STUDY

Requested by the IMCO committee

European Parliament

Promoting product longevity

How can the EU product safety and compliance framework help promote product durability and tackle planned obsolescence, foster the production of more sustainable products, and achieve more transparent supply chains for consumers?

Policy Department for Economic, Scientific and Quality of Life Policies
Directorate-General for Internal Policies
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Abstract

Product longevity can play a useful role in achieving the Paris Agreement goals – material efficiency is an important contributor to energy efficiency and is also important in its own right. The product safety and compliance instruments available at European level can contribute to these efforts, if wisely applied.

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This document was requested by the European Parliament's Committee on Committee on the Internal Market and Consumer Protection.

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LIST OF ABBREVIATIONS

AI	Artificial Intelligence
BMU	Bunderministerium Für Umwelt, Naturschutz und nukleare Sicherheit (German Federal Ministry for the Environment, Nature Conservation and Nuclea Safety)
EEA	European Economic Area
EMC	Electro Magnetic Compatibility
ESO	European standardisation organisation
EU-27	All references to EU-27 refer to the EU as it exists in 2020 (i.e. EU-28 minus the UK)
GHG	Greenhouse Gas (e.g. CO_2)
GJ	Gigajoule (one billion joules)
HHI	Herfindahl–Hirschman Index
ICT	Information and Communications Technologies
LED	Light-Emitting Diode
NGO	Non-Governmental Organisation
OECD	Organisation for Economic Co-operation and Development
OLED	Organic Light Emitting Diode
PED	Price Elasticity of Demand
SDA	(Input-Output) Structural Decomposition Analysis
TCO	Total Cost of Ownership
UK	United Kingdom
US	United States

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EXECUTIVE SUMMARY

General considerations as regards product longevity

We tend to assume that longer product lifetimes are better, but even in terms solely of environmental goals, this is not always the case. Product-specific and sector-specific impacts across the production, usage and end of life phases need to be considered, and there are often trade-offs between these. Notably, prolonging the life of a product type that is in the middle of substantial improvement in its environmental efficiency may delay the take-up of these improved products, sometimes with negative environmental impact that can outweigh the gains from producing and disposing of smaller quantities. Even for the same product, different approaches may be needed over time in response to market evolution and technological evolution.

This implies that a one-size-fits-all horizontal approach to product lifetime is unlikely to be appropriate – different approaches are suitable to different products at different times.

Consumer welcome longer product lifetimes for some products, but in other cases are worried about high costs of acquiring or maintaining products with long lifetimes, or are worried about being locked in to obsolescent products.

There are gaps in the reliable information available to consumers about competing products when it comes to service records, product lifetimes and *Total Cost of Ownership (TCO)*. It is challenging to provide TCO data, and we know of no good existing solution.

The literature on planned obsolescence focuses on suppliers who intentionally supply products with a short lifetime in order to sell replacements to consumers. The degree to which this is actually the case is largely unknown – surprisingly little is concretely known about producer preferences in terms of product lifetime. Whether economic incentives favour short product lifetimes might depend on the degree of global competition to which the product is subject. In any case, producer preferences about product lifetime may reflect legitimate trade-offs, just as is the case with consumer preferences.

Irrespective of whether producers intentionally reduce the lifetime of their products, it is likely that at least some producers place too little emphasis on long product lifetimes.

There are suggestions in the literature that product lifetimes are becoming shorter. Hard data is available but limited and suggests that, if anything, the opposite was the case in the United States (US) in the second half of the Twentieth Century: the average lifetime of durable household goods and of automobiles got substantially longer over time, not shorter. How this has evolved over the past twenty years, however, is hard to say.

Product longevity in specific sectors

Perhaps the best way to understand issues of product longevity is to see how they have played out, or might potentially be altered, for actual products. We delved deeper into two areas: (1) the **automotive sector**, and (2) **smartphones and tablets**.

Even for a single product or sector, the environmental effects of an increase in longevity are complex. A study by Kagawa et al. (2008) showed plausibly that increasing the lifetime of passenger vehicles by a year in Japan from 1990 through 2000 would have generated substantial environmental benefits.

However, the results are specific to that country and time period. Whether an increase in vehicle longevity in the EU today would be positive or negative for the environment cannot be claimed solely on the basis of that work.

It is often claimed that Japanese vehicles gained market share in the US in the 1970s because domestic automobiles had poor repair records, wore out quickly, and were inefficient in terms of fuel consumption. Japanese cars did indeed have better fuel consumption and better repair records, but models introduced from 1977 on do not appear to have remained in service longer than domestic automobiles. Whether Japanese passenger vehicles were actually more durable than US passenger vehicles in the early 1970s is uncertain. On the other hand, the limited longevity of automobiles made in the US roughly between 1955 and 1975 was probably in large part a result of over-pricing of repair parts by US manufacturers who had substantial market power. Initial design is important, but cost and ease of repair can be equally important.

Smartphones and tablets could potentially be used for four years, but most are used for only two years. Many are replaced (1) because the battery has died, and cannot be replaced by the user; or (2) because the screen has cracked, and cannot be replaced by the user, or (3) because the manufacturer no longer is willing or able to support the software.

It is easy to say that all batteries (and screens) should be replaceable, but there are legitimate reasons to prefer non-replaceable components, some of which also indirectly benefit consumers. User-replaceable batteries are not the only way to ensure that the phone can be used for its full potential lifetime. Other solutions are possible, and are to some extent being implemented.

Suitability of the various EU product safety and compliance instruments

There is a broad constellation of measures at the level of the European Union (EU) that seek to promote product safety and other EU policy goals including environmental goals. A number of these are well suited to the promotion of increased product longevity, and there are instances where this is already being done. Measures at Member State level are also relevant. Any detailed policies will need to be highly differentiated product by product, and adaptable over time.

As far as existing instruments at EU level, other than in the Ecodesign framework, there is very little connection today between any existing EU instrument and product longevity. A number of measures could, however, be extended so as to take greater account of product longevity.

At EU level, we focus on three groups of measures:

- Product safety regulations;
- Product (and service liability) regulation;
- The Ecodesign framework and the trustmarks that support safety and environmental goals, including CE and the energy labelling framework.

Among these, the Ecodesign framework is the most promising in terms of promoting product longevity, and should be the preferred mechanism. It supports both "hard" and "soft" mechanisms. Its use in the case of light sources provides a clear proof of concept of how the current Ecodesign framework can accommodate (1) needs for **minimum product lifetimes**, (2) needs to **inform prospective customers about the expected lifetime** of a product in order to facilitate informed

choice, and (3) the **promotion of modularity** to facilitate ease of replacement by the user of defunct components. The new Circular Economy Action Plan rightly places its emphasis here.

The product safety framework, perhaps in conjunction with the CE trustmark, could be used to require and enforce product longevity in specific cases. These arrangements are however mainly suitable only for cases where a "hard" enforcement is appropriate. "Soft" approaches ensuring that consumers can make informed choices will often be preferable to "hard" approaches that outright block the sale of products that some consumers may want. We see no obvious reason to prefer these arrangements to the more flexible possibilities of the Ecodesign framework.

The EU has a good, comprehensive strict liability regime for products. It is difficult, however, to see any applicability of this framework to the promotion of longer product lifetimes.

For public policy, good process is always important. Given the complexity of this topic, and the need for product-specific and sector-specific knowledge, adherence to Better Regulation principles is especially important. We would particularly emphasise the importance of a comprehensive consultation process that obtains feedback from market players and consumer advocates. The Ecodesign framework seems to us to be workable in this regard.

Not every relevant initiative is an EU initiative. The EU would be well advised to coordinate with Member State initiatives, especially in the trustmark area (for example, Blue Angel in Germany) in order to avoid inconsistencies that might be counter-productive.

Reliable private / non-private entities could play an important complementary role, as with Stiftung Warentest in Germany or Consumers Reports in the US. This does not mean that there is no role for government – the German government played an important role in creating Stiftung Warentest, and continues to play an important role in funding it.

Industry can also play a constructive role, and will sometimes be able to deliver on these policy objectives faster or at less cost than mandatory requirements.

The new Circular Economy Action Plan is directionally appropriate. Being directionally right is positive, but it is only a first step. The ultimate success of any measures taken will ultimately depend on getting the details right as well.

1. INTRODUCTION

KEY FINDINGS

The questions taken up in this study are timely. There is political will in Europe to move forward on the Paris Agreement and on environmental issues in general. It is doubly timely today in light of the European Commission's release in March 2020 of a new Circular Economy Action Plan (European Commission, 2020a) as part of the European Green Deal.

This study takes a broad view both of the instruments available at EU level to promote product safety (together with other EU goals), and of the linkages between product longevity and energy savings.

Product longevity can play a useful role in achieving Paris Agreement goals – material efficiency is an important contributor to energy efficiency, and is also important in its own right. Promotion of the Circular Economy is in order.

Policy Department A requested a study on behalf of the European Parliament's Committee on Committee on Internal Market and Consumer Protection (IMCO) in order to reflect on the ways in which the various product safety instruments available at European level could be used to promote the environmental goals of the Paris Agreement. It is one of four interrelated research papers that have been launched in order to inform the IMCO Committee in preparation for a planned own-initiative report entitled "Towards a more sustainable single market for businesses and consumers".

In preparing this study, we have chosen to take a broad view both of the instruments available at EU level to promote product safety, and of the linkages between product longevity and energy savings.

1.1. Product longevity and the Paris Agreement

We were called on to assess the relevance of EU product safety instruments to achieve the goals of the Paris Agreement. Those goals are stated in Article 2(1) of the Paris Agreement primarily in terms of holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and of pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels.

Reduction of material waste is not evident in the Paris Agreement. Nonetheless, it is clear that reduction of material waste can play a key role in achieving Paris Agreement goals. Indeed, a study by Circle Economy and Ecorys (2016) has claimed that more than "50 % of our greenhouse gas emissions are related to material management"[1].

The same study estimates that full implementation of the Circular Economy could reduce global greenhouse gas (GHG) emissions by 7 billion tonnes of CO_2 per year. The Circular Economy is as much a way of looking at the world as a specific measure. It incorporates not only recycling, but also repair, re-use, remanufacturing, refurbishing, and more (see Figure 1).

[1] Circle Economy and Ecorys (2016), Implementing Circular Economy Globally Makes Paris Targets Achievable.

Figure 1: Stages of the Circular Economy

Circular Economy	Strategies		
Linear economy Rule of thumb: Higher level of circularity = fewer natural resources and less environmental pressure Increasing circularity	Smarter product use and manufacture	R0 Refuse	Make product redundant by abandoning its function or by offering the same function with a radically different product
		R1 Rethink	Make product use more intensive (e.g. through sharing products, or by putting multi-functional products on the market)
		R2 Reduce	Increase efficiency in product manufacture or use by consuming fewer natural resources and materials
	Extend lifespan of product and its parts	R3 Re-use	Re-use by another consumer of discarded product which is still in good condition and fulfils its original function
		R4 Repair	Repair and maintenance of defective product so it can be used with its original function
		R5 Refurbish	Restore an old product and bring it up to date
		R6 Remanufacture	Use parts of discarded product in a new product with the same function
		R7 Repurpose	Use discarded product or its parts in a new product with a different function
	Useful application of materials	R8 Recycle	Process material to obtain the same (high grade) or lower (low grade) quality
		R9 Recover	Incineration of materials with energy recovery

Source: Dutch PBL (2018) [2]

As we explain in Section 3, the implementation of Circular Economy principles to products such as automobiles could potentially result in a significant reduction in the production of GHGs.

1.2. The political context

The questions taken up in this study are timely. There is political will in Europe to move forward on the Paris Agreement. This is perhaps most visible in the strong performance of Green parties in the European Parliament's 2019 Parliamentary elections[3], but it is visible across the board.

The EU has stated repeatedly its aim to be at the forefront of global action against climate change. In this context, it has adopted policies to reduce its GHG emissions and to support the production of energy from clean and renewable sources, while being active in international climate negotiations. The

[2] José Potting and Aldert Hanemaaijer (eds.) (PBL); Roel Delahaye and Rutger Hoekstra (CBS); and Jurgen Ganzevles and Johannes Lijzen (RIVM) (2018) "Circular economy: what we want to know and can measure: Framework and baseline assessment for monitoring the progress of the circular economy in the Netherlands". Based on earlier work by the Dutch RLI (2015) "Circulaire economie. Van wens naar uitvoering".

