and Ecodesign Work Plan 2020-2024 provide an opportunity to tackle electronic devices as part of the European Green Deal², while the first “right to repair” legislation for household appliances was already passed back in 2019.³ This report aims to identify the way to achieve this, focusing on a specific product group and paying particular attention to the potential of ecodesign and energy labelling.

We identify five major obstacles as cause of most cases of premature obsolescence: deficient robustness, lack of repair and upgrade possibilities, software and firmware constraints, lack of possibilities to refurbish and reuse, as well as fashion trends. These are then paired with policy

recommendations for policymakers to tackle the problem, applying measures such as requirements on laptop robustness, repairability, battery lifetime extension and consumer information.

The paper shows that the EU ecodesign and energy labelling regulatory instruments have a great potential to contribute to the reversal of the current throwaway culture, double laptop lifetimes, and save some 5 million tonnes of CO₂ equivalent by 2030 – equivalent to taking nearly 3 million cars off the road.

The findings of this report can be considered horizontal in nature, even though it focuses on only one example of consumer electronics that currently reach retirement age significantly too early. The recommendations can contribute to an overdue discussion on how the environmental impact of the digitalisation of our societies can be reduced.

This will not only require more durable products, but also the empowering of both consumers and repair communities when failures do occur. Changes are urgently required to shift towards so-called product-as-service business models, as well as to encourage increased innovation and competition in the durability and repairability of devices. Consumers must be able to make informed choices about their purchases on such important considerations as expected product lifetime, the ease of repair and the overall impacts on the environment.

The recommendations to tackle longevity obstacles can be summarised as follows:



Ecodesign minimum requirements on:

- ruggedness
- replaceability and upgradeability of priority parts (including by using non-OEM spare parts)
- pricing, availability and delivery time of spare parts
- battery durability and optimisation
- introduction of a common charger
- software and firmware update availability
- tools for optimised user configuration, data deletion and reset



Ecodesign information requirements on:

- repair manuals
- information on impacts of software updates ahead of their installation
- optimal user configuration



Information on the EU energy label on:

- repairability score of the product
- durability information (incorporating software support, expected battery life, and casing upgradeability)
- information on the free warranty repair period offered



Whenever relevant, these requirements should be supported by **environmentally ambitious state-of-the-art standards**

As a package, these proposals are expected to contribute to:



a potential doubling in laptop lifetime, from 5 to 10 years



reduction in the accidental failures of laptops, 11% of which fail in the first three years of use



extended battery lifetime by up to 50% and substantial reduction in users dissatisfied with their laptop battery lifetime



increased availability of more affordable replacement parts and improved repair information, resulting in 33% improvement in successful repairs



considerably reduced repair times and a corresponding reduction in the cost of repair



reduction of 12,000 tonnes of electronic waste by 2025 through the introduction of a common charger for laptops



increased efficiency of refurbishment and recycling by establishing a solid market for reused devices, and incentivising repairable designs



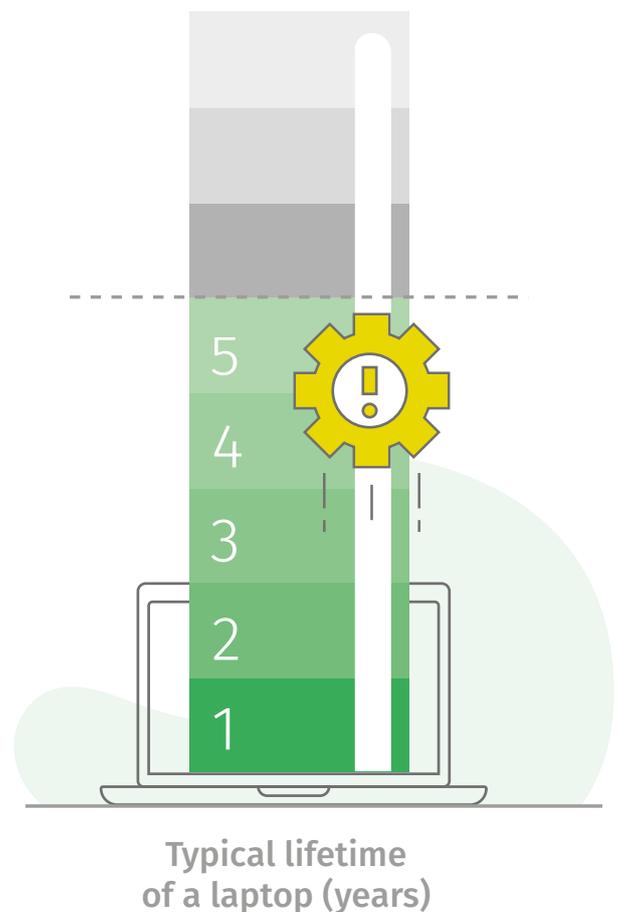
doubling in the availability of refurbished laptops on the market after their first useful lifetime

What the consumer wants, they don't (always) get

Laptops fail frequently.⁴ These failures can, however, often be prevented with easily achievable design improvements or changes to commercial practices. While consumers expect laptops to function for 7 years or more, the typical lifetime of a laptop today is a mere 4 to 5 years.⁵ To make matters worse, the lifespan of consumer electronics is continually decreasing.⁶

Very little (if any) information on laptop durability and repairability is made available to consumers at the point of sale and there is still a lack of clarity regarding commercial warranty periods and obligations.⁷

As a 2019 consultation shows, 84% of respondents think the European Union should act to extend the lifetime of products.⁸ In another survey, 77% preferred to repair goods rather than buy new ones.⁹ However, these good intentions continue to be side-tracked by service difficulties and the poor economics of repair.



Addressing the climate crisis requires laptops that are around for longer

Although in relative terms the energy efficiency of laptops has improved over time, their production still requires significant amounts of energy as well as precious materials. The embedded energy (non-use) impacts of these products, which include manufacturing, transportation and end-of-life treatment, are in fact as high or higher than their

environmental impacts in-use. According to a previous study by the Coolproducts campaign¹⁰, approximately 52% of greenhouse gas emissions of a laptop computer are attributable to its non-use impacts.

