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BEREC Report on ICT sustainability for end-users: Empowering end-users through environmental transparency on digital products

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Executive Summary

The green transition stands as a fundamental concern for European citizens who want to play an active role in meeting global environmental targets: 88% of Europeans support the goals of this green transition, while 77% of them feel a personal responsibility to act to limit climate change.[1] However, those wishing to actively contribute to this transition often encounter hurdles, primarily in the form of insufficient information regarding the environmental impact of products, as well as lack of comparability and reliability of such information when available. Additionally, unfair market practices, especially those related to planned obsolescence, pose significant challenges to environmental goals.[2] Given the undeniable significance of the ongoing digitalisation of the daily lives of European citizens, it is imperative for the digital sector to address these issues and play a vital role in empowering end-users to engage in the green transition.

In light of these considerations, BEREC has undertaken an in-depth examination of transparency regarding the environmental impact of digital products (both goods and services[3]) and the empowerment of end-users regarding their ability to make environmentally sustainable decision on these products. Building upon two initial BEREC reports focusing on the roles of regulators and the industry in the realm of Information and Communication Technology (ICT) environmental sustainability, this report focuses on the specific challenges pertaining to digital services and end-user devices. BEREC initiated a comprehensive fact-finding process to enhance the knowledge of member National Regulatory Authorities (NRAs) which involved: (i) a review encompassing key concepts derived from both pertinent literature and European Union (EU) initiatives; (ii) an internal questionnaire to assess activities carried out at the national level; (iii) a workshop featuring the European Commission, expert consulting firms (namely Ramboll and RESILO), and representatives from consumer and environmental organisations (namely BEUC and the European Environmental Bureau, EEB). The main findings derived from these endeavours are presented within this report, with the following key messages:

1. Providing reliable, comparable and clear environmental data enables end-users to integrate environmental aspects in their purchasing decisions and promotes the most sustainable products within digital markets. This approach, previously termed “data-driven regulation” in BEREC's publications,[4] can leverage various tools including environmental labels, indices, public data bases and best practices. This report insists on the need of a standardised approach that considers all relevant environmental impacts of ICT products life cycle (e.g. GHG emissions, energy efficiency, mineral/metal consumption) and welcomes the recent

[1] Eurobarometer “Fairness perceptions of the green transition” (2022)
[2] The European commission also lists some of these challenges in the impact assessment of the empowering consumers in the green transition initiative. Executive summary here (2022).
[3] This definition is consistent with the definition of “ICT product” by ITU. Read more here.
[4] The idea of a “data-driven regulation” refers to the provision of information to enlighten consumption’ choices and provide positive incentives within markets, complementary to the traditional tools of regulators. The concept was used in various BEREC documents including : BEREC Report on ICT Sustainability (2022) or BEREC Report on ex ante regulation for gatekeepers (2022). BEREC also mentioned this concept in its 2021-2025 Strategy.

initiatives of the EU, such as the extension of energy labelling to digital devices or the upcoming EU digital product passport.

2. Environmental transparency plays a pivotal role to inform end-users about their environmental rights as consumers. These entitlements encompass a range of rights such as guaranteed conformity, right to repair, protection against unfair commercial practices, (especially with regard to obsolescence and greenwashing). More generally, informational resources serve as mechanisms to facilitate implementation of new EU regulations that harmonise the realms of consumer protection and environmental compliance.

3. Information is also key to raising awareness on end-users' digital services and devices' environmental footprint. While the digital services are mostly perceived as intangible phenomenon, their lifecycle represents multiple environmental impacts in terms of GHG emissions, but also of the critical raw materials used across their life cycle, including waste after the decommissioning phase. Information on best practices to mitigate this impact as well as promotion of criteria to support greener digital services could reinforce the empowerment of online users. Furthermore, as end-users' devices represent the majority of the ICT sector's environmental footprint, transparency tools should also serve the purpose of environment-friendly use of digital devices and expansion of their lifespan. Finally, it should be used to mobilise manufacturers and all value chain parties to more sustainable production.

4. Important steps have been taken on environmental transparency and end-users' empowerment during the EU Green Deal, and challenges remain ahead. The implementation of this new ambitious disposals would mobilise important resources (including energy labelling and digital product passport). Also, the number of existing initiatives in Member states highlights the need for strong coordination to have harmonised and comparable tools in EU digital markets.

5. The efforts of the ICT industry are essential for end-users empowerment and environmental transparency on digital products. It will be important to go further in terms of publication of environmental data by industry players of the digital value chains including from devices manufacturers, content and applications providers and telecom operators. This data is needed to build a holistic view of digital devices and services environmental footprint.

6. Associating consumer and environmental organisations as well as the scientific community in the design and execution of environmental and consumer regulation appears crucial. These stakeholders are decisive players to build actionable and science-based tools to promote end-users' empowerment and ICT sustainability. Beyond transparency, these organisations can bolster efforts made by public bodies and the industry in fostering a digital sector sustainable by design, granted the provision of suitable means.

7. Telecom regulators have a role to play to support end-users' awareness on the environmental footprint of ICT products, in collaboration with other competent bodies. The growing expertise of NRAs on ICT environmental footprint and their traditional activities on end-users' empowerment could support existing efforts to better inform end-users on the sustainability of digital devices and services. Some NRAs have already launched individual

initiatives and further projects are expected among BEREC members. BEREC will also play an active role in 2024 with an online communication campaign focused on end-users devices' sustainability.

As a final word, BEREC reiterates its commitment to work towards a sustainable digital sector and to support with its expertise the twin green and digital transition in Europe.

1. Introduction

Digital technologies are shaping citizens' day-to-day lives and remodelling economic actors' business models. Even though digital solutions can support the decarbonisation of other sectors, the prominence of digitalisation makes it clear that the ICT sector, must also undergo its own green transition and take its part in achieving environmental targets, including net zero emissions by 2050. These sustainability goals were notably highlighted by the European Green Deal[5] which sets out the objective of achieving climate neutral digital infrastructures by 2030 and the application of circular economy principles to digital devices life cycle. Another important environmental target to note is the need to decrease the pressure on demand for raw materials, especially metals and minerals used in the production of digital devices.[6]

Since 2020, BEREC has been committed to supporting the implementation of the European Green Deal's ICT-related goals. In this context, the empowerment of end-users through information on their rights and the environmental impact of digital services and devices appears as a key lever for the development of environmentally sustainable digital offerings.

As mentioned in BEREC's first report on ICT Sustainability,[7] end-users can have difficulties in accessing information on environmental impact, for example data and indicators concerning the digital equipment and services they are using, or regarding actionable rights or best practices in terms of using digital goods and services in an environmentally sustainable way. This absence of available information is not aligned with the growing general interest in global environmental targets. According to Eurobarometer, in 2022, a large majority of Europeans (93%) believed that climate change is a serious problem the world is facing. Moreover, 73% of Europeans agreed that the cost of damage caused by climate change is much higher than the investments needed for the green transition[8] and three-quarters (75%) of Europeans agreed that action taken to tackle climate change will foster innovation.[9]

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[5] This is only one example. Significant environmental targets are mentioned in other communication and plans such as: the European digital strategy "Shaping Europe's Digital Future" (2020), EU New Circular Economy plan (2020) and more recently EU Action Plan to Digitalise the Energy sector (2022).

[6] According to the OECD, the world's consumption of raw materials is set to nearly double by 2060. https://www.oecd.org/environment/global-material-resources-outlook-to-2060-9789264307452-en.htm

[7] BEREC report "Assessing BEREC's contribution to limiting the digital sector's impact on the environment" (June 2022)

[8] This is reinforced by the results of a study called Stern Review, made by the economist Nicholas Stern in 2006, that the cost of inaction would be greater for the future generations than the costs of actions taken today.

[9] Special Eurobarometer 538 Climate Change - page 59.

In 2023 and for 2024, BEREC has added the empowerment of end-users through environmental transparency on digital products in its agenda on sustainability. The focus of this report is to analyse the means to increase ICT-related environmental transparency towards end-users, in order to enable their contribution to the green transition. It should be noted that this workstream is part of a larger body of work by BEREC on the environmental footprint of the ICT sector, including the promotion of environmental accountability of companies – which is essential to accelerate the digital sector's green transition. For example, in 2023, BEREC published report on sustainability indicators for ECN/ECS,[10] that provides detailed analysis of existing practices on regulation (including CSRD/Due Diligence Directive, Taxonomy framework, …) and identifies the challenges for telecom regulators with regards to environmental data collection. This report focuses on specific issues considering the user perspective, for instance in terms of availability, readability and reliability of information as well as its impact on consumption choice. It should be noted that there is still a clear correlation between the aspects covered by BEREC previous report on the industry's non-financial reporting framework and the requirements in terms of sustainability-related communication to end-users.

This BEREC report on 'Empowering end-users through environmental transparency on digital products' aims to analyse existing findings in terms of environmental information to end-users in order to support their empowerment in achieving sustainable digital technologies, both goods and services. To do so, a summary of relevant EU regulation and key concepts from literature are presented in this report, as well as the inputs provided during BEREC workshop organised for this purpose with expert consultants collaborating with the European Commission and representatives of environmental and consumer associations. This document also features a benchmark of initiatives supporting the empowerment of end-users carried out by NRAs, various public authorities and third parties in BEREC member states. Finally, the report concludes with recommendations on the role of telecom regulators in promoting environmental transparency. The report will be complemented in 2024 by a communication campaign regarding the environmental footprint of end-users devices,[11] best practices to reduce the environmental impact of their devices, and their new rights to more transparency and sustainable devices thanks to the achievements of the EU Green Deal (i.e. "right to repair", "smartphones and tablets labelling", EU digital product passport).

As in its other previous publications, BEREC aims to adopt a holistic approach to the issues related to ICT sustainability. To this aim, the different aspects of the digital ecosystem will be included in the analysis, i.e. networks, data centres, devices, digital services and ways of use, as well as the interdependencies between those different elements. Furthermore, the entire life cycle of digital products is considered, as well as all the relevant environmental impacts including greenhouse gas (GHG) emissions, energy consumption, critical raw materials and

[10] BoR (23) 166

[11] This communication campaign will be focused on users' digital devices whereas the European Commission DG Energy is working on a campaign regarding end-user's digital services. See: EU Action Plan to Digitalising the Energy System (2023).

abiotic resources used (mineral/metal). Particular attention will be given to ICT products on business to consumers markets, hence, digital services and devices.

2. Key concepts on empowering end-users through environmental information on digital products

This chapter will gather the most striking concepts BEREC identified when approaching the topic. This analysis is thus based on desk research of past BEREC publications, a literature review and an analysis of the existing European regulatory initiatives related to the empowerment of end-users in the green transition as well as on information and transparency regarding the environmental sustainability of the ICT sector.

2.1. Environmental transparency for end-users' awareness and data-driven regulation

Environmental transparency is one of the tools for action in the European Green Deal, and more broadly, for the green transition. The provision of information on sustainability to end-users is crucial to develop data-driven incentives favouring the most environment-friendly production patterns as well as the consumption of sustainable products in the digital sector.

2.1.1. Environmental information on markets for a data-driven regulation on ICT sustainability

When having clear, reliable and informative indicators on the environmental impacts of ICT, end-users are enabled to integrate environmental criteria into their decision making on consumption. The positive influence of information dissemination on markets is not limited to the digital sector or environmental sustainability. The publication of data is used to support the regulatory objectives defined by the public authorities. BEREC has conceptualised this phenomenon as "**data-driven regulation**" [12] which means making data available to enlighten users' consumption choices and guide the market with the right information. Applied to sustainability, the publication of clear, readable and reliable environmental information can help enlighten consumption choices and make the end-users important players in promotion of the most sustainable products. Through this process, economic players could be incentivised through information displaying to invest in the development of green digital

[12] The concept of "data-driven regulation" refers to the provision of information to enlighten consumption' choices and provide positive incentives within markets, complementary to the traditional regulatory tools. Indeed, regulators can rely on the collection (also via crowdsourcing), storage, processing, usage and publication of data to support their supervisory, analysis and detection activities and making stakeholders more accountable. Moreover, making valuable data available means empowering end-users and citizens to make well-informed choices and steer the market into the right direction. The concept was used in various BEREC documents including : BEREC Report on ICT Sustainability (2022) or BEREC Report on ex ante regulation for gatekeepers (2022). BEREC also mentioned this concept in its 2021-2025 Strategy.

devices and services. Data-driven regulation can also be seen as a means to redirect competition towards environmental goals, and to make environmental information available to support the decision-making process of public entities.

A vast number of information-tools can be used to communicate to end-users the impact and environmental characteristics of products, among others, **labels, indices, logos, (open) databases or communication campaigns.** Various studies have underlined that providing consumers with information prior to purchase enables them to make informed decisions that reduce the environmental impact of their consumption habits and to assess this impact. A survey by Wrap showed that labels signalling energy consumption can influence purchasing decisions and information on monetary running costs may also have an impact.[13] In experimental settings, end-users who received information about product durability and reparability were three times more likely to make sustainable choices (with significant variation between product groups).[14] In general, a lack of clear, comparable and comprehensive information about the environmental impacts of products has been identified as a persistent challenge for empowering consumers to play an active role in the green transition.[15] However, the effect of labels seems to vary when it comes to different types of end-users.