[3] The Greens and their allies won 74 seats in the 2019 election for the European Parliament, including 22 in Germany, 12 in France and 11 in the UK (no longer a Member State). They had never previously held more than 55 seats.

"FridaysForFuture" movement has mobilised mainly young people to demand stronger climate policies.

In this context, the European Commission President Ursula von der Leyen is making good on her promise to broaden and strengthen EU climate policy. The Commission made a proposal on 4 March 2020 for a European Climate Law that would require the EU to become climate neutral by 2050 – likely making Europe the first continent to do so. To reach this ambitious goal, she put forward a proposal of a European Green Deal, i.e. a full-fledged policy framework encompassing the climate, energy, environmental, industrial, economic and social aspects of this unprecedented process. The proposal includes cutting emissions, investing in green technologies and protecting the environment.

Furthermore, the German government has signalled in many ways that it intends to make environment a key theme during its upcoming EU Presidency (in the second half of 2020).

Despite all of this positive movement, there has been a backlash against fossil-fuel price increases perceived as unfair, as seen with the "gilets jaunes" movement in France and beyond. Distributional effects are important – who is impacted, and how[4]? This implies that **European climate policies should be not only ambitious, but also thoughtfully crafted and fair.**

1.3. Product safety and compliance instruments at EU level

At EU level, the product safety and compliance framework is broader than mere product safety regulations. It could be said to consist of:

- Product safety regulations;
- Product (and service liability) regulation;
- The Ecodesign framework and the trustmarks that support both safety and environmental goals, including CE and the energy labelling framework.

As we explain in Section 4, some of these instruments are more readily applied to extending product lifetimes than others. Notably, the Ecodesign framework is very promising, and its current application to light sources and luminaires (lighting fixtures) could be said to light a possible way forward.

Member State measures can also be relevant, especially as regards trustmarks. It is also worth noting that not all relevant measures depend on government – there are a number of good examples of private, not-for-profit institutions that help to alleviate information asymmetries between consumers and producers.

1.4. The new Circular Economy Action Plan

In March 2020, the European Commission announced a new Circular Economy Action Plan (European Commission, 2020a) as part of the European Green Deal, together with a number of supporting documents including a new Eurobarometer survey (Kantar, 2020).

This new plan significantly expands on existing initiatives, notably including the Ecodesign framework, in ways that are highly relevant to this study. It also includes a new "Right to Repair" that might prove to be highly significant. Section 4.4 includes a summary of the proposed measures, to the extent that they are visible today. The comparative assessment of the practicality of various instruments in Section 4.7 takes the new Circular Economy Action Plan into account.

[4] Georg Zachmann, Gustav Fredriksson and Grégory Claeys (2018), "The Distributional Effects of Climate Policies", Bruegel.

The new plan rightly seeks to reflect Circular Economy principles into the basic design of key products. This reflects the recognition that as much as 80 % of the environmental impact of a product can be determined at the design stage (European Commission, 2012). It is nonetheless important to take a holistic view across the entire product life cycle, including production, usage, and end of life, and to consider repair, recycling and remanufacturing at the same time as production and use.

1.5. Structure of this document

In Section 2, we discuss product longevity in its many dimensions: how concerns over product longevity emerged from 1960s consumerism, how it relates to the overall product life cycle, how it is viewed by consumers, and how it might be viewed by producers. In Section 3, we provide examples or case studies of product longevity in two distinct product segments where it has been studied, and that also feature prominently in the new Circular Economy Action Plan (European Commission, 2020a): automobiles, and smartphones (together with tablets and laptop computers). In Section 4, we discuss available product safety and compliance instruments at EU level, and also touch on Member State instruments as well as alternatives provided by private institutions.

Findings are numbered and appear in the text at the point at which they are identified, as well as in the Key Findings boxes at the start of each Section. We do not separately present recommendations since they are fairly obvious in light of the findings.

2. PRODUCT LONGEVITY

KEY FINDINGS

- Even in terms solely of environmental goals, it is not always the case that extending product lifetime is positive. Impacts across the production, usage and end of life phases need to be considered, and there are often trade-offs among these.
- Even for the same product, different approaches may be needed over time in response to market evolution and technological evolution.
- A one-size-fits-all horizontal approach as regards product lifetime is unlikely to be appropriate – different approaches are suitable to different products at different times.
- Consumers are satisfied with the longevity of some products, dissatisfied with others.
- Consumer attitudes toward increased product longevity are distinctly mixed. They would welcome longer product lifetimes for some products, but in other cases are worried about high costs of acquiring or maintaining products with long lifetimes, or are worried about being locked in to obsolescent products.
- Consumers have limited reliable information about product lifetimes and Total Cost of Ownership (TCO).
- Surprisingly little is concretely known about producer preferences in terms of product lifetime.
- Whether economic incentives favour short product lifetimes might well depend on the degree of global competition to which the product is subject.
- Producer preferences as regards product lifetime may reflect legitimate trade-offs, just as is the case with consumer preferences.
- Given information asymmetries, some producers may place too little emphasis on long product lifetimes.
- There are some suggestions in the literature that popular sentiment is that product lifetimes are getting worse over time. Hard data is available (but limited) and suggests that, if anything, the opposite was the case in the US in the second half of the Twentieth Century: the average lifetime of durable household goods and of automobiles got substantially better over time, not worse.

In this section, we begin with a discussion of the historical roots of the issue, beginning with a rise of the consumer movement in the United States (US) in the 1960s. We proceed by explaining that product longevity manifests differently across different phases of the product life cycle, and that it entails more than product design and component selection. We explore whether things are getting worse or better over time. We then delve into attitudes of consumers and (to a more limited degree) of producers.

2.1. Planned obsolescence and product longevity

Concerns with needlessly short product lifetimes became prominent with the publication of Vance Packard's *The Waste Makers* in 1960[5]. This instant US best-seller argued that companies produced goods with product lifetimes far shorter than that which they were realistically able to achieve because to do otherwise would reduce their ability to sell new or replacement products to consumers.

In *The Waste Makers*, Packard identified three main reasons for consumers to discard products: obsolescence of *function*, *quality* or *desirability*. Cooper (2004) expands on this model by distinguishing among (1) *psychological obsolescence*, which arises when we are no longer attracted to products or

[5] Packard, V. (1960). *The waste makers*. Harmondsworth: Pelican.

satisfied by them; (2) *economic obsolescence*, which occurs when there are financial factors that cause products to be considered no longer worth keeping; and (3) *technological obsolescence*, which is caused when the functional qualities of existing products are inferior to newer models.

To the extent that obsolescence of function reflects the emergence of a new product that does the job better than the old, it could be viewed as being positive. To the extent however that obsolescence of quality reflects intent on the part of the producer to ensure that "a product breaks down or wears out at a given time, usually not too distant" (Packard, 1960), it is problematic (see Section 2.4).

2.2. Product longevity and the product life cycle

When one considers product sustainability, one must reflect on effects over the entire lifetime of the product: not only over its period of usage (the part that we mainly see as consumers), but also over its period of production, and its end of life period (typical characterised by disposal or by some form of recycling or re-use), as depicted in Figure 2.

Figure 2: The typical product life cycle

Source: Bruegel

When a product wears out or is discarded for some other reason (see Section 2.3), it typically needs to be replaced. Extending the lifetime of a product tends to reduce the frequency with which goods of a given class need to be replaced. This results in reduced consumption of materials and energy that would otherwise go into production, which is environmentally positive.

If goods last longer, then they are less often disposed of, which likewise tends to be positive. There are various forms of recycling, remanufacturing and re-use that can serve to mitigate the cost of end of life, but reducing the frequency with which products go to end of life tends to be even better. Extending product lifetimes consequently tends to be positive for the environment in the end of life phase as well.

The impact of extended lifetimes during the usage phase is not necessarily environmentally positive – in fact, it can often be negative for the environment. Products such as automobiles and washing machines are becoming more efficient over time. Driving a given number of kilometres with a newer, more fuel-efficient vehicle generates less greenhouse gas (GHG) than driving the same number of kilometres with an older, less fuel-efficient vehicle. When we extend the lifetime of these products, it means that older, less efficient products stay in service longer, consuming more energy and therefore generating more GHGs.

Practical assessments as to whether there is a public policy rationale for prolonging product lifetime consequently need to carefully weigh a trade-off: *Do the environmental gains during the production and end of life phases outweigh possible environmental costs during the usage phase for this particular product at this point in time?*

For a given product, these trade-offs might well evolve over time as the market and the technology evolves. An answer that holds in one decade might not hold in the next.

Extending product lifetime might also have adverse consequences relative to the broader migration of product categories. Prolonging the lifetime of today's gasoline-powered automobiles might slow the take-up of electric powered vehicles and self-driving vehicles. Switching to a different product category, there might be little point in prolonging the lifetime of Blu-Ray players and DVD players at a time when both are rapidly being phased out in favour of video streaming.

2.3. Consumers and product longevity

Cooper (2004) has observed that "appliance life spans are determined by consumer behaviour as much as by design specification". By means of an extensive survey of UK consumers, he determined that consumers tended to have very different expectations for different types of products. Consumers expected a lifetime of between 11 and 13 years for cookers, refrigerators, freezers, and televisions, but a lifetime of just six years for small work or personal care appliances, mobile phones, and toys. A majority of consumers (51-52 %) felt that product lifetimes were too short for washing machines, dishwashers, tumble driers, and small work appliances or personal care appliances.

A just-published Eurobarometer survey (Kantar, 2020) found that 69 % of consumers in the EU-27 (i.e. the EU-28 minus the UK) want their mobile phones and tablets to last five years or more (see Figure 3)[6]. Only 20 % desired less than five years[7].

Finding 1. Even in terms solely of environmental goals, it is not always the case that extending product lifetime is positive. Impacts across the production, usage and end of life phases need to be considered, and there are often trade-offs among these.

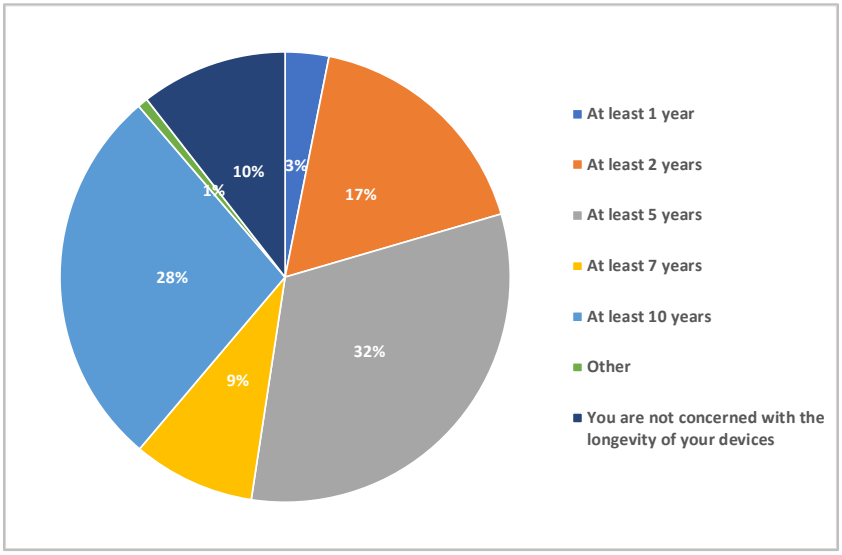
Finding 2. Even for the same product, different approaches may be needed over time in response to market evolution and technological evolution.

Finding 3. A one-size-fits-all horizontal approach as regards product lifetime is unlikely to be appropriate – different approaches are suitable to different products at different times.

[6] The survey was based on just over 1,000 respondents in each of 24 EU Member States, plus just over 1,500 in Germany, and just over 500 in Cyprus, Luxembourg and Malta. The results shown here exclude the UK, which is no longer a Member State. The 5 % of "don't know" respondents are also excluded from these percentages. The question posed was: "QC2: For how long would you like to keep using your current digital devices (e.g. smartphone or tablet) provided that there is no severe drop in performance?".