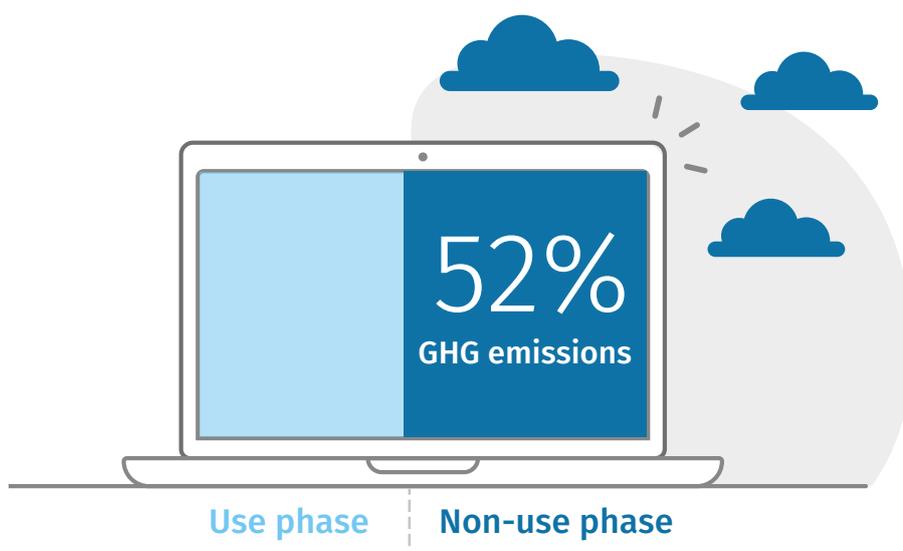


Figure 1 Climate impact of laptops over lifetime¹¹

The situation can be substantially improved: better design of laptops can improve their reparability and extend their lifetime, which will result in spreading the share of non-use climate impacts over a longer time period. While in some cases replacing an old product might be advisable because of the increased efficiency of the new purchase, early replacement of laptops cannot be justified in this way. The efficiency improvements of new laptops are by far outweighed by the impact of resource extraction and environmental pollution brought about during the production of a new device.¹²

As it is, laptops that could be given a second life with only minor upgrades are far too often prematurely replaced with new ones. The discarded devices are then disposed of

or put away and forgotten, despite their significant second-hand value. Any lifetime extension of a computer – either through repair, remanufacture or second use – postpones the material impacts caused by the manufacture of a new product. Sadly, few components and materials comprising a personal computer are effectively reused or recycled. This is not helped by the fact that only over a quarter of the material weight of a laptop is fully recyclable (Figure 2).

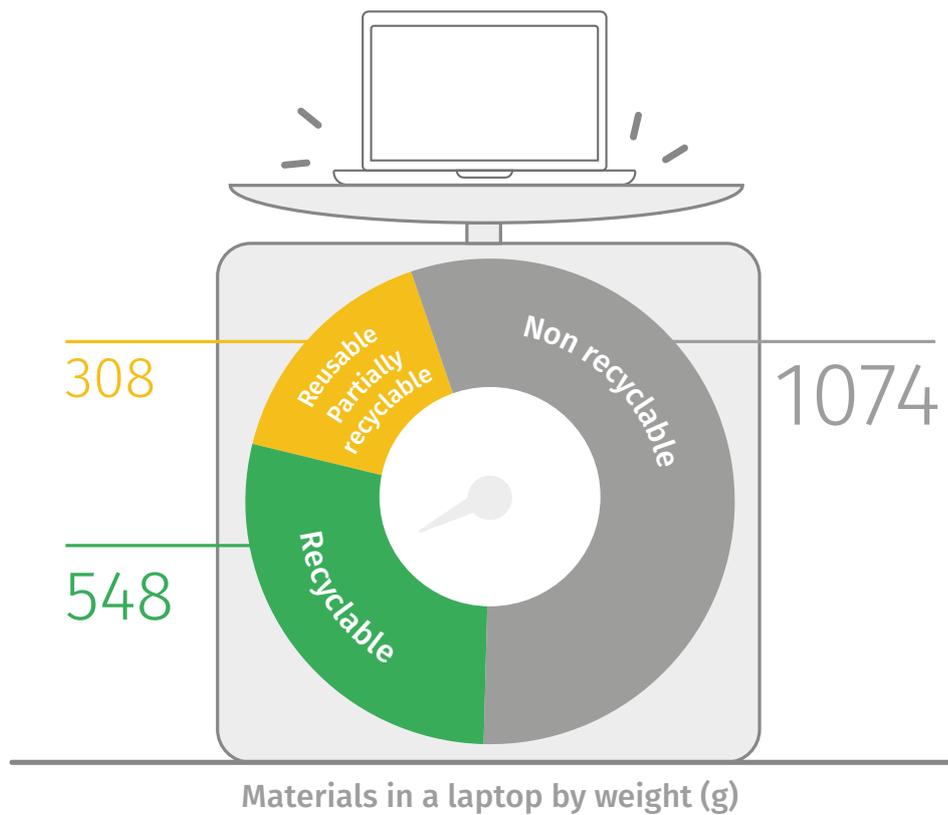


Figure 2 Typical materials comprising a laptop and their potential for reuse or recycling¹³

Reasons for laptops retiring early

There are multiple explanations for why laptops reach their end-of-life prematurely. These include dwindling battery life, reduced ability to cope with the latest technology, the inability to upgrade for improved performance levels, as well as difficulty in repairing the device in the case of component failure.

The main obstacles to a prolonged lifespan of computers are outlined below, followed by recommendations on how to best address them. We strongly believe that all the causes of early retirement of laptops identified below should be tackled at the same time, in order to address the problem in the most comprehensive way possible.



Deficient robustness

Laptops are intricate electronic products that are subject to strenuous use due to their portable nature. One third of all laptops fail within 3 years. Of these failures, around two thirds are due to hardware malfunction, and one third are due to accidental damage¹⁴ – commonly caused

by dropping the device or its falling off a desk, as well as due to tripping over cables or liquid spills.¹⁵ Some laptop models have significant weaknesses in their ability to withstand shock and contact with water. Better design can reduce the likelihood of these kinds of failures while still ensuring the repairability of the product (i.e. without the need to resort to the use of adhesives to glue different elements together).



Lack of repair & upgrade possibilities

A component can be considered to have “failed” when it no longer meets the performance requirements of the user. In this context, battery performance and the ability to replace batteries are key limitations for laptops. It was found that 68% of laptop users felt their laptop battery lifetime was insufficient, and battery failures were found to have caused business problems for more than half of all users.¹⁶ In addition to insufficient battery performance, other common component failures which lead to premature replacement of laptops include issues related to computer screens, keyboards, hard disk drives and chargers.