These expected positive effects of environmental transparency are only foreseeable if sustainability-related communication towards end-users is sufficiently standardised and reliable to enable comparability and prevent greenwashing. The European Union is aware of this challenge and is working to create a legal framework to standardise information tools and avoid unsubstantiated green claims.

2.1.2. Overview of the EU's initiatives supporting reliable information tools on sustainability for end-users

Firstly, the European framework on Ecodesign is paired with a **regulation on energy labelling** that already improves the communication on certain categories of products[16]. First introduced for a number of household appliances in 1994 and subsequently expanded in 2004 – with a comparative scale from A (most efficient) to G (least efficient) – the EU energy label aims to help consumers to choose the most energy efficient products and to incentivise businesses to adopt more energy efficient technologies. In 2019, 79% of EU Citizens considered this label when buying energy efficient products, according to a specific Eurobarometer 492.[17] A more comprehensive labelling scheme for smartphones and tablets has been provided by the Commission Delegated Regulation with regard to the energy labelling of smartphones and slate tablets including information about the device's energy

[13] Wrap (2019) *Effectiveness of providing pre-purchase factual information.*
[14] Cerulli-Harms et al (2018) *Final Report: Behavioural Study on Consumers' Engagement in the Circular Economy. Preparatory study for the Proposal for a Directive on empowering consumers for the green transition.*
[15] European Commission (2021) *Preparatory study to gather evidence on ways to empower consumers to play an active role in the green transition*.
[16] EU Regulation 2017/1369 setting a framework for energy labelling and repealing Directive 2010/30/EU
[17] Special Eurobarometer 492: Europeans' attitudes on EU energy policy https://data.europa.eu/data/datasets/s2238_91_4_492_eng?locale=en

efficiency rating, the durability of a screen, the number of times a battery can be charged, the battery run time per charge, as well as the device's reparability score and ingress protection capacity (see Figure 1).[18]

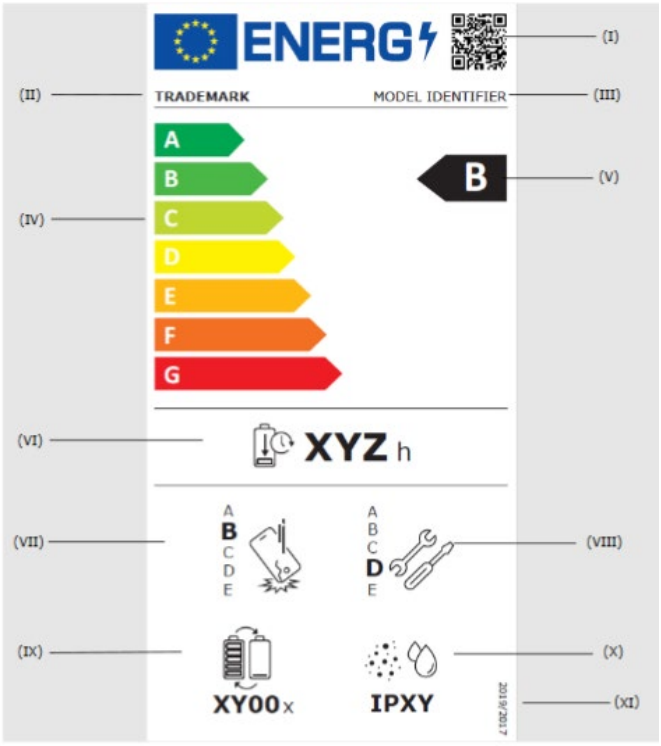

Figure 1: Label for smartphones introduced by the energy labelling of smartphones and tablets regulation (2023) [19]

Another complementary initiative to mention is the **voluntary EU Ecolabel**[20] recognised in all Member States of the European Union, as well as Norway, Liechtenstein and Iceland. The voluntary label, introduced by an EU regulation in 1992 (Regulation EEC 880/92), has gradually become one of the reference points for consumers who want to help reduce pollution by purchasing more environment-friendly goods and services. The label is awarded to products that have a lower environmental impact than comparable products. The EU Ecolabel is intended to enable consumers to identify more environment-friendly and healthier products. In terms of product groups – the "electronic equipment" category currently covers televisions, computer monitors, and signage displays.

[18] Commission Delegated Regulation (EU) 2023/1669 of 16 June 2023 supplementing Regulation (EU) 2017/1369 of the European Parliament and of the Council with regard to the energy labelling of smartphones and slate tablets
[19] Same as above.
[20] https://eu-ecolabel.de/en/

The 2022 Commission's proposal for a **new Ecodesign for Sustainable Products Regulation** (ESPR),[21] amending the 2009 Ecodesign Directive,[22] includes the establishment of EU Digital Product Passport aimed to communicate information required for products, potentially also to provide end-to-end traceability. The upcoming "**Digital Product Passport**" is designed to offer insights into the environmental sustainability of products. Accessible through scanning a data carrier, this passport should provide details like product's longevity, reparability, recycled materials used, and the availability of spare parts. It aims to empower consumers and businesses with the information they need to make well-informed purchasing decisions, simplify repair and recycling processes, and enhance transparency regarding a product's environmental impact throughout its life cycle. Additionally, the product passport is expected to support public authorities in more effectively conducting inspections and controls. Additional information on the ESPR proposal is provided in Section 2.2.

With its other proposal for a **Directive on green claims,**[23] published in March 2023, the Commission aims to create a framework of environmental labels/schemes/claims that citizens can trust. More precisely, it introduces common criteria to substantiate and verify environmental claims. Based on this directive, green claims should be recognised as based on scientific evidence and state of the art of the technical knowledge. They should also demonstrate the significance of impacts, aspects and performance from a life cycle perspective. These claims should make apparent whether a positive achievement leads to significant worsening of another impact. In the same line, reporting of greenhouse gas offsets should be assessed in a transparent manner. The proposal also calls for national authorities to establish a validation procedure.

The above-mentioned directive notably outlined the **Product Environment Footprint** (PEF)[24] as one of the methodologies of reference to substantiate industry-players' environmental claims. The PEF methodology was developed by the European Commission to reduce fragmentation of methods to assess the environmental impact of products. The **PEF Product Category Rules** (PEFCR, also named "**PCR**") are Product Environmental Footprint rules specific to different product groups/categories. These Category Rules standardise how life cycle analysis of product in one product group is conducted and communicate the environmental impacts to end-users. As mentioned in BEREC Report on sustainability indicators, implementation of PCR is only at the beginning in the digital industry and could be critical to achieve greater harmonisation and transparency in the sector, including towards end-users.

The European Economic and Social Committee (EESC) discussed a complementary idea of lifespan labels which make the (material or functional) lifetime of a device transparent to end-

[21] https://commission.europa.eu/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/sustainable-products/ecodesign-sustainable-products-regulation_en
[22] https://commission.europa.eu/energy-climate-change-environment/standards-tools-and-labels/products-labelling-rules-and-requirements/energy-label-and-ecodesign_en
[23] Proposal for a Directive on Green Claims (2023)
[24] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32021H2279

users prior to purchase. [25] This proposal targets an issue that appears to be difficult for end-users to understand and where the majority would like to receive more information. Although this proposal has never been implemented at European level, it should be noted that some European countries[26] and third parties have implemented or are in the process of implementing a "durability" index (see also: Box 1) that tends to echo the EESC proposal (see Chapter 4). Lifespan labelling appears to be an effective measure to increase circular practices of end-users, but in the case of digital devices, this lifespan may be influenced by a number of factors (see also: Box 2). For instance, the functional lifespan of a phone is limited through hardware, software and mobile network compatibility. The hardware components may have different lifespans (e.g., the battery may cease to function properly long before the processors do), while the software functionality is limited by the period of support which device manufacturers offer for the operating system. Network compatibility on the other hand is less of an issue with smartphones due to their swift replacement cycles, but may be a concern in a machine-to-machine (M2M) context.[27]

FOCUS ON KEY CONCEPTS #1: DURABILITY

Durability is the ability of a physical product to remain functional, without requiring excessive maintenance or repair, when faced with the challenges of normal operation over its design lifetime.[28] Often synonymous with product lifespan, durability of product plays a vital role in achieving a circular economy. Prolonging a product's usefulness reduces resource consumption, waste, and helps consumers save money by reducing the need for frequent replacements. A durable product is robustly constructed with high-quality materials and designed to enhance material efficiency and promote:

1. Reusability: extending a product's life through resale, refurbishment, or recycling.
2. Maintenance: making product maintenance accessible, simple, and cost-effective for end-users.
3. Reparability: designing products for easy repair and ensuring accessible repair services.
4. Upgradeability: enabling upgrades within product groups to extend their lifespan without full replacement, including personalisation.
5. Longevity: designing reliable and robust product components.

Product durability is not determined solely by its manufactured lifespan; instead, it is influenced by consumer usage patterns, habits, and perceptions of durability. Studies show that many electronic devices are disposed while still functional, with consumer behaviour

[25] European Economic and Social Committee, The potential effects on consumers of the real lifetime of products display, 2016 https://www.eesc.europa.eu/en/our-work/publications-other-work/publications/potential-effects-consumers-real-lifetime-products-display

[26] E.g., France notified an upgrade to repairability index in 2020.

[27] For instance, some connected objects and services are dependent on 2G or 3G networks, which require a migration plan in case this network is shut-off to limit environmental impacts.

[28] Cooper, Tim (1994). "Beyond Recycling: The longer life option" (PDF). The New Economics Foundation, Whitechapel Road, London: 5

often driven by the availability of new models rather than product failure. Consumers also tend to underestimate the expected lifespans of their devices, highlighting the impact of technological innovation on replacement decisions.

Another adjacent concept is the recyclability of a product to ease its recycling, notably by reducing material diversity and facilitating material separation.

Box 1: How to define and main issues on durability (based on Standard assessment for the circular economy under the eco-innovation action plan from DG Environment, 2015).

While a variety of labelling and ranking schemes exists, it is important to note that they are generally not comparable because they use different indicators to evaluate particular categories. Additionally, the weight given to indicators can lead to large differences in terms of outcomes, which are often not transparent or comparable for consumers. The above-mentioned proposed directives from the European Commission could be a path for greater reliability and comparability of labelling scheme and more generally, information tools to end-users.

2.2. Communication on environmental rights to empower the end-users in the green transition

Where consumer rights and environmental regulation meet, informing end-users about their rights and securing their interest is a necessity provided by the European framework. Evidences from literature and institutional sources also underline the importance of communication and information to enable users' to play an important role in the green transition.

2.2.1. The importance of informative content to support the implementation end-users rights in the green transition

End-users' empowerment in the green transition of the digital economy[29] also encompasses protection and expansion of their rights, especially in the context of circular economy. For instance, the fight against programmed obsolescence and for extending the lifespan of digital equipment is at the intersection of environmental regulation and protection of consumers' rights. Other levers include measures such as the ecodesign of digital devices and services or the facilitation of end-users' environmental waste collection.

The promotion of the interests of consumers and informing EU citizens about their rights as consumers, including may include disposals relate to consumers journey in the green transition, is actually a regulatory prerogative of the European Union: article 169 of the Treaty on the Functioning of the European Union, on the protection of consumers, stipulates that the

[29] The term digital economy encompasses ICT solutions as well as other digital products such connected devices, consistent with OECD approach.

EU shall contribute, inter alia, to protecting the economic interests of consumers as well as to promoting their right to information and education in order to safeguard their interests.

More generally, the role of environmental transparency and information is important to support the implementation of the environmental regulatory initiatives and has long been called for by researchers, consumer bodies[30] and even by the consumers themselves. For instance, according to a consumer survey published in 2022 by the European Commission, EU citizens consider the lack of information on the environmental sustainability of products (29%) and the lack of information about products' reparability (27%) as significant barriers preventing them from adopting more sustainable consumption behaviours.[31] Another example from the study: while 30% of Europeans outline the usefulness of information on devices lifespan, only 2% of IT products on EU market displayed information about legal guarantee. Empowering consumers through the provision of information on opportunities of environmental (and economic) savings has thus become a key element of the EU policy framework aiming to increase consumer engagement in the circular economy.[32]

2.2.2. Overview of European initiatives fostering end-users' role in the green transition

The **directive on empowering consumers** for the green transition through better protection against unfair practices and better information[33] is one of the regulations at the intersection of consumer protection and environmental regulation. This directive aims to better inform consumers on the environmental characteristics and durability of the products they buy. It foresees an obligation to inform consumers about the guaranteed durability of products including in the frame of commercial guarantees that secure a durability of at least two years. According to this new regulation, the seller must also provide relevant information on repairs, such as the reparability score (where applicable), or other relevant repair information. Finally, the directive updates the list of commercial practices which are considered unfair, in particular generic environmental claims (including indices or labels) such as "eco-friendly", "eco", "green", "nature's friend", "ecological" and "environmentally correct", or practices which encourage the consumers to replace their products earlier than (technically) necessary. By 27 March 2026, Member States shall adopt and publish the measures necessary to comply with this Directive. Member States shall apply those measures from 27 September 2026.