[7] The remaining respondents either answered that they were not concerned about the longevity of their mobile device, or provided some other answer. Again, the 5 % of "don't know" respondents are excluded from these percentages.

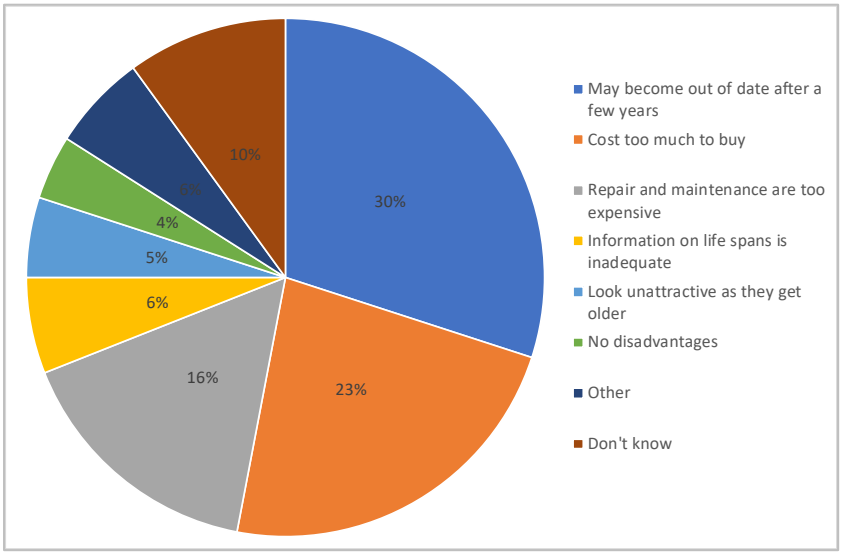
Figure 3: Desired longevity for smartphones and tablets, EU-27, 2019



Source: Kantar (2020), "Attitudes towards the impact of digitalisation on daily lives", Eurobarometer 503; Bruegel calculations

Not all consumers seek longer product lifetimes for all products. Consumers have many reasons to question the advantages of products designed for a long product lifetime. The Cooper (2004) survey also suggests that consumers who generally bought premium quality models did not have significantly higher expectations of appliance life spans. "It follows that many consumers who want longer lasting appliances do not generally purchase premium quality models. [A possible] explanation is that price alone does not enable consumers to identify appliances designed for longevity, as the relationship between price and quality is not consistent". (Cooper, 2004)

Figure 4: Perceived disadvantages with devices designed to last a long time

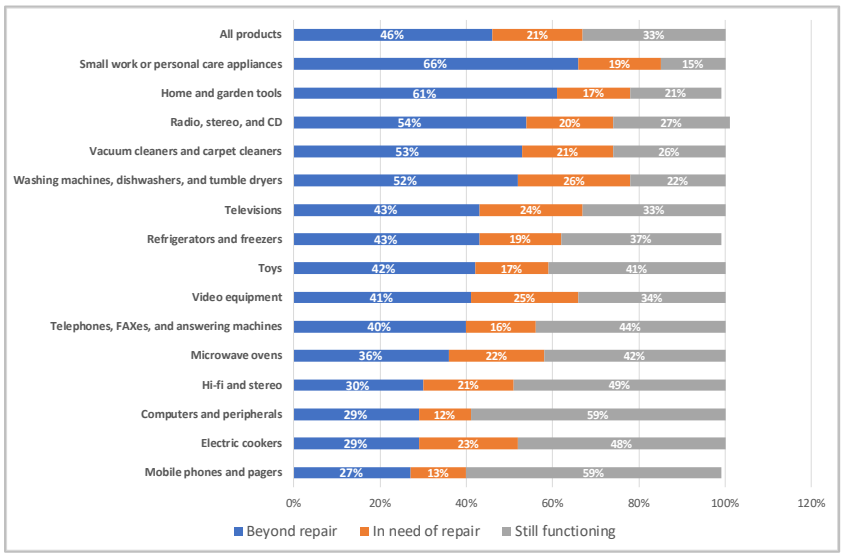


Source: Cooper (2004), Bruegel calculations

The reasons to discard a product can vary greatly depending on the nature of the product, the degree to which the technology is evolving, and consumer expectations. Most of the mobile phones and pagers (a largely obsolescent category today) that were discarded in Cooper's 2004 survey were still usable, while most of the personal care appliances, garden tools and vacuum cleaners were broken beyond cost-effective repair (see Figure 5). Comparing this to the data from new Eurobarometer survey

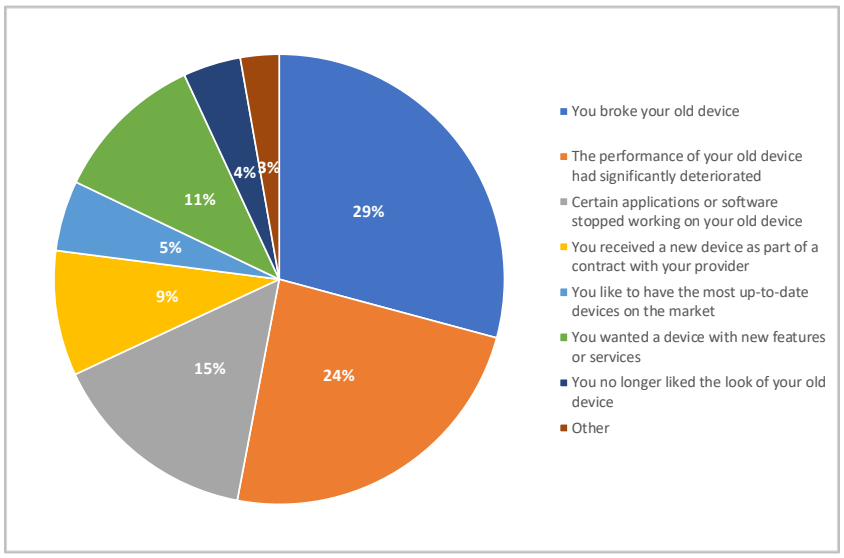
(Kantar, 2020), however, it becomes clear that a large fraction of the devices discarded by 2019 respondents were broken, or else experienced performance that had deteriorated, or else were no longer able to run the latest applications – in a majority of cases, replacement could be said to have been obligatory (see Figure 6)[8].

Figure 5: Condition of discarded appliances (UK, 2004)



Source: Cooper, 2004, Bruegel calculations

Figure 6: Reasons for the most recent replacement of a smartphones, tablet, or laptop, EU-27, 2019

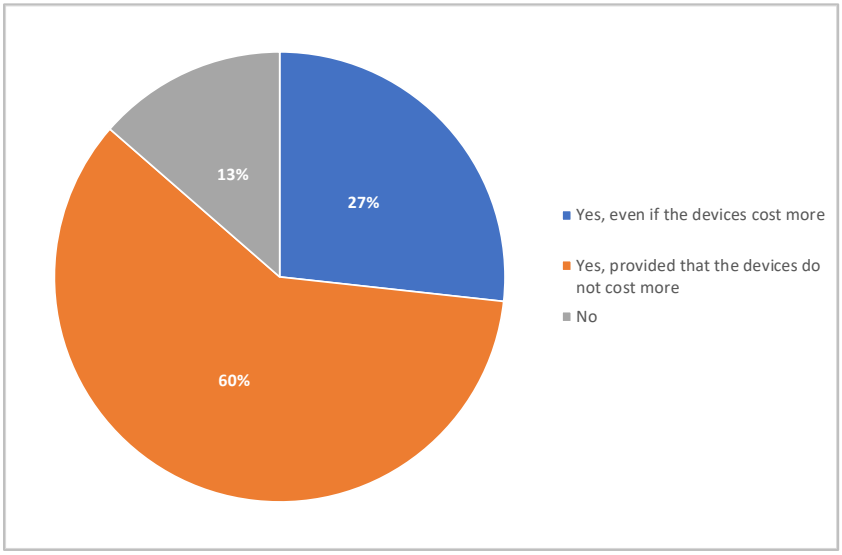


Source: Kantar (2020), "Attitudes towards the impact of digitalisation on daily lives", Eurobarometer 503; Bruegel calculations

[8] The results shown here once again exclude the UK, which is no longer a Member State. The 1 % of "don't know" respondents are also excluded from these percentages, as well as significant numbers who have never replaced such a device, or who do not own any digital devices. The question posed was: "QC3 Think about the last digital device (e.g. mobile phone, tablet, laptop, etc.) you replaced. What were the main reasons for purchasing a new device?" The number of responses is greater than the number of respondents because up to three responses were permitted.

Finally, we note that large numbers of EU consumers have expressed interest in greater ability to obtain repairs the smartphones, tablets and laptops[9]. One should interpret these results with caution, however, since the respondents do not really bear the cost of their choices.

Figure 7: Should manufacturers be required to make it easier to repair digital devices or replace their individual parts (e.g. screens or batteries)? EU-27, 2019



Source: Kantar (2020), "Attitudes towards the impact of digitalisation on daily lives", Eurobarometer 503; Bruegel calculations

Finding 4. Consumers are satisfied with the longevity of some products, dissatisfied with others.

Finding 5. Consumer attitudes toward increased product longevity are distinctly mixed. They would welcome longer product lifetimes for some products, but in other cases are worried about high costs of acquiring or maintaining products with long lifetimes, or are worried about being locked in to obsolescent products.

Finding 6. Consumers have limited reliable information about product lifetimes and Total Cost of Ownership (TCO).

2.4. Producers and product longevity

The literature speculates as to the motivations of producers, but these remain largely unknown.

We know of no instance where it was unequivocally proven that a producer intentionally reduced the lifetime of its product in order to increase its own sales of a product. It has however been alleged on occasion. There is one current case, for instance, where a producer has agreed to a settlement with its customers (without however admitting fault) over claims that it had intentionally slowed down its mobile phones in order to force its customers to upgrade to a newer model[10].

[9] The results shown here once again exclude the UK, which is no longer a Member State. The 3 % of "don't know" respondents are also excluded from these percentages, as well as 6 % who do not use digital devices. The question posed was: "QC4: Should manufacturers be required to make it easier to repair digital devices or replace their individual parts (e.g. screens or batteries)?".

[10] Jack Nicas (2020), "Apple Agrees to Pay Some iPhone Owners $25 Each", New York Times, available at: https://www.nytimes.com/2020/03/02/technology/apple-iphone-lawsuit-settlement.html?nl=todaysheadlines&emc=edit_th_200303&campaign_id=2&instance_id=16400&segment_id=21809&user_id=f3acea35b787c88809bb9206844f7e3e&regi_id=20115710303; https://www.nytimes.com/2020/03/02/technology/apple-iphone-lawsuit-settlement.html.

When Packard wrote *The Waste Makers* in 1960, markets tended to be national and many producers enjoyed a degree of market power on those national markets. Under those conditions, it may well have been reasonable to assume that a product that wore out would necessarily be replaced with a product from the same company.

Today, one might well question this assumption in regard to those products where the market has become globalised and where products are subject to substantial competition. The replacement product might well come from a different producer in a different country.

The discussion of the automobile industry in the United States and in Japan in Section 3.1 provides an opportunity to dig deeper into these considerations.

It is also worth noting that some companies have consciously chosen a strategy that apparently runs opposite to that of planned obsolescence. Over a period of decades, Japanese automobile manufacturers such as Toyota and Honda presented themselves to consumers in the US and elsewhere as offering longer product lifetimes, lower frequency of repair, and better fuel economy (see for instance Crandall, *Regulating the Automobile*, 1986). (As we explain in Section 3.1.2, there is room to debate whether their products were actually more durable at the time.) Purchasers understood this to represent a substantial gain in terms of the lifetime **Total Cost of Ownership (TCO)** for the vehicle. This approach to the marketplace is thought to have enabled Japanese vehicle producers to gain substantial market share in the United States and elsewhere, at the expense of US companies that were thought to sell less reliable and less durable vehicles.

Finding 7. Surprisingly little is concretely known about producer preferences in terms of product lifetime.

Finding 8. Whether economic incentives favour short product lifetimes might well depend on the degree of global competition to which the product is subject.

Finding 9. Producer preferences as regards product lifetime may reflect legitimate trade-offs, just as is the case with consumer preferences.