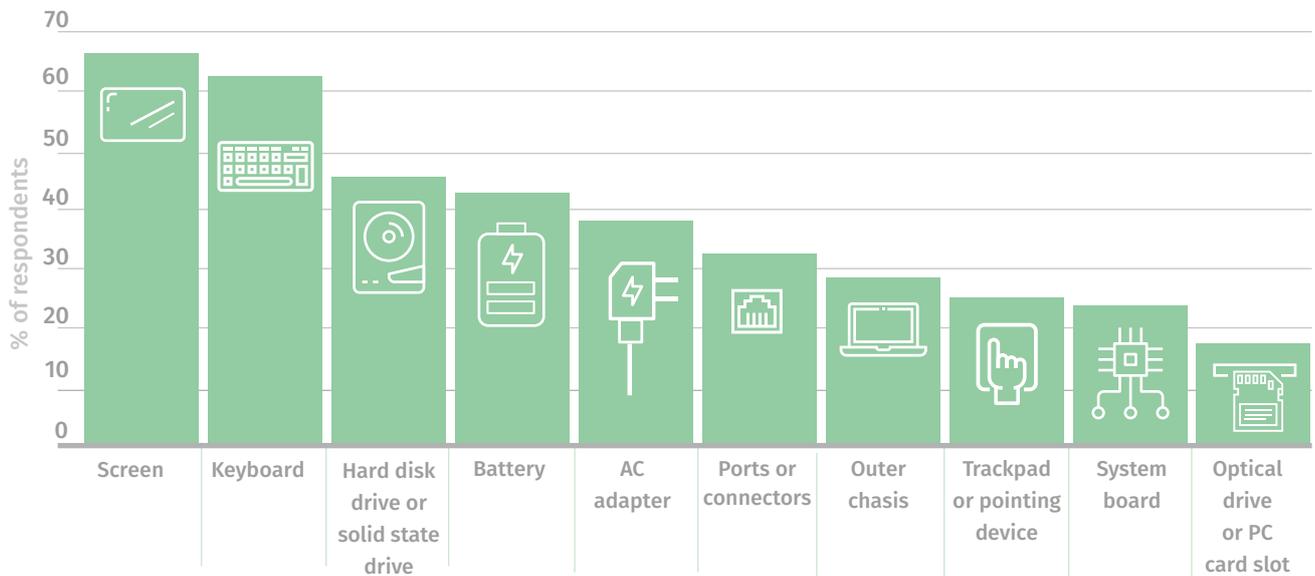


Figure 3 Typical laptop component failures¹⁷

The potential to upgrade components for higher energy efficiency or performance, to repair faulty parts, and to replace data-sensitive components in high security environments is vital to laptop longevity. Upgradeability is found to be a relevant consideration in around half of computer purchases,¹⁸ and about a quarter of new laptop sales are motivated by the belief that the old laptop did not have enough functions.¹⁹ However, a number of commercial manufacturer warranties become void if users break seals to upgrade their hard drive or random-access memory (RAM), increasing the likelihood that laptops will not be upgraded but replaced with a new machine instead.²⁰

At the same time, the potential for repair is often dictated by the labour costs involved, which are lower the more modular the design (when parts are made to be easily removed and replaced). While innovative designs can be both lightweight and modular to facilitate repair, lightweight solutions are often more easily and affordably achieved with integrated designs. Manufacturers resorting to such solutions frequently claim they are more durable and thereby minimise the need for repair.²¹ However, the actual lifetime of these - often unrepairable - devices is dictated by the quality of their materials and the lifetime of their components. If the screen, battery or keyboard breaks, repair can be so difficult and expensive that the device is prematurely discarded.

Meanwhile, consumers are keen to extend the life of their laptops. As demonstrated by the data collected during the community repair events by The Restart Project, they are the most common devices in need of fixing.²² Of all laptops brought to these events, 40% are at least six years old, which clearly shows that users would like to keep laptops in use for longer than five years.²³ Preliminary research of community repair data indicates that the top three types of faults in laptops relate to performance (when a laptop becomes very slow, normally due to software issues), power storage and integrated screens. While repair volunteers have an excellent track record with performance-related issues, the majority of battery and screen-related repairs are much more difficult to execute without easy access to spare parts and modular designs.²⁴

The degree of modularity, which impacts the possibility to upgrade and repair the device when needed, can vary greatly between models and manufacturers (see Figure 4). For example, according to iFixit, a company providing free repair guides online, there are a number of repair-friendly laptop designs that allow for a battery to be replaced within as little as 2 minutes.²⁵ In contrast, in order to replace the battery on one of the newer models of MacBook Pro, a procedure of 66 steps is necessary, taking a total of around 3 hours.²⁶

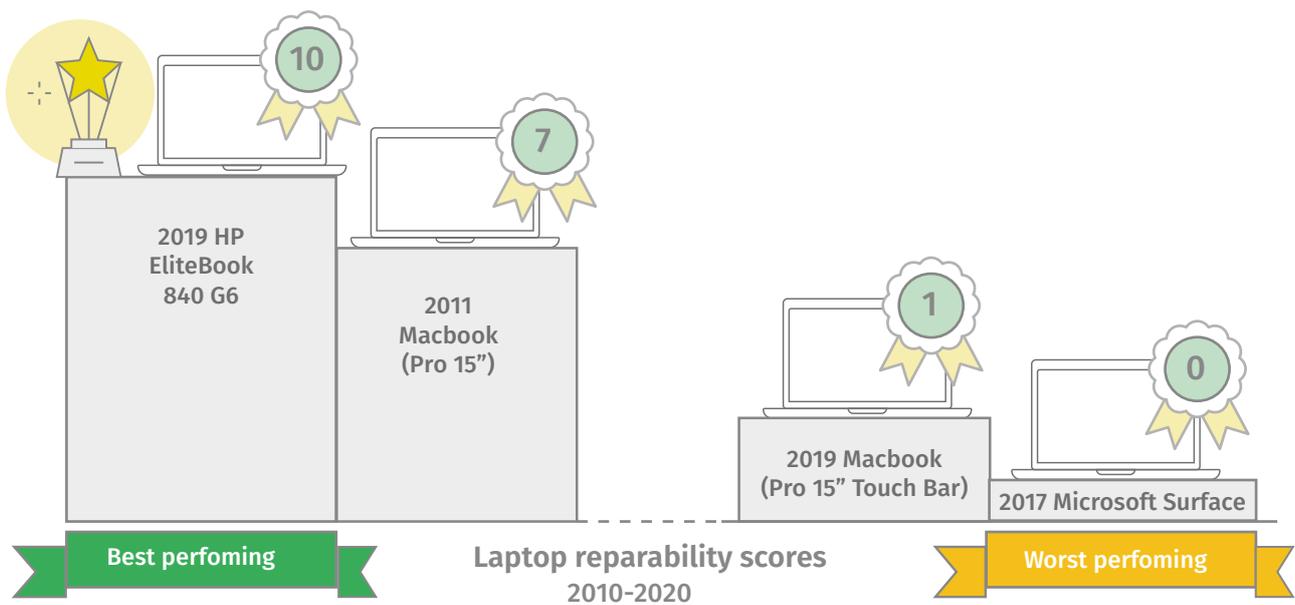


Figure 4 Variations in laptop design approach, illustrated by iFixit repair scorings²⁷

There is no end to issues here: a variety of additional economic factors can present barriers to repair, reuse, refurbishment and upgrade. Spare parts are often expensive or unavailable, repair instructions are difficult to access, labour time necessary for repair results in prohibitive costs, or the time period necessary for a repair (or for a spare part to be delivered) is too long for the user. The repair support service offered by manufacturers is key to ensure laptop longevity. A recent study of portable electronic devices revealed that out of 17 brands, only three provided the necessary spare parts and repair manuals for typical repair operations.²⁸

Firmware is similar to software, but is co-developed with the device itself and, in contrast to software, cannot be obtained from any alternative provider.²⁹ The manufacturer is responsible for providing firmware (BIOS³⁰) updates such as bug and security fixes to ensure that their product functions as sold. Firmware enhancements can also facilitate the installation of upgraded components, which makes firmware and operating system updates key to ensuring that laptops can be used longer. Without them, software and hardware incompatibilities may occur, once more leading to premature replacement of laptops.