Aside from the establishment of the EU digital product passport described in Section 2.1, **the Ecodesign for Sustainable Products Regulation** will introduce new requirements for product design with a view to making them more recyclable, durable, reparable, and efficient.

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[30] Braun et al. (2022) *Politische und regulatorische Ansätze zur Verlängerung der Nutzungsdauer von Smartphones*. WIK Diskussionsbeitrag Nr. 486.

[31] Preparatory study to gather evidence on ways to empower consumers to play an active role in the green Transition (2022)

[32] EU new Circular Economy Action Plan (2020)

[33] Directive (EU) 2024/825 of the European Parliament and of the Council of 28 February 2024 amending Directives 2005/29/EC and 2011/83/EU as regards empowering consumers for the green transition through better protection against unfair practices and through better information

It also introduces requirements to include information and performance requirements for certain products, e.g. information on how to install, use, maintain and repair the product or information for treatment facilities on disassembly, recycling, or disposal at end-of-life. The proposal also encourages Member States to develop mechanisms such as eco-vouchers and green taxation to incentivise consumers to make sustainable choices. The proposal, once adopted, will be completed with a series of delegated acts and is notably applicable to mobile phones, cordless phones and tablets set in the Ecodesign regulation. In addition, the legal warranty period of products has been extended to five years, which allows end-users to turn to the seller or manufacturer for repair or replacement of specific components and has been often cited as an effective measure to increase the lifespan of devices.[34]

In order to complete the consumer sustainability journey (after product design and information), the Commission has issued a proposal for **Directive on the "right to repair"**[35] to introduce new consumer rights for easy and attractive repairs. This proposal is currently being negotiated (a political agreement was reached in February 2024), and addresses repairs that may occur during and/or after the legal guarantee has expired, the need to improve transparency of information on repair services and the conditions of such repair, and also facilitating comparisons of repair services.

Finally, it is worth mentioning that other pieces of legislation, not directly targeting end-users, may also have an impact on end-users' experience and could interact with the environmental information delivered to end-users. One example is the revised Energy Efficiency Directive,[36] which introduces new energy efficiency targets for different sectors. In the digital sector, the directive encompasses specific requirements for data centres, the EU taxonomy, or the ongoing evaluation of the efficiency of the Directive on Waste Electrical and Electronic Equipment[37] that could influence end-users' future rights in terms of recycling. In the context of the latter, the European Commission issued recently policy recommendations to Member States on how to improve and incentivise the return of used mobile phones and those which count as e-waste, tablets, laptops and their chargers.[38] Such policies can include financial incentives such as discounts, vouchers, deposit-return schemes, monetary rewards, or better visibility of collection points where people can return small electronics intended for recycling). For instance, to encourage the repair of devices, some Member States have introduced repair subsidies.

FOCUS ON KEY CONCEPTS #2: OBSOLESCENCE

[34] Bachér et al. (2020) ETC/WMGE Report 2/2020: Electronics and obsolescence in a circular economy. European Topic Centre on Waste and Materials in a Green Economy.
[35] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52023PC0155
[36] EUR-Lex - 32023L1791 - EN - EUR-Lex (europa.eu)
[37] Waste from electrical and electronic equipment – evaluating the EU rules (europa.eu)
[38] Commission Recommendation on improving the rate of return of used and waste mobile phones, tablets and laptops (europa.eu)

Obsolescence refers to the status of something as not being usable anymore. When a device is obsolete, this means it can no longer be used as expected. However, there are different ways for a device to become obsolete. Usually, four types of obsolescence are identified:

- **Material obsolescence** occurs when the hardware components of a device no longer support usage (e.g. the casing or the screen is broken).
- A device becomes **functionally obsolete** when its software components no longer allow for proper usage (e.g. apps no longer support a particular version of the operating system or the hardware no longer performs well enough to let the apps run).
- **Economic obsolescence** takes place when repair or maintenance becomes too expensive in comparison to replacing the device.
- Last but not least, a device becomes **psychologically obsolete** when the functionality it offers in comparison to other devices no longer corresponds to how the device performed compared to when it was purchased (e.g. the device is not rated as among the top three phones).

Each of these forms of obsolescence merits attention because each type requires different measures: psychological and also economic obsolescence cannot be addressed with a right to repair, whereas information on how to extend the lifespan of a battery will do little to delay functional obsolescence.

Current initiatives of the European Commission focus in particular on three types of obsolescence: hardware/material obsolescence, caused by wear, breakage and often the impossibility to repair; software/functional obsolescence, caused by having no support for the software used by the device or by new versions of the software operating systems being incompatible with devices' capacities; and last but not least, cultural/psychological obsolescence (under letter d of the above), which plays on the users' behaviour, so that they replace their devices more often than necessary, out of habit, a desire to keep up with trends, or because of sales or advertising practices that they give them an incentive to replace their phone very frequently.

Box 2: Adapted from How to define and main issues on obsolescence (based on Manhart et al. (2016) Resource Efficiency in the ICT Sector. Final report. Greenpeace.)

2.3. Promoting sustainable digital services

Despite their perceived intangibility, end-user digital services' life cycle has an environmental footprint. Hence, better information to end-users on this impact and best practices to minimise their footprint as well as promotion of digital services sustainable by design could be levers for end-users' empowerment in the green transition of the digital economy.

2.3.1. Informing about the environmental impact of digital services' lifecycle

Digital services are very often perceived as a purely intangible phenomenon. However, the development, maintenance and operation of a digital service relies on the use of infrastructures, devices and resources (see Figure 3). In the initial phase of its life cycle, the design of the service relies on human and technical capital that has an environmental footprint. The implementation phase of the digital service relies on the use of infrastructures and devices. When one end-user accesses a digital service (website, application, social network, video platform, generative messaging…), it necessarily depends on the operation of digital infrastructures – networks and data centres – which are transmitting the data. Moreover, the use of a digital service mostly takes place via devices, which have significant environmental impacts, notably through the manufacturing and energy consumption (see Sub-section 2.4).

BEREC is well aware that there is no linear correlation between data traffic and energy consumption of infrastructures. It notes that newer and more energy-efficient technologies and equipment can limit the increase of energy consumption of digital infrastructures and associated GHG emissions particularly for fixed networks (i.e., fixed fibre networks are associated with less operational emissions than mobile networks). At the same time, increased data traffic is driving the deployment of new infrastructures that could generate increased environmental impacts. Especially as the different elements that compose the digital ecosystem are interdependent; the deployment of new networks involves growth of data centres infrastructures and terminal devices. In this context, attention should be given to minimise digital services impact on devices and infrastructures' footprint by promoting proper ecodesign criteria and environmental transparency on these services.[39]

Another related issue to underline is the effect of digital services on the lifespan of devices through functional obsolescence in the implementation and end of life phases. For instance, if a service is only available on the latest edition of a smartphone or TV or is designed to be used only through one type of device (for instance, through a specific headset, on a tactile screen, etc.), it will encourage the obsolescence of devices in tandem. Therefore, downwards compatibility of software should be an important aspect to consider in tandem with these services when investigating the lifespan of devices (see also Box 3 on obsolescence). An illustration would be the negative impacts of service updates on the functioning of a device – understood as a market failure – which are responsible for lifespan shortage of devices.

As societies become more digitised, it is necessary to ensure that the evolution of digital services design supports environmental targets. For instance, development of the attention economy and the business model of certain digital services providers influences digital consumption and can increase the overall environmental impact of consumers' uses. To illustrate, some services rely on advertising revenues from users/captive audiences and use design to increase the time spent on their platform including auto-play or infinite scrolling

[39] BEREC's Response to the Exploratory Consultation, p.4 and 5 (May 2023)

functionalities.[40] Improving the information of end-users regarding the environmental footprint of their digital services could raise awareness and provide a more holistic view and promote positive pattern of digital uses.

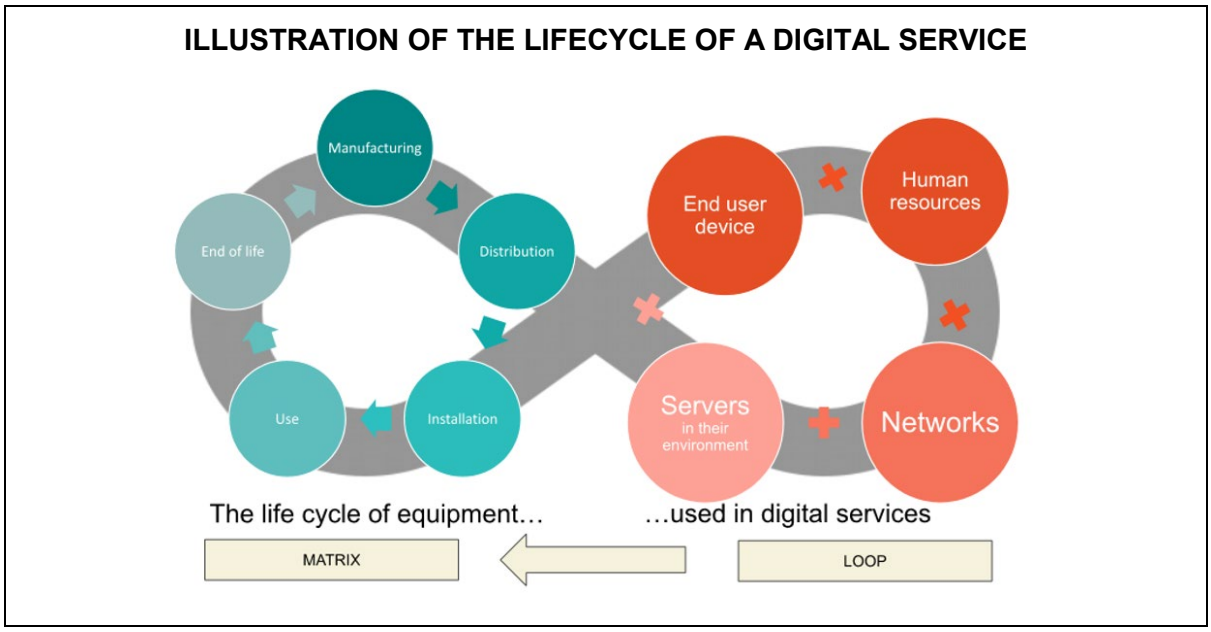


Figure 2: "Life cycle of a digital service" Julie Orgelet - DDemain - LCA and digital responsibility consultant (2021).

2.3.2. Initiatives to develop greener end-users' digital services

In this context, developing greener digital services and informing end-users on ways of use seems key to reduce the environmental impact of end-users' online services. Information can enable raising awareness on the impact of digital services while outlining best practices from business players or end-users. Even though there is no specific regulatory toolbox on the environmental footprint of digital services at EU level, it can be noted that some recent disposals and proposals could include new tools to promote sustainability of digital services. For instance, the **EU consumer protection regulation** protects end-users against unfair commercial practices through the provision of software updates.[41] The impact of emerging digital services is also at watch: for instance, the upcoming **Artificial intelligence (AI) Act**[42] foresees instruments to facilitate the drawing of Codes of Conduct for AI systems which can

[40] To learn more about attention of the economy and addictive online patterns: https://www.europarl.europa.eu/news/fr/press-room/20231023IPR08161/new-eu-rules-needed-to-make-digital-platforms-less-addictive

[41] Directive on empowering consumers for the green transition through better protection against unfair practices and better information (see subsection 2.2.2)

[42] Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL LAYING DOWN HARMONISED RULES ON ARTIFICIAL INTELLIGENCE (ARTIFICIAL INTELLIGENCE ACT) AND AMENDING CERTAIN UNION LEGISLATIVE ACTS

include sustainability-related best practices to minimise the environmental impact of AI design, training and use. Also, a number of publications are reflecting possible levers of actions towards digital services sustainable by design.[43] In this context, it is important to note that sustainability is becoming increasingly linked to concerns around autonomy, supply-chain security or resilience, highlighting the long-term strategic considerations to which environmental sustainability can contribute.[44]

On the side of market-players, the ecodesign of digital services could be a means of action to balance environmental targets by providing versions of the service available on old devices, incorporating carbon footprint calculators in the user interface of the service, using energy efficient encoding and decoding algorithms[45] or limiting dark patterns that lead to online overconsumption (e.g., video auto-play, infinite scrolling, unstoppable notifications, etc.).[46]

Regarding possible user-focused means of action, BEREC acknowledges the existing work of the European Commission, especially on its recent **external study "Assessment of the energy footprint of digital actions and services".**[47] Additional details of this study were presented at BEREC internal workshop on 20 September 2023 and are summarised in Chapter 3 of this report. The following table extracted from the study offers a synthesis of impacts of standard digital services and recommendations identified to reduce their energy impact:

[43] See for instance the paper : Good practices in digital service ecodesign for software developers, Cyrille Bonamy, Cédric Boudinet, Laurent Bourgès, Karin Dassas, Laurent Lefèvre, Benjamin Ninassi, Francis Vivat https://hal.science/hal-03977001/
Another example is the German platform on sustainable software supported by the Federal agency for the Environmental and the Ministry for Environment : https://knowledge.sdialliance.org/softawere

[44] See for instance Digital Autonomy Hub (2022) Digitale Selbstbestimmung und Nachhaltigkeit: Verbraucher:innen verloren zwischen Informationslücken und fehlender Regulierung.