Finding 10. Given information asymmetries, some producers may place too little emphasis on long product lifetimes.

2.5. Trends in product longevity

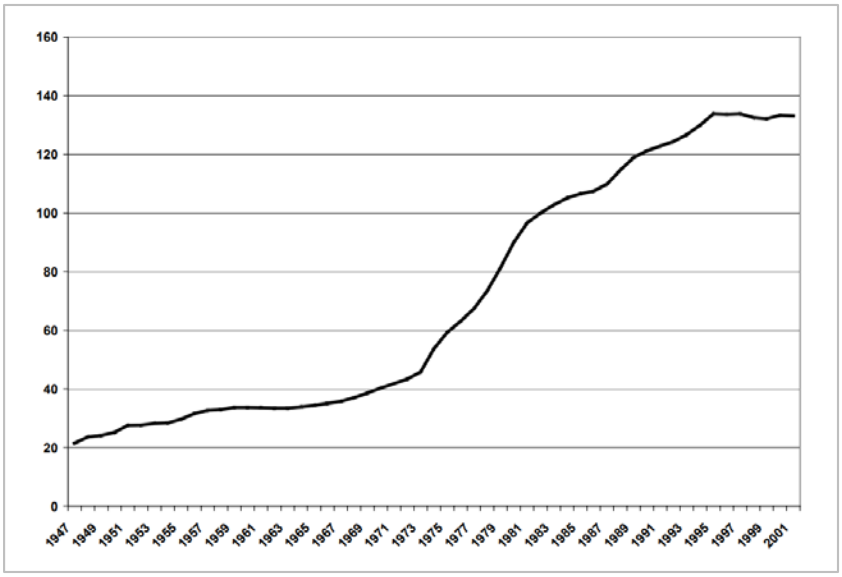
In the focus groups organised by Cooper (2004), many participants expressed the view that appliances do not last as long as in the past, although a few disagreed. There are suggestions in the literature that modern appliances such as cookers, vacuum cleaners, kettles and irons are less durable than in the past.

There is limited hard evidence as to trends in product lifetime over time, but there are some suggestions in the literature that product lifetime may actually be getting better, not worse, over time. In order to calculate producer and consumer price indices, national statistical agencies have to estimate economic obsolescence. A study by Johnstone et al (2002) for the OECD[11] provides Figure 8, which shows the estimated trend for commodities produced by "durable" manufacturing sectors in the United States since 1947 (indexed against 1982 = 1.0). Product lifetimes for durable household goods

[11] Nick Johnstone, Nadia Caïd, and Ysé Serret (2002), "Decision-Making and Environmental Policy Design for Consumer Durables", OECD, ENV/EPOC/WPNEP(2002)7/FINAL.

improved substantially in the seventies, improved at a somewhat slower rate in the eighties, and did not level off until the nineties.

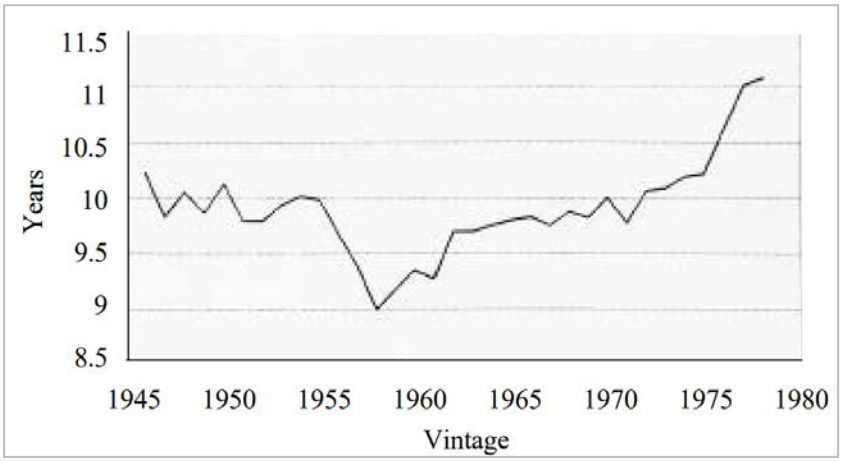
Figure 8: Estimated Economic Life of Durable Products in the United States, 1947-2001[12]



Source: OECD (2002), "Decision-Making and Environmental Policy Design for Consumer Durables"

Similar trends are visible for automobile longevity in the United States. Hamilton and Macauley (1988) found a strong positive trend in US automobile life expectancy starting in the late 1950s (see Figure 9). "The average age of domestically produced automobiles has increased by nearly 30 percent since the mid-1960s -- from 5.6 years in 1969 to 7.2 years in 1991. Over the same time period, life expectancy has increased by approximately the same relative amount." They found similar longevity trends among both Japanese and US automobiles (see Section 3.1.2), suggesting that this was a global trend not limited to the US. It is worth noting that these figures suggest that automobile life expectancy was at its worst just as Vance Packard would have been writing *The Waste Makers* in 1960.

Figure 9: Automobile life expectancy in the United States, 1945-1980



Source: Bruce W. Hamilton and Molly K. Macauley (1998), Competition and Car Longevity

[12] Data obtained from United States Department of Labour, Producer Price Indices (www.bls.gov/servlet).

Finding 11. There are some suggestions in the literature that popular sentiment is that product lifetimes are getting worse over time. Hard data is available (but limited) and suggests that, if anything, the opposite was the case in the US in the second half of the Twentieth Century: the average lifetime of durable household goods and of automobiles got substantially better over time, not worse.

3. PRODUCT LONGEVITY IN SPECIFIC SECTORS

KEY FINDINGS

- Even for a single product or sector, the environmental effects of an increase in longevity are complex. A study by Kagawa et al. (2008) plausibly found that increasing the lifetime of passenger vehicles by a year in Japan during the period 1990 through 2000 would have generated substantial environmental benefits. However, the results are specific to that country and time period. Whether an increase in vehicle longevity in the EU today would be positive or negative for the environment cannot be claimed solely on the basis of that work.
- It is often claimed that Japanese vehicles gained market share in the US in the 1970s because domestic automobiles had poor repair records, wore out quickly, and were inefficient in terms of fuel consumption. They did indeed have better fuel consumption and better repair records, but models introduced from 1977 on do not appear to have remained in service longer than domestic automobiles.
- The poor longevity of automobiles made in the US roughly between 1955 and 1975 was probably in large part a result of over-pricing of repair parts by US manufacturers who had substantial market power. Initial design is important, but cost and ease of repair can be equally important.
- Smartphones and tablets could potentially be used for four or more years, but many are used only two years. Many are replaced (1) because the battery has died, and cannot be replaced by the user; or (2) because the screen has cracked, and cannot be replaced by the user, or (3) because the manufacturer no longer is willing or able to support the software.
- It is easy to say that all batteries (and screens) should be replaceable, but there are legitimate reasons to prefer non-replaceable components, some of which also indirectly benefit consumers. User-replaceable batteries are not the only way to ensure that the phone can be used for its full potential lifetime. Other solutions are possible, and are to some extent being implemented.
- The new Circular Economy Action Plan is directionally appropriate. Being directionally right is positive, but it is only a first step. The ultimate success of any measures taken will ultimately depend on getting the details right as well.

Perhaps the best way to understand issues of product longevity is to see how they have played out, or might potentially be altered, for actual products of sectors in the past or in the future. We consider automobiles as one example, and smartphones and tablets as another.

3.1. The automobile industry

In this section, we review two studies that bear on the impact of longevity in the market for passenger vehicles, based on experience and on theoretical analyses for Japan and the United States.

3.1.1. Product longevity in the automobile industry

On the basis of an elegant and sophisticated paper by Kagawa et al. (2008), "The Economic and Environmental Consequences of Automobile Lifetime Extension and Fuel Economy Improvement: Japan's Case", it is often claimed that lengthening the life of automobiles would generate substantial environmental gains. The paper claims that, had the lifetime of all passenger vehicles been lengthened by a year over the period 1990-2000, it would have resulted in energy savings of 40,671,000 gigajoules of energy. The paper then goes on to note that "the energy-saving impact of the one-year lifetime extension was approximately 1.3 times larger than that of the most significant technological

improvement in the electric power generation sector", which is to say that it claimed there would have been more to gain through this lifetime extension than through any other known set of measures.

The paper uses sophisticated mathematical and economic models to explore many of the extremely complex factors that need to be taken into account in any assessment of the effects of extending product lifetimes, such as:

- An extension of automobile lifetime of up to one year not only affects production and disposal costs, but also delays the take-up of more fuel-efficient models;
- The production changes have ripple effects into the broader economy;
- Reduced expenditure by consumers means that the money is spent on other things (rebound effects), with environmental consequences.

This work thus provides a useful signpost as to how such an analysis needs to be done. At the same time, not all of the quantitative results are persuasive, and some are very Japan-specific.

Kagawa et al. (2008) actually found that gasoline consumption would have *increased* with longer automobile product lifetimes in Japan 1990-2000. The normal expectation is that the gasoline consumption would *decrease* because longer product lifetime has the effect of delaying the take-up of newer and more fuel-efficient vehicles. Normally, consumers would buy new automobiles with greater fuel efficiency, thus improving energy efficiency over time. *Prolongation of the life of the existing fleet of automobiles delays this change, leaving less efficient vehicles in service longer, and therefore actually reduces energy efficiency.*

As we explained in Section 2.2, we would normally expect that greater product longevity improves energy efficiency in the production and the end of life phases of a product's lifetime, because less of the product needs to be produced or destroyed/recycled. We would however also expect, for products that are enjoying an improvement energy efficiency that improves over time, that greater product longevity reduces energy efficiency during the usage phase. The key question thus becomes, **is more energy gained in production and end of life than is lost during usage?**

Kagawa et al. (2008) found that "since lifetime extension stimulates a decrease in the demand for ordinary new passenger vehicles (with relatively low fuel economy)[13] and an increase in the stock for old small passenger vehicles (with relatively high fuel economy)[14] over the [1990-2000] period, this leads to a reduction in gasoline consumption due to differences in fuel economies." In other words, **the increased vehicle longevity would have delayed a migration from efficient small cars to somewhat less efficient larger cars that was taking place in Japan over the same period**, and this effect would have been greater in impact than the expected increase in fuel consumption. This result is probably valid, but runs counter to the normal expectation.

Needless to say, this effect was specific to Japan in the period in question. **This means that the crucial trade-offs between environmental gains in the production and end of life phase versus expected environmental losses during the usage phase remain unexplored.**

The Kagawa et al. (2008) study may thus be strong in terms of its *explanatory power* for Japan from 1990 through 2000 but its *predictive power* for the EU from 2020 to 2030 (or for that matter for Japan from 2020 to 2030) is weak.

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[13] Low fuel economy (also known as « good » fuel economy) means a car can be driven farther on a full tank of gasoline than a car with a high fuel economy (also known as « bad » fuel economy), which can't drive as far on the same amount of gasoline.

[14] Idem.

3.1.2. Product design versus product repair in the US automobile industry

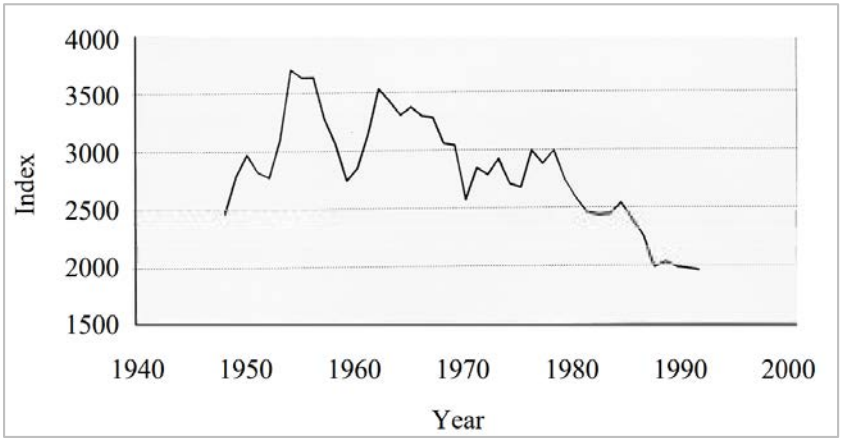
We noted in Section 2.5 that the longevity of passenger vehicles in the US increased greatly from the late 1950s to 1980. It is often claimed (see for instance Crandall, *Regulating the Automobile*, 1986) that Japan made huge gains in market share in comparison within the United States by selling more durable vehicles, with less need for maintenance and better fuel economy, at a time when US manufacturers were selling expensive vehicles with poor fuel economy and a need for frequent repairs.