Software & firmware constraints

Software is continually evolving. The latest operating systems and new programmes often put a heavy strain on the computational performance of older laptops. This slows down devices over time until eventually they are unable to operate effectively. Further issues can be caused by “bloatware” – often unnecessary software that takes up excessive space – as well as redundant programmes, malicious or obsolete software and viruses.



Lack of possibilities to refurbish & reuse

In the past, the growth of the refurbished laptop market was limited by consumer awareness and confidence.³¹ However, it is now finally on the rise, driven by the increasing demand for affordable computers, as well as by the ever more attractive post-refurbishment warranties. In addition, remanufactured models can retain substantial value for a number of premium brands. For example, remanufactured MacBook computers are sometimes sold for 70 to 90%

of their initial price.³² This presents the opportunity not only for specialised refurbishing companies, but also for computer manufacturers, who can push used goods back into the supply chain.³³

In addition to design for modularity, the absence of an easy way to erase and reset data is an important reason for which laptops are frequently denied a second life. In terms of data sanitisation, simply deleting data from a hard drive and formatting it does not prevent later recovery – it just makes the data invisible. An extra step using additional software tools is usually necessary to have the data fully wiped out. Out of concern for their privacy, many laptop users choose to store old laptops instead of allowing reuse. Considering that, in the UK²⁶, for every phone in use up to four discarded ones sit in drawers, and that 68% of Americans have held onto an old laptop for two years or more without using it³⁴, it is highly likely that for every laptop in use there is at least one forgotten, discarded computer somewhere.

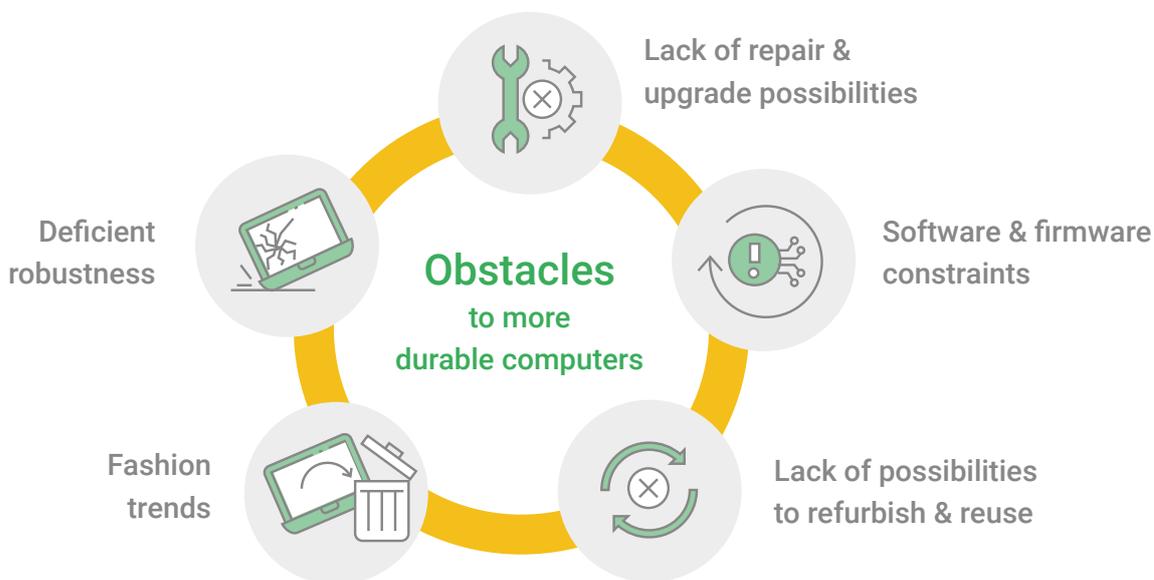
Furthermore, obstacles to computer remanufacture include the users' ability to reset devices. If a user discards their device without implementing a factory reset, some device enrolment systems (such as Apple's iCloud) either do not allow a reset by a third party, or do not allow BIOS passwords to be changed without a high cost being charged by the manufacturer.³⁵ Meanwhile, in the case of

other devices, BIOS settings are so restrictive that they prevent the installation of non-original parts or updated operating systems.⁷



Fashion trends

Consumers are often encouraged to replace their device with the newest model due to the availability of desirable new functionalities, which cannot be obtained via adjustments to their existing device.³⁶ Moreover, a large proportion of consumers upgrade their devices for reasons of style, as fashion trends have been built around the social currency of a new device (e.g. new shape or finish) rather than valuing the evolving style that can be achieved by modular adjustment (e.g. new casings). 45% of German consumers claim to have replaced their devices simply because “there is a new model on the market”³⁷, while 16% of UK consumers claim to prioritise stylish design in their purchasing decisions.³⁸ Outdated aesthetics can thus present a barrier to the reuse and remanufacturing of older products – a fifth of respondents in Europe are deterred from purchasing second-hand products because they usually look less appealing.³⁹



Setting sights on new horizons for laptops

The current design of laptops and the infrastructure around their manufacturing can be greatly improved to ensure the longevity of the devices, benefit the environment and better reflect user needs and expectations. A number of readily available solutions are set out below.

Longevity obstacle	Solution
<p data-bbox="153 1227 478 1265">Deficient robustness</p> 	<p data-bbox="584 1211 829 1265">✓ Rugged designs</p> <p data-bbox="584 1283 1401 1473">A number of manufacturers sell “rugged” laptops that are able to withstand drops, extreme temperatures, vibrations and contact with water, sand or dust. Although currently these models target niche audiences, such as outdoor, scientific research or military environments, the market for these models is expected to grow over the next five years.⁴⁰</p> <p data-bbox="584 1507 1417 1854">It is often claimed that in order to achieve a rugged design, parts need to be integrated and fixings sealed with glues. However, modularity and robustness are not mutually exclusive. Durable designs that are also easy to repair and sufficiently slim and lightweight to meet user needs are achievable if designers are motivated to rise to the challenge. More affordable models have already begun to offer rubberised bodies, spill resistant keyboards, and strengthened displays within the slimmer form of a conventional laptop.⁴¹ Others offer resistance to dust, water and high temperatures, while at the same time being easy to disassemble with simple tools.⁴²</p> <p data-bbox="584 1888 1396 2033">If companies are willing to go the extra mile, they can arrive at a better product that provides improved user satisfaction and builds greater brand loyalty. 95% of iFixit users stated that a successful repair makes them more likely to buy another product from the same manufacturer.⁴³</p>

Longevity obstacle

Lack of repair & upgrade possibilities



Solution

✓ Modularity of key parts

Key parts⁴⁴ should be designed to be easily and individually removed with basic tools. The ability to replace the battery in particular is critical to ensure laptop longevity, yet in many cases this remains a very difficult operation. Integrated lithium-ion batteries present the biggest problem in this context, as they contain large quantities of critical materials and have substantial manufacturing impacts.⁴⁵

If key parts are not designed in a modular way, upgrades and repairs can become unfeasible. For example, the 2019 Macbook Pro has zero modular components: the processor, RAM and flash memory are soldered to the logic board, and the top case assembly (including keyboard, battery, speakers, and touch bar) is glued together.⁴⁶

✓ Maximum time for disassembly

In order to make repair and parts harvesting easier, a maximum time for disassembly for priority parts should be specified by law. While consistency of measurement results is challenging due to variability in the skills of the person carrying out the disassembly, proxy approaches exist for calculating the disassembly time of a part based upon the number and type of fasteners involved.