[45] Including by the use of efficient codecs, i.e., technology or software is used to compress and decompress digital data, such as audio and video files. The term "codec" is a portmanteau of "compressor-decompressor." Codecs are essential for digital multimedia communication and storage, as they help reduce the size of large media files for efficient transmission and storage, while allowing for their playback or viewing. Additional information: https://www.techtarget.com/searchunifiedcommunications/definition/codec

[46] https://eco-conception.designersethiques.org/guide/en/content/0-introduction.html

[47] https://op.europa.eu/en/publication-detail/-/publication/d3b6c0a1-1171-11ee-b12e-01aa75ed71a1

Digital behaviours[48]	Average energy consumption of the action (and GWP[49]) in the EU	Recommended best practices to save energy
1h of video streaming	0.051 kWh (56 gCO_2eq)	Use smaller devices Use fixed networks Decrease video resolution
1h of video gaming	0.051 kWh (60 gCO_2eq[50])	Use smaller devices Use fixed networks Reduce the number of hours playing video games
1h of video conferencing	0.128 kWh (135 gCO_2eq)	Use fixed networks Limit the number of participants Reduce the time of the meetings
1h of music streaming	0.048 kWh (58 gCO_2eq)	Use smaller devices Use fixed networks Try not to watch videos only for the music
1h of social networking	0.024 kWh (42 gCO_2eq)	Use fixed networks Use social networks with more static content (less videos) Reduce the daily usage of social networks
Write and send an email	0.009 kWh (5 gCO_2eq)	Limit the number of recipients Limit the size of the attached files Unsubscribe from irrelevant newsletters
Download a file (1 GB) to a PC	0.004 kWh (2 gCO_2eq)	Use fixed networks Download a file only if necessary

[48] It should be noted that the type of device employed for using digital services has an impact on the environmental footprint of that behaviour. For this reason, the use of smaller devices is usually recommended from the perspective of energy efficiency, as smaller devices for the most part consume less energy. However, BEREC highlights that other dimensions of environmental impacts must be taken into account as well. The resource consumption of smaller devices, for instance, may be much higher due to miniaturisation than that of larger devices when considered in relation to their total weight.

[49] Global warming potential (GWP) is a measure of how much infrared thermal radiation a greenhouse gas added to the atmosphere would absorb over a given time frame, as a multiple of the radiation that would be absorbed by the same mass of added carbon dioxide (CO_2). GWP is 1 for CO_2.

[50] Note from BEREC: The differentiated CO_2eq for 1 hour of online video streaming and 1 hour of video gaming is due to the embodied emissions of large-screen devices and comparison with small-screen devices. According to the study, video streaming mostly relies on smaller devices (e.g. smartphones) which is not the case online gaming. More precisely, the study presents statistics based on large CAPs estimations and public data reports: Video streaming through a smartphone represents 64.95% on smartphone compared with 11.30% with regard to online gaming. The most used device for online gaming is TV, which represents 45.34% of uses. Hence, the embodied emissions for the same amount of time (and energy consumption) are larger, based on the LCA. More information on the study report.

Store data (1 GB) in the cloud for 1 year	0.147 kWh (98 gCO_2eq)	Clean regularly your data stored in the cloud Turn off the automatic syncing of photo uploads
Prolong the lifespan of a phone	8.7 $kgCO_2eq$ avoided emissions per year	Repair your phone instead of replacing it Consider extending the lifetime of your phone before purchasing a new one.
Switch off the Wi-Fi router (for 2 weeks)	3.77 kWh energy savings (2.2 $kgCO_2eq$ avoided GHG emissions)	Switch-off the Wi-Fi router while on holidays/away from home

Table 1: Extract from the European Commission external study "Assessment of the energy footprint of digital actions and services" (2023).

2.4. Reducing the environmental impacts of end-users' digital devices

End-users have a role to play to expand the lifespan of their digital devices. Better information on devices environmental footprint and possible best practices could be complementary to industry-focused regulatory disposals aiming at more sustainable digital devices.

2.4.1. Understanding the different type of impacts of end-users' digital devices on the environment

When analysing the environmental footprint of the digital sector in three bricks (data centres, networks and devices), it becomes clear that end user devices constitute a major part of the environmental footprint the sector. Based on literature, the carbon footprint of these devices (televisions, smartphones, computers, tablets, etc.), represents 60% to 80% of total emissions from the digital sector.[51] Another external source outlined a share of 65% to 90% if the other environmental impacts indicators recommended by the PEF methodology are considered (i.e. energy consumption, mineral/metal consumption, waste production…).[52]

End-user devices have varying environmental impacts across their life cycle. A smartphone, for instance, causes between 16 and 110 kg CO_2e over its entire life cycle (on average about

[51] This estimation is based on a literature review by WIK and Ramboll. The variation in numbers is due to the differentiated hypothesis, databases and approaches adopted by the studies analysis by the consultants. See BEREC External Sustainability Study on Environmental impact of electronic communications https://www.berec.europa.eu/en/document-categories/berec/reports/external-sustainability-study-on-environmental-impact-of-electronic-communications X

[52] 'Digital technologies in Europe: an environmental lifecycle approach" (NegaOctet, 2021) https://www.greenit.fr/wp-content/uploads/2021/12/EU-Study-LCA-7-DEC-EN.pdf

37kg), but not each phase of the life cycle contributes equally to the environmental impact. As the largest environmental impact from devices stems from production, it is necessary to find ways to extend the lifespan of devices. Extending the lifespan of every smartphone by one year corresponds to savings of 2.1 million tons of CO_2 by 2030 (equals reducing the CO_2e footprint of smartphones by 31%, or in other words, keeping one million cars off the road for an entire year), as well as savings of 27% of primary energy and 29% of water consumption.[53] This means that it is necessary to identify ways and means to encourage consumers to keep their devices for longer, as well as make these devices usable for longer periods of time through reparability and durability of performance.

Devices are also responsible for other forms of impact including raw materials and resources depletion. To keep the same example, a modern smartphone contains approximately 40–80 different mineral/metal elements, including rare earth elements[54] and its water footprint is estimated to about 13 tonnes of water.[55] Digital devices are also one of the main drivers of the increase of waste electrical and electronic equipment (widely known as e-waste or WEEE). Electrical and electronic equipment are among the EU's most rapidly expanding waste categories, with an annual growth rate of 2%, while only 40% of electronic waste is recycled within the EU.[56]

2.4.2. Overview of initiatives to extend the lifespan of end-users' digital devices

Extending the lifespan of digital devices by further developing device refurbishment and repair is one key area of focus, as is raising consumer awareness of these issues. Devices traditional distribution models, as well as certain advertising strategies (for instance encouraging the renewal of functional devices for newest/fashionable product) are identified as contributing to the phenomenon of devices' cultural or psychological obsolescence, but also as signals that refurbishment issues are not properly taken into account. To extend the life of every device, one of the paths that could be explored would be to support distribution models that reduce incentives to replace devices that still work perfectly well.

Faced with this observation, European legislators have already taken regulatory measures to mitigate these impacts. The table below summarises the main regulations and initiatives that could interact with end-users' empowerment and sustainability of their devices. Implementing a more circular approach in the production and use of devices is an essential step in reducing their footprint. In this sense, the information delivered to consumers can enable them to adapt their consumption choices, in addition to the tools already provided for by the European framework.

[53] Bachér et al. (2020) *ETC/WMGE Report 2/2020: Electronics and obsolescence in a circular economy*. European Topic Centre on Waste and Materials in a Green Economy.
[54] https://tupa.gtk.fi/raportti/arkisto/50_2021.pdf
[55] Burley (2015) Mind your step. The land and water footprints of everyday products. Friends of the Earth.
[56] EU new Circular Economy Action Plan (2020)

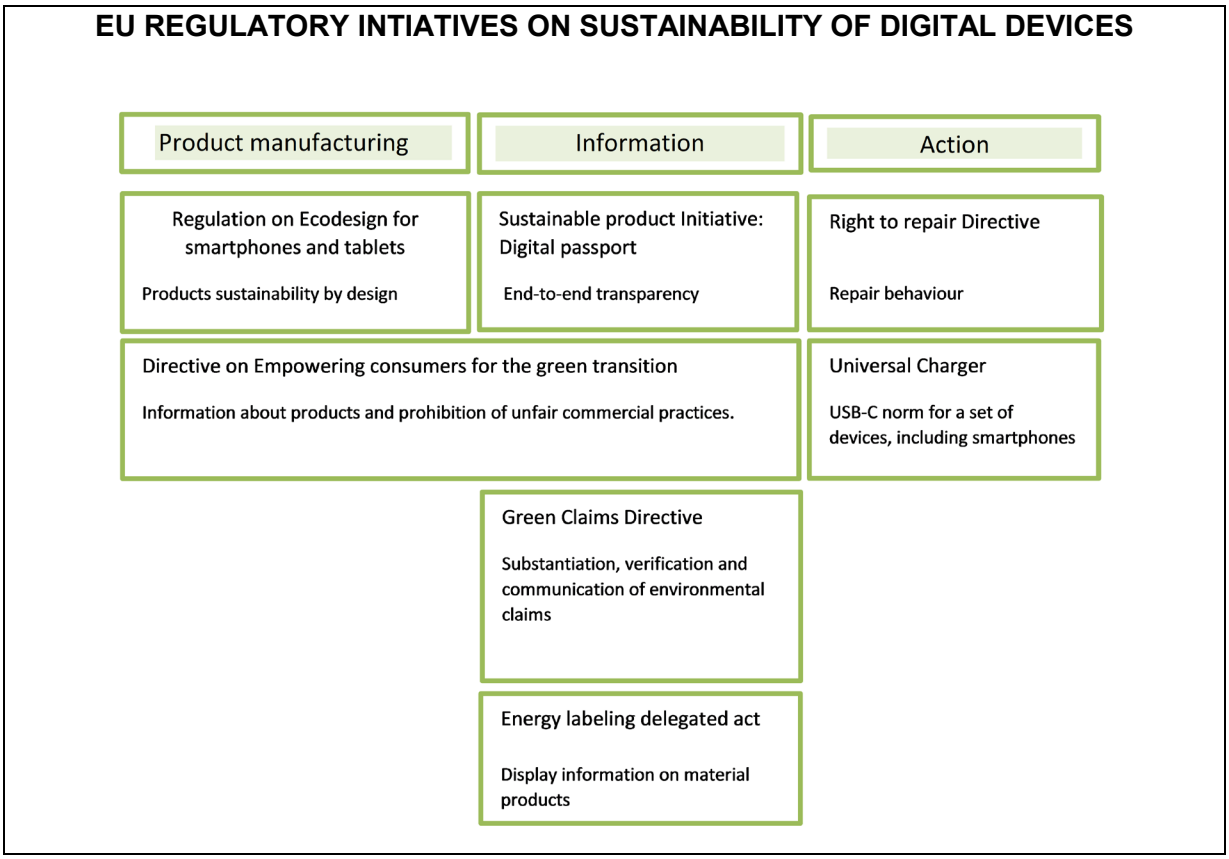


Figure 3: End-User empowerment and sustainability of devices – BEREC Summary of EU regulation

On the side of disposal, the implementation of the new EU regulatory framework on circular economy will be crucial. Additional initiatives might be needed in terms of recycling of devices. Currently, about 700 million devices in Europe are hibernating (i.e. they are no longer used but also not recycled), which by far exceeds the current population of the EU (estimated at 450 million). Repairing or recycling these hibernating devices could recover nearly 14.920 tonnes of gold, silver, copper, palladium, cobalt and lithium worth over one billion Euro.[57] These critical raw materials are extremely important in smartphones in particular and amount to 7% of the total weight of the device.[58] The production of smartphones and tablets alone is responsible for about 9.4% of worldwide production of cobalt and 8.9% of worldwide production of palladium.[59] Increasing the eco-designing and circularity of devices is therefore

[57] Rizos et al. (2019): *Identifying the impact of the circular economy on the Fast-Moving Consumer Goods Industry: opportunities and challenges for businesses, workers and consumers – mobile phones as an example.* Centre for European Policy Studies (CEPS).
[58] Bachér et al. (2020) *ETC/WMGE Report 2/2020: Electronics and obsolescence in a circular economy. European Topic Centre on Waste and Materials in a Green Economy.*
[59] Manhart et al. (2016) *Resource Efficiency in the ICT Sector. Final report.* Greenpeace.

also a clear priority from the perspective of securing long-term availability and sustainable usage of critical raw materials.[60]

FOCUS ON KEY CONCEPTS #3: REPARABILITY

Reparability refers to the ease with which a product can be repaired or restored to its original functionality when it malfunctions or becomes damaged. The concept of reparability is crucial in the context of sustainable product design and the circular economy, as it directly influences the lifespan of a product and its environmental impact.