Hamilton and Macauley (1998) suggest that it was not a matter of more durable vehicles being produced, or imported from Japan, but rather a matter of **repairs becoming more cost-effective**. The US automobile manufacturers had substantial market power in the 1950s, and chose to exploit their pricing power by taking high mark-ups on replacement parts while keeping the cost of initial purchase at reasonable levels. As foreign imports, mostly from Japan, increasingly provided competition in the US market, the domestic manufacturers could no longer maintain this strategy. The price of parts fell to competitive levels, and it became cost-effective to repair older vehicles in the US.

The decline in the market power of the US automobile industry is clear (see Figure 10). As Hamilton and Macauley explain, "[i]n the late 1950s and early 1960s, automobile manufacturing was the most highly concentrated major industry in the United States. [The] Hirschman-Herfindahl index [HHI] of concentration[15] stood at about 3500 to 3700. By 1990, the index stood at approximately 2000." In competition economics, this corresponds to a dramatic decline in industry concentration.

Finding 12. Even for a single product or sector, the environmental effects of an increase in longevity are complex. A study by Kagawa et al. (2008) plausibly found that increasing the lifetime of passenger vehicles by a year in Japan during the period 1990 through 2000 would have generated substantial environmental benefits. However, the results are specific to that country and time period. Whether an increase in vehicle longevity in the EU today would be positive or negative for the environment cannot be claimed solely on the basis of that work.

Figure 10: HHI of the US automobile industry, 1950-1990

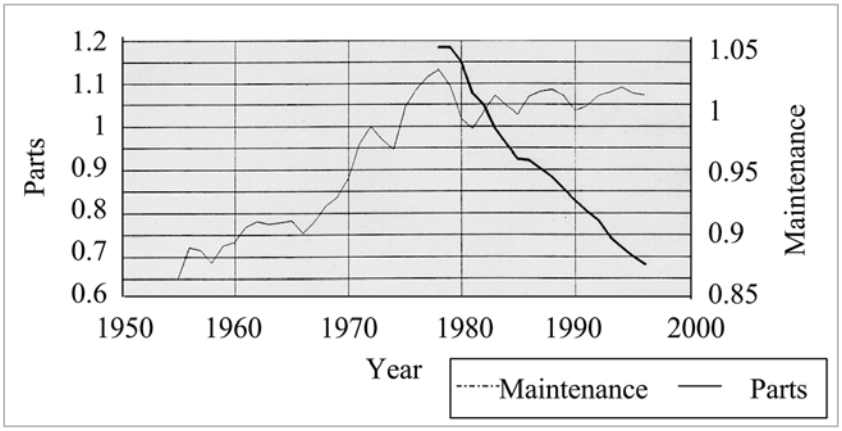


Source: Hamilton and Macauley (1998)

[15] The Herfindahl–Hirschman Index (HHI) is a measure of the concentration of an industry. It is widely used in competition economics. A perfect monopoly would have an HHI of 10,000. In evaluating mergers, the US Department of Justice contains an industry with an HHI in excess of 1,800 to be "highly concentrated".

Large-scale entry of Japanese imports began during the 1970s, and the pricing power of the US automobile manufacturers declined. The inflation-adjusted cost of automobile maintenance, which had previously been climbing, stabilised and the inflation-adjusted cost of parts declined dramatically (see Figure 11).

Figure 11: The Consumer Price Index of US auto maintenance and parts, 1955-1995



Source: Hamilton and Macauley (1998)

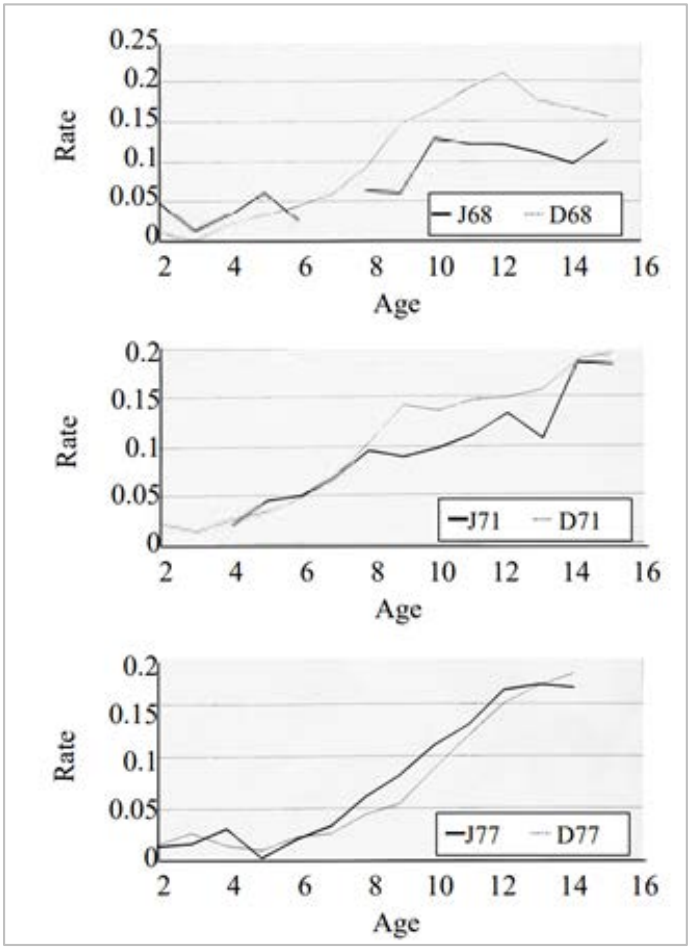
The argument that the US manufacturers would have preferred to take their mark-ups on parts rather than on the initial purchase price makes economic sense. Under *Ramsey-Boiteux* pricing principles[16], a monopolist should take high mark-ups on services with a low price elasticity of demand (PED), and low mark-ups on goods with a high price elasticity of demand. Avoiding over-pricing the vehicle helped to sell more vehicles. Once the vehicle was sold, the manufacturer had a strong competitive advantage (versus third party suppliers and junkyards) in the sale of spare parts. This is the same logic that is thought to motivate manufacturers of razors to take their profits mainly on the blades, and manufacturers of computer printers to take their profits mainly on the ink cartridges.

Surveys of readers of the US publication Consumer Reports throughout the 1970s and 1980s on frequency of repair (as tabulated by Crandall, 1986) show that the frequency of repair record for Japanese cars was consistently much better than for domestics.

Were the Japanese cars really achieving greater longevity through better design? Possibly not, at least during the years in which Japan made the largest gains in market share. Figure 12 shows the death rates of Japanese-made and US-made automobiles in the US as a function of the year in which they were made, or vintage. In the late 1960s and early 1970s, the Japanese cars tended to remain in service longer than their US-built counterparts. "By the 1977 vintage there is essentially no difference. The only support for superior durability of Japanese cars comes from the very small vintages which were imported well before the surge years of Japanese cars. Surprisingly, for vintages beyond the early '70s, Japanese and domestic cars look indistinguishable."

[16] Ramsey pricing seeks to set the level of taxation so as to maximise social welfare. Boiteux subsequently broadened the focus so as to apply the same concepts to the prices charged by a (public) monopolist.

Figure 12: Japanese and domestic auto death rates in the US, by vintage



Source: Hamilton and Macauley (1998)

Finding 13. It is often claimed that Japanese vehicle gained market share in the US in the 1970s because domestic automobiles had poor repair records, wore out quickly, and were inefficient in terms of fuel consumption. They did indeed have better fuel consumption and better repair records, but models introduced from 1977 on do not appear to have remained in service longer than domestic automobiles.

Finding 14. The poor longevity of automobiles made in the US roughly between 1955 and 1975 was probably in large part a result of over-pricing of repair parts by US manufacturers who had substantial market power. Initial design is important, but cost and ease of repair can be equally important.

3.1.3. Implications for the new Circular Economy Action Plan

The just-released Circular Economy Action Plan (European Commission, 2020a) considers a number of value chains that are of particular interest going forward, one of which covers batteries and vehicles. For this value chain, they intend to undertake a number of specific initiatives.

First, they intend to put forward a new regulatory framework for batteries. Key elements include (1) rules on recycling, and on the recovery of valuable materials; (2) a gradual phase-out of non-rechargeable batteries where feasible; and (3) imposition of sustainability and transparency obligations with an eye to promoting re-use, repurposing and recycling.

Second, they are looking to propose new rules for end of life of vehicles. For automobiles and for many other products, they hope to better integrate planning for end of life (including recycling, remanufacturing and repurposing) into the initial product design process.

In parallel with this, they intend to launch a strategy on Sustainable and Smart Mobility. Human mobility can increasingly be thought of going forward as a service rather than a product, with implications for profound efficiency gains in the entire value chain.

In parallel with these initiatives, and as a horizontal cross-sectoral approach, the Commission seeks for the first time to establish a new 'right to repair' in order to systematically address the availability of spare parts, easy access to re-use and repair services, and access to repair documentation. These ideas are not much developed in the Circular Economy Action Plan (European Commission, 2020a), but they are important.

It will be necessary to put much more policy flesh on these policy bones, but the ideas are directionally appropriate. The historic experience in the automobile industry suggests that **design is not the whole story** – addressing bottlenecks and confronting commercial incentives that may sometimes run counter to cost-effective repair can be equally important.

The focus on batteries would also appear to be in order. Batteries are a significant issue for automobiles, and are likely to be a huge issue for electric vehicles – the battery can be a very expensive component.

These same considerations hint at reasons why any prolongation of product lifetime for passenger vehicles – a potential initiative which, interestingly, is not visible in the Circular Economy Action Plan – might prove to be counter-productive at this particular point in time. Any prolongation of the lifetime of existing vehicles risks a slight delay in the take-up of new electric vehicles and self-driving vehicles, thus potential delaying a technology evolution that produces benefits of its own.

3.2. Smartphones and tablets

Smartphones and tablets can provide another illustrative example, more of what could be considered prospectively than of what has already been done. There have been multiple calls to take stronger action on the durability and longevity of smartphones and tablets at EU level (European Parliament, 2018; ANEC and BEUC, 2018)[17] in order to promote sustainability over the full product life cycle, taking into account composition, durability, disassembly, reparability and recyclability[18].

3.2.1. Longevity considerations for smartphones and tablets

Smartphones and tablets should typically be able to operate for at least four to five years, perhaps more, but many are replaced within two years (which historically was roughly the lifetime of the battery). Some users always want to have the latest technology, but there is good reason to believe that a great many of these mobile devices are replaced (1) because the battery has died, and cannot be replaced by the user; or (2) because the screen has cracked, and cannot be replaced by the user, or (3) because the manufacturer no longer is willing or able to support the software. Recent Eurobarometer survey results (Kantar, 2020) show that 69 % of consumers in the EU-27 want their mobile phones and tablets to last five years or more (see Figure 3 in Section 2.3). They also indicate (see Figure 6 in the

[17] European Parliament (2018) 'Resolution of 31 May 2018 on the implementation of the Ecodesign Directive (2009/125/EC)', 2017/2087(INI); and ANEC and BEUC (2018) 'Consumer associations' views on the release of the Ecodesign Work Plan 2016-2019 as well as on related Commission acts', position paper, European Association for the Coordination of Consumer Representation in Standardisation and the European Consumer Organisation.

[18] The discussion here is based on J. Scott Marcus (2019), "To the commissioner responsible for Digital services, content and networks", in *Braver, Greener, Fairer: Memos to the EU leadership 2019-2024*, Bruegel, https://bruegel.org/2019/09/memos-2019/.

same section) that 68 % of EU-27 consumers most recently scrapped a smartphone, tablet or laptop for at least one of three reasons: (1) they broke their previous device; (2) the performance of the old device had significantly deteriorated; or (3) certain applications or software stopped working on their old device. It is clear that a great many EU consumers would like to be able to get these devices repaired, but face challenges in doing so (see Figure 7 in Section 2.3).