✓ Repair information

Design for repair is not enough – supporting information is essential to ensure a successful repair. According to a recent study, the cause of one out of three failed repair attempts was the lack of repair information.⁴⁷

While some manufacturers such as Dell and HP provide open access to repair guides for a number of years, the majority restrict access to repair information and spare parts, citing intellectual property rights and competitiveness issues as the reason. However, in practice, the argument is greatly overstated, as competitors could easily physically reverse-engineer products and obtain more information than could be learned from a repair guide. Repair instructions should therefore be made publicly available, and include an exploded diagram locating the parts and explaining how they can be changed.

Longevity obstacle

Lack of repair & upgrade possibilities



Solution

✓ Capping the cost of spare parts

Requirements could be placed on the support services offered by manufacturers so that they are obliged to make key spare parts available at a fair price, which could be specified as less than a certain percentage of the original sales price.

✓ Capping the time for spare part delivery and warranty repair

Depriving a user of access to their laptop for extended periods of time can make them give up the idea of repair altogether, particularly in business environments. To avoid such delays, a maximum delivery time of one week for spare parts should be introduced. In addition, the maximum period of time for repair under warranty should be specified too.

✓ User information on repair and durability

In a recent survey, 45% of consumers rated information on product lifetimes as important. However, in the absence of clear information on this issue, the majority of interviewees would choose the cheapest model.⁴⁸

Providing consumers with point-of-sale information on the durability and reparability of laptops, as well as the length of additional free warranty periods, can empower them to make informed purchasing decisions and motivate manufacturers to compete on this basis. This could take the form of a simple repair rating, which aggregates factors such as the fasteners used, tools, working environment and skills necessary to access and replace key parts, and the availability of spare parts. This approach could then be replicated outside of Europe, covering other markets considering the international nature of the industry. Other labels beyond the EU energy label should therefore incorporate, as mandatory requirements, durability and reparability considerations, and thereby play a role in stimulating public demand for most long lasting devices.

On the other hand, whenever repair of any of the key parts is not possible, manufacturers should be obliged to declare this.

Longevity obstacle

Lack of repair & upgrade possibilities



Software & firmware constraints



Solution

✓ Battery optimisation

Laptop batteries deserve particular attention. Some models available on the market last as little as 300 charge cycles, which is equivalent to about one year of intense use.⁴⁹

In order to ensure minimum acceptable durability, at the very least they should be required to function at 80% capacity after 300 charging cycles, and design should be adapted to ensure their easy replacement at the end of life. In addition, pre-installed battery optimisation software could extend the battery lifetime by up to 50%²⁸, allowing the user to manually schedule charging cycles and limit the state of charge of the battery to a defined value when connected to the grid, or automatically configuring such functionality based on usage patterns.

✓ Guaranteed update availability

Free security updates and bug fixes should be guaranteed for software and firmware for as long as possible, and for the duration of the expected product lifetime as a minimum. This would allow devices to remain operational, facilitate the upgrade of components and avoid premature replacement.

✓ Lightweight software and firmware options

The slower operation of old devices often leads to a new purchase. To avoid this, lightweight versions of software and firmware should be made available to adapt to lower specification devices whilst optimising performance. For example, some non-core features, such as visual transitions and gesture controls, might not be made available in a lightweight version of a given software or firmware. While such solutions are rarely an investment priority for manufacturers, as they require extra development effort, there are already some independent lightweight operating system solutions that have minimal hardware requirements, such as Ubuntu.⁵⁰

✓ Pre-installation user information

Software and firmware providers should be obliged to inform users on how the installation of new software (especially operating system updates) will impact their devices. This way, users can make an informed choice between the latest version and the version that will provide the most satisfactory experience for their device specification. Users should have the option not to install new software or operating systems that will undermine the performance of their device.

Longevity obstacle

Software & firmware constraints



Lack of possibilities to refurbish & reuse



Solution

✓ Software installation and usage clinics

Manufacturers could offer a service to help users tailor their software and firmware installations and settings to ensure best performance. In addition, they could also teach users how to best operate their devices. This could be done by means of a visit to a service centre, but to reach the widest audience it could also be supported by written information or a dedicated application.

✓ Diagnosis and factory reset tools

To reduce the cost of checking the status of second-hand laptops and increase confidence in the quality of second-hand devices, a software tool could be made available to automatically evaluate the used laptop for aspects such as memory errors, battery cycle status or water damage. In addition, devices should be equipped with inbuilt and easily accessible diagnostic and reset interfaces for diagnostic support, failure detection, software and firmware updates, resetting of failure modes and resetting of factory settings in order to facilitate the process of preparing for reuse.

✓ Data deletion tools

Inbuilt data deletion tools could ensure that users have confidence that all sensitive data will be permanently removed from their device at the end of the first (or subsequent) use. This would help laptops quickly enter the re-use stream, optimise the environmental benefits of second use and ensure that the best value is obtained for the device.

✓ Apps to facilitate second-hand markets

Users could be provided with information on the potential value of the device they wish to sell on different platforms and, on the other hand, with streamlined delivery options.

Longevity obstacle

Lack of possibilities to refurbish & reuse



Solution

✓ Easier parts harvesting

Modular designs are important not only to facilitate repair and refurbishing of whole laptops, but also to enable the harvesting of parts for reuse in instances where repair is not possible. Parts using slow-evolving technologies, such as mid-range cameras and power supplies, USB connectors, power connectors and wifi or Bluetooth modules, are best suited for this purpose²⁶. Such harvesting can be facilitated by quality standards for reused and remanufactured parts, and infrastructure to enable easy sales and purchase of reused parts.

✓ Interoperability of chargers

Waste and costs due to divergent chargers could be reduced by standardised designs that enable power supplies to be used with different laptops, and by shipping devices without the charger. Introducing a common charger and thus avoiding new chargers upon each new purchase, would prevent some 12 000 tonnes of electronic waste by 2025.⁵¹

Fashion trends



✓ Swappable aesthetics

Even when functionality is not impacted, aesthetic damage to laptop casings can also drive early product replacement.⁵² Modular designs could enable the outer casing of laptops to be changed, providing a low-cost and low-impact update to existing devices. Such options could boost the appeal of refurbished devices, as well as create the opportunity for additional functions to be added to the design, such as waterproofing.