To increase the reparability of products, several key levers can be employed including:

- designing products with modular components that can be easily replaced or repaired;
- providing clear and accessible repair documentation, such as manuals or guides, to assist end-users and professional repair services;
- encouraging a culture of repair by making spare parts readily available and affordable and implementing a "right to repair";[61]
- developing information-tools (indices, labels) to inform the consumer about the future reparability of their product.[62]

The relationship between reparability and product durability is closely intertwined. A reparable product tends to have an extended lifespan, as it can be maintained and fixed when issues arise.

Box 3: Definition of reparability and levers (Sources: Maitre-Ekern, Dalhammar, Regulating Planned Obsolescence (2016) and Cordella, Sanfelix, Development of an Approach for Assessing the Reparability and Upgradability of Energy-related Products (2018)).

Even though device manufacturers are key players to promote sustainable digital devices, end-users have a role to play reducing the frequency of device replacement and extending the life and use of devices. Regarding the usage of devices, there are already some indications that end-users are increasingly using their phones for longer periods of time (3-4 years)[63] than

[60] Rizos et al. (2019): *Identifying the impact of the circular economy on the Fast-Moving Consumer Goods Industry: opportunities and challenges for businesses, workers and consumers – mobile phones as an example.* Centre for European Policy Studies (CEPS) *Critical and strategic metals in mobile phones: A detailed characterisation of multigenerational waste mobile phones and the economic drivers for recovery of metal value.* Journal of Cleaner Production Vol. 419.

[61] EU new Circular Economy Action Plan (2020)

[62] Bas Flipsen, Conny Bakker, Guus van Bohemen, Developing a Reparability Indicator for Electronic Product, 2016.

[63] Schischke et al. (2021) Ecodesign preparatory study on mobile phones, smartphones and tablets. Final Task 3 Report: Users (product demand side); https://telecoms.com/523027/vodafone-uk-reckons-we-now-only-change-phones-once-every-four-years/

what was previously common (2-3 years),[64] which outlines that consumers would be willing to use their devices longer having the appropriate incentives. Nevertheless, there is much work yet to be done, as a significant portion of end-users' devices does not enter the circular economy loop. According to statistical data of the digital economy and society in the EU (DESI),[65] households retain some of their old devices at home rather than recycling them or offering them to the second-hand market. In 2022, 10 % EU citizen recycled their old phone when replacing it. As indicated by a Eurostat study, the increasing adoption of ICT equipment and the rapid introduction of new devices featuring advanced functionalities contribute to a growing volume of discarded devices, including laptops, tablets, mobile phones, smartphones, and desktop computers. This situation prompts questions regarding the fate of unused ICT devices. It should also raise questions regarding the reasons why consumers choose to keep devices they no longer use (lack of information, privacy concerns, etc).

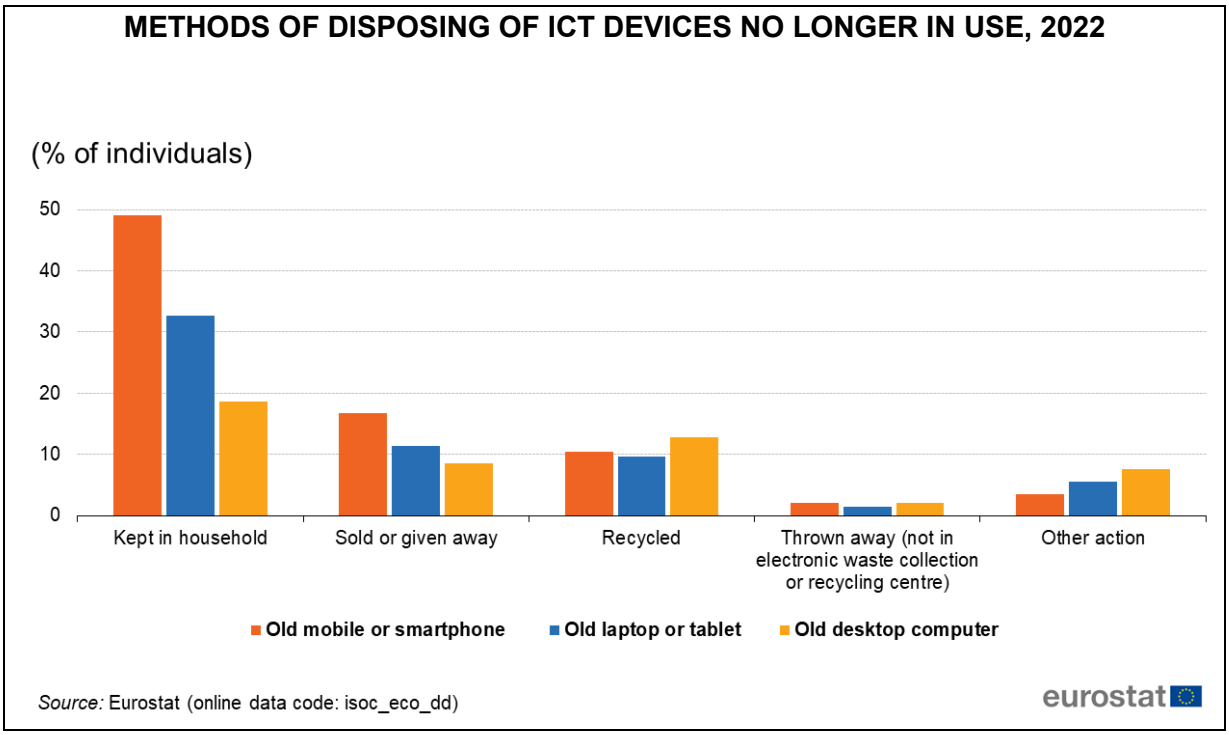


Figure 4: Extract from the article Green ICT - digital devices in households based on DESI 2022 statistics (Source: Eurostat).

In this perspective, BEREC wants to contribute to raising the awareness of end-users on the impact of their devices and best practices to reduce their environmental footprint. In the following table, BEREC summarises specific levers identified to empower end-users to reduce the environmental footprint of their devices for main environmental impacts, based on related literature.

[64] Tröger et al (2017): *Smartphones werden häufiger ersetzt als T-Shirts. Die Nutzungsmuster und Ersatzgründe von KonsumentInnen bei Gebrauchsgütern.*

[65] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Green_ICT_-_digital_devices_in_households

Digital devices	Type and estimation of environmental impacts	Recommended good practices	Sources
All devices	GHG footprint and resources	Keep using device as long as possible	https://www.eea.europa.eu/publications/influencing-consumer-choices-towards-circularity Bachér et al. (2020) ETC/WMGE Report 2/2020: Electronics and obsolescence in a circular economy. European Topic Centre on Waste and Materials in a Green Economy Assessment of the energy footprint of digital actions and services, DG ENER, 2023 Center for Sustainable Systems, University of Michigan. 2022. "Green IT Factsheet." Pub. No. CSS09-07 Suckling, J., Lee, J. Redefining scope: the true environmental impact of smartphones? Int J Life Cycle Assess 20, 1181–1196 (2015). https://doi.org/10.1007/s11367-015-0909-4
All devices	GHG footprint and resources	Extending the product lifetime. In the event of a breakdown, check whether equipment can be repaired before buying a new one.	https://www.eea.europa.eu/publications/influencing-consumer-choices-towards-circularity Suckling, J., Lee, J. Redefining scope: the true environmental impact of smartphones?. *Int J Life Cycle Assess* **20**, 1181–1196 (2015). https://doi.org/10.1007/s11367-015-0909-4
All devices	Energy consumption	Switch off equipment when it's not in use: unplug it from the wall socket or plug it into a power strip with a switch than can be turned off.	Arcep, FAQ, 2023 Center for Sustainable Systems, University of Michigan. 2022. "Green IT Factsheet." Pub. No. CSS09-07.
Smartphones	Energy consumption	Switch equipment to "airplane" mode. Cut Wi-Fi via the router's interface.	Arcep, FAQ, 2023

Smartphones	Energy consumption and resources (battery)	Unless planning to use them for a longer period of time, charging should be stopped as soon as the charge level reaches 80%, and charging started only when the charge level is below 25%. Not to leave equipment on the charger for longer than is necessary for recharging.	Center for Sustainable Systems, University of Michigan. 2022. "Green IT Factsheet." Pub. No. CSS09-07. https://www.makeuseof.com/ways-reduce-carbon-footprint-phone/
All devices	27 kg CO_2e avoided/year 127 kg MIPS (material input per service) avoided/year 314 kg of WEEE avoided[66] 91% for water consumption and 60-71% for electric/electronic waste	Whenever possible, to buy second-hand or reconditioned device (provided for hand devices that software updates are still available for that model.)	https://www.eea.europa.eu/publications/influencing-consumer-choices-towards-circularity Suckling, J., Lee, J. Redefining scope: the true environmental impact of smartphones?. *Int J Life Cycle Assess* 20, 1181–1196 (2015). https://doi.org/10.1007/s11367-015-0909-4 Nemeth et al. (2023) *Sustainability Impact Measurement: Refurbed GmbH*. Fraunhofer Austria Research GmbH contracted by Refurbed GmbH. https://drive.google.com/file/d/1pCGfFlit1056PKMZfawvIzk5ddpGoMH/view
All devices	WEEE	Putting functional equipment no longer needed (smartphones, headphones, etc.) into re-use/resell, recycling or reconditioning channels rather than keeping it in a cupboard.	Center for Sustainable Systems, University of Michigan. 2022. "Green IT Factsheet." Pub. No. CSS09-07. Suckling, J., Lee, J. Redefining scope: the true environmental impact of smartphones?. *Int J Life Cycle Assess* **20**, 1181–1196 (2015). https://doi.org/10.1007/s11367-015-0909-4
All devices	Reducing the screen size to 3” in comparison to	Choosing smaller screen devices when possible	Manhart et al. (2016) *Resource Efficiency in the ICT Sector. Final report. Greenpeace*. https://www.greenpeace.de/sites/default/files

[66] https://infos.ademe.fr/magazine-novembre-2022/faits-et-chiffres/appareils-reconditionnes-oui-mais-pas-nimporte-comment/

	5" would lead to a reduction of the GHG emissions associated with production by 7,5% (increasing the size to 7" leads to an increase of GHG emissions by 19%) 32% of CO_2E emissions in production are related to the LCD screen		/publications/20161109_oeko_resource_efficiency_final_full-report.pdf
Smart-phone	18m² land and 12.760 litres of water required for the production of a single smartphone	Slowing down the rate of replacement of smartphones	Burley (2015) *Mind your step. The land and water footprints of everyday products*. Friends of the Earth. https://catalogue.unccd.int/587_mind-your-step-report-76803.pdf
All devices	Avoided GHG emissions, energy consumption, water consumption and mineral/materials depletion	Challenging the need to buy (an additional) device and consider alternatives such as renting, leasing or using only one device for different functionalities.	https://www.eea.europa.eu/publications/influencing-consumer-choices-towards-circularity

Table 2: BEREC summary of best practices to reduce the environmental footprint of end-users devices.

To complete this overview, BEREC organised a workshop with BEUC, EEB and European Commission as presented in the next Chapter. BEREC also included a benchmark of related initiatives in European countries and identifies possible next steps and role for electronic communications regulators (Chapter 4).

3. Summary of BEREC Workshop on End-Users' Empowerment through environmental transparency on digital goods and services

This Chapter summarises main inputs from hybrid BEREC internal workshop on empowering end-users through environmental information on digital goods and services, describing presentations and discussions with expert consulting firms working with the European Commission and representatives of environmental and consumers associations.

3.1. Presentation of the study "Assessment of the energy footprint of digital actions and services" (Ramboll and Resilio)

Consultants from Ramboll and Resilio presented their study **"Assessment of the energy footprint of digital actions and services"** commissioned by DG ENERGY of the European Commission as part of the European Green Deal and RePowerEU action plan. The study aims to increase transparency on energy consumption in the ICT sector and to demonstrate the behavioural factors which are best suited to influence and reduce its adverse impacts. It sheds light on the energy use by using a model of ten common daily digital behaviours, such as one hour of video streaming, one hour of videogaming or writing and sending an email.