Figure 13: A cracked screen that cannot be replaced by the user is one of several reasons why an otherwise serviceable smartphone might need to be replaced

Source: Bruegel

There are valid economic reasons why a manufacturer might prefer a design that does not permit the battery to be changed, and similar considerations are relevant to the screen. As consumers, we regret this decision if and when the battery dies, but we also benefit from these trade-offs in daily usage. Among the reasons given for a shift away from removable batteries in high-end Android-based smartphones (Apple iPhone never had replaceable batteries) are [19]:

- The need for a removable panel tends to bias the smartphone design toward plastic, rather than the sleek and popular metal-and-glass design that is now prevalent among high-end smartphones;
- The removable panel makes the smartphone more susceptible to moisture and dust;
- A removable battery forces a rectangular shape, rather than taking advantage of nooks and crannies within the phone that a more flexible design might utilise. This needlessly ties up space in the smartphone that could otherwise be used to provide other functions.

These trade-offs are legitimate, but it should be noted that **producers make this economic calculation without pricing in the negative externality of the e-waste generated.**

There are attempts to create a more sustainable smartphone. The FairPhone design is highly modular, enabling user replacement of battery, screen, audio jack, or camera – in fact, the camera is user-upgradeable [20]. The company also has initiatives to promote re-use and proper recycling of old smartphones. This is a very interesting initiative, but it cannot be said to have yet had a mass market impact.

[19] Raymond Wong, 'Smartphones with removable batteries are never coming back', *Mashable*, 1 January 2018, available at: https://mashable.com/2018/01/01/why-phones-cant-have-removable-batteries-anymore/.

[20] See FairPhone, "Long-Lasting Design", available at, https://www.fairphone.com/en/impact/long-lasting-design/.

It is easy to say that all smartphone tablets and batteries should be user-replaceable, but this is not the only way to address the problem, and one can debate whether it is the best solution for consumers and the best for the environment. Two alternatives that are already being implemented to some extent by the industry are:

- Enhancing battery life to be in line with that of the rest of the phone (at least 4-5 years)[21];
- Making professional battery replacement easier and less expensive (Apple and Huawei have programmes in place).

The continued availability of software maintenance, notably including security patches, is crucial to the continued secure use of the device. Producers may in practice support software longer, but common industry practice for Android devices is for the producer to commit software support for only two years from the date of launch of the device – *not* the date of purchase (Raphael, 2019).

It is easy to say that the producer should not prematurely discontinue software support for the smartphone or tablet, but attempts to ensure continued software support beyond the time that the producer chooses might raise practical challenges. Most of the smartphones and tablets used by Europeans are produced in third countries. If a producer were to become insolvent, without having its assets and responsibilities assumed by a successor company, it is difficult to see how an obligation could be enforced on a no longer existing producer in a third country. One can also readily imagine an instance in this increasingly "my country first" world where a smartphone producer might be unable to provide software updates due to an unrelated trade dispute between two non-EU countries, and is effectively a victim of *force majeure*[22].

As noted in Section 4, a general EU framework is already in place to promote energy efficiency (the Ecodesign Directive, 2009/125/EC), but it has mainly been brought to bear on devices with high energy consumption such as washing machines and clothes driers, rather than on low energy consumption devices that require frequent replacement. It has not been applied to smartphones or tablets – an area that is highly visible to EU consumers.

There are different ways in which public policy might attempt, consistent with the existing EU Ecodesign framework, to shift the balance so as to prolong product lifetime and to reduce needless waste. An outright prohibition on the sale or importation of devices with short product lifetimes has been tried elsewhere[23], but that is an extreme solution that has negative impacts on competition and on consumer choice. A much less-intrusive approach, but with uncertain effectiveness, would be to create or adapt trustmarks or ecolabels to favour mobile devices for which the manufacturer has committed support for at least, say, four years, and where either the battery is exchangeable or the battery can be shown to have an effective lifetime under normal use of at least four years.

Ensuring that consumers are well informed as to the effective lifetime that they can expect from a smartphone or tablet could also be considered as a means of enabling informed consumer choice among devices that are available in this competitive marketplace. Consumer organisations already play some role in this space, and public policy might choose to do more, as we explore in Section 4.

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21 This is achievable today. Huawei believes that their current batteries are good for some 4.4 years under normal conditions of charging and use (private communication). It is worth noting that in the application of the Ecodesign framework to light sources, the recognition that the LED or OLED lamps are now likely to last just as long as the fixture is a significant consideration in the determination as to whether it is necessary to be able to replace them.

22 Any resemblance to any existing dispute is purely coincidental.

23 Joel Hruska, 'New Bill Mandates Replaceable Batteries in Consumer Electronics', *ExtremeTech*, 31 January, available at: https://www.extremetech.com/mobile/263101-washington-state-mulls-bill-mandating-replaceable-batteries-easily-repaired-consumer-electronics.

Finding 15. Smartphones and tablets could potentially be used for four or more years, but most are used on two years. Many are replaced (1) because the battery has died, and cannot be replaced by the user; or (2) because the screen has cracked, and cannot be replaced by the user, or (3) because the manufacturer no longer is willing or able to support the software.

Finding 16. It is easy to say that all batteries (and screens) should be replaceable, but there are legitimate reasons to prefer non-replaceable components, some of which also indirectly benefit consumers. User-replaceable batteries are not the only way to ensure that the phone can be used for its full potential lifetime. Other solutions are possible, and are to some extent being implemented.

3.2.2. Implications for the new Circular Economy Action Plan

The Commission has placed a high priority on electronics and Information and Communications Technology (ICT), including smartphones, tablets, and laptops, as a key value chain recognised in the new Circular Economy Action Plan (European Commission, 2020a). Printers and printer cartridges are a possible additional target.

The key thrust is to implement measures under the Ecodesign Directive (see Section 4.3.1) in order to ensure that these devices are designed for energy efficiency, durability, reparability, upgradability, maintenance, re-use and recycling.

The planned phase-out of non-replaceables is a focus in connection with vehicles, but it has clear and direct relevance here as well (see Section 3.1.3).

The electronics and ICT sector is clearly viewed as a "poster child" for the proposed new "right to repair". For this sector, it is intended to include a right to update obsolete software.

The Commission has also signalled interest in an EU-wide take back scheme to enable the return or sell-back of old mobile phones, tablets and chargers. This seems promising, but it is not of direct interest for this study since it deals with recycling in the end of life phase rather than with product longevity as such.

There are also plans for the introduction of a common charger for these devices. Maximum potential environmental benefits are probably limited (Ipsos et al., 2019).

As with automotives, the plans seem to be directionally right, but very few of the crucial details have been provided so far. The focus on ease and practicality of repair is appropriate, particularly in light of long-standing consumer frustration with non-replaceable batteries, cracked screens, and software that cannot be maintained or upgraded. The results from the Eurobarometer survey (Kantar, 2020) from Section 2.3 make clear that European consumers hope for something better.

Being directionally right is positive, but it is only a first step. The ultimate success of any measures taken will ultimately depend on getting the details right as well.

4. INSTRUMENTS AVAILABLE TO ADDRESS THE NEED

KEY FINDINGS

There is a broad constellation of measures at EU level that seek to promote product safety, as well as other EU policy goals including environmental goals. A number of these are well suited to the promotion of increased product longevity, and there are instances where this is already being done. Measures at Member State level are also relevant.

- Other than in the Ecodesign framework, there is very little connection today between any existing EU instrument and product longevity.
- Detailed policies will need to be highly differentiated product by product, and adaptable over time. "Soft" approaches ensuring that consumers can make informed choices will often be preferable to "hard" approaches that outright block the sale of products that some consumers may want.
- The Ecodesign framework is well-suited to the promotion of the full range of product longevity goals, and should be the preferred mechanism. It supports both "hard" and "soft" mechanisms. Its use in the case of light sources provides a clear "proof of concept" as to how the current Ecodesign framework can accommodate (1) needs for minimum product lifetime, (2) needs to inform prospective customers as to the expected lifetime of a product in order to facilitate informed choice, and (3) for the promotion of modularity so as to facilitate ease of replacement by the user of components that have gone bad. The new Circular Economy Action Plan rightly places its emphasis here.
- The product safety framework, perhaps in conjunction with the CE trustmark, could be used to require and enforce product longevity in specific cases if desired. These arrangements are however mainly suitable only for cases where a "hard" enforcement is appropriate. We see no obvious reason to prefer these arrangements to the more flexible possibilities of the Ecodesign framework.
- The EU has a good, comprehensive strict liability regime for products. It is difficult to see any applicability of this framework to the promotion of longer product lifetimes.
- Given the complexity of this topic, and the need for product-specific and sector-specific knowledge, good adherence to Better Regulation principles is especially important. We would particularly emphasise the importance of a comprehensive consultation process that obtains good feedback from both market players and consumer advocates.
- The EU would be well advised to coordinate with Member State initiatives, especially in the trustmark area.
- Reliable private/non-private entities could play an important role, as with Stiftung Warentest in Germany or Consumers Reports in the US.
- Private (not-for-profit) institutions can also play an important role in ensuring that consumers are well-informed as to the quality, service record and/or expected longevity of durable consumer products and services.
- Industry can also play a constructive role, and will sometimes be able to deliver on these policy objectives faster or in a less costly manner than mandatory requirements.
- Consumers would benefit, not only from information about service records and expected product lifetime among competing products, but also from comparative statistics on the Total Cost of Ownership (TCO). It is challenging to provide this, and we know of no good existing solution.

In Sections 4.1, 4.2, and 4.3, we review a number of EU legislative measures relevant to product safety, and consider their applicability to the achievement of longer product lifetime and relatedly to the ease of repair of products. We include the Ecodesign framework and the trustmarks that support both safety and environmental goals, including CE and the energy labelling framework.

The use of harmonised European standards is heavily intertwined with most of the measures involving European product safety and enforcement, but the use of standards is expressed slightly differently in each legislative instrument. It is covered primarily in Section 4.3.1. in conjunction with the Ecodesign framework.

In Section 4.4, we provide a summary of the just-released revision to the Circular Economy Action Plan, issued by the European Commission as part of the European Green Deal. The Circular Economy Action Plan draws on and expands on some of the existing instruments.

In subsequent sections, we consider Member State initiatives and the role of private (typically non-profit) institutions.

Finally, we provide a comparative analysis of the relevant opportunities that these measures provide in Section 4.7.

4.1. Product safety regulations

Product safety is explicitly governed by a range of measures at European Level. Some measures seek to ensure harmonisation in the Single Market, and these are complemented by a directive that ensures product safety in a horizontal fashion.

Product specific legislation is already in place to ensure harmonisation for articles such as toys, electrical appliances, and automobiles. Chemical risks have been a particular focus of specific measures, especially as regards textiles, toys, cosmetics, and tattoo ink. Child safety has been another focus, with an emphasis on baby carriers, changing units, and safety barriers. There are also measures to protect devices that children might mistakenly wish to play with, such as cigarette lighters.

Harmonisation measures thus already exist for many devices of interest. Especially relevant for this study is the 2006 Machinery Directive, which covers a wide range of electrical and electronic products – not only household appliances intended for domestic use, audio and video equipment, information technology equipment, but also robots. Since it is written as a directive, it specifies an overall binding framework, but leaves detailed implementation to the EU's Member States (European Union, 2006; European Commission, 2018)[24]. As with many other instruments relating to product safety, products conforming to relevant aspects of standards that have been published in the Official Journal (see Section 4.3.1) are deemed to be compliant with the Machinery Directive. The CE trustmark (see Section 4.3.2) represents a key enforcement mechanism for the Machinery Directive.

Directive 2001/95/EC of the European Parliament and the Council of 3 December 2001 on general product safety aims to complement these measures by ensuring that only safe consumer products are placed on the market, and in doing so acts as a safety net for products and risks not covered by the harmonisation legislation. As the directive itself notes in Recital 5, it was created in the recognition that it would be impractical to develop legislation for every product which exists or which might be developed in the future. Consequently, there was a need for a broad-based, legislative framework of a horizontal nature to deal with such products, and also to cover any gaps or shortcomings with a view to ensuring a high level of protection of safety and health of consumers. The directive does not cover pharmaceuticals, medical devices, or food which are regulated separately.