✓ Revised extended producer responsibility requirements

While EU laws establish “extended producer responsibility” for waste electronics products, enforcement at the national level has born varying results. A revision of these requirements to include fee variations based on the reparability and durability of the product in question would go a long way in making genuine extended producer responsibility a reality, especially if combined with a robust enforcement approach.

Longevity obstacle

Fashion trends



Solution

✓ Product as service models

The current business model that most laptop manufacturers follow is inherently unsustainable. The main indicator for growth is the number of products sold. If they perform inadequately or break once outside the warranty period, the user usually opts for a new purchase. Early replacements are also encouraged through the launch of new products with updated aesthetics and technology.

If laptops were subjected to repairability and durability requirements, and provided on a service rather than product basis, the relative impacts of laptop manufacture could be significantly reduced, making the “fashion” of device renewal more sustainable. For example, a consumer could pay for a service package of network connectivity and laptop functions (including software packages, storage capacity, software load times and battery duration). Tiers of service could enable laptops that are no longer desirable on a premium contract to be reused on a more basic contract. This alternative business model could provide steady income streams and open untapped markets for customers who would not otherwise be able to afford new products. Green Public Procurement (GPP) offers a key opportunity to pilot the use of this type of alternative business solution.

✓ Tax breaks for repair and alternative business models

In addition to durability and repairability requirements, tax reductions, exemptions or other fiscal incentives should be offered at the national level for both repair activities and product-as-a-service approaches, in order to stimulate the uptake of novel business models.⁵³

Using existing policy tools can make change happen

A range of policy mechanisms is already available that can be leveraged in order to overcome the longevity obstacles and implement some of the solutions outlined above. These include not only the Ecodesign Directive and the Energy Labelling Regulation, which are the focus of this paper, but also dedicated directives on guarantees, extended producer

responsibility, defective goods and consumer rights, as well as standards and regulations concerning electronic waste, public procurement and battery treatment.

Proposed policy solutions focusing in particular on ecodesign and energy labelling are listed below:

Longevity obstacle



Deficient robustness

Potential legislative requirements

✓ Rugged ecodesign requirements

A minimum requirement under the Ecodesign Directive should specify that manufacturers comply with existing laptop durability standards. These include not only standards related to shock resistance, but also to vibration, drop tests, temperature stress, screen resilience, water spill ingress, keyboard lifespan and screen hinge lifespan.

Impact

Reduction in the accidental failure of 11% of laptops that fail in the first three years of use.⁵⁴

Longevity obstacle



Lack of repair & upgrade possibilities

Potential legislative requirements

✓ Requirements on replaceability of parts

The ecodesign regulation for computers should introduce a requirement for easy removal and exchange of the following priority parts without damage, using basic repair tools (as defined in standard EN 45554):

- batteries
- external power supplies
- LCD/OLED panels
- data storage
- memory
- keyboard and track pads
- printed circuit boards
- fan assemblies
- catches and hinges
- cameras*
- USB connectors, power connectors*
- Wifi/bluetooth modules*

**parts of relevance for parts harvesting, rather than spare parts provision*

The regulation should also specify a requirement for a maximum proxy-based time for disassembly for the above-mentioned parts.

✓ Requirement on availability of spare parts

The ecodesign regulation should include a requirement that all priority parts be available as spare parts to independent operators and consumers for at least ten years after placing the last unit of the model on the market.

Impact

Extension of laptop lifetimes in the 31% of laptops that fail during the first three years.

Improved repair and upgrade achieved due to:

- **Reduced repair time/cost:** Considerable reduction in repair times (e.g. from 3 hours to 2 minutes for battery replacement) and corresponding reduction in the cost of repair.
- **Reduced spare part cost:** Reduction in the cost and increased likelihood of repair thanks to lower prices of spare parts.
- **Improved information:** Additional 33% of successful repairs that would otherwise have failed due to the lack of information.

Extension of laptop lifetimes due to improved batteries and usage regime in terms of:

- **Extension of battery lifetime:** by up to 50%.
- **Improved performance:** Significant reduction in laptop users dissatisfied with their laptop battery lifetime.

Potential legislative requirements	Impact
<p> Requirement on delivery time for spare parts</p> <p>A maximum delivery time of one week for spare parts should be introduced, bearing in mind that the “Product 10Y Repairable” label used by the SEB Group⁵⁵ guarantees shipment of spare parts in 24 to 48 hours.</p>	<p>Extension of laptop lifetimes in the 31% of laptops that fail during the first three years.</p> <p>Improved repair and upgrade achieved due to:</p>
<p> Requirement on a maximum price for spare parts</p> <p>The ecodesign regulation should require that manufacturers make priority parts available as spare parts at a fair price, specified as less than a certain percentage of the original product sales price.</p>	<ul style="list-style-type: none"> • Reduced repair time/cost: Considerable reduction in repair times (e.g. from 3 hours to 2 minutes for battery replacement) and corresponding reduction in the cost of repair.
<p> Requirement on acceptance of non-original equipment manufacturer (OEM) spare parts</p> <p>The ecodesign regulation should require that laptops must be designed to accept non-OEM spare parts to remove this potential barrier to repair.</p>	<ul style="list-style-type: none"> • Reduced spare part cost: Reduction in the cost and increased likelihood of repair thanks to lower prices of spare parts.
<p> Requirements on repair information</p> <p>Current ecodesign regulations that address the availability of repair information for other products specify the audience as professional repairers covered by valid liability insurance. This creates an additional administrative and financial burden for repairers and market surveillance authorities, and prevents non-profit repair initiatives such as repair cafés from accessing the repair information essential for their operation. To maximise the ability to repair, new ecodesign regulations should include requirements on unrestricted access to repair information, such as an exploded diagram locating the priority parts and the sequence describing how they are to be changed. This could be achieved by specifying that the information must be provided to “independent operators” as defined in Regulation 715/2007 on vehicle repair.⁵⁶</p>	<ul style="list-style-type: none"> • Improved information: Additional 33% of successful repairs that would otherwise have failed due to the lack of information. <p>Extension of laptop lifetimes due to improved batteries and usage regime in terms of:</p> <ul style="list-style-type: none"> • Extension of battery lifetime: by up to 50%. • Improved performance: Significant reduction in laptop users dissatisfied with their laptop battery lifetime.

Potential legislative requirements

Impact

✓ **Repairability score on the EU energy label**

A repair rating should be introduced on the EU energy label which would display an aggregated repair score for the product in question. This would account for considerations such as disassembly depth or time, as well as the tools necessary to perform the repair. Moreover, consumers should be provided with information on the additional free warranty periods, either by displaying this directly on the label or by incorporating this as a factor in the aggregated repair score.

Extension of laptop lifetimes in the 31% of laptops that fail during the first three years.