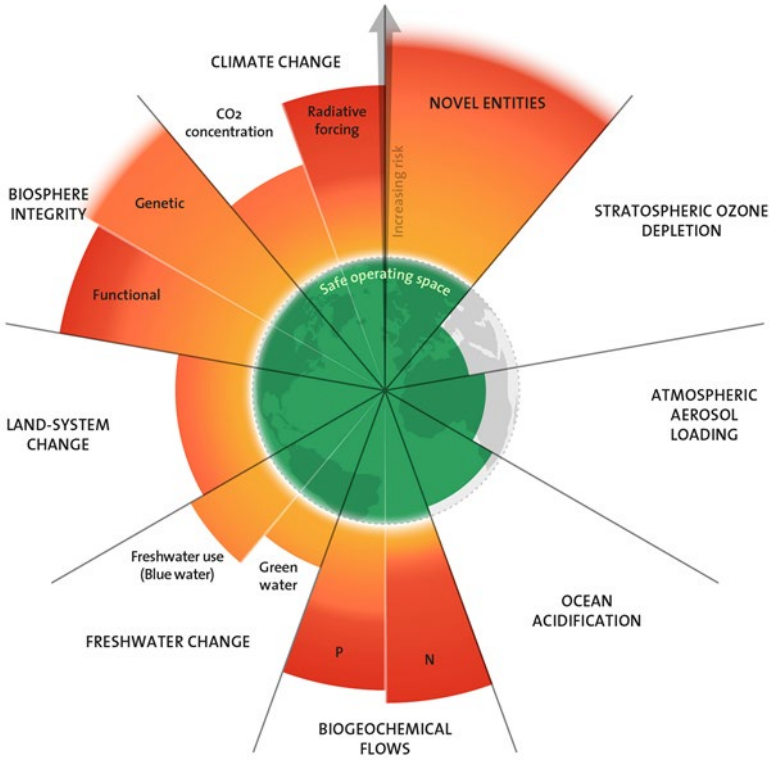
The consultants first described which factors contribute and which mitigate the impact of energy consumption of daily digital behaviours according to existing literature. It was highlighted in the existing studies, that while individual behaviour had very little impact in terms of energy consumption, the collective behaviour has a very significant impact and is worth to be taken into account. The identified factors that decrease energy consumption of digital behaviour are the use of smaller devices, lowering of video resolution and use of fixed instead of mobile network. In terms of personal behavioural adjustments, limiting social media and gaming time, efficient cloud data management and optimising the operation of the router are levers for energy savings identified in literature. The consultants noted that some of the ten identified digital behaviours are studied more frequently than others and that a lack of transparent assessment on ICT energy consumption exists for disruptive technologies like 5G or 6G.

Secondly, the consultants showed how their study models the ten digital behaviours by conducting a comprehensive Life Cycle Assessment (LCA) using ISO 14040/44 and adhering to the procedural conditions outlined by the path methodology. For the purpose of the analysis, the source of the impact was divided into three categories: end-user, network and data centre. To offer an easily understandable and visual comparison, the study refers to a Daily Climate Budget per digital behaviour, which is based on the Planetary Boundary framework (see Box 4), combined with a recommendation on how to mitigate the energy consumption of that digital behaviour. The study uses the concept of the nine planetary boundaries as well as the world population in 2023 for estimating the Daily Budget, by deriving the annual planetary

boundaries of the world and dividing them per capita. The calculation is designed to assess the maximum daily emissions allowable to remain within established limits, as well as the per capita allocation of specific behaviours in terms of daily budget shares (e.g., 3%, 4%, 2%, etc.), depending on the context or application. Moreover, the impacts in terms of all planetary boundaries have been calculated for each of the ten analysed behaviours separately. So even if the daily budget is a constant, the planet boundaries differ according to the nature of the behaviour.

FOCUS ON KEY CONCEPT #4: PLANETARY BOUNDARIES FRAMEWORK AND DAILY BUDGET CALCULATION

The planetary boundaries framework refers to a set of nine natural global quantitative boundaries within which humanity can continue to develop and thrive for generations to come. It was developed by a group of 28 scientists to identify the processes that regulate the stability and resilience of the Earth system. These "planetary boundaries" were initially proposed in 2009 and have been revised several times. In 2023, a significant milestone was achieved by quantifying all nine processes that control Earth's stability and resilience: biosphere integrity, climate change, novel entities, stratospheric ozone depletion, atmospheric aerosol loading, ocean acidification, biogeochemical flows, freshwater change, and land system change. The latest update not only quantifies all nine boundaries but reveals that six of them have been breached. According to this framework developed by the group of scientists exceeding one or several of these boundaries raises the risk of causing large-scale, abrupt, or irreversible environmental changes. Although such changes may not occur suddenly, these boundaries represent a critical threshold that heightens risks to both people and ecosystems. These boundaries are interconnected within the Earth system, so addressing climate change alone is not enough for sustainability. A comprehensive approach considering the interplay of boundaries, particularly climate and biodiversity loss, is essential in both scientific understanding and practical applications.



Source: Azote for Stockholm Resilience Centre, based on analysis in Richardson et al 2023.

Constructing a "daily budget" from this framework involves allocating a sustainable limit for various aspects of human activity within a single day, where limits are set for various environmental parameters to ensure the long-term health of the planet. For example, daily budgets can be calculated for carbon emissions (“daily climate budget”), water consumption, or food waste.

Box 4: Explaining the Planet boundaries framework and daily budget approach (Stockholm Resilience Centre website and DG Energy external study “Assessment of the energy footprint of digital actions and services”).

One of the take-aways that the consultants presented is that, generally, a significant amount of impact comes from devices, followed by consumption of networks. However, the impact may not always necessarily follow this sequential order for all digital behaviours, for example, when sending an email of 1 megabyte file, the greatest impact was created by data centres, followed by the end-user device, while the network used only a marginal amount of energy.

Finally, the consultants discussed some limitations of the study, related to the overall lack of publicly available information, especially on the environmental impacts of networks and cloud providers.

3.2. Joint presentation on consumer and environmental organisations' views by BEUC and EEB

In the second part of the workshop, representatives from **Bureau Européen des Unions de Consommateurs (BEUC)** and the **European Environmental Bureau (EEB)** presented their work on end-user empowerment through environmental transparency schemes (such as labelling or scoring mechanisms). Ecodesign and Energy Labelling frameworks are instruments that should go hand in hand, where ecodesign sets minimum requirements for products and energy labelling encourages manufacturers to offer more energy efficient products. BEUC and the EEB recognised the importance of transparency and information availability to end-users, but also stressed that this alone is not enough to encourage behavioural changes. Therefore, BEUC and EEB are actively working on making the offer on the market more sustainable in terms of energy efficiency, durability and reparability to reach the target of a digital sector being ***sustainable by design***. The two organisations acknowledge the important steps taken with the European Green Deal. In their view, it is also important to promote an alignment of price signals and sustainability and not to put the burden on consumers to access information. EEB also noted that the social dimension should not be forgotten – the most vulnerable groups in society should also have access to high quality and sustainable solutions.

When discussing the environmental information schemes, EEB noted that it is important to rely on third party verified schemes, such as Ecolabel, instead of non-comparable, non-verified or self-declared information schemes. Furthermore, the number of schemes should be minimised to avoid proliferation and confusion. BEUC agreed that information accessibility is key and that initiatives such as the Digital Product Passport are very important. However, physical labels should not be substituted by digital labels as not all consumers can access or use digital tools.

In the context of regulation, BEUC mentioned the **Ecodesign framework** (i.e. the proposed Ecodesign Regulation for sustainable products amending the 2009 directive), on which they have worked actively. BEUC noted that the Ecodesign and Energy Labelling frameworks not only focus on the energy efficiency, but also look into many new sustainability aspects that are important from a consumer perspective, such as durability, reparability and reliability. BEUC is very pleased with the new energy label for smartphones which is in line with the ongoing revision of the Ecodesign framework. As for other EU new regulations, their ambitiousness will require allocation of appropriate resources for implementation which will be a challenge.

Both BEUC and EEB recognised **greenwashing** as one of the major issues in the context of environmental transparency. According to their studies, 53% of green claims give vague, misleading or unfounded information. BEUC noted that the Green Claims proposal is important to ensure that environmental claims are based on verifiable information. EEB stressed the importance of active involvement of a wide range of stakeholders and specific affected communities in this area. Additionally, EEB believes that substantial focus should be given to the issues and impacts which are hard to measure and that regulators should favour

transparency by making the supporting evidence to claims publicly available and including due diligence on the whole value chain. They stressed the importance of enabling proper comparability between economic actors competing in the same market. Additionally, EEB described different tools to check the reliability of claims, such as non-exclusion criteria, a proven methodology (e.g. PEF/ISO 1400 series, etc.), third party verification or independent audits. Finally, the **CSRD** criteria should create more harmonised information schemes, however, it may be more difficult to link information schemes with consumers as the CSRD targets companies and not consumer interfaces. Therefore, they promote inclusion of CSRD reporting in the **Digital Product Passport**, when appropriate. The organisations also invited regulators to encourage stakeholders to rely on EFRAG standards when implementing CSRD.

Finally, BEUC and EEB have jointly proposed recommendations to regulatory authorities. Specifically, with respect to design and informational prerequisites, both BEUC and EEB advocate for the establishment of rigorous and fair ecodesign standards for ICT products. They also emphasise the importance of outlining comprehensive and horizontal environmental (as well as social) performance criteria for ICTs. This is particularly crucial because some ICT products are currently absent from the scope of the Ecodesign and Energy Labelling Working Plan for 2022–2024, leading to an exemption from the regulatory mandates articulated within this framework.

BEUC recommended GPP criteria and ecolabel schemes for digital services and stressed the importance of the right to repair and the reparability of products. They also considered as a relevant proposal to take into account the ICT sector with a systemic approach to be able to promote sustainability of digital services, which are not specifically targeted by the above-mentioned regulations. Finally, they believe that social aspects should be integrated into labelling schemes. Regarding the end of life and enforcement, EEB suggested to extend the producers' responsibility schemes under a revised WEEE Directive, to consider incentive schemes to avoid wasting small ICT materials and to ensure enforcement of Ecodesign, (Energy) labelling schemes, empowering consumers and waste policy. They also called to establish a harmonised system at EU level on the set of indicators/criteria that should be documented and associated to internet/ICT service providers and suppliers and to try to align those with Ecodesign, CSRD and other EU requirements.

Both BEUC and EEB called for a reporting approach that goes beyond energy use and includes social perspectives. BEUC has asserted that an approximate 5% of digital products are destroyed due to unsold inventory, coinciding with the presence of individuals lacking compatible devices. This clearly indicates a degree of inefficiency and dysfunctionality within the system, the resolution of which has the potential to reduce the waste of digital products. In light of this, BEUC maintains confidence that the forthcoming Ecodesign for Sustainable Products Regulation (ESPR) should incorporate provisions aimed at rectifying the challenge of perfectly functional yet unsold devices and prohibit their unwarranted disposal.

4. Existing national initiatives in Member States

This part is based on the feedback to an internal questionnaire to national regulatory authorities for electronic communications (NRAs) within BEREC to map the existing initiatives related to environmental transparency and information to end-users.

4.1. NRAs' initiatives

Ten BEREC member NRAs reported conducting initiatives on these issues. Their initiatives mostly address research, data collection/publication and communication campaigns.

Publications (including data, surveys & reports)	Public Campaigns	Best Practices/ Info on Website
Arcep, BIPT, NKOM, NMHH, PTS, RAK, RTR, SPRK, Traficom	ACM, NKOM, RTR	Arcep, NMHH, RTR, Traficom

ACM in Netherlands conducted campaign on 'green talks' to help consumers distinguish false green claims from correct ones.

Arcep, the French regulatory authority, is actively addressing the environmental impact of ICT and information to end-users. Since 2020, they've collected data from various digital industry players sharing the results annually in "Achieving Digital Sustainability" report. This data collection[67] has recently expanded to include device manufacturers and data centres. Arcep's initiatives extend to research and education. They have conducted studies[68] to better understand ICT's environmental impact, especially of energy consumption, and have collaborated[69] with ADEME[70] to assess the digital environmental footprint in France. Their approach involves reducing the number of devices and extending lifespan thereof to enhance sustainability. To engage consumers, Arcep offers practical tips on their website, covering areas like energy reduction and device longevity. The NRA has also published in collaboration with other authorities a General Policy Framework for the Ecodesign of Digital

[67] https://en.arcep.fr/news/press-releases/view/n/environnment-180423.html
[68] https://www.arcep.fr/fileadmin/user_upload/grands_dossiers/environnement/etude-environnement-4Gvs5G-executive-summary-comite-expert-mobile_janv2022.pdf, https://en.arcep.fr/uploads/tx_gspublication/environment-impact-ICT-sector-methdological-gap-analysis_april2023.pdf
[69] https://www.arcep.fr/uploads/tx_gspublication/dossier-presse-Etude-Ademe-Arcep-lot3_mars2023.pdf
[70] The French Agency for the Ecological Transition.

Services[71] to support more sustainable digital solutions, in application of a French law aimed at reducing the environmental footprint of the digital sector and enacted in 2021.[72]

BIPT, the Belgian authority annually collects data on the evolution of energy consumption, CO_2 emissions and waste disposal of the major telecom operators. These results are published in an annual report on the sustainability of the telecom networks in Belgium.[73] In the latest report, additional attention was given to the energy consumption of the end user devices provided by the telecom operators. This report also offered practical tips end users can follow to lower their environmental footprint.