[24] European Commission (2018), "Liability for emerging digital technologies Accompanying the document 'Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions: Artificial intelligence for Europe'", COM(2018) 237 final; European Union (2006), Directive 2006/42/EC of the European Parliament and of the Council of 17 May 2006 on machinery, and amending Directive 95/16/EC (recast) (OJ L 157, 9.6.2006, pp. 24-86).

As far as the suitability of using product safety rules to promote product durability in order to meet the goals of the Paris Agreement, a strength is that the rules can be sufficiently differentiated. A limitation is that this instrument provides only for a "hard" regulatory intervention. "Soft" approaches ensuring that consumers can make informed choices will often be preferable to "hard" approaches that outright block the sale of products that some consumers may want. These safety regulations do not appear to be preferable to the use of the more flexible instruments in the Ecodesign framework, which accommodates both "hard" and "soft" approaches.

4.2. Product (and service) liability regulations

The EU has a comprehensive *strict liability* regime for products (but not for services)[25]. Key elements of the product liability framework in the EU[26] are:

- *What constitutes a defect:* A product is defective when it "does not provide the safety which a person is entitled to expect". That there are better products on the market does not necessarily mean that a product is defective. (Article 6)
- *Who is liable:* Liability falls to the producer of a product: to the manufacturer of the product, to any company that presents itself as a producer (e.g. by putting its name or trademark on the product), or any importer. If no producer can be identified, each supplier of the product is treated as its producer unless it identifies the true producer. (Article 3)
- *Strict liability:* The injured person carries the burden of proof of the defect in the product, the actual damage, and the causal link between the defect and the damage; however, the injured person does not have to prove a fault of the producer. (Article 4)

The directive seeks a fair, balanced and economically efficient allocation of responsibility between producer and consumer. Due to information asymmetries, it might be exceedingly difficult for a consumer to prove that a producer was at fault for a defective product. (European Union, 1985; see also State of California, 1944)[27].

Given that the overall product and service liability framework needs review in light of the emergence of self-driving vehicles and Artificial Intelligence (AI) as both Parliament and Commission have noted[28], it is tempting to consider carefully whether liability rules could play some supporting role. However, they are simply not the most promising instrument. First, even though these horizontal rules can respond case-by-case, they only do so *ex post*. There is no obvious way to provide granular, product-by-product guidance *ex ante*. Second, it is difficult to see how the consumer would demonstrate actual harm in the case where a product wears out more quickly than it arguably should have.

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25 J. Scott Marcus (2018), "Liability: When Things Go Wrong in an Increasingly Interconnected and Autonomous World: A European View", *IEEE Internet of Things Magazine*, Institute of Electrical and Electronics. See also European Commission (2018), "Liability for emerging digital technologies: Accompanying the document 'Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions: Artificial intelligence for Europe'", COM(2018) 237 final.

26 European Union (1985), Council Directive 85/374/EEC of 25 July 1985 on the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for defective products (amended in 1999).

27 European Union (1985), Council Directive 85/374/EEC of 25 July 1985 on the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for defective products (amended in 1999); State of California (1944), Escola v. Coca Cola Bottling Co. (1944) 24 C2d 453, Traynor concurrence, http://online.ceb.com/CalCases/C2/24C2d453.htm, viewed 9 September 2018.

28 European Parliament resolution of 16 February 2017 with recommendations to the Commission on Civil Law Rules on Robotics, 2015/2103(INL); and European Commission (2020), Report on the safety and liability implications of Artificial Intelligence, the Internet of Things and robotics, COM(2020) 64 final.

4.3. The Ecodesign framework and related trustmarks

A general EU framework is already in place to promote energy efficiency (the Ecodesign Directive, 2009/125/EC). Ecodesign includes both trustmarks and an industry consultation framework. As we noted in Section 3.1.3, Ecodesign has typically been used in regard to energy consumption of appliances that require considerable power, such as washing machines, and not to product lifetime issues. However, it can easily be re-purposed and extended, and in fact has already been moving in this direction.

In this section, we explain how the Ecodesign framework works in general, how it interacts with the CE trustmark and the Ecolabelling framework, and how it is applied to light sources.

4.3.1. The evolving Ecodesign framework

The Ecodesign framework (as defined in Directive 2009/125/EC) can be used to impose mandatory environmental standards on any *energy-related product* (very broadly defined) in the interest of promoting energy efficiency.

Ecodesign envisions both mandatory obligations, which can be enforced by granting or withholding the CE trustmark (see Section 4.3.2), and also "softer" controls through for instance labelling and information measures (see Section 4.3.3). Notably, there is scope for voluntary agreements with industry and for self-regulation (Art. 17, Annex VIII).

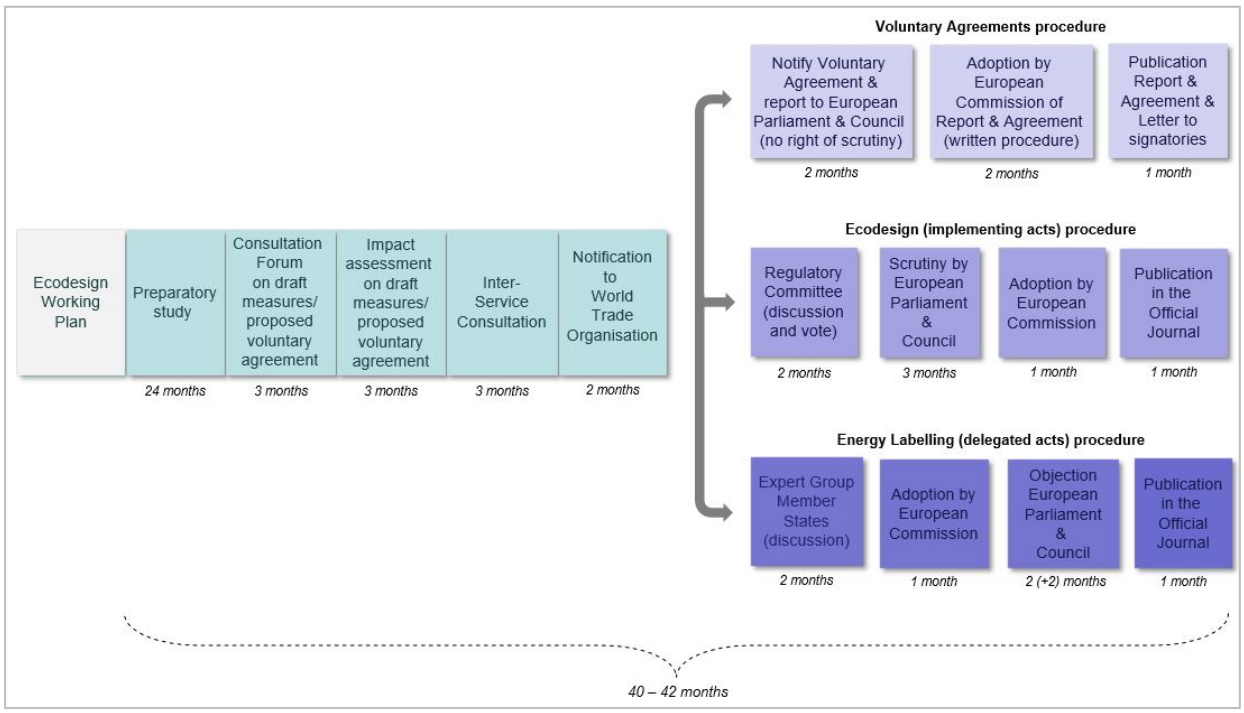
Starting with the Ecodesign working plan 2016-2019, Ecodesign has been evolving in the direction of taking a more activist role toward the durability, repairability, and efficient recycling of energy-using products. As the Commission has noted, the "availability of spare parts, easy replaceability and access to repair and maintenance information for professional repairers have been introduced for refrigerating appliances, household dishwashers, household washing machines and household washer-driers, electronic displays and refrigerating appliances with a direct sales function".

The Ecodesign framework has been implemented using a procedural structure (see Figure 14) that seems to be well suited to the kind of detailed, product-specific measures that are warranted in regard to the promotion of product durability. It provides flexibility, and provides for extensive feedback from stakeholders and from the Member States. As the Commission explains[29], the steps are:

- An in-depth "preparatory study" with the involvement of stakeholders that explores the technical, economic, environmental and social aspects of a product group;
- An extensive stakeholder consultation (including industry, consumer organisations, environmental Non-Governmental Organisations (NGOs), Member States representatives, etc.) through the so-called 'Consultation Forum';
- An assessment of the impacts on the environment, industry and consumers, followed by expert discussions and a vote in a committee with Member State representatives;
- Final scrutiny by the European Parliament and Council who may reject the measure.

[29] European Commission (2019), "New energy efficiency labels explained", https://ec.europa.eu/commission/presscorner/detail/en/MEMO_19_1596.

Figure 14: The Ecodesign framework decision process for energy efficient products



Source: European Commission (2019)[30]

Standardisation plays a substantial role in the Ecodesign framework, as in all product safety and measurement measures. It identifies three *European standardisation organisations (ESOs)*[31], and empowers the Commission to issue mandates to each. Standards are developed by a consensus-based process that include national standardisation organisation, consumer advocates, trade unions and environmental interests. The main standards of interest here are *harmonised standards*, which are defined in the Regulation on European standardisation as "European standard[s] adopted on the basis of a request made by the Commission for the application of Union harmonisation legislation" (Regulation 1025/2012, Art. 2(c)). Compliance with a European harmonised standard is in principle voluntary. If the product cannot be sold in the EU/EEA without a CE trustmark, however, compliance is *de facto* obligatory.

In the Ecodesign framework, the Commission is empowered to create and maintain *implementing measures* for products where the volume sold is sufficiently high, where the environmental impact within the Union is significant, and where either market failure is present or else a wide variety of products is present on the market (Art. 15). A harmonised standard that has been published in the Official Journal can identify the portions of the standard which must be complied with in order to be deemed in compliance with the relevant implementing measure, in which case all Member States must presume the product to be in compliance (Art. 9) and may not impede free movement or sale within their respective territories. The Ecodesign framework contains the provisions necessary to empower the Commission to determine whether a standard is adequate to define compliance with an implementing measure, and to issue a mandate for a revised standard if appropriate (Arts. and 10).

[30] European Commission (2019), "New energy efficiency labels explained", available at: https://ec.europa.eu/commission/presscorner/detail/en/MEMO_19_1596.

[31] The European Committee for Standardisation (CEN), the European Committee for Electrotechnical Standardisation (Cenelec), and the European Telecommunications Standards Institute (ETSI). See also European Union (1985).

4.3.2. The CE trustmark

Trustmarks are a component of the European aegis for product safety, reliability and harmonisation that is sometimes overlooked.

The CE trustmark can be used to promote sustainable practice. The CE marking indicates that the manufacturer or importer claims compliance with the relevant EU legislation applicable to a product, regardless of the place of manufacture. It is recognised worldwide. For example, most electrical products must comply with the Low Voltage Directive and with the "Electro Magnetic Compatibility" (EMC) Directive, the latter meaning that the device will work as intended, without interfering with the use or function of any other device. Toys must comply with the Toy Safety Directive. Relevant EU requirements could include safety, health, and environmental protection.

The CE trustmark can thus be viewed as an enforcement or compliance mechanism for EU product safety rules, and also for other EU regulations. Environmental protection is already in scope, and standards for the CE trustmark can in effect be highly granular. In particular, the use of the CE marking to ensure compliance with any mandatory Ecodesign rules is already reflected in Articles 3 and 5 of the Ecodesign Directive (Directive 2009/125/EC).

The CE trustmark is a strong mechanism, and therefore a rather forceful intervention. Products of relevant categories cannot be sold in the EU or the European Economic Area (EEA) without the CE marking. Consequently, its use for a related but distinct purpose would need to be thought through carefully. As previously noted, it risks removing from the market products that some consumers desire, thus restricting consumer choice. Benefits and risks would therefore need to carefully be weighed.

At the same time, the CE mechanism is in principle well suited to enforce compliance with other EU rules, including any rules on product lifetimes that were felt to be sufficiently important to warrant "hard" enforcement.