Improved repair and upgrade achieved due to:

- **Reduced repair time/cost:**

Considerable reduction in repair times (e.g. from 3 hours to 2 minutes for battery replacement) and corresponding reduction in the cost of repair.

- **Reduced spare part cost:**

Reduction in the cost and increased likelihood of repair thanks to lower prices of spare parts.

- **Improved information:**

Additional 33% of successful repairs that would otherwise have failed due to the lack of information.

✓ **Minimum battery durability & replaceability requirement**

The ecodesign regulation for computers should include a minimum requirement stating that after 300 charging cycles batteries are to perform at 80% of initial capacity in order for the device to be placed on the EU market, as well as for them to be easily replaceable without the need for specific tools.

Extension of laptop lifetimes due to improved batteries and usage regime in terms of:

- **Extension of battery lifetime:** by up to 50%.

- **Improved performance:**

Significant reduction in laptop users dissatisfied with their laptop battery lifetime.

✓ **Battery optimisation requirement**

The ecodesign regulation should require that all laptops have a battery charge optimisation function enabled by default, which either optimises the battery charging regime automatically depending upon learned usage profiles, or allows the user to manually schedule charging cycles and limit the state of charge to a defined value when the device is plugged in.

Potential legislative requirements

✓ Battery durability labelling

The EU energy label should include ratings for battery life based on the number of cycles at which 80% of initial capacity is still achieved.⁵⁷ This needs more detailed data analysis, but could be along the lines of the following:

at 1000 charging cycles = A⁵⁸

at 850 charging cycles = B

at 750 charging cycles = C

at 600 charging cycles = D

at 500 charging cycles = E

at 400 charging cycles = F

at 300 charging cycles = G (minimum requirement)

Consumers should also be provided with information on the number of cycles at which the battery is considered to have failed, which would require the definition of a capacity threshold for a failed battery.

Impact

Extension of laptop lifetimes in the 31% of laptops that fail during the first three years.

Improved repair and upgrade achieved due to:

- **Reduced repair time/cost:** Considerable reduction in repair times (e.g. from 3 hours to 2 minutes for battery replacement) and corresponding reduction in the cost of repair.
- **Reduced spare part cost:** Reduction in the cost and increased likelihood of repair thanks to lower prices of spare parts.
- **Improved information:** Additional 33% of successful repairs that would otherwise have failed due to the lack of information.

Extension of laptop lifetimes due to improved batteries and usage regime in terms of:

- **Extension of battery lifetime:** by up to 50%.
- **Improved performance:** Significant reduction in laptop users dissatisfied with their laptop battery lifetime.

Longevity obstacle



Software & firmware constraints

Potential legislative requirements

✓ Update availability requirement

Ecodesign requirements should be introduced for software and firmware updates to be made available for free for a minimum of ten years after placing the last unit of the model on the market.

✓ Software durability rating

The EU energy label should incorporate an icon to indicate whenever software support is offered for longer than 10 years after purchase.

✓ Pre-installation user guidance requirement

As part of ecodesign requirements, manufacturers should be obliged to provide user information on how software and firmware updates impact performance, and to provide users with the option not to install updates that may have a detrimental effect on performance. Alternatively, tailored versions of the updates to optimise performance for the particular laptop model should be offered.

✓ Requirement for user information and tools for optimised user configuration

The ecodesign regulation should require that users are provided with up-to-date information on the best:

- version of the operating system,
- system settings,
- storage regime for their device.

This could be in the form of written information, an app or a free service provided at the service centre.

Impact

The 20% of users who would otherwise have replaced their device due to software obsolescence use their computers for longer.

Ensuring that laptop performance is optimised can contribute to a further extension of laptop lifetime.

Longevity obstacle



Lack of possibilities to refurbish & reuse

Potential legislative requirements

✓ Requirement on provision of diagnosis tools

The ecodesign regulation should require that easily accessible diagnosis tools are provided with laptops to enable automatic evaluation of hardware status in terms of memory errors, battery cycle status, water damage and impact shocks.

✓ Requirement on provision of data deletion tools

The ecodesign regulation should require that easily accessible data deletion tools⁵⁹ are provided as standard with laptops to enable greater confidence in data sanitisation and increase user willingness to pass laptops onto the second-hand market. This requirement would be fully in line with existing policies on data protection such as the General Data Protection Regulation (EU) 2016/679 and its Article 25 on “data protection by design and by default”.

✓ Requirement on a common external power supply

The ecodesign regulation for computers should specify that for chargers rated 100W or less, the external power supply connector should be USB-C type and that any power supplies shipped with the product should comply with at least the USB 3.1 standard (with backward interoperability) to ensure the potential for reuse.

Impact

Secure data deletion could double the volume of laptops reused after the first useful lifetime.

Increased growth in the refurbished laptop market due to a considerable reduction in the 68% of products stored for two years without use.

Savings of 12,000 tonnes of electronic waste by 2025 through the introduction of a common charger for laptops.⁶⁰

Longevity obstacle



Fashion trends

Potential legislative requirements

✓ Casing upgradeability rating

A score for casing upgradeability should be incorporated into an durability or repair rating as part of the EU energy label.

Impact

Contribution to the doubling of laptop lifetime.

The minimum requirements on material efficiency, energy label ratings on repair and durability and other measures outlined in this paper would undoubtedly lead to significant improvements in the longevity of laptops. In fact, if the rate of accidental failures, software obsolescence and repair obstacles were reduced, battery lifetime extended and refurbishment made more viable, laptop lifetime would be expected to double. Assuming a best-case scenario where new products have a similar energy consumption to older products, doubling laptop lifetime would lead to a substantial reduction in greenhouse gas impacts despite the continued increase in laptop users:

Facilitating repair would, moreover, not only benefit consumers and the planet, but also the first-in-class manufacturers. In addition to reducing business risks (market, regulatory and cost-related), it would have positive impacts on brand loyalty and would create new jobs locally through increased repair and refurbishing activities.⁶²