NKOM in Norway will in 2024 establish a knowledge-based common reference and benchmark of the environmental footprint from the Norwegian digital infrastructure, both for the current status and for future scenarios. The scope will include data centres, networks, telecom satellites and end-user devices. The methodology will be aligned to established standards and, as far as possible, to coming EU regulations and codes of conduct. The analysis will serve as a basis for identifying and prioritising sustainability measures and activities, for advising policymakers, as a point of reference for legal assessments and decisions, and for communication purposes. It may be used as benchmark in incentive/discount models in frequency auctions, innovation projects, etc. Furthermore, NKOM prioritises education and awareness, sharing research insights on climate impact from Electronic Communication Networks (ECNs) and different fibre deployment approaches.

NMHH, the Hungarian regulatory authority recently conducted an online survey[74] to gauge consumer awareness of environmental factors when choosing electronic devices and subscription plans. NMHH also shares practical advice through articles[75] on mindful internet and smart device usage, promoting both reduced digital footprint and environmental sustainability. Additionally, NMHH launched the "NetreFel"[76] campaign in 2021 to accelerate the phase-out of 3G technology. This program not only supported affected end-users but also encouraged old device recycling in line with environmental regulations.

PTS, the Swedish authority has started its first collection of data regarding energy consumption in communication networks towards mobile operators and broadband providers. The collection also includes energy efficiency indicators for mobile operators. Next step of this

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[71] General Policy Framework on Digital Services Ecodesign (May 2024) : https://www.arcep.fr/uploads/tx_gspublication/general_policy_framework_for_the_ecodesign_of_digital_services_version_2024.pdf

[72] French Law “Reducing the environmental footprint of the digital sector” (2021) Available in French

[73] https://www.bipt.be/consumers/publication/communication-of-19-december-2023-on-the-sustainability-of-the-telecom-networks-in-belgium

[74] https://nmhh.hu/dokumentum/228626/elektronikus_hirkozlesi_piaci_fogyasztonak_vizsgalata_internethasznalok_2021.pdf

[75] https://nmhh.hu/cikk/231709/Hogyan_hasznaljuk_tudatosan_okoseszkozeinket, https://english.nmhh.hu/article/226947/Sustainability_is_less_important_when_buying_mobile_devices, https://nmhh.hu/cikk/238426/Kattintasok_halojaban_fenntarthato_egy_digitalis_jovo

[76] https://netrefel.hu/

data collection focused on energy consumption of networks would be to publish this data to better inform on ECN/ECS environmental footprint.

RAK, representing Bosnia and Herzegovina, raises awareness about green initiatives and the reduction of energy consumption in the ICT sector by collaborating with the scientific community on publishing topical studies.

RTR in Austria has launched a communication campaign[77] in October 2023, focusing on environmental issues within the ICT sector. This campaign primarily leverages social media platforms and a dedicated section of their website to engage and educate the public. A report will be published in the course of November 2023.

SPRK, the regulatory authority in Latvia, emphasises publications and reports, offering environmental policy documentation and reports on their website.[78] These publications include content related to the United Nations Sustainable Development Goals (SDGs).

Traficom, the Finnish regulatory authority, publishes data on the energy consumption of communication networks on their website[79] and have conducted a consumer survey on the intersection of ICT and the environment. In addition, Traficom runs targeted campaigns to promote environmental awareness. As part of their HD transition campaign,[80] they conducted a survey on TV recycling, emphasising the responsible disposal of electronic devices. Recycling of smart products is also featured in a broader campaign that encourages conscious purchasing practices.[81]

4.2. Examples of activities from other national authorities

As telecom regulators are not alone in their investigation of ICT sustainability and in informing end-users, this section provides a description of activities by other competent authorities.

In **Portugal**, information about the empowerment of consumers regarding the digital transition is available on the website of the Portuguese Environment Authority.

In **France**, there are several laws and initiatives empowering end-users: An anti-waste law includes an obligation for operators to inform consumers about the carbon footprint associated with the use of Internet access service and data usage on mobile and fixed telecom networks. The French agency for the environmental transition (ADEME) has led the development of a reparability and durability index that is mandatory when distributing devices and aims to better

[77] https://www.rtr.at/TKP/was_wir_tun/telekommunikation/weitere-regulierungsthemen/nachhaltigkeit/sustainability.en.html
[78] https://www.sprk.gov.lv/sites/default/files/editor/capn/Vides politika_2022.pdf, https://www.sprk.gov.lv/content/ilgtspejas-attistiba, https://www.sprk.gov.lv/sites/default/files/editor/SPRK_strategija_2022-2026.pdf
[79] https://tieto.traficom.fi/en/statistics/energy-consumption-communications-networks
[80] https://www.traficom.fi/en/news/old-televisions-actively-reused-and-recycled-finland-last-year-almost-99-television-waste-was
[81] https://www.traficom.fi/fi/s/alyaostoksiin/alya-ostoksiin

inform consumers about the nature of their purchases. Furthermore, the law foresees to publish key indicators on policies reducing their environmental footprint. Another law aims at reducing the environmental footprint of the digital sector[82] and mentioned in Chapter 4.1, contains various new measures including a requirement to publish recommendations about information for consumers on the energy impact and carbon footprint of on-demand media services and video streaming platform services.[83] Additionally, the "High committee for digital sustainability" coordinates in collaboration with relevant authorities and stakeholders the implementation of a decarbonisation roadmap based on voluntary engagements from the digital industry in compliance with another national law related to climate and resilience.

There are also several initiatives of the **German** environmental authorities (e.g., environmental ministry, environmental agency), for example related to the provision of information on sustainable consumption, in order to foster sustainable consumption including of electronic devices such as smartphones and tablets. This information covers areas such as reparability, recycling and security of smart phones. The German Environmental Agency conducted and published several studies about the environmental footprint of ICT goods and services, e.g. a study on green cloud computing or on software-related obsolescence.[84] A voluntary environmental labelling scheme of innovative products was established (EU Ecolabel[85] and Blue Angel[86]). Information about different product labelling schemes is provided by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

In **Turkey**, a code of conduct was adopted to encourage reuse and refurbishment of mobile phones/tablets. A "Regulation on the Sale of Refurbished Products" adopted by the Ministry of Commerce aims to reduce waste by encouraging the refurbishment of devices and facilitating their sale.

In **Spain**, the Royal Decree 110/2015 of 20 February, on waste of electric and electronic equipment, related to "information of public authorities to users" sets out that different campaigns and information should be collected and provided in the local entities, autonomous communities and the State.

In **Ireland**, Electronics & ICT is one of the priority areas of the Circular Economy Programme. Furthermore, MyWaste project, aiming at reducing and proper management of waste, is an initiative of Regional Waste Management Offices of the Department of the Environment, Climate and Communications.

The **Czech** Statistical Office published in 2022 an overview about the environmental footprint of various human activities. The Czech Environmental Information Agency, which belongs

[82] French Law "Reducing the environmental footprint of the digital sector" (2021) Available in French
[83] Recommendation of ARCOM (French Regulatory Authority for Audiovisual and Digital Communication) on the information delivered to consumer on environmental impact of audiovisual services (2023)
[84] https://www.umweltbundesamt.de/publikationen/analyse-der-softwarebasierten-einflussnahme-auf
[85] Details in Chapter 2
[86] The Blue Angel is an autonomous certification that establishes criteria for environmentally sustainable goods and services. Serving as a purchasing guide, the Blue Angel has functioned as a voluntary, market-driven label within environmental policy https://www.blauer-engel.de/en

under Ministry of the Environment, issues a national variation of EU Ecolabel to goods and services (Ekologicky šetrný výrobek/služba) which prevents greenwashing.

In October 2018, **Malta** commemorated the inaugural “International E-waste Day” with an event for children and young individuals. This initiative aimed to foster a repair and reuse culture while discouraging the prevalent “throw-away” mindset.

The **Austrian** ministry for climate protection operates a comparison tool called Topprodukte.at which compares the reparability index scores of approximately 40 smartphones and also offers a repair bonus. Regarding end-of-life, the ministry for finances, together with the centre for information security, has developed guidelines for deleting data from smartphones before they are recycled. In addition, the coordinator for electronic waste has developed information on how to dispose ICT equipment (in particular smartphones). Furthermore, the chamber for workers and employees has published information on ICT sustainability as a brochure. Finally, it can be noted that the “repair bonus” (Reparaturbonus) is available to all consumers. It covers 50% of the cost of repairs up to 200 Euro and has been frequently requested for smartphones in particular.[87]

4.3. Benchmark of third parties’ initiatives

BEREC members listed various initiatives launched by third parties like organisations, academics and business players. These initiatives often complement or add to the work of public authorities and help to map the ecosystem of engagement with sustainability in national contexts.

4.3.1. Non-profit organisations

In the case of non-profit organisations, different types of initiatives are observed in an effort to increase transparency and raise awareness to end-users in terms of sustainability in the ICT sector.

Podcasts, campaigns, workshops and conferences on sustainability in the digital world appear to be a common approach adopted by several organisations, e.g. by "Ecologists without borders” in **Slovenia** or DECO[88] in **Portugal**. In **France**, related initiatives include “Digital Collage” workshop and the Halte à l'obsolescence programmée (HOP) project which focuses on product durability.

In addition, examples are given of universities that are actively engaging in the process of raising awareness on sustainability issues by offering related courses as in the case of University of Maribor in **Slovenia** and INRIA – Public Scientific and Technical Research

[87] https://www.reparaturbonus.at/
[88] The Portuguese Association for consumer protection.

Establishment in France, which offers Impact'Num, a so-called MOOC (Massive open online course) on the environmental impacts of digital technologies.

In some countries, awareness is raised through related publications. In **France**, HOP publishes white papers on obsolescence and legal action, while the GreenIT collective publishes reports on the environmental footprint of digital activities. The Shift Project is also a key organisation working on digital technologies footprint: this French non-profit think tank advocates the shift to a post-carbon economy and has published several reports on the digital sufficiency and sustainability.[89] Greenpeace in **Austria** and elsewhere has a strong focus on the sustainability impacts of devices, publishing studies and mobilising the public, e.g. through petitions.

Various other initiatives are also present in different countries in an effort to increase awareness. In **Portugal**, the environmental organisation "Quercus" has developed a site that informs consumers on how to manage their waste (including ICT devices). In **Finland**, Aalto University provides a tool to measure the data demand of websites, while LUT University has ongoing projects on green coding, and the non-profit organisation TIEKE had a Green ICT project that advised ICT companies in climate conscious digital service development. In addition, in France, the Institut du Numérique Responsable has created a carbon footprint calculator, Boavizta evaluates digital environmental footprint through inter-organisational working groups and EcoInfo has published EcoDiag methodologies for end-users to understand the environmental footprint of digital activities.

In **Germany**, the Green Consumption assistant, Ecotopten and Ökoinstitut provide information to raise awareness while the worldwide label TCO[90] certified provides sustainability certification for IT products.

4.3.2. Projects led by the private sector

Companies lead several projects in their efforts to raise awareness among end-users. The Eco Rating Initiative, gathering industry companies from multiple countries, including Finland, Germany, Greece and Ireland, seeks to evaluate the environmental impact of the entire process of production, transportation, use and disposal of mobile phones.

Actions are also taken by companies to reduce waste. In multiple countries (i.e. **Slovenia, Ireland, Latvia, Finland**, etc.), companies promote e-invoicing, refurbishing, trading in tablets/ phones and recycling programs. Refurbishing providers are not only becoming widespread,

[89] https://theshiftproject.org/en/category/thematic/digital/

[90] TCO Certified is a third-party certification independent of the IT industry and buyers. TCO Certified meets the requirements of ISO 14024 Ecolabel Type 1 and has been approved by the Global Ecolabelling Network. All verification is carried out by independent verification organisations in accordance with ISO 17025, the international standard for competence requirements applied to testing and calibration laboratories. TCO Development is owned by TCO, the Swedish Confederation of Professional Employees, a non-profit and politically independent organization. TCO works internationally with economic issues, employment, working conditions, and trade union and human rights.

but also make sure to engage in communication campaigns to underline the importance of their activities (e.g., a study commissioned by Refurbed on the sustainability dimensions of refurbished in comparison to new devices). [91]

In addition, companies collaborate also mutually. This is the case in the **Netherlands**, where one operator and one manufacturer hosted a joint conference on technology and sustainability. Another example is the collaboration of an operator with WWF through the NGO global initiative "One million phones for the planet", a worldwide partnership aiming at motivating consumers to trade in, refurbish, or recycle their old devices, while also raising awareness about reducing carbon emissions and promoting a circular economy.

Publication of relevant information on their website appears to be also another common approach among companies to raise awareness. This is the case in multiple countries such as **Norway, Belgium, Germany** and **Netherlands**.

Operators' initiatives are not limited to the above. For example, a company in **Greece** promotes sustainability initiatives such as cloud solutions through events and workshops. In **Belgium**, one company offers mobile subscriptions tracking CO_2 emissions and solutions to compensate for these emissions. In **Sweden**, operators conduct climate/sustainability programmes which are communicated to end-users. Finally, in **Turkey**, one company has adopted e-waste management and ensures the reuse of products by sales accounting for 100% of network infrastructure devices.

5. Conclusions: Summary and future work

In conclusion, environmental transparency is an important field for citizens and plays a pivotal role within the EU regulations in achieving green targets and fostering sustainable digital landscape. This BEREC report sheds light on some of the critical aspects of end-users' empowerment and awareness regarding ICT sustainability. To do so, it underlines the variety of approaches to reach end-users, including labels, scoring systems, indices, and comprehensive databases. These instruments can have an impact on the development of more sustainable production patterns by enabling a form of data-driven regulation, complementing the traditional tools of regulators to promote sustainability in the sector. They can improve end-users' knowledge of their environmental rights as well as promoting better understanding of the footprint of their digital services and devices, as well as best practices to mitigate these impacts.

It is worth noting that significant progress has been made in environmental and consumer protection regulations in Europe. This BEREC report underscores the myriad benefits associated with enhancing environmental transparency towards end-users. This encompasses facilitating communication to support the implementation of end-users' green

[91] Nemeth et al. (2023) *Sustainability Impact Measurement: Refurbed GmbH*. Fraunhofer Austria Research GmbH, commissioned by Refurbed GmbH.

rights, offering valuable information to promote sustainable digital practices, and raising awareness about the environmental impact of ICT devices. For example, initiatives related to empowering end-users and proposals for guidelines on environmental claims will better protect end-users from greenwashing and standardise the evidence systems regarding the environmental performance of companies. Furthermore, the European framework for ecodesign and energy labelling allows for the establishment of standardised labels and, in the coming years, an EU digital product passport. It should be noted that this framework will continue to be gradually extended to digital products, including recently smartphones and tablets, although intangible digital services are excluded. Another illustration will be the ongoing work of the European Commission, including DG Energy's recent external study[92] and recognised as crucial elements in this endeavour.

BEREC welcomes these advancements, although it acknowledges that the implementation of some of these new regulatory initiatives will be complex and will have to be paired with the appropriate resources. The challenges also include the need for readability of environmental transparency disposals to consumers whereas several initiatives already exist at national level. These endeavours highlight the need for a harmonised and collaborative approach associating EU bodies, national authorities, the industry and consumer/environmental organisations. Additionally, it will be crucial to ensure that a labelling scheme informs about all significant environmental impacts of the life cycle of the product, e.g. related to production, aside a focus on longevity of device hardware. In this context, it is important to note a lack of initiatives to increase end-users' awareness related to the environmental impacts of software.

While transparency for environmental impacts is increasingly addressed through legislation, leading to harmonisation and thus better comparability for end-users, BEREC notes that the lack of (standardised) information by device manufacturers significantly complicates the assessment of the environmental impacts of individual devices' life cycle as well as the device industry as a whole. For instance, the information pertaining to the functional lifespan of a device for instance depends on information provided by chip manufacturers and operating system (OS) providers. The same reasoning is to be applied for digital services providers. Some parts of the digital service value chain are still opaque in terms of environmental data, preventing the dissemination of precise information about the environmental footprint of digital services including to end-users (also important to evaluate the impact of the operation phase of devices). BEREC emphasises that there is still work to be done to enhance the environmental transparency of ECN/ECS, which is also crucial for the electronic communications sector, as well as for calculating the environmental impacts of the life cycle of end-user devices and digital services, which rely on electronic communications infrastructures in their operation phase. This demonstrates that in order to make environmental information available to end-users, information needs to be provided at every level of the digital value chain and to adopt holistic approach when analysing the environmental footprint of ICT components.

[92] https://op.europa.eu/en/publication-detail/-/publication/d3b6c0a1-1171-11ee-b12e-01aa75ed71a1

When seeking to enable consumer decision-making as a force for change, it is paramount to ensure that the information provided to consumers is science-based and actionable. In BEREC's view, this is an area where the scientific community as well consumer organisations should engage further and cooperate closely with the legislators when designing interventions. In some cases, this also means that the provision of information to end-users needs to be complemented with dedicated tools to encourage circular practices and products by design. For this reason, initiatives like the "right to repair" need to be seen in tandem with data-focused initiatives, and it is important to leverage synergies between these different approaches by arranging legislative initiatives in a complementary manner.

This report delves into the perspectives of EU environmental and consumer organisations (i.e. BEUC and EEB) regarding the significant strides taken with the EU Green Deal. These organisations welcome the upcoming EU framework while also underlining the challenges in implementing these new disposals in the EU. Furthermore, both emphasise the importance of promoting a "sustainable by design" approach within the digital sector beyond the provision of data.

This report also recognises the significant contributions of other competent authorities and third parties in this ongoing effort. Activities by third parties are very diverse, including supporting for programs to encourage end-users to recycle old devices, publication of reparability kits and indices to facilitate comparability between devices. Although the profusion of initiatives may raise challenges in terms of harmonisation and comparability, this may also be a sign of collective awareness on the need to accelerate the green transition of the ICT sector and to enable consumers to take part in it.

Regulators of electronic communications can play a role in fostering awareness about the environmental footprint of digital products and end-users' empowerment in the green transition. An overview of first projects launched by BEREC members to improve the environmental information provided to end-users as well as to support their empowerment in the green transition is also proposed. A group of NRAs have embarked on various initiatives, such as publishing reports, developing best practice guidelines, and conducting communication campaigns. It seems to be only a starting point – further development of initiatives is expected among BEREC members in this regard.

In terms of future work, BEREC and its member NRAs could provide their knowledge and technical expertise in contributing to the implementation of the European Green Deal regulatory disposals or voluntary initiatives. The growing expertise of NRAs regarding the assessment of environmental impacts as well as the collection of environmental data by some of them could notably help to assess the environmental footprint of ECN/ECS, which is key to understand the environmental impact of the life cycle of digital devices and services. Furthermore, as BEREC and NRAs traditional work includes safeguarding end-user interests, they could be effective channels to communicate best practices and environmental information to stakeholders, including consumers.

Practically, to support the existing efforts and build on the outputs of this report, BEREC will launch a communication campaign in 2024 to contribute to the dissemination of reliable

information on the environmental impact of devices and potential best practices for extending their lifespan. It will also continue its activity on sustainability indicators in ICT sector, especially for electronic communications components of the Internet ecosystem.

Finally, as part of its commitment to support the twin green and digital transition, BEREC seeks to keep supporting the collective efforts towards ICT sustainability in collaboration with industry players, the academic community and civil society and to the benefit of European citizens.

Glossary

Bureau Européen des Unions de Consommateurs (BEUC): BEUC is the umbrella group for 45 independent consumer organisations from 31 countries. Their role is to represent them to the EU institutions and defend the interests of European consumers.[93]

CO_2e: CO_2 equivalent of a GHG emission is the amount of carbon dioxide that would cause the same cumulative radiative forcing over a given period of time, i.e., would have the same ability to trap the solar radiation.

Corporate Sustainability Reporting Directive (CSRD): CSRD modernises and strengthens the rules concerning the social and environmental information that companies have to report. A broader set of large companies, as well as listed SMEs, will be required to report on sustainability. Some non-EU companies will also have to report if they generate over EUR 150 million on the EU market.[94]

The new directive will ensure that investors and other stakeholders have access to the information they need to assess the impact of companies on people and the environment and for investors to assess financial risks and opportunities arising from climate change and other sustainability issues. Finally, reporting costs will be reduced for companies over the medium to long term by harmonising the information to be provided.

The first companies will have to apply the new rules for the first time in the 2024 financial year, for reports published in 2025. Companies subject to the CSRD will have to report according to European Sustainability Reporting Standards (ESRS). The standards are developed in a draft form by the EFRAG, known as the European Financial Reporting Advisory Group, an independent body bringing together various different stakeholders.

Data-driven regulation: Making data available to enlighten users' consumption choices and guide the market with the right information. Applied to sustainability, the publication of clear, readable and reliable environmental information can help enlighten consumption choices and make the end-users important players in promotion of the most sustainable products.

Digital Product Passport: Designed to offer insights into the environmental sustainability of products. Accessible through scanning a data carrier, this passport will provide details like a product's longevity, reparability, recycled materials used, and the availability of spare parts.

Digital uses: This refers to the use of digital products (goods and services).

European Environmental Bureau (EEB): EEB is the largest network of environmental citizens' organisations, with over 180 member organisations from 40 countries.

[93] https://www.beuc.eu/
[94] https://finance.ec.europa.eu/capital-markets-union-and-financial-markets/company-reporting-and-auditing/company-reporting/corporate-sustainability-reporting_en

Enabling effect: Enablement (also described as the enabling effect) is the reduction of emissions that occurs outside a solution's lifecycle or value chain but resulting from the use of that solution.

Environmental Sustainability:[95] The United Nations Brundtland Commission defined in 1987 sustainability as '*meeting the needs of the present without compromising the ability of future generations to meet their own needs*.'[96] It encompasses three dimensions: environmental, economic and social. An attempt definition of environmental sustainability would be the conditions of balance, resilience, and interconnectedness that allows human society to satisfy its needs while neither exceeding the capacity of its supporting ecosystems to continue to regenerate the services necessary to meet those needs nor by our actions diminishing biological diversity.

EU ecolabel: Launched in 1992, the EU Ecolabel logo has become a byword for quality while meeting the highest environmental standards. The EU Ecolabel helps consumers, retailers and business make truly sustainable choices.[97]

Greenwashing: Behaviour or activities that make people believe that a company is doing more to protect the environment than it really does. [98]

Indicator: Quantitative tool to measure a parameter or a performance of one entity (organisation, geographical area, product, etc.).

Life cycle: A life cycle begins with extracting raw materials from the ground and generating energy. Materials and energy are then part of manufacturing, transportation, use (e.g., operation of networks), and eventually recycling, reuse, or disposal. A life cycle approach (LCA) identifies both opportunities and risks of a product or technology, all the way from raw materials to disposal. There is a considerable number of life cycle approaches, ranging from qualitative (life cycle thinking) to quantitative approaches.

Life cycle approach/assessment: It is a compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product or service throughout its life cycle.

Planetary Boundaries: The planetary boundaries framework refers so a set of nine natural global quantitative boundaries within which humanity can continue to develop and thrive for generations to come. It was developed by a group of 28 scientists to identify the processes that regulate the stability and resilience of the Earth system.[99]

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[95] https://scholarworks.rit.edu/cgi/viewcontent.cgi?article=1007&context=jes
[96] United Nations Brundtland Commission http://www.un-documents.net/our-common-future.pdf
[97] https://environment.ec.europa.eu/topics/circular-economy/eu-ecolabel_en
[98] https://dictionary.cambridge.org/dictionary/english/greenwashing
[99] Rockström, J., W. Steffen, K. Noone, Å. Persson, et.al. 2009. Planetary boundaries: exploring the safe operating space for humanity. Ecology and Society 14(2): 32; Rockström, J., Steffen, W., Noone, K., Persson, Å., et.al. 2009. A safe operating space for humanity. Nature 461: 472-475 DOI 10.1038/461472a; Steffen, W., K. Richardson, J. Rockström, S.E. Cornell, et.al. 2015. Planetary boundaries: Guiding human development on a changing planet. Science 347: 736, 1259855

Metric: Unit of measurement.

Obsolescence: Obsolescence refers to the status of something as not being usable anymore. When a device is obsolete, this means it can no longer be used as expected.

Product Environmental Footprint (PEF*)*: The PEF is a methodology to measure the life cycle environmental performance of products and considers the relevant environmental impacts of all steps needed. Up to 15 different environmental impact categories are considered (climate change; ozone depletion; human toxicity, cancer; human toxicity, non-cancer; particulate matter; Ionising radiation, human health; photochemical ozone formation, human health; acidification; eutrophication, terrestrial; eutrophication, freshwater; eutrophication, marine; ecotoxicity, freshwater; land use; resource use, minerals, and metals; resource use, fossils). The most relevant parameters are chosen depending on the objective and product.

Product Environmental Footprint Category Rules (PEFCR): Based on the PEF/OEF methodologies, the PEFCR are set of rules set by the European Commission to calculate the environmental impact of category of products and secure the validity and comparability of the assessment.

Rebound effect: A phenomenon where improvements in efficiency lead to an increase of demand that offsets the positive effects of efficiency improvements.

Reparability: Reparability refers to the ease with which a product can be repaired or restored to its original functionality when it malfunctions or becomes damaged. The concept of reparability is crucial in the context of sustainable product design and the circular economy, as it directly influences the lifespan of a product and its environmental impact.

Scopes 1, 2, 3: Terminology to designate one organisation/product carbon footprint through its life cycle. Scope 1 concerns all GHG emitted directly by the company: heating in premises, emissions from vehicles owned by the company, etc. Scope 2 refers to indirect and energy-related emissions: these are the emissions created during the production process. Scope 3 includes all indirect emissions. In general, we find the majority of the emissions produced by the company in this scope: purchase of goods, services, etc.

Standard: Structured set of recommendations, normative or not, and good practices used for the implementation of a method in a context, for a product category, or for a particular objective.