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BEREC Report on Sustainability Indicators for Electronic Communications Networks and Services

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Content

Executive Summary

The protection of the environment is higher than ever on the agenda of European and global public decision makers. In line with its Strategy 2021-2025, BEREC has committed itself to contribute to the 'twin' green and digital transition by supporting the ICT-related parts of the European Green Deal and international environmental targets. In June 2022, BEREC published a first report on sustainability '*Assessing BEREC's contribution* to limiting the impact of the digital sector on the environment'.[1] One of the toughest challenges identified by this Report was the lack of available data, as well as the need to adopt a harmonised approach to methodologies and standards for assessing the environmental impact of digital technologies. BEREC is committed to addressing these challenges, participating in processes for a common and harmonised assessment methodology and transparency measures regarding the environmental footprint of electronic communications networks and services (ECN/ECS) in the European Union (EU). Hence, BEREC decided to include in its Work Programmes 2022 and 2023 a new workstream elaborating on sustainability indicators for ECN/ECS.

BEREC based its work on sustainability on the existing EU regulations and initiatives that are detailed in this Report as well as on active dialogue with other relevant bodies engaged in this topic. The document provides a summary of main findings from a call-for-input lead by BEREC in 2022 by means of two questionnaires and a series of workshops with stakeholders to establish an overview of sustainability indicators currently used and which are perceived as relevant for assessing the environmental footprint and performance of the electronic communications sector. It also presents a preliminary assessment of main challenges and learnings regarding sustainability indicators for ECN/ECS.

First, BEREC reviewed **National Regulatory Authorities (NRAs) and other competent authorities first actions on environmental transparency** in the electronic communications sector with a dedicated questionnaire published in 2022. Within BEREC, four NRAs have started to include environmental aspects in their data collection (BE, ES, FI, FR)[2] based on general provisions on data collection set out in the European Electronic Communications Code (EECC), and/or on additional competencies provided at national level, and/or in collaboration with other competent authorities and stakeholders. Due to the novelty of the topic and the absence of standardised data collection, the sustainability indicators currently in use are diverse. The most common indicators collected by these NRAs relate to energy and electricity consumption, carbon footprint, water consumption, energy efficiency and the share of recycled and reused products distributed.

Second, BEREC engaged with various stakeholders from **academia, industry associations, civil society organisations and other relevant authorities during technical workshops**.[3]

[1] BEREC Report on sustainability: Assessing BEREC's contribution to limiting the impact of the digital sector on the environment, 9 June 2022, BoR (22) 93.

[2] Data collection from CNMC: some environmental data from operators for purposes other than sustainability analysis not published.

[3] Detailed in Chapter 3 of the present report.

The need for strong collaboration between authorities and active dialogue with stakeholders appears evident due to the profusion of initiatives on the matter. BEREC highlights its intention to build collaborative bridges with the current work being conducted notably by the European Commission, RSPG, OECD-NER, ITU and ETSI.

To inform BEREC on sustainability indicators currently used by ICT companies and to get an overview of challenges in data collection and reporting, BEREC also published a **questionnaire for industry players based on the list of 19 sustainability indicators** including impact indicators from the European Commission's Product Environmental Footprint (PEF) and Organisation Environmental Footprint (OEF)[4] methodologies and other environmental performance indicators. The analysis of the 81 answers received from the ICT industry shows that important efforts have been made towards environmental reporting, with a noticeable wide variety of environmental data published by the industry. Specifically, 56 companies (69% of the respondents) confirmed some form of reporting of environmental data, 48 (59%) of which also responded that they also publish this data, including 27 (33%) who do so in open data format (including 7 who do so only partially).

The most popular environmental footprint indicators collected and published by these companies are those related to their energy consumption and carbon footprint.[5] For the latter, the majority of respondents report on their direct emissions (i.e., Scope 1) and also on emissions related to energy consumption (Scope 2). About half of the companies that responded to BEREC provide information on their other indirect emissions, despite the technical challenges associated with calculations of these Scope 3 emissions.[6]

Questionnaire results showed that other frequently collected environmental footprint indicators by the sample were notably those related to the generation of electronic waste ('e-waste') and water consumption/use. With regard to the indicators that were least frequently used by respondents, these included land use, ecological and human toxicity, consumption of raw materials including abiotic resources (mineral, metal, and fossil)[7] and eutrophication. Despite the lower number of companies which collect data on these indicators, some are still considered 'somewhat relevant" or 'very relevant" by a significant number of respondents – e.g., raw material depletion indicators were considered 'very relevant' by 14 (17% of total industry respondents) and 'somewhat relevant' by 21 companies (26% of total). In comparison,

[4] Recommendation on the use of Environmental Footprint methods (2021, DG Environment) https://environment.ec.europa.eu/publications/recommendation-use-environmental-footprint-methods_en

[5] BEREC notes that calculation of the carbon footprint can defer depending on the emissions factors used to translate and energy consumption in carbon footprint.

[6] In the context of GHG emissions, Scope 1 refers to the emissions related to the organisation's owned or controlled resources (direct emissions); Scope 2 to the indirect emissions from the energy purchased by the organisation, and Scope 3 to all other indirect emissions along the value chain (upstream and downstream) Scope 3 emissions typically account for the biggest GHG emissions for most organisations.

[7] Abiotic resources comprise all raw non-biotic raw materials, i.e., all raw materials that are not derived from living organisms. These resources include fossil fuels, ore and other mineral raw materials, construction minerals such as sand, gravel, and rock, and industrial minerals such as silica, sand and potash.

the eutrophication and human toxicity indicators were mostly regarded as 'not relevant' by the industry players.

The environmental performance indicators included by BEREC in its questionnaire (i.e., use of renewables, distribution or use of materials from the circular economy, use of second-hand materials, lifespan, recyclability, waste heat recovery and reparability) are mostly perceived as 'somewhat relevant' or 'very relevant' by the respondents with the exception of 'waste heat recovery'. The most used performance indicators are also the ones related to energy performance: 51 companies report their use of renewable energy[8] (63% of total respondents) and 50 companies their energy efficiency (62% of total). Some of the circular economy performance indicators related to recycling and second-hand products and materials are also relatively widespread. For instance, 26 companies (32% of total) report their distribution or use of recycled/second-hand products and 23 the recyclability of their products (28% of total). It can be noted that stakeholders which do not yet report information on environmental impact, as well as those who have experienced problems with this type of reporting, appear to agree that a common methodology and technical tools would be beneficial for the practice of standardised environmental reporting in the ICT sector.

BEREC notes a general agreement among stakeholders on the need for more available information on the environmental footprint of electronic communications, which strengthens BEREC's initial findings in its previous report on environmental sustainability. While stakeholders are currently taking a range of approaches to collecting and reporting their environmental impacts, it is crucial for the ICT industry to adapt common best practices as soon as possible. A standardised, comparable group of metrics could facilitate a faster and fairer transition to a more environmentally sustainable digital sector which will ultimately benefit all stakeholders in the industry.

Lastly, from its findings, BEREC presents a **preliminary assessment** of main challenges ahead and proposes in this Report a pilot classification of the 19 sustainability indicators reviewed for ECS/ECN based on level of adoption and support according to the first experiences of NRAs and industry players' feedback. Main outputs could be highlighted as follows:

1. Detailed studies and information of environmental impacts are important to fully characterise the impact of the digital sector and to progressively adopt a multi-criteria approach to such assessments, while **PEF/OEF** methodologies are expected to become the norm for all industries in the EU. The development of lifecycle analysis based on PEF and OEF in the electronic communications sector is only starting and will be crucial to meet the objectives of climate change mitigation and of circular business models. The provision of environmental data by digital actors seems essential in this perspective as it would indeed increase the pool of available data for

[8] The rate of renewable energy as measured by the companies who replied to BEREC questionnaire may encompass both the energy is actually physically used (self-consumption) or owned (PPAs, GOs).

these studies and facilitate the precise measurement of the environmental impact of digital technologies and the choice of relevant sustainability indicators to monitor.

2. The industry is already deploying significant efforts to publish environmental information in the context of existing EU regulation on the matter, with growing interest from both shareholders and consumers. Technical assistance in **standardisation efforts of the industry and third-party evaluation through a public authority, where relevant, is needed to improve comparability and reliability of the information reported**. It is also important to encourage industry players to **implement open data** in order to increase the level of **harmonisation and comparability** of environmental reporting in ICT, and specifically in electronic communications. The digital component of such reporting can be a powerful tool for ensuring transparency and for promoting effective and efficient data-driven regulation.

3. From the preliminary results of BEREC call-for-input**, sustainability indicators** could be ranked into three groups:

    i. Firstly, 'Group A' indicators which are already **collected by at least one member NRA of BEREC and are supported by a significant number of companies.** They tend to enjoy a certain degree of maturity in the industry, and include energy consumption, carbon emissions, e-waste and distribution of recycled/reused/refurbished products. Methodologies and studies have been published to collect or standardise the use of these indicators even if challenges remain, for instance, in calculating Scope 3 emissions.

    ii. Secondly, 'Group B', which encompasses **indicators that are supported by companies to a medium degree but are not yet collected by any NRA in BEREC** (e.g., the use of abiotic resources or circular economy performance such as durability, recyclability of products), indication of a lesser degree of maturity.

    iii. Finally, 'Group C' is a third category which gathers **indicators with the lowest level of maturity, low support and adoption from the industry and neither collected by NRA in Europe** based on BEREC questionnaires.

    To feed future discussions, this Report proposes a pilot classification[9] of sustainability indicators that could be considered as relevant to document ECN/ECSs environmental impact based on NRAs' initial experiences in the matter and on the feedback of the 81 industrial players that answered the BEREC questionnaire. Moreover, it should be noted that this categorisation is not yet supported by a quantitative impact assessment. Hence, these first results should not pre-empt the parallel work of the European Commission and other relevant bodies, or future BEREC positions on the matter. Furthermore, even the less matured indicators in Group C, with the lowest level of

[9] See p. 48 'Table 4 – Preliminary classification of sustainability indicators for ECN/ECS based on the analysis of BEREC 2022 questionnaires"

adoption, support from private respondents can still be considered relevant for further research (especially quantitative assessment) in the context of the EU's environmental targets.