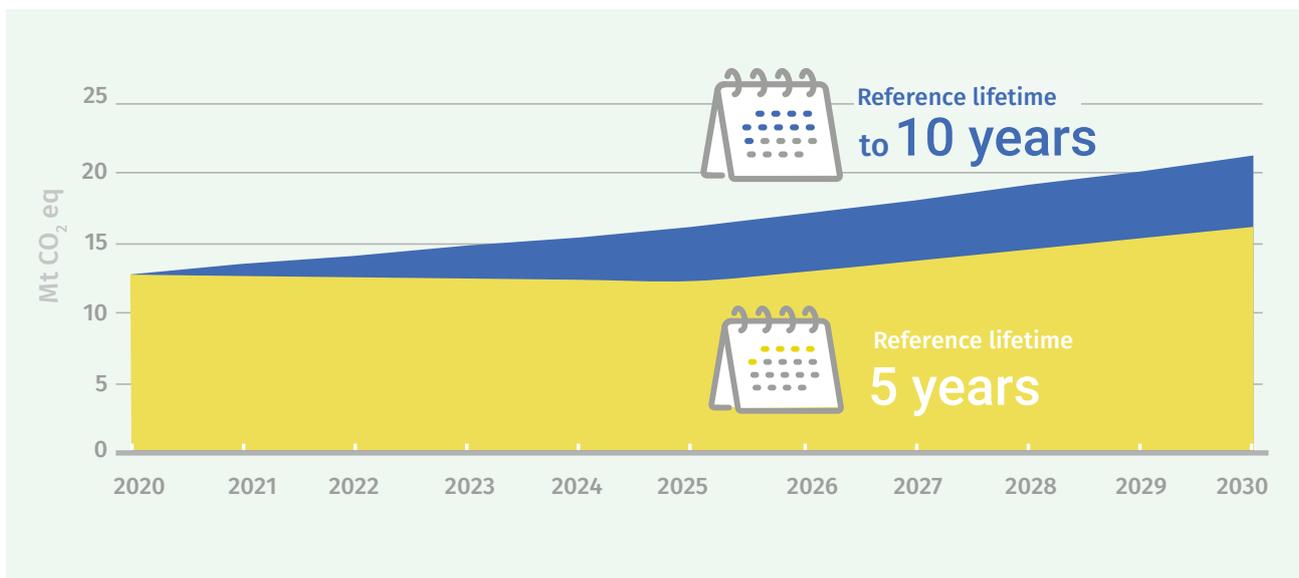


Figure 5 Total estimated laptop GHG impacts in the EU⁶¹

Notes and References

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- 3** European Commission (2019), The new ecodesign measures explained, Press Release, 1 October 2019, https://ec.europa.eu/commission/presscorner/detail/en/QANDA_19_5889
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- 5** Wieser, H., Tröger, N. (2016), The use time and obsolescence of durable goods in the age of acceleration. An empirical investigation among Austrian households. AK Wien, referenced in JRC technical report (2018)
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- 20** Byrne, M., (2015), Laptop and Tablet Warranties: What They Cover, <https://www.laptopmag.com/articles/warranty-guide>
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- 23** Based on data collected at events part of Restart's network, for more info: <https://therestartproject.org/fixometer/>
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- 27** Data source: iFixit tests, <https://www.ifixit.com/laptop-repairability>
- 28** Dell, HP, Fairphone Top Greenpeace Ranking on Product Repairability, Sustainable Brands (2017) <https://sustainablebrands.com/read/product-service-design-innovation/dell-hp-fairphone-top-greenpeace-ranking-on-product-repairability>
- 29** Firmware consists of micro-instructions installed on read-only memory at a part/hardware level. It makes it possible for the hardware to function, determines its compatibility and interoperability, and is essentially a type of semi-permanent software. Operating systems could be considered both software and firmware, depending on how a laptop is manufactured
- 30** BIOS, the Basic Input/Output System, is the most basic firmware of the computer, which is embedded in a chip on the computer's motherboard. It recognises and controls various devices that make up the computer. Reset is often necessary at the BIOS level for reuse
- 31** Some 39% of respondents were found to express a lack of confidence in the quality of remanufactured products in a dedicated survey, see SquareTrade Research (2009), https://www.squaretrade.com/html/pdf/SquareTrade_laptop_reliability_1109.pdf
- 32** Business model case study Leapp, <https://www.remanufacturing.eu/studies/3f16822be130d2d33ddb.pdf>
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- 41** For example, 2019 models: HP ProBook x360 11 G1 EE Notebook PC and Lenovo ThinkPad 11e
- 42** For example, the Dell 7404 (<https://rugged.tech/product/dell-latitude-14-rugged-extreme-7404-i7/>) Which is water and dust proof, drop tested to 90cm and to extreme temperatures, but also modular (it has 8 peripheral circuit boards apart from motherboard) and easy to fully disassemble with simple tools (see <https://www.youtube.com/watch?v=BLzAO3Ndd5s> - the battery and hard drive can even be removed without tools) with full disassembly instructions supplied in the user’s manual (https://topics-cdn.dell.com/pdf/latitude-7404-laptop_owners-manual_en-us.pdf).
- 43** Brook Lyndhurst Ltd (2011), Public understanding of product lifetimes and durability, Department for Environment, Food and Rural Affairs, p 51, http://randd.defra.gov.uk/Document.aspx?Document=Publicunderstandingproductlifetimes1_Finalpublishedreport.pdf
- 44** This includes batteries, external power supplies, screen and backlight assemblies, data storage (HDD, SSD or eMMC), memory, keyboards, track pads, printed circuit boards, cooling fan assemblies, catches and hinges
- 45** Marwede M., Clemm C., Dimitrova G., Tecchio P., Ardente F., Mathieux F. (2017); Analysis of material efficiency aspects of personal computers product group - Technical support for Environmental Footprinting, material efficiency in product policy and the European Platform on LCA; EUR 28394 EN; doi 10.2788/89220
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55 See <http://www.groupeseb.co.uk/repairable.html>

56 Regulation (EC) No. 715/2007 on availability of vehicle repair and maintenance information defines “‘independent operator’ as an undertaking other than authorised retailer and repairer which is directly or indirectly involved in the repair and maintenance of vehicles

57 Testing standards could be PCMark (home and consumer) and/or MobileMark (business and enterprise)

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59 These tools should comply with existing standards on data cleansing (e.g. HMG IS Standard No 5 (in the UK), DIN 66399 (Germany), NIST 800-88r1 (US)

60 Own calculations

61 Based on the analysis supporting Zuloaga, F., Schweitzer, J.P., Anastasio, M., Arditi, S. (2019), Coolproducts don’t cost the earth, Full Report, EEB: <https://www.coolproducts.eu/policy/revealed-the-climate-cost-of-disposable-smartphones>

62 This, however, depends on the freedom of choice that the user has for their repair actor. Many repairs carried out by original manufacturers involve worldwide shipping of devices rather than local repair, which has greater environmental impacts and results in less local benefits. Every year, around 118,000 tonnes of IT equipment and spare parts are shipped by

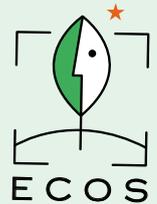
manufacturers worldwide for repair and remanufacturing. 40% of these are ‘out of warranty’ repairs that could potentially have been resolved locally, and around 6 % of the products shipped turn out to be unrepairable, see the contribution of the Digital Industry to repair, remanufacturing and refurbishment in a Circular Economy, DIGITALEUROPE (2017): <https://www.digitaleurope.org/wp/wp-content/uploads/2019/01/The%20Contribution%20of%20the%20Digital%20Industry%20in%20a%20Circular%20Economy%2020170412.pdf>

LONG LIVE THE MACHINE

How ecodesign & energy labelling can
prevent premature obsolescence of laptops



Mundo-B, rue d'Edimbourg 26,
1050 Brussels, Belgium • +32 (0)2 894 46 68
info@ecostandard.org • ecostandard.org
 @ECOS_Standard  ECOS-EU



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repair.eu  @R2REurope