4.3.3. Energy labelling

The European energy labelling framework of Regulation (EU) 2017/1369 (which replaces and repeals Directive 2010/30/EU), and which is closely aligned with Ecodesign Directive, provides for a "softer" use of trustmarks that do not necessarily permit or prevent the sale of a product, but rather serves to ensure that consumers are properly informed (see Figure 15, which depicts the new format).

The 2017 Regulation is applicable to any new *energy-related product*, which is defined very broadly as any "good or system with an impact on energy consumption during use which is placed on the market or put into service, including parts with an impact on energy consumption during use which are placed on the market or put into service for customers and that are intended to be incorporated into products".

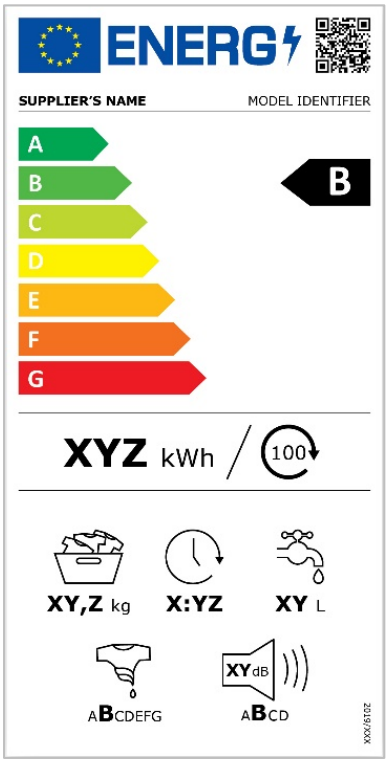
Energy labels are tailored to specific products through Delegated Acts. They need not be limited to energy consumption, but can also include "where appropriate, the use of other resources and supplementary information concerning the product, in which case the label shall emphasise the energy efficiency of the product. Supplementary information shall be unambiguous and with no negative impact on the clear intelligibility and effectiveness of the label as a whole towards customers. It shall be based on data relating to physical product characteristics that are measurable and verifiable by market surveillance authorities." (Art. 16(3)(c))

As with the Ecodesign framework (see Section 4.3.1), the Ecolabel process is integrated with the European standardisation process. The Commission is obliged to publicly indicate any "harmonised

standards that satisfy the relevant measurement and calculation requirements of the delegated act" (Art. 13).

We see no reason why information relevant to product lifetime could not be included on the energy label, as long as it does not detract from the overall clarity of the label. This appears to have been put in place as regards light sources (see Section 4.3.4).

Figure 15: An example of an energy labelling trustmark (washing machines and washer-driers)



Source: European Commission[32]

4.3.4. The application of the Ecodesign framework to light sources

Regulation (EU) 2019/2020 laying down ecodesign requirements for light sources and separate control gears demonstrates what can be done.

It defines the lifetime of LED/OLED light sources as "the time in hours between the start of their use and the moment when for 50 % of a population of light sources the light output has gradually degraded to a value below 70 % of the initial luminous flux." It then sets a minimum expected lifetime.

It also requires the lifetime to be "visibly displayed on the packaging".

The Regulation also includes a provision to facilitate repair and disassembly (including at the time when the luminaire is taken out of service). In the past, incandescent light bulbs had a lifetime far shorter than the fixture (or luminaire) into which they were placed. Consequently, light bulbs were designed to be easy to replace. As the Commission noted in its Impact Assessment for this Regulation, the expected lifetime of an LED or OLED might well be comparable to that of the luminaire, so it was increasingly common for the LED to be permanently mounted. The Commission noted that this could be problematic but also accepted that there could legitimate reasons to do so.

[32] European Commission, "About the energy label and ecodesign", available at, https://ec.europa.eu/info/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/energy-label-and-ecodesign/about_en.

Taking all of this into account, Article 4 of the Regulation obliges manufacturers and importers to ensure "that light sources and separate control gears [a sort of power supply] can be replaced with the use of common available tools and without permanent damage to the containing product, unless a technical justification related to the functionality of the containing product is provided in the technical documentation explaining why the replacement of light sources and separate control gear is not appropriate." Instructions on how to dismantle must be provided to end-users or qualified persons as appropriate.

This Regulation provides an excellent "proof of concept" as to how the current Ecodesign framework can accommodate needs for minimum product lifetime, for informing prospective customers as to the expected lifetime of a product in order to facilitate informed choices, and for promoting modularity so as to facilitate ease of replacement by the user of components that have gone bad.

4.4. The EU's new Circular Economy Action Plan

As part of the European Green Deal, the European Commission published an updated Circular Economy Action Plan in March 2020 (European Commission, 2020a), together with a number of supporting documents. Prominent among the supporting documents is a new Eurobarometer consumer survey of "Attitudes towards the impact of digitalisation on daily lives" (Eurobarometer 503, 2020).

As noted earlier, the new plan rightly seeks to reflect Circular Economy principles into the basic design of key products. This reflects the recognition that as much as 80 % of the environmental impact of a product can be determined at the design stage (European Commission, 2012). These efforts will focus on seven relevant value chains:

- Electronics and ICTs;
- Batteries and vehicles;
- Packaging;
- Plastics;
- Textiles;
- Construction and buildings; and
- Food, water and nutrients.

The Commission has made clear that the "core of this legislative initiative will be to widen the Ecodesign Directive beyond energy-related products so as to make the Ecodesign framework applicable to the broadest possible range of products and make it deliver on circularity." This is fully in order, and arguably overdue. It is in line with our assessment that the Ecodesign framework represents the most promising set of instruments in this area.

Another major element is consumer and purchaser empowerment by means of trustmarks and information. Particularly relevant is the intent to "ensure that consumers receive trustworthy and relevant information on products at the point of sale, including on their lifespan and on the availability of repair services, spare parts and repair manuals." This is coupled with increased scrutiny to ensure that companies make good on their environmental claims.

Finally, the Circular Economy Plan includes an attempt to drive more circularity into EU industrial processes.

4.5. Member State initiatives

One should not neglect the possibility to work with the Member States, some of which are also moving to establish trustmarks.

For example, the German government already uses its Blue Angel trustmark to encourage the energy and resource efficiency of some 12,000 products. The Blue Angel recognises products that are safe, and more environmentally friendly than comparable products. Household products, paper and printing, electrical products and more fall within its scope. Key criteria to be awarded a Blue Angle include:

- resource-conserving production (water, energy);
- preferential consideration of recycled materials e.g. for paper and plastic;
- sustainable products made out of raw materials;
- the avoidance of pollutants in products;
- reduced emissions of harmful substances into the soil, air, water and indoor spaces;
- reduction in noise and electromagnetic radiation;
- efficient use and products that use a low level of energy or water;
- durability, repairability and recyclability;
- good fitness for use; and
- return systems and services that enable the common use of products such as car sharing.

The German BMU (Federal Ministry for the Environment, Nature Conservation and Nuclear Safety) also plans to develop criteria and a trustmark for environmentally compatible Artificial Intelligence (AI). (German BMU, 2019)

Many other Member States have relevant initiatives either in place or in plan.

It is not clear how these programmes should relate to corresponding initiatives at EU level, but there seem to be opportunities to maintain dialogue between the EU and the Member States, to seek synergies, and to avoid any counter-productive inconsistencies.

4.6. Private actors including non-profit organisations

It is worth noting that private entities, especially not-for-profit institutions, play an important role in many countries in helping to ensure that consumers are properly informed as to the quality, service record and/or expected longevity of durable consumer products and services.

In Germany, we would point to Stiftung Warentest[33]. Stiftung Warentest is in principle a private not-for-profit foundation that publishes numerous magazines, books and web articles that serve to review products and services. It was founded by the German government, and receives an annual subsidy from the government to compensate it for not accepting advertising (which might compromise its independence), but is otherwise independent and self-funding.

[33] See https://www.test.de/.

In the US, Consumer Reports (formerly Consumers Union) fulfils a similar role, especially through its magazine *Consumer Reports,* and through books, web articles, and a huge number of product reviews[34]. Consumers Reports is fully independent and self-financing.

Both would appear to be very effective. The difference in structure between the two reflects in part differences in EU versus US preferences as to the degree of government involvement, but also reflects the fact that the US is a larger market than any individual EU Member State. Operating in a market that has more consumers presumably makes it easier to cover the fixed costs of running such a service.

Finding 17. Private (not-for-profit) institutions can also play an important role in ensuring that consumers are well-informed as to the quality, service record and/or expected longevity of durable consumer products and services.

4.7. Comparative assessment of the suitability of the instruments

Comparative assessment of the different instruments available at EU level leads to some clear conclusions. We begin with some general observations.

The Commission itself has observed that "there is no comprehensive set of requirements to ensure that all products placed on the EU market become increasingly sustainable and stand the test of circularity." (European Commission, 2020a). This finding is in line with Montalvo et al. (2016).

Finding 18. Other than in the Ecodesign framework, there is very little connection today between any existing EU instrument and product longevity.

Finding 19. Detailed policies will need to be highly differentiated product by product, and adaptable over time. "Soft" approaches ensuring that consumers can make informed choices will often be preferable to "hard" approaches that outright block the sale of products that some consumers may want.

Next, we provide a comparative assessment of available instruments at EU level.

Finding 20. The Ecodesign framework is well-suited to the promotion of the full range of product longevity goals, and should be the preferred mechanism. It supports both "hard" and "soft" mechanisms. Its use in the case of light sources provides a clear "proof of concept" as to how the current Ecodesign framework can accommodate (1) needs for minimum product lifetime, (2) needs to inform prospective customers as to the expected lifetime of a product in order to facilitate informed choice, and (3) for the promotion of modularity so as to facilitate ease of replacement by the user of components that have gone bad. The new Circular Economy Action Plan rightly places its emphasis here.

Finding 21. The product safety framework, perhaps in conjunction with the CE trustmark, could be used to require and enforce product longevity in specific cases if desired. These arrangements are however mainly suitable only for cases where a "hard" enforcement is appropriate. We see no obvious reason to prefer these arrangements to the more flexible possibilities of the Ecodesign framework.

Finding 22. The EU has a good, comprehensive strict liability regime for products. It is difficult to see any applicability of this framework to the promotion of longer product lifetimes.

[34] Consumer Reports, "Products A-Z", https://www.consumerreports.org/cro/a-to-z-index/products/index.htm.

For action at EU level, adherence to the Better Regulation framework is always important. We place strong emphasis on the need for good process in line with Better Regulation principles. As emphasised in Sections 2 and 3, it is not necessarily the case that lengthening the product lifetime of every product is positive for energy consumption and reduction of GHGs. Further, the detailed measures chosen can be highly product-specific and sector-specific, and need to reflect the likely evolution of the sector over time.

Finding 23. Given the complexity of this topic, and the need for product-specific and sector-specific knowledge, good adherence to Better Regulation principles is especially important. We would particularly emphasise the importance of a comprehensive consultation process that obtains good feedback from both market players and consumer advocates.

In addition, synergies with Member State initiatives and with private initiatives should not be forgotten. Initiatives undertaken by industry can also be highly relevant, in line with Recital 18 of the Ecodesign Directive, which says in part: "Priority should be given to alternative courses of action such as self-regulation by the industry where such action is likely to deliver the policy objectives faster or in a less costly manner than mandatory requirements."

Finding 24. The EU would be well advised to coordinate with Member State initiatives, especially in the trustmark area.

Finding 25. Reliable private/non-private entities could play an important role, as with Stiftung Warentest in Germany or Consumer Reports in the US.

Finding 26. Industry can also play a constructive role, and will sometimes be able to deliver on these policy objectives faster or in a less costly manner than mandatory requirements.

We have also identified one notable gap in all existing arrangements of which we are aware:

Finding 27. Consumers would benefit, not only from information about service records and expected product lifetime among competing products, but also from comparative statistics on the *Total Cost of Ownership (TCO)*. It is challenging to provide this, and we know of no good existing solution.

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Product longevity can play a useful role in achieving the Paris Agreement goals —material efficiency is an important contributor to energy efficiency and is also important in its own right. The product safety and compliance instruments available at European level can contribute to these efforts, if wisely applied.

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