4. In this context, both **BEREC's and NRAs' expertise could contribute to improving transparency, measurement, and mitigation of the ICT sector's environmental footprint**. Regarding the institutional design and the precise indicators that should be collected depending on the regulatory or non-regulatory targets, BEREC notes that further discussions are needed with other competent authorities and stakeholders, as well as some level of flexibility granted at national level to adapt to differentiated contexts. While the data collecting provisions (Article 20) in the EECC do not prevent NRAs from collecting environmental data, a clearer and harmonised mandate to collect information on the environmental impact of ECN/ECS, would be a favourable development to examine.

In terms of future work, BEREC will pursue its analysis environmental transparency including through its work item on the empowerment of end users through information on digital products and services in 2023 and 2024.[10] It will also follow the work of the European Commission and competent bodies on environmental key performance indicators (KPIs) and reporting for electronic communications. As a final statement, BEREC reiterates its willingness to participate with its expertise in accelerating the twin green and digital transition.

[10] See '3.1. BEREC contribution to empowering end users through environmental transparency on digital products and services', p.30: https://www.berec.europa.eu/en/document-categories/berec/berec-strategies-and-work-programmes/berec-work-programme-2023

1. Introduction and objectives

Connectivity has profoundly reshaped our economies and societies over the past decades, bringing important opportunities for innovation and development. Digital technologies also represent one of the important drivers for building solutions to reply to the current and upcoming environmental challenges. Digitalisation is indeed opening possibilities for GHG emissions reduction and industrial process optimisation in several sectors, such as energy, agriculture or transport. However, the digital sector itself also must undergo its own environmental transition to meet European and international targets.

As indicated in the report '*Assessing BEREC's contribution to limiting the impact of the digital sector on the environment*' (2022), the share of ICT in global GHG emissions is about 2-4%. The digital economy is also responsible for natural resources depletion such as fossil fuels sources and abiotic resources. That is why the **European Green Deal** not only sets out climate neutrality objectives for digital infrastructures, but also the adoption of circular economy models by the ICT sector. Despite the steady increase in consumption of digital, there have been significant efforts deployed by ICT companies to limit the increase of their environmental footprint, particularly through investments in energy efficiency. In this context, environmental transparency of the digital sector is essential to better understand where efforts are needed to successfully conduct a greener digitalisation. It seems that the way forward is to keep track of ICT companies' environmental impacts and performance, to inform competent authorities with necessary information to build adapted regulation and policies, as well as to provide users with understandable and reliable environmental information on their digital products and services, to allow them to make informed sustainable choices. Following the adoption of its 2021-2025 Strategy, BEREC has been engaged in furthering its knowledge on the green transition of the digital sector, so that it can contribute to collective efforts against climate change and environment degradation. One of the most pressing issues identified was the lack of data and of common harmonised methodologies to assess the environmental impact of the ICT. Despite the profusion of studies and standards, the complexity of digital value chains raises technical difficulties detrimental to obtaining clear information on digital technologies environmental footprint.

The EU has launched several projects to improve environmental transparency in the sector, such as the **revision of the Energy Efficiency Directive**,[11] that includes new mechanisms to collect environmental data from data centres and the adoption of an eco-design and energy labelling regulation for smartphones and tablets. For ECN/ECS, the European Commission's digital strategy '**Shaping Europe's Digital Future'** calls for increased environmental transparency for this specific part of the Internet ecosystem. The important role of BEREC and NRAs in the process of adoption of common sustainability indicators for ECN/ECSs was highlighted by Member States in their **Toulouse Declaration after the 2022 Digital**

[11] Proposal of a directive on energy efficiency (recast)
https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0558

Assembly,[12] as well as by the Commission in its recent '**Digitalising the energy system – EU action plan'**.[13] The provision of common sustainability indicators on electronic communications environmental footprint and publication of environmental data from industry could be important to increase regulators' analysis capacity, as well as to improve the level of environmental information transparency to end users, thereby creating virtuous incentives within the sector (data-driven approach).

Hence, to start investigating the topic of environmental transparency in digital markets, BEREC included a workflow in its Work Programme to conduct research on the indicators which might help evaluate the environmental sustainability ECN/ECS based on stakeholders' and authorities' initiatives on the matter and on indicators already used and promoted by the industry. To meet circular economy ambitions, the work of BEREC is not focused on GHG emissions alone but also weighs the different environmental impacts such as resource use, water consumption and e-waste in the context of the PEF/OEF methodologies. As stated in the previous BEREC Report on sustainability, BEREC's work intends to cover all relevant environmental impacts, including the life cycle analysis and GHG emissions through circular economy approach and multi-criteria assessment. Taking into account the strong interlinks between different components of the ecosystems, BEREC is not solely considering stakeholders' activities on sustainability of ECN/ECS, but it considers feedback all relevant parts of ICTs from infrastructures to services, usages and devices. Indeed, its call-for-input (workshops and questionnaires) includes contribution not only on electronic communications networks and services but also on data centres, devices and digital services.

With this new Report, BEREC pursues three main objectives:

1. To identify the **main categories of environmental impacts of electronic communications** studied by stakeholders (industry players, academics, associations, and public decision makers) and possible prioritisation for these categories according to the objectives of respective players;

2. To **map the indicators chosen to monitor these impacts** and the main standards used in the calculation of these indicators, as well as industry's view on most useful indicators in the context of various business activities;

3. To provide an **overview of existing initiatives by NRAs and other competent authorities** and develop **preliminary assessment** of the most relevant environmental sustainability indicators, without pre-empting ongoing reflections in Member States and in other EU bodies.

Environmental sustainability constitutes a somewhat new topic for electronic communications regulators. Hence, comparatively to its latest publication on sustainability, BEREC chose to

[12] https://www.berec.europa.eu/en/news-publications/news-and-newsletters/berecs-commitment-to-sustainability-underlined-in-twin-transition-statement-by-eu-member-states

[13] EU action plan on digitalising the energy system https://ec.europa.eu/commission/presscorner/detail/en/QANDA_22_6229

pay particular attention to existing work of EU bodies to base its work on European framework (Chapter 2). BEREC also engaged with stakeholders (public organisations, academics, civil society experts, industry associations) through technical workshops in order to collect views on main challenges ahead in terms of environmental transparency and to get a better understanding of existing work on sustainability indicators (Chapter 3). At this stage, NRAs' work on environmental sustainability is not harmonised based on a common European regulation. In the absence of a harmonised regulation, projects of electronic communications regulators on environmental sustainability and sustainability indicators are largely dependent on their national context and mandate, where relevant. BEREC takes into account these differentiated perspectives and scope and provides in this Report an updated overview of activities on measuring environmental sustainability led by European electronic communications regulators (Chapter 4). BEREC also reflects on feedback from the industry about which sustainability indicators they deem relevant in the context of their business activities, and which are already in use in companies (Chapter 5). Based on these elements and different sources, this Report proposes preliminary assessment of BEREC on the means to foster environmental transparency in the sector and to meet EU targets in this area (Chapter 6) as well as conclusions and snapshot of BEREC's future work on the topic (Chapter 7).

2. European Framework

In line with the European Green Deal goal and EU's digital strategy, environmental transparency of the digital sector is a topic addressed throughout the EU horizontal environmental legislation as well as by non-regulatory initiatives. This section outlines the existing work on indicators and measurements for environmental footprint – EU proposals, Directives and Regulations, studies and non-regulatory EU initiatives.

2.1. Existing regulatory initiatives on environmental transparency

BEREC has reviewed some of the main regulations on the topic in order to have clearer view on existing or upcoming obligations already imposed on electronic communications players.

The BEREC 2022 Report on sustainability already highlighted key European legal instruments on environmental sustainability including the **Ecodesign Directive**[14] and the **EU labelling framework**, the **Waste of Electrical and Electronic Equipment Directive** (WEEE Directive),[15] and the **Energy Efficiency Directive**, currently under revision.

Additionally, the **revised Corporate Sustainability Reporting Directive (CSRD)**[16] strengthened and modernised the requirements under EU law for all public-interest companies, including listed SMEs (approximately 50 000 companies total, micro undertakings are not included), to report information regarding social and environmental impact. Companies subject to the CSRD will have to report in line with the European Sustainability Reporting Standards (ESRS), in order to standardise and improve transparency, akin to the standards already in place for financial accounting reporting. Common sustainability reporting standards will also allow for the digitalisation of sustainability reporting and can facilitate its supervision and enforcement. All information/data must be provided in machine readable format under the CSRD. These rules will apply from the financial year 2024, for reports published in 2025, to ensure that investors and other stakeholders can assess risks arising from climate change and other environmental issues.

[14] DIRECTIVE 2009/125/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:02009L0125-20121204&from=EN

[15] Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE) (recast) Text with EEA relevance https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32012L0019

[16] Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 amending Regulation (EU) No 537/2014, Directive 2004/109/EC, Directive 2006/43/EC and Directive 2013/34/EU, as regards corporate sustainability reporting (Text with EEA relevance) https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32022L2464

Complementary to the CSRD, in 2022, the Commission also adopted a proposal for a **Directive on Corporate Sustainability Due Diligence (CSDD).** This seeks to bring in the complexity of global value chains in due diligence focusing on both environmental sustainability, including pollution and biodiversity loss, and human rights (e.g., child labour and worker exploitation). As ECN/ECS are often plugged into global supply chains, this will be important for the sector in terms of improving transparency of the environmental impact of business activities and advancing the green transition. The CSDD will apply to EU companies in the designated categories 'Group 1' (all EU limited liability companies with over 500+ employees and excess of €150 million net turnover worldwide), and 'Group 2' (other limited liability companies operating in 'high impact' sectors, with over 250 employees and €40 million net turnover worldwide).[17] For non-EU companies, the rules would apply if the turnovers cited for Groups 1 and 2 are generated within the EU.

As mentioned in the **Digitalising the energy system – EU Action Plan**, the European Commission will explore the possibility to develop common indicators for measuring the environmental footprint of electronic communications services (Q4 2023) with the aim to establish an EU Code of Conduct for the sustainability of electronic communications networks (Q4 2025). It will also explore introducing separate reporting lines for indirect GHG stemming from data centre services and the purchase of cloud computing under the CSRD.[18] This Action Plan aims to decouple the energy footprint of the ICT sector from the exponential growth of data.

The **EU Taxonomy**[19] was adopted in 2020 as a classification system, establishing a list of environmentally sustainable economic activities in order to support the objectives of the European Green Deal. It aims at providing investors and policymakers with appropriate definitions which economic activities can be considered environmentally sustainable. In principle, the EU Taxonomy aims to reduce the risk of 'green washing' and to increase transparency for investors. To this end, it seeks to establish uniform criteria for screening of environmental impacts for the purposes of sustainable investment.[20] Given that the EU Taxonomy's scope[21] is rather broad, in particular when aiming at non-financial reporting of relevant undertakings, it might have an impact on methodologies applied for measuring environmental impacts outside its immediate objectives. To ensure reliability, consistency and comparability of sustainability-related disclosure, existing indicators should be used as proposed by the European Parliament in its resolution of 29 May 2018 on sustainable

[17] For Group 2, the Corporate Sustainability Due Diligence rules will start to apply 2 years later than for Group 1.

[18] Communication Digitalising the energy system – EU action plan https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022DC0552&qid=1666369684560

[19] Regulation (EU) 2020/852 of the European Parliament and the of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088, official journal of the European Union (OJ L 198/13 – L198/43, 22.06.2020), hereinafter: EU Taxonomy.

[20] EU Taxonomy, Recital 11.

[21] The EU Taxonomy applies to measures adopted by Member States on requirements for financial market participants, financial market participants themselves and undertakings subject to publication obligations in accordance pursuant to Article 19a or Article 29a of Directive 2013/14/EU, Taxonomy, Article 1.

finances[22] and the indicators referred to in Regulation (EU) 2019/2088.[23] The EU Taxonomy Regulation amends the former Regulation on sustainability-related disclosures to mandate authorities established by previous Regulations to jointly develop technical standards in relation of contributions to the environmental objectives of the EU Taxonomy.[24]

The six environmental objectives covered by the EU Taxonomy are climate change mitigation, climate change adaptation, the sustainable use and protection of water and marine resources, the transition to a circular economy, pollution prevention and control, and the protection and restoration of biodiversity and ecosystems.[25] Under the EU Taxonomy, the European Commission shall adopt delegated acts further specifying technical screening criteria, for the respective objectives. Given the parallelism of the European Green Deal and the overlap in the need to measure environmental impacts, BEREC will continue to monitor developments carried out under the EU Taxonomy with the aim of contributing to a harmonised measuring methodology and where applicable, to use the possibly developed guidelines for its own analysis.

The European Commission published a new legislative proposal in March 2022 for the **Ecodesign for Sustainable Products Regulation** (ESPR) revising the 2009 Eco-design directive, as part of the broader **Sustainable Product Initiative** (SPI).[26] The main objective of the ESPR is to increase sustainability and reduce the negative life cycle environmental impact of products. Building on the existing Ecodesign Directive, the scope is expanded beyond energy-related products, establishing sustainability performance and information requirements on a wide range of products, along with the introduction of Digital Product Passports and a registry for relevant data. The ecodesign requirements focus on complying with rules on product durability; reliability; reusability; upgradability; repairability; possibility of maintenance and refurbishment; presence of substances of concern; energy use or energy efficiency; resource use or resource efficiency; recycled content; possibility of remanufacturing and recycling; possibility of recovery of materials; environmental impacts, including carbon and environmental footprint; and the expected generation of waste materials. The proposed text recalls the importance of using data-driven tools including the PEF Methodology as laid down by the Commission Recommendation (EU) 2021/2279[27] as well as other parameters related to the environmental performance of the products.

[22] OJ C 76, 9.3.2020, p. 23, see taxonomy, Recital 20.

[23] Regulation (EU) 2019/2088 of the European Parliament and of the Council of 27 November 2019 on sustainability-related disclosures in the financial services sector (OJ L 317, 9.12.2019, p. 1).

[24] EU Taxonomy, Recital 35.

[25] EU Taxonomy, Article 9, see also Recital 23. 9 June 2022, p. 13-19.

[26] Proposed regulation on eco-design for sustainable products https://environment.ec.europa.eu/system/files/2022-03/COM_2022_142_1_EN_ACT_part1_v6.pdf

[27] Commission Recommendation (EU) 2021/2279 of 15 December 2021 on the use of the Environmental Footprint methods to measure and communicate the life cycle environmental performance of products and organisations.

In order to reduce waste generation, the proposal includes transparency requirements relevant to the destruction of unsold goods. Under certain circumstances,[28] it foresees the companies' ability to self-regulate by requesting the European Commission to examine their ecodesign measures as an alternative. In this case, the proposed self-regulation measures should achieve the same objectives as those set by the ESPR. Finally, other provisions include rules on labels indicating the performance of groups of products, measures regarding the destruction of unsold goods and obligations of online marketplaces concerning market surveillance.

Under the 2020 **Circular Economy Action Plan** and in line with European Green Deal objectives on efficient use of resources, new requirements on **ecodesign and energy labelling for mobile phones, cordless phones and slate tablets**[29] were proposed by the European Commission in application of the Ecodesign Directive and the EU label Regulation. These new rules aim at ensuring better information on the environmental performance of these products and to improve the energy efficiency, durability and repairability in the design of mobile and tablet devices. The draft Regulation on energy labelling for smartphones and tablets foresees the display of three types of information: energy efficiency classes, repeated free fall reliability class and repairability class. The proposed Ecodesign Directive notably stipulates for this category of products that consumer should be able to easily repair, upgrade and maintain these devices, and that they can be recycled and reused. It can be noted that the European Commission is also working on **new ecodesign requirements for off mode, standby mode, and networked standby energy consumption of electrical and electronic household and office equipment**[30] that could also improve the monitored environmental performance of electronic communication.

The European Commission also proposed the initiative **Substantiating Green Claims – Environmental performance of products & businesses** that will require companies to substantiate claims they make about the environmental footprint, by quantifying the impact of their products/services using standardised methods. This initiative should also complement the measures in existing legislation, by increasing the reliability, comparability, and verifiability of environmental claims about products, via requirements that such claims be substantiated and verified using life cycle analysis methods, including the PEF methodology. The aim is to reduce 'greenwashing' and helping commercial buyers and investors make more sustainable decisions and increase consumer confidence in green labels and information. A first step was already made in 2022 with the publication of the **proposal for Directive on Empowering Consumers in the Green Transition** which foresees an obligation to provide information on

[28] By companies representing at least 80% of all units placed on the markets for the products concerned.

[29] Commission Regulation laying down ecodesign requirements for mobile phones, cordless phones and slate tablets pursuant to Directive 2009/125/EC of the European Parliament and of the Council and amending Commission Regulation (EU) 2023/826 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=PI_COM%3AC%282023%293538

[30] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/1558-Review-of-ecodesign-requirements-for-standby-and-off-mode-electric-power-consumption_fr

repairability ahead of purchase, and protection against unfair practices linked to early obsolescence.

2.2. Non-regulatory initiative: DG Connect study tackling electronic communications environmental performance (2022)

In addition to the regulatory framework in place, BEREC deemed important to examine the '***Study on Greening Cloud Computing and Electronic Communications Services and Networks Towards Climate Neutrality by 2050***',[31] which was published in March 2022. For the purposes of this Report, the section of this study on ECN/ECS is more relevant.

This study examined criteria for meaningful environmental sustainability assessments and found a large number of different methods and metrics with a clear focus on energy-related issues. However, it also concluded that circular economy aspects are still insufficiently covered by metrics currently in use. With regard to climate protection, leakage quantities of refrigerants from cooling systems and the associated GHG emissions are also still inadequately recorded. The trend of massively growing data volumes is expected to continue and speed up further, resulting in the corresponding increase in the ecological importance of data centres and networks.

Despite the large number of existing measurement methods and metrics, the study identified a lack of relevant available data as a key obstacle to overcome. Concerning ECN/ECS, the study proposes (1) the setup an ECN Energy Register, in order to create an overview of the different providers and the efficiency of different network technologies, (2) the favourable treatment of energy efficient networks (kWh/GB) in State Aid and with respect to permit granting, (3) the introduction of an energy efficiency type of label for electronic communications services in order to provide greater transparency to businesses and consumers, and (iv) the introduction of minimum efficiency requirements for subsidised deployments and ecodesign requirements for electronic communication services.

The practices of ECN/ECS providers regarding the mandatory and voluntary reporting of their environmental performance were also examined, as well as the impact on consumer behaviour. The study investigated indicators for reporting on energy consumption, CO_2 equivalent, material consumption, water consumption, e-waste management, use of renewable energies, use of renewable raw materials, and energy intensity of communication networks.

The study also looked at methodologies for corporate reporting: methodologies on environmental aspects related to stakeholders and consumers was distinguished into

[31] https://digital-strategy.ec.europa.eu/en/library/study-greening-cloud-computing-and-electronic-communications-services-and-networks-towards-climate

non-sector-specific and sector specific environmental reporting methodologies. The relevant desk research and data collection showed that ECN/ECS companies maintain environmental management systems according to the standard ISO 1400113. Although some companies in the study published sustainability reports (mostly within their annual reports), their content was very technical and difficult for consumers to understand. Regarding the specific environmental impacts recorded for reporting purposes, all companies indicated three impact categories: energy consumption, CO_2 equivalent and water consumption. Finally, the Global Reporting Initiative (GRI) and the Greenhouse Gas Protocol (GHG Protocol) were shown to be the standards selected to record the environmental indicators because they are well known and credible.

3. Results from stakeholders' workshops on environmental transparency and related reports

In addition to the examination of the regulatory framework and other initiatives taken by the European Commission, BEREC considers important to collect the views of stakeholders on environmental transparency. In this context, BEREC conducted a **series of technical workshops** between September and December 2022 with various stakeholders: public and international bodies, academics, civil society organisations and industry associations. This chapter summarises the main findings from these workshops providing a deeper understanding of recent work of stakeholders related to sustainability indicators and their practical experiences. This section also features snapshots of three publications from some of the stakeholders met by BEREC which present interesting outputs on environmental impacts' assessment and reporting in the sector. Please note that the information provided in this section does not represent an endorsement by BEREC.

3.1. Workshop with public authorities and international bodies

BEREC organised a workshop with certain international bodies who are leading in work on sustainability indicators and environmental transparency. The goal was to enforce coordination of efforts and build upon possible synergies across organisations.

In this context, the **Radio Spectrum Policy Group (RSPG)** was invited to present their activities related to the role of radio spectrum management helping to combat climate change, focusing mainly on the related Opinion issued by RSPG's subgroup on Climate Change.[32] Their published work expresses views on availability of methodologies to assess the impact of wireless technologies on climate change, use of environmentally friendly energy sources and self-regulation, the spectrum used in weather forecasting and monitoring climate change, and gathering of long-term climate-related data regarding spectrum use. Considerations regarding effective use of spectrum for climate change data-gathering and monitoring are also included in their work. The second cycle of work started in 2022, where practices of Member States on how energy efficiency is measured and nationally managed, were collected. This was followed by assessment of how these policies could facilitate the green transition within Europe, to reduce carbon emissions. In 2023, the RSPG will issue further results regarding the collection and assessment of information on how energy efficiency is measured and managed nationally in relation to the spectrum area, using methodologies by ITU and ETSI (ETSI ES 203 228 standard was mentioned as possibly suitable for this purpose).

The work of the **International Telecommunication Union – Telecommunications sector (ITU-T) Study Group 5**, was also presented during the workshop. It focuses on the production

[32] https://rspg-spectrum.eu/wp-content/uploads/2021/06/RSPG21-026final_RSPG_Report_on_Climate_Change.pdf

of standards and studies related to methodologies for evaluating ICT effects on climate change and publication of guidelines for using ICT in an eco-friendly way. The ITU-T L1470 standard was presented by the representative of ITU-T's Study Group 5. This is one of the most important deliveries as it sets out the trajectory for emissions for the time period of years 2015–2030 aiming to support the reduction of the percentage of emissions in order to reach the Paris agreement target. The topic of biodiversity protection was also discussed during the workshop as specific work items are conducted to better assess digitalisation impact on natural ecosystems and also to which extent ICT can give back to biodiversity, with use cases such as IoT sensors to protect areas and monitor leaving species. A broad set of other standards which contribute to better harmonisation of environmental reporting was presented, amongst which: the L-1400 series related GHG Emissions and achieving Net Zero in the ICT Sector, L1000 -1001- 1002 and L.1023 on e-waste and implementing a circular economy, L1350 and L.1331 regarding energy efficiency metrics, L.1333 on building green networks and finally, L.1380 and L.1480 related to ICTs for climate action.

Focus 1#: ITU Greening Digital Companies report (2021)

ITU has been developing technical standards and providing methodologies and guidance to the ICT sector on how to set science-based targets, to achieve Net Zero emissions, and to assess energy consumption and GHG emissions. Looking at climate change indicators, the '***Greening digital companies: Monitoring emissions and climate commitments'*** **report**[33] analyses 150 leading tech companies in terms of GHG emissions and energy use. The aim of the report is to serve as a resource for companies to learn from best practices on improving emissions reduction performance and accelerating the achievement of carbon free operations.

The report highlights that there are differences among digital companies in their approach to achieve carbon neutrality. Targets differ by ambition, scope[34] and measurement even among companies that have established an emission reduction target. The report identified gaps in data quality and quantity. Not all companies report Scope 2 metrics (location- and market-based), and few compile all relevant categories of Scope 3 upstream and downstream emissions. The report highlights the need to boost efforts in order to enhance upstream and downstream Scope 3 data. As the total company footprint cannot be calculated, due to the lack of reporting on upstream and downstream emissions from other companies in the ICT sector, there exists the risk of double counting.

The companies studied accounted for seven of the top ten largest corporate purchasers of renewable energy in 2020, making up almost half of the renewables purchased globally that year. 13 of the digital companies are paying for 100% renewable energy, however, only four of them are actually receiving it from the grid at all times and can report zero Scope 2

[33] International Electronic communication Union (ITU) and World Benchmarking Alliance (WBA). 2022. Greening digital companies: Monitoring emissions and climate commitments. Co-authored by ITU and the World Benchmarking Alliance https://www.itu.int/en/ITU-D/Environment/Documents/Publications/2022/Greening-Digital-Companies-22June2022.pdf

[34] Terminology to designate one organisation/product carbon footprint through its life cycle (additionally detailed in the Glossary section).

emissions using the market-based approach. Constraints on electrical grids mean that despite paying for renewable electricity, it is not always possible for electricity generated from renewable sources to be delivered to the companies. This problem was identified by the report as a major barrier to reducing GHG emissions.

In the same workshop, a representative of the **Organisation for Economic Co-operation and Development Network of Economic Regulators (OECD-NER**) presented the organisation's insights regarding the contribution of economic regulators to environmental sustainability. She stated that economic regulators could be setting measures on infrastructure, investment and planning, influencing consumers' and operator's behaviour, and collecting data to make decisions. However, she noted that at this point, the economic regulators do not have a clear mandate to promote environmental sustainability. She described five areas of possible actions from the regulators: (1) defining their role and objectives towards the environmental agenda, especially, whether beside the economic powers environmental objectives should be included, and how to approach potential trade-offs between economic, social and environmental objectives; (2) coordination between different actors and bodies in the field; (3) appropriate power to deliver objectives, including expanded data collection power that could be proposed; (4) regulatory management tools to incorporate environmental concerns; and (5) the right skills and sufficient financial resources would be needed for this agenda. The OECD-NER representative mentioned that within their planned activities for 2023–24, the organisation will examine the contributions of economic regulators to environmental sustainability, document current practices and analyse survey results related to 'Governing Green': use comparable, cross-country and cross-sectoral data to map regulators' mandates, functions and processes related to environmental objectives. This is part of their 5-year data-gathering exercise for the governance of regulators.

3.2. Workshop with academics and civil society organisations

A discussion was also organised with academic and civil society organisations to feed BEREC's understanding of existing literature on ICT environmental assessment and sustainability indicators.

Dr Kelly Widdicks from the University of Lancaster presented one of her latest publications together with other researchers: '*The climate impact of ICT: A review of estimates, trends and regulations*'.[35] According to this research, the global impact of ICT is in the range of 2,1-3,9% of global emissions. She recalled that ICT makes an impact on each stage of the life cycle, meaning there are emissions emitted during the extraction of raw materials required for those

[35] The climate impact of ICT: A review of estimates, trends and regulations (2021), Charlotte Freitag, Mike Berners-Lee, Kelly Widdicks, Bran Knowles, Gordon Blair, Adrian Friday https://arxiv.org/abs/2102.02622

technologies as well as during the manufacturing processes, transport to the business and to end users which echo the need to develop LCA analysis of ICT carbon footprint. Dr Widdicks underlined that ICT drives carbon emissions in other industries due to rebound effects (i.e., the increase of ICT demand offsets the positive effects of energy efficiency improvements from the use of ICT services). ICT enables efficiencies only in those sectors where it completely substitutes traditional, carbon intensive activities. In reality, ICT services are used in addition to more traditional activities, so the sector creates a surplus of carbon emissions according to her latest research. She underlined that there are serious reasons to believe that the environmental impact of ICT will increase. Dr Widdicks observed that companies focus on using renewable energy and on carbon offsetting to the detriment of other relevant levers of actions to cut GHG emissions. She is convinced that regulators should encourage meeting the emission reduction objectives, in order to align the ICT impact with the Paris agreement targets. Dr Widdicks also advocated for ICT organisations to be transparent and to share data reports in order to raise awareness.

A representative from **Green IT**, presented the study '*Digital technologies in Europe: an environmental lifecycle approach*' (2021). Besides GHG emissions, the study assesses different environmental impacts from ICT based on EU PEF methodology indicators which include, among others, raw materials depletion, ecological toxicity and consumption of fossil resources. She mentioned that digital technologies alone spend 40% of the sustainable GHG emissions budget of Europe according to their findings. The study presented by Green IT analyses all the components of the ICT sector: networks, data centres, devices and services. It concludes that user equipment accounts almost three quarters of the ICT environmental impacts in Europe. The Green IT representative also presented main recommendations made by the authors of the studies. According to them, it is necessary to systematise the use of Multicriteria LCA studies compliant to ISO 14040-44 with critical review, framed by the PEF/OEF methodologies. Incentivising data transparency with open data regarding some quantitative figures of already existing infrastructure is also needed. The researchers would recommend making API mandatory to allow users to continue using their connected objects.

Focus 2#: 'Digital technologies in Europe: an environmental lifecycle approach"
(NegaOctet, 2021)

The study '*Digital technologies in Europe: an environmental lifecycle approach*'[36] conducted by independent consortium NegaOctet, was commissioned by a European Parliamentary group and published in 2021. It assesses the environmental impacts of ICT in the EU, based on a Life Cycle Assessment (LCA), along with policy recommendations for digital development compatible with the Green Deal. The study takes into account the four life cycle phases (manufacturing, distribution, use and end-of-life phase) and proposes a multicriteria LCA of ICT environmental impact in Europe, in compliance with ISO 14040:2006 and ISO 14044:2006. Out of 19 indicators examined within the study, 8 were highlighted as being the most important when investigating and describing the extent of ICT sector's environmental footprint (first column below). According to the data used, the most relevant environmental impacts of digital services in the EU related to digitalisation are abiotic impacts/indicators of ICT sector identified by the study. The second column displays figures of the absolute value of the different environmental impacts/indicators using the unit recommended for LCA/multicriteria analysis (examples: antimony (Sb) equivalent for minerals and metals resources, CO_2 equivalent for climate change impact, petajoules (PJ) for energy consumption/use of fossil resource, etc.). The last column presents the percentage for each of the environmental impact indicators described representing the relative importance of each of these impacts in the overall environmental footprint of the digital sector in Europe, with reference to the prioritisation method recommended by the PEF framework and the Joint Research Centre (JRC).[37]

Types of digital services impacts	Impacts value	Ranked relevance/importance of indicators'[38]
Resource use, minerals and metals	**5,76 tonnes Sb eq.**	**22.9%**
Resource use, fossils	**3,96 PJ**	**17.0%**
Acidification	1,19 mol H+ eq. (in billions)	4.5%
Ecotoxicity, freshwater	3,09 CTUe	4.7%
Climate change	**185 Mt CO_2 eq.**	**16.2%**
Ionising radiation, human health.	**278 GBq U235 eq**	**11.1%**
Particulate matter	8,000 [disease occurrence]	4.0%
Photochemical ozone formation - human health -	464,000 tonnes NMVOC eq.	1.8%

Table 1 – Digital services impacts per EU-28 inhabitant and weighted results (source: Green IT/ NegaOctet)

[38] See footnote 38.

Another speaker at this workshop, **Dr Vlad Coroama** from the Technical University of Berlin, presented part of his search on digital technologies' energy consumption. He explained that there were different scenarios of predicted ICT electricity consumption. He affirmed that Internet traffic currently accounts for a significant part of ICT electricity consumption and this traffic has extremely increased during the last 20 years. Dr Coroama stated that that despite the fact that there are many different research papers on the topic, the level of uncertainty is extremely high due to the different models and hypothesis used. The differences could stem from the various system boundaries applied in different assessment methodologies in terms of energy consumption. He mentioned the two types of assessments used: overall energy and energy intensity, but the values proposed can differ depending on the year of assessment. Another reason for the different results between studies, according to Dr Coroama, is that in most cases, either top-down or bottom-up modelling is used for determining the energy consumption of ECNs, and that the choice of modelling methodology would have a major impact on the result. He stated that there is a certain level of conflict regarding data provision methodologies, and underlined that clear, perhaps standardised methodologies are needed in terms of data collection.

A representative from the **Geographical Survey of Finland (GTK)** presented the study '*Digitalisation and natural resources'* (2021).[39] The study investigates the raw materials acquisition by the ICT sector, especially the need in abiotic resources for some devices such as smartphones and TVs. The GTK representative touched upon three main features of the raw materials acquisition in the digital ICT industry: wide and increasing range of elements for desired electronics, large number of chips and devices, the speed of technology introduction cycles and the competition with other industries for some rare earth elements (including renewables energy). She highlighted different challenges in relation with the different life cycle stage of ICTs: the raw material acquisition (e.g. scarcity, non-renewable materials, challenging working conditions, import dependencies, etc.), their incorporation in the design of products in the manufacturing phase and impact on their use as well as the treatment of these materials in the decommissioning phase (low collection of recycling rates due to the complexity of products). She underlined that EU industries are largely dependent on imports for many raw materials and there are vulnerabilities along the supply chain. The GTK representative concluded the presentation by elaborating on potential solutions to address these issues including eco-design requirements, digital passports for products and material to increase its traceability, efforts to optimise recycling, circular economy models, as well as more responsible value chains. She looks at new EU regulatory initiatives on Eco-Design and raw

[37] After normalisation and weighting, 8 environmental impact indicators were selected as being the most important for digital services, representing 80 % of the global weighted results. The weighting and normalisation factors are those recommended by the Joint Research Centre.

[38] See footnote 38.

[39] Digitalisation and natural resources (2021), Geological Survey of Finland, Toni Eerola (ed.), Pasi Eilu (ed.), Jyri Hanski, Susanna Horn, Jachym Judl, Marjaana Karhu, Päivi Kivikytö-Reponen, Panu Lintinen and Bo Långbacka https://tupa.gtk.fi/raportti/arkisto/50_2021.pdf

materials as ways to make progress to ensure more sustainable and circular ICT products and supply chains.

3.3. Workshops with industry associations

BEREC also held two technical workshops with key industry associations in Europe to collect their views on efforts to improve environmental transparency in their sector and the potential supporting role of regulators.

A representative of the **European Competitive Telecommunications Association (ECTA)** highlighted during one of these workshops the importance of environmental sustainability, stressing that the ECN/ECS already play a crucial role in achieving the European Commission's ambitious targets and their contribution in this perspective should further increase in the coming years. She acknowledged that it is the right time to start working on methodologies, indicators and voluntary actions as well as the necessity to identify metrics for positive contribution. ECTA representative also elaborated on specific actions engaged by the association members in terms of environmental transparency and environmental impacts. In terms of most relevant indicators, she insisted on GHG emissions and energy consumption. She argued that sustainability indicators could represent competitive tools and that no regulatory measures are necessary according to the association's current analysis.

A representative of **European Telecommunications Network Operators' Association (ETNO)** presented the association projects related to environmental transparency and sustainability. He mentioned the introduction of sustainability indicators in ETNO's report '*The State of Digital Communications*' published every two years. He also detailed the participation of ETNO in the that European Green Digital Coalition's (EGDC) members, which include agreeing to have Science-Based Targets (SBT) for reducing emissions by 2030 and to become climate neutral no later than 2040. ETNO representative stated that for years, the enablement effect of the sector has been underestimated and stressed the importance of the EGDC's work to define the net enablement potential of the ICT sector when it comes to reduction of the CO_2 emissions. He formulated several observations regarding the state-of-play of environmental reporting in the electronic communications industry: the importance of existing initiatives and the need not to duplicate the work, the necessity to think about the impact on climate change in the context of current policy debates on contribution/pricing of traffic in internet traffic markets and the need to invest also in demand-side instruments, where regulators could play a role. Regarding the topic of lack of comparability between different companies due to absence of common methodology, ETNO joined ECTA's point of view to suggest that harmonisation efforts should rely on identifying methodologies for comparing the environmental performance of industry players by looking especially at the similarities. ETNO representative presented the concept of 'comparability with purpose', meaning also keeping in mind why do we want to compare (e.g. for academic interest or for policy objectives).

Moreover, a representative of the **European Wireless Infrastructure Association (EWIA)** highlighted that environmental sustainability is a new field for EWIA and that work on the matter is based on three dimensions: investigating benefits of infrastructure sharing with respect to better use of scarce resources, monitoring EWIA's members activities in this area, and finally, taking a look to sustainability challenges and opportunities associated to 5G being available everywhere by 2030. EWIA representative stated that at least 5 out of 9 members reported having published an environmental report. Regarding the question of most relevant indicator, he underlined the carbon footprint impact and the stringent monitoring of energy and fuel consumption and percentage of green energy.

FTTH Council's representative stated that their work on environmental sustainability is in progress. He observed that in terms of digital footprint, it seems that when it comes to the digital footprint, terminals stand for 50–60% of emissions, 80% of which is coming from the production of the terminals. He mentioned that there are no rules for calculating life cycle assessments and that some of FTTH Council's members are working on that. FTTH Council's representative mentioned that fibre technology is consuming less energy than other broadband technologies. To refine energy accounting, several companies are also working on measuring the energy use as there is no common industry-wide approach. He underlined that more awareness is needed about environmental transparency. FTTH Council representative listed several important points to take into consideration to increase environmental transparency such as: more standardisation especially in measurement, assurance that the environmental value of innovations of companies are perceived in the market, a clear inventory of national initiative and more automation.

A representative of **GSMA** presented the ESG Metrics for Mobile report[40] and their ongoing work on a strategy paper on circular economy for devices which focuses on increasing the longevity of devices and measures to move towards zero waste. In terms of most relevant indicators, GSMA representatives also highlighted energy consumption and carbon footprint indicators. The relevance of indicators related to circular economy performance was also acknowledged. GSMA representatives also mentioned two of their ongoing projects. First, GSMA is involved in the work of the EGDC where they are working on calculating the net environmental impact of digital technologies. Second, they are collaborating with ITU and GeSI on Scope 3 emissions. GSMA considered that KPIs being identified by the European Green Digital Coalition on indirect environmental effects will drive the future work of the European Commission on the EU Taxonomy. He advised that BEREC should not undermine the efforts already put in place by the European Commission and European and international organisations in the domain of sustainability indicators.

[40] ESG Metrics for Mobile, GSMA/EY (2022) https://www.gsma.com/betterfuture/esg-metrics-for-mobile

Focus 3#: 'ESG Metrics for Mobile: realizing value for society through common industry KPIs' *(GSMA/EY, 2022)*

GSMA developed with EY the report '***ESG Metrics for Mobile: realizing value for society through common industry KPIs'***. It emphasises the need for more effective and consistent approaches to measuring and communicating economic, social and governance (ESG) performance. However, this landscape of reporting is currently complex, fragmented and not always aligned to the environmental impact of the industry.

This report reviewed 25 leading mobile operators' ESG data from sustainability or integrated reports. The results of the review found that almost every operator provides information on material topics such as GHG emissions, energy consumption, digital inclusion and waste management. However, the problem is that these operators do not report in a consistent manner. The table below shows the diversity of reporting practices on environmental issues among the different mobile operators studied.

Topic for Reporting	% of the 25 mobile operators reporting on topic
Scope 1 and 2 emissions	96%
Scope 3 emissions	60%
Energy consumption	96%
Renewable energy consumption	52%
Waste management	84%
E-waste management	52%

Table 2 – Analysis of the indicators reported by 25 mobile operators (Source: GSMA)

3.4. Summary of key takeaways from the workshops

The series of technical workshops by BEREC was an opportunity to provide an overview of the work carried out by various stakeholders on environmental transparency and reporting methods.

It seems that the question of measuring the environmental footprint of digital technologies and the definition of relevant indicators and standards are on the agenda of various bodies, such as the RSPG and the ITU. The work of the OECD-NER also seems to show that the need for environmental data and indicators is the subject of reflections for different type of economic regulators.

A large number of studies from the academia or lead by civil society experts seek to tackle the various environmental impacts of ICTs and can be mobilised to feed the work on the associated indicators, particularly applicable to ECN/ECS. In this context, the BEREC technical workshop with academic and civil society stakeholders made it possible to discuss the carbon impact of digital technologies (Dr Kelly Widdicks), its energy consumption (Dr Vlad

Coroama) and its consumption of raw materials and abiotic resources (GTK). The importance of LCA/multicriteria assessments was also highlighted during the workshop (Green IT).

Industry associations met by BEREC reported a significant number of initiatives from the industry contributing to environmental transparency in the digital sector. The indicators most highlighted by the associations met to analyse the impact of the electronic communications sector are the carbon footprint and the energy consumption (ECTA, ETNO, EWIA, GSMA). Indicators related to the circular economy were also mentioned (GSMA). Measurement method harmonisation efforts are also a topic of interest discussed (e.g. FTTH Council). A great interest of telecom industry players on digitalisation enabling effects on other sectors' decarbonisation was indicated (ECTA, ETNO, GSMA).

The workshops were part of a broader call-for-inputs from BEREC which also included two questionnaires. The first was intended for NRAs and public authorities. Their answers are analysed in the following Chapter 4. The second questionnaire was aimed at digital economic players, 81 of whom responded to BEREC's questions as presented in Chapter 5 of this Report.

4. National regulatory authorities' approach to environmental transparency and indicators

4.1. Previous findings from BEREC latest publications on sustainability

As was made evident during BEREC's Report '*Assessing BEREC's contribution to limiting the impact of the digital sector on the environment*', some NRAs have been proactive in collecting data relevant to the environmental footprint of digital services.

Environment-related work already carried out by NRAs at the time of the preceding BEREC Report on sustainability included work related to indicators. Specifically, Arcep, the French NRA, has started work on an environmental barometer for digital goods and services, focusing on collecting, processing and publishing data in relation to the environmental footprint. In addition, Arcep in cooperation with French environmental agency ADEME, issued a report on measuring the ICT environmental footprint through a life cycle and multi-component analysis. In November 2019, the Finnish NRA, Traficom, contributed to a working group established by the Finnish ministry of Transport and Communications on climate and environmental strategy for ICT. Among other work items resulting from this strategy, Traficom collected data from the largest electronic communications operators in Finland on energy consumption and environmental impact. ComReg, the Irish NRA, has included questions in its '*Confidence and Awareness*' survey to gain insights into consumer attitudes toward the environmental sustainability of mobile service providers. In the 2022 survey results, over 3 in 5 (63%) respondents stated that environmental sustainability is an important factor when choosing a mobile phone provider.

Since the previous BEREC Report, more NRAs have carried out work related sustainability indicators, the next section will elaborate on this work and related challenges they have identified.

4.2. NRAs' current activities on environmental data collection

In order to obtain recent information on the potential ongoing and planned activities and work of NRAs on the indicators and the collection of data that measure the environmental impact of

the ECN/ECS, BEREC sent as part of its larger call-for-input[41] a questionnaire to NRAs and public bodies from October 21st to December 2nd 2022. The questionnaire[42] included questions on (1) the mandate to collect environmental data, (2) data collection that have already been concluded, (3) actions by other public authorities on the environment and (4) challenges that have been identified to foster environmental transparency in the sector.

BEREC received responses from **NRAs of 27 European countries** (of which 24 are EU members[43]). Responses were also received from one other public authority.[44]

4.2.3. NRAs' environmental data collection

In their answers, 5 NRAs stated that they have a legal mandate to collect environmental data from electronic communications operators or other digital industry players.

- Only one of those 5 NRAs mentioned having a specific regulation defining the scope of their mandate to collect environmental data (FR). In France, a law was passed at the end of 2021, extending the perimeter of Arcep's data collection from electronic communications operators to device manufacturers, data centre operators, network equipment manufacturers, online communication services and operating system providers. This mandate serves to produce an annual survey ('*Achieving digital sustainability*') of the digital ecosystem.

- The other four NRAs stated that they do not have a specific mandate (ES, CY, SE, BA), but national laws that transpose Article 20 of the EECC ('information requests to undertakings') impose a reporting obligation to the operators and other industry players to ensure conformity with the provisions of, or decisions or opinions adopted in accordance with the EECC. At the request of a particular NRA, related stakeholders should provide information or documents that the authority needs for clearly defined statistical or analytical purposes, reports, and studies within the competence of the EECC. However, the EECC does not explicitly authorise NRAs to collect data with reference to the environment. This raises the question whether improvements of the legal basis on European level could be helpful to further facilitate and harmonise the role of NRAs with regard to environmental transparency.

[41] BEREC call-for-input on sustainability indicators included: technical workshops presented in Chapter 3, questionnaire to NRAs and public authorities presented in the present Chapter 4 and a questionnaire to industry players analysed in Chapter 5.

[42] The questionnaire sent is presented in Annex IV of the document.

[43] No response was received from EE, LT and SK. Following non-EU countries responded: IS, NO and BA. More information in Annex II.

[44] The Irish Environmental Protection Agency provided a separate contribution. The response of CNMC also included the contribution of the Ministry of Economic Affairs and Digital Transformation and is considered as the response of the NRA.

Furthermore, four NRAs[45] are currently collecting environmental data from electronic communications operators. This activity mainly focuses on network operators (FI, BE, ES, FR), devices manufacturers (FR) and data centre operators (FR). The following table provides an overview:

NRA	Country	Perimeter	Type of indicators	Standards used

Arcep	FR	Electronic communications operators, devices manufacturers, data centres' operators	First publication focuses only on electronic communications operators. The second data collection decision published end of 2023 decision include data centres and devices manufacturers.
			
			Electronic communications operators:
			• GHG emissions (scope 1 and 2),
			• energy consumption of networks (by technology)
			• mobile phones volumes (sold, collected, recycled and repackaged).
			
			Device manufacturers:
			• GHG emissions
			• Use of rare earths and precious metals
			• Devices volumes:
			  ○ sold by the screen size and by the screen technology or by network compatibility (mobile phone)
			  ○ sold repackaged (only for mobile phones)
			  ○ collected in order to recycle or repackage them.
			  ○ in use by year of sale
			• Devices duration of use by year of commercialisation
			• Electric consumption of TV and computer screen in operating and idle mode
			
			Data Centres operators:
			• GHG emissions
			• Number and location of data centres
			• Floor area (total, reserved to host IT equipment)
			• data centres energy consumption
			• IT equipment energy consumption
			• maximum permissible electrical power of IT equipment
			• Water consumption by types of water
				GHG emissions are referring to the GHG Protocol, energy consumption for data centres is referring to the ISO/IEC 30134-2 standard

[45] BA has also indicated that they collect environmental data, but this is limited to the collection of data concerning non-ionising electromagnetic radiation in the vicinity of radio stations. As this is outside of the scope of this report, the answers are not taken into account.

			• Cooling systems used • water discharge areas and conditions Next publications/data collection will aim to tackle other type of economic actors within the digital ecosystem. Examples are content and application providers or operating system providers.	
BIPT	BE	3 largest networks operators	• Electricity consumption of different parts of the network (datacentres, network, offices, retail, modems/set top boxes) • Production and use of renewable energy • Total energy consumption, • Energy efficiency (consumption in function of data/clients/revenue) • CO_2-emission (Scope 1 and 2, if available Scope 3) • Carbon neutrality • Water consumption, reuse of water, waste, • Efforts on recycling and refurbishment, • Number of items recycled/refurbished	GRI standards: energy GRI 302; Water GRI 303; GHG emissions GRI 305 and GHG protocol; Waste GRI 306
CNMC	ES	Main network operators (one-time ad-hoc questionnaire)	• Electricity consumption per data unit (kWh/GB) • Global CO_2 emissions • Consumption per user (Wh/user) • PUE (Power Usage Effectiveness) for data centres	N/A
Traficom	FI	Network operators	• Energy consumption of networks • Use of renewable energy	No

Table 3 – Overview of the currently collected data by NRAs

This data has been collected only once by the Spanish NRA CNMC and is not published. The other NRAs only published this data partly and aggregated data.[46]

The Danish *Agency for Data Supply and Infrastructure* does not yet collect any data on environment sustainability but plans to launch a consultation on indicators regarding energy consumption and climate effects of the Danish electronic communications sector (Scopes 1 and 2).

[46] BE: https://www.bipt.be/consumers/publication/sustainability-of-telecommunication-networks-and-operators-in-belgium-presentation-of-report
FR: https://www.data.gouv.fr/fr/datasets/enquete-annuelle-pour-un-numerique-soutenable/
FI: NAFI: https://traficom.fi/en/news/first-study-energy-consumption-communications-networks (press release)

In 2022, the German NRA BNetzA commissioned a study on indicators for electronic communications infrastructure,[47] which was published in 2023. Preliminary findings of the study indicate that currently, the LCA in line with DIN EN ISO 14040/14044 might be the most promising approach to assess environmental impacts of activities carried out in the sector, but also pointing at difficulties for data availability. While the PEF methodology tries to address such problems, lack of relevant Product Environmental Footprint Category Rules (PEFCR) was observed. While for some sets of ICT infrastructures PEFCR documents are available (e.g., IT equipment (storage)), this is not yet the case for a large number of components used in the sector.

The Hungarian NRA NMHH examined the topic of energy savings related to the 3G switch-off, using the information available in connection with mobile technologies. No study has been published, but the first high-level conclusion was that the switch-off of 3G will definitely result in energy savings in the short term, but the increasing data traffic has to be taken into account, because it increases the sector's overall energy demand.

As technical challenges, the NRAs collecting information pointed out that it is necessary to properly define the scope and boundaries of the network (or parts of it) for which the energy consumption is calculated. In addition, the need for the reported figures must be comparable, homogeneous, and based on the same definitions is emphasised.

22 NRAs collect other information that can be useful from an environmental perspective. Examples include market data (e.g., fixed and mobile (voice) traffic, number of users/subscribers, revenue, turnover, etc.), number of sites and individual connections (also based on access technologies), data consumption and transmission speeds collected within the operations of the NRAs. Some NRAs (CZ, HU, IT, CY) openly pointed to the fact that this data is collected for other purposes, e.g., market analysis and/or annual reports on the electronic communications' sector and end users and cannot be currently assessed from an environmental perspective. For instance, one NRA (AT) mentioned their recurring data collection on fixed and mobile broadband connections as well as fixed and mobile data volume. These are then published on a quarterly basis and are available in open data format. Secondary usage of the data for environmental purposes could be useful. Two NRAs (IE, ES) stated that consumer surveys monitoring the behaviour and trends could be useful to provide additional information sustainability-related end user behaviour and current market trends. One of them (IE) specifically dedicated one of their consumer surveys on consumer attitudes towards environmental sustainability.

4.3.2. Actions by other public authorities related to the environment

Eleven of the 27 NRAs stated that other public authorities are collecting environmental data in the digital sector, six stated that no other authority is involved in such activities, and 10 are

[47] Identifizierung und Entwicklung von maßgeblichen Indikatoren zur Beurteilung der ökologischen Nachhaltigkeit von elektronischer Telekommunikationsinfrastruktur (2023), Ramboll and WIK: https://www.bundesnetzagentur.de/DE/Fachthemen/Digitalisierung/Nachhaltigkeit/Indikatorenstudie/start.html

not aware. The other authorities involved in environmental data collection are mostly national environment agencies or ministries.

The activities of these national bodies aim to provide transparency of data they collect or to deepen the understanding of the general links between environment and ICTs. They are very often focused on energy and resource efficiency (of networks in NL, of cloud computing in AT, of data centres in SE), data collection and sustainability-related statistics (AT, BA, SE), and conducting studies on digitisation and sustainability (DE) or on the environmental footprint of digital technologies (FR). One NRA (NL) also mentioned that other national bodies are participating in international working groups on projects related to sustainability/climate indicators in the electronic communication industry (e.g., within the RSPG or ITU). Another NRA (BA) reported that other national bodies are conducting public consultations on selected indicators for the environment.

Moreover, one NRA noted that the ministry responsible for electronic communications may request the provision of environmental data from electronic communications operators, however, no specific environmental data has been collected so far (ES). Another NRA (MT) mentioned that Environment and Resources Authority became responsible to implement the WEEE Directive and published data on the disposal of the ICT related waste. Also, secondary use of environmental data was reported by one NRA (ES) in relation to the recent implementation of EU legislation[48] introducing a measure that any electronic communications operator network which has been subsidised by public funds is obliged to comply with, among others, the Do No Significant Harm (DNSH) principle along with environmental principles. One NRA (FR) also mentioned that the national environmental authority was recently granted the responsibility to set reparability/durability index for electronic devices or to develop a methodology for Internet providers to communicate to end users the carbon footprint associated with their data consumption.

In addition to the NRAs, one other authority responded to BEREC's questionnaire. The *Environmental Protection Agency (EPA)* (IE) collects general data from electronic communications operators (such as location of sites, base stations, etc.) but focus more on EMF aspects rather than on energy consumption. The EPA mentioned also *Irish Water* as an agency collecting data on water usage and *Eirgrid* was listed as an agency collecting data on datacentres' use of grid electricity.

4.3.3. Challenges identified by NRAs to foster environmental transparency in the sector

19 NRAs indicated that a main challenge was the definition of a common set of indicators and common methodology which would assist in collecting meaningful and comparable data within or across sectors in Europe. The clearer a picture the industry has of its environmental

[48] Regulation (EU) 2021/241 establishing the Recovery and Resilience Facility, and Regulation (EU) 2020/852 on the establishment of a framework to facilitate sustainable investment

impacts, the sooner evidence-based and effective steps can be taken to reduce them, as mentioned by one NRA (IE). These NRAs directly pointed out to the need to ensure transparency of the data, especially to empower the end users to behave more consciously when using the ICTs. It would require a harmonised minimum set of indicators and an obligation to publish the obtained data. Some of these NRAs also mentioned that real transparency would require an independent authority (the NRA or some third party) to verify the data (BE, HR, NO, FR). Two NRAs mentioned that data should be requested on a regular basis from the sector/industry (SE, BE).

10 NRAs proposed an aggregated publication of the data as a useful way of reporting, but several NRA proposed to publish also separate data (BE) or comparison (CZ, GR, IT, ES) to allow the end users to make even more informed choices. Also, some NRAs are well aware about the different methodologies used by the operators. Therefore, they consider it useful to provide the data of a good level of detail (e.g., for different types of networks) and based on the existing standards to make sure that all the economic players share the same type of data (BE, CZ, IT). Nevertheless, 19 of the NRAs stated that there is a need for one common methodology which may signify that the existing framework is not sufficient. Having one set of indicators measured by one common methodology showed to be a priority for the NRAs, as the trustworthiness of the data comparability would thus be ensured, to their meaning. One NRA (IT) also mentioned that a single database on the emission factors was proposed as a useful tool by an operator they consulted.

One NRA (DK) specified that first, a coherent and consistent methodology for data collection on Scope 1 and 2 energy use and emissions should be developed in short term and in medium and long term, it would be very important to develop a coherent and thorough methodology for Scope 3 energy use and emissions. Another NRA (IT) shared result of a consultation with operators where differences between Scope 3 categories reported by different entities were identified. But they also mentioned that different companies might not have access to the same data and information which might be an obstacle to define a single methodology.

The role of public authorities in the process was also addressed by four NRAs (BE, HR, NO, FR). As already mentioned, these NRAs believe that an independent authority, potentially the NRAs themselves, should process the data comparisons. One NRA (CZ) responded that in case a reporting obligation should be imposed in the EU, there should be a single point of contact/reporting and the data shared within the public administration for further analytical purposes, rather than to impose reporting the same data to multiple authorities under various legislation.

One NRA (IE) elaborated on the idea to align BEREC work and electronic communications of the work of the sector with the two relevant EU directives/proposals: the Corporate Sustainability Reporting Directive seeks to have standards for sustainability reporting that is more aligned with standardised financial reporting, including both risks and impacts. Environmental footprint and data/information must be provided in machine readable format; and the Proposal for a Directive on Corporate Sustainability Due Diligence which seeks to

bring in the complexity of global value chains in due diligence focusing on both environmental sustainability and human rights.

Another NRA (ES) proposed that BEREC should work on guidelines on common data and methodology that would help to compare the figures among economic players. Opposed to that, one NRA (IT) stressed out the important role of European Green Digital Coalition when addressing the work of the European Coalition in determining the technical criteria of sustainable economic activities and that any intervention from BEREC should complement the work put in place by other EU and international organisations.

5. Analysis of industry players feedback on environmental reporting practices and sustainability indicators

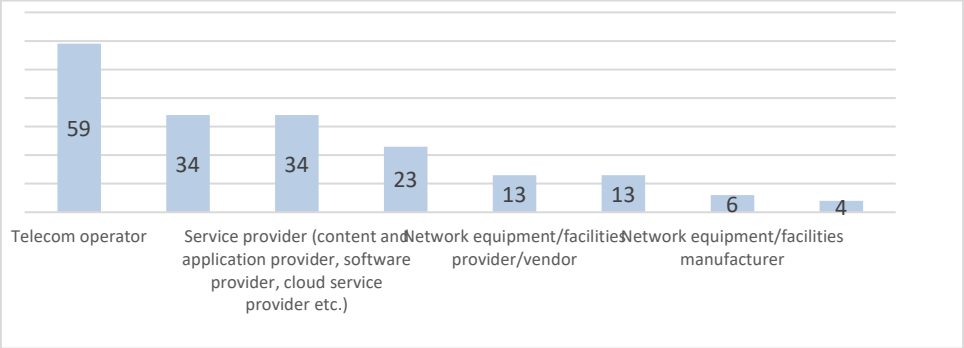
5.1. Presentation of the questionnaire and respondents

In order to have a more complete view, BEREC included in its call-for-input a questionnaire to industrial stakeholders from October 21st to December 2nd, 2022. The objective was to collect information on their practices in terms of environmental reporting and to help identify which indicators are deemed feasible and useful according to the existing methodologies for the purpose of sharing environmental information, assessing the sector's environmental footprint at the European level, and improving the comparability of electronic communications industry players' environmental impact. The questionnaire[49] tackled four different main aspects as regards ECN/ECSs: (1) environmental reporting practices, (2) indicators on their environmental footprint, (3) indicators on their environmental performance and (4) challenges regarding the environmental transparency to address.[50] This chapter will follow a similar structure and is completed by Annex I which provide additional details and information on stakeholders feedback.

BEREC received **81 responses to the questionnaire to industry players**. As shown in a graph below (Graph 1), participants to BEREC's call-for-input mainly operate as electronic communications operators (59), service providers (34), data centre operators (34) and devices providers/vendors (23). Some participants also operate as manufacturers of devices and/or providers of network equipment/facilities or of other activities (satellite operators, wireless infrastructure provider, physical network provider according to passive layer only model (PLOM), broadcasting network operator, electronic communications system integrator), and also associations responded to the questionnaire. Most participants state that they operate in more than one economic activity.

[49] The questionnaire sent is presented in Annex V of this Report.

[50] BEREC made in its questionnaire a distinction between indicators on environmental footprint that constitute tools to measure the environmental impact of specific activities, produce while indicators on environmental performance aim to represent the efforts of one company in terms of efficiency, decarbonisation, and circular economy.



Graph 1 – Economic activities reported by the participants to BEREC's call-for-input

It has to be noted that within the responses received, electronic communications operators, service providers, data centre operators and, to similar degree, devices providers/vendors (often in overlapping roles) are represented significantly more than manufacturers of devices and/or providers of network equipment/facilities. This may have influenced the feedback on overall 'relevance' and/or reporting of indicators, as likely not every indicator will have the same relevance for the company or use depending on the business model.

BEREC would like to outline that the results of the questionnaire present the perception and analysis of industrial respondents and does not constitute endorsement for one or another position.

5.2. Environmental data collection and reporting practices

5.2.1. Information by stakeholders on reporting and publishing data on environmental impact

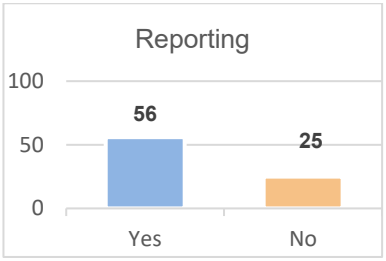
Stakeholders were asked whether they report information and data on environmental impacts (such as energy consumption, GHG emissions, water/land use) and environmental performance (such as energy efficiency, reparability, recyclability rate).

As shown in the graph below (Graph 2), out of the 81 respondents, 56 replied that they report data on environmental impacts. 42 out of those 56 are electronic communications operators (as a standalone economic activity or combined with other activity), 4 are data centre operators (combined with other activities), 5 are network equipment/facilities manufacturers (combined with other activities), whereas 5 report other economic activities.

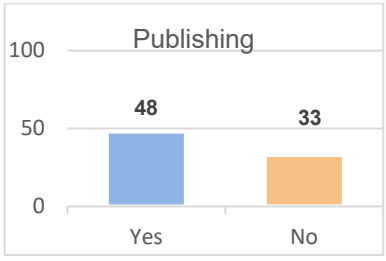
Stakeholders were asked whether they publish information and data on environmental impacts (such as energy consumption, GHG emissions, water/land use) and environmental performance (such as energy efficiency, reparability, recyclability rate).

As shown in the graphs below (Graph 3), out of 81 respondents, 48 replied that they do publish data on environmental impacts, out of which 34 are electronic communications operators (as a standalone economic activity or combined with other activity), 4 are data centre operators (combined with other activities), 5 are network equipment/facilities manufacturers (combined with other activities), whereas 5 report other economic activities.

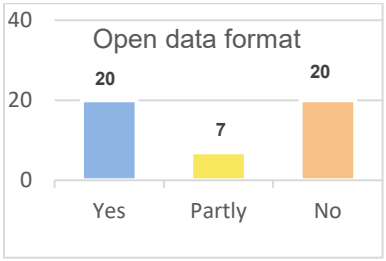
36 respondents stated that there are regulations or legal requirements framing their environmental collecting/reporting/publishing at national or European level. Regarding the format in which the data on environmental impacts are being published by stakeholders, 27 out of 47[51] stakeholders who publish data on environmental impacts have reported that they are using an open data format at least partly (Graph 4).



Graph 2 – Responses on whether data on environmental impacts are reported



Graph 3 – Responses on whether data on environmental impacts are published



Graph 4 – Responses on whether published data on environmental impacts are in an open data format

Stakeholders who publish data on environmental impacts have reported that they combine various methods for publishing the relevant data. Out of 48 respondents who are publishing environmental data, the majority (38) are publishing this data at least on an annual basis, such as a Corporate Social Responsibility report or at least within its subsection (35). 30 stakeholders have also reported using a web page on a company website for reporting, while 27 are using other means of reporting, including the one of Committees for Development Policy (CDP).

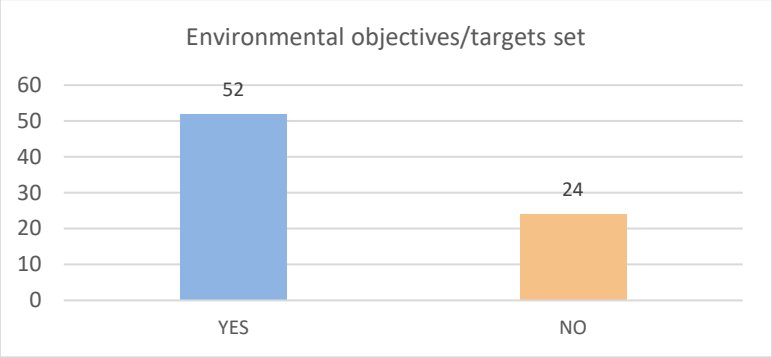
5.2.2. Information on stakeholders' objectives/ targets on limiting the environmental footprint

In its questionnaire, BEREC asked stakeholders whether they set objectives/targets aimed at limiting the environmental footprint and if applicable, the method used. 52 of the respondents reported having set objectives aiming at limiting their environmental footprint and improving their environmental performance.

Specifically, 15 respondents stated that their objectives are based solely on a specific framework, 21 respondents stated that their objectives are solely based on company-defined

[51] One respondent replied that they publish information, however, they did not provide further information regarding the format and the means of publication.

goals/strategy, while 13 respondents mentioned that their objectives are based both on a specific framework and on company-defined goals/strategy. 26 respondents reported that their objectives/targets are based on Science Based Targets initiative (SBTi) solely or combined with other company-defined goals and two stakeholders are in the process of validating their targets by SBTi.



Graph 5 – Responses on whether environmental targets/objectives were set by companies to limit their environmental footprint and/or improve their environmental performance.

Stakeholders were also asked to further describe objectives/targets in terms of timeline scope, measurement, ambition level, etc. In this respect, the stakeholders mentioned company-defined goals/strategies mostly related to Net Zero emissions, reduction in terms energy use and consumption of their activities, transition from fossil fuels to renewable energy and optimisation of environmental impacts across the value chain.

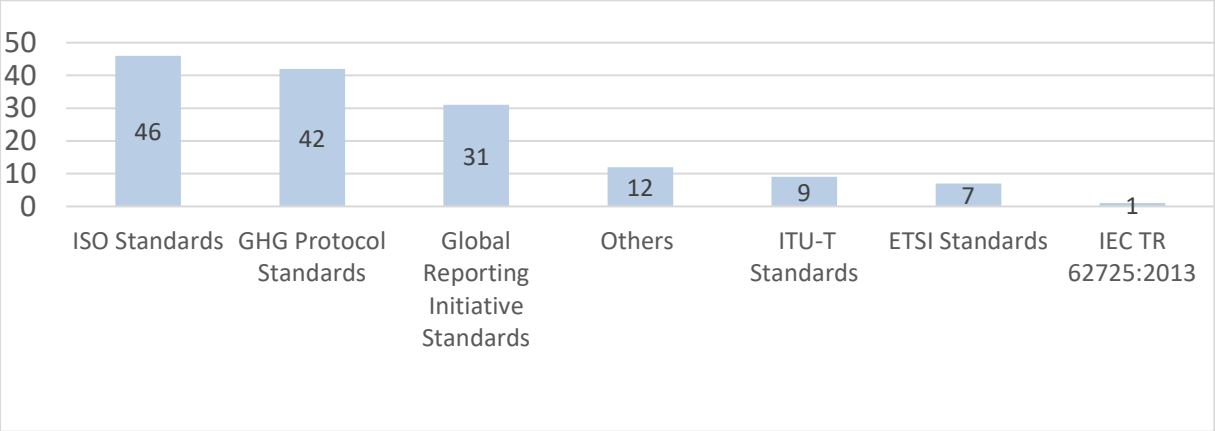
Stakeholders were also asked whether those objectives/targets were monitored and how. Out of the 52 companies responding to that question, 47 reported that they do monitor the objectives set and the method they follow: 17 mentioned that the objectives are audited/verified through a third party, 23 stated that no external party is involved in the monitoring phase but are self-checked and 8 mentioned that the objectives are both audited by a third party and checked internally and/or with some other procedure (i.e., as other procedure, a stakeholder mentioned ISO 14064 certificate, CDP Reporting, ISO 50001).

5.2.3. Information on stakeholders' use of standards, protocols, or guidelines to monitor sustainability

Stakeholders were asked whether they use any of standards, protocols, or guidelines to monitor the sustainability of their company or their electronic communications. 62 out of 81 responded in the affirmative. From the responses, it is evident that companies use a variety of standards, protocols, and guidelines to monitor sustainability. It should be noted that standards included in the questionnaire are not equivalent: they cover different scope and form of impact (e.g., some mono vs. multicriteria), and some can be sector specific while others can be applied in various industries. This section provides an overview of replies and is completed by a Table in Annex elaborating on the standards mostly referenced by the

sample of companies who replied to the BEREC questionnaire (Annex I 'Summary of stakeholders' feedback on main standards used' p.61).

Specifically, ISO standards are used by 46 respondents, GHG protocol standards by 42 respondents, Global Reporting Initiative standards by 31 respondents, ITU-T standards by 9 respondents and ETSI standards by 7 respondents (Graph 6). In most cases companies use a combination of different standards and protocols, in particular, 23 respondents use a combination of all three. Graph 6 provides an overview of the responses received.



Graph 6 – Responses on information on use of specific standards, protocols, or guidelines to monitor sustainability

More specifically, the following ISO Standards were mentioned among the group of 46 respondents that specified using ISO standards or a combination of standards:

- ISO 14001:2015: Environmental management systems – Requirements with guidance are used by 36 respondents of which 23 combine them with other standards.
- ISO 50001: Energy management are used by 25 companies, of which 22 are combined with other standards.
- ISO 14064-1:2018: Greenhouse gases — Part 1: Specification with guidance at the organisation level for quantification and reporting of greenhouse gas emissions and removals are used by 9 companies, 8 of which are combined with other standards.
- ISO/IEC DTR 30133 Standard is used only by one company in combination with other standards.
- Other ISO standards (CYS EN ISO 9001:2015, ISO 45001:2018, CYS EN ISO 22301:2019, ISO/IEC 27001:2013, ISO 9001, ISO 27001) are used by 8 companies, in most cases in combination with other standards.

Within the group of 42 companies which declared using GHG Protocol Standards or in combination with other standards, most respondents prefer the use of 'Protocol Corporate (Value Chain) Standard – not specific to ICT sector". Specifically:

- ‘Product Life Cycle Accounting and Reporting Standard – not specific to ICT sector” used by 11 companies (four companies with only that standard, seven companies use this standard in combination with others).
- ‘Protocol Corporate (Value Chain) Standard – not specific to ICT sector” used by 24 companies, of which 12 in combination with other standards.
- ‘Product Life Cycle Accounting and Reporting Standard – ICT Sector Guidance” used by 7 companies, of which 5 in combination with other standards.
- ‘Other” standards are used by 12 companies. Examples of these other standards include GHG Protocol Corporate Accounting and Reporting Standard, GHG protocol calculation tool for emissions in Scope 1 and 2 and Product Life Cycle following the methodology of ISO 14040.

Finally, as regards the use of GRI standards the respondents listed a variety of standards used. Many of the participants responded that they follow the core version of GRI standards, largely the 2016 edition. Adding all those who have provided information, around 40 GRI indexes are measured, the following being the most used by 10 or more participants:[52] GRI 302: Energy 2016, GRI 305: Emissions 2016, and GRI 306.

5.3. Indicators quantifying the environmental footprint of electronic communications

For this section of the Report, BEREC addressed feedback from stakeholders based on a specific list of indicators to estimate environmental footprint of products. The list of indicators is largely based on the list of impact assessment indicators from the European Commission’s PEF and OEF methodologies.[53]

5. 3.1. Relevance of listed indicators for measuring the environmental impact of activities according to respondents

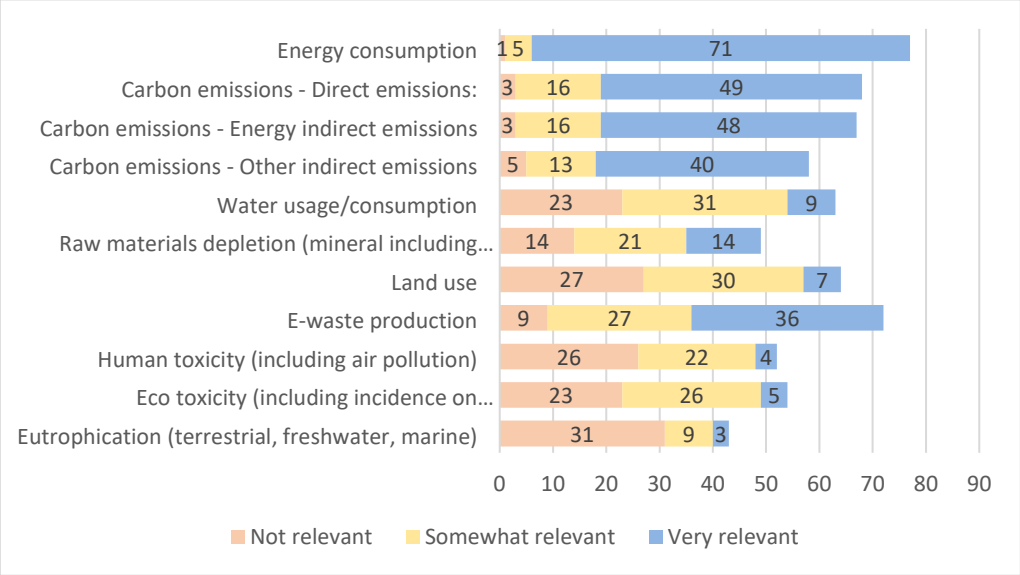
Stakeholders were asked to state the ‘relevance’ of the sustainability indicators listed below vis-a-vis their organisation’s environmental impact, in order to identify the ones deemed feasible and useful in the context of their business activities (Graph 7[54]). The analysis of results should be used with precaution as the term ‘relevance’ was not specifically defined in the questionnaire. Also, this information on ‘relevance’ described below reflects industrial respondents’ views on these indicators but does not constitute BEREC’s assessment on possible differentiated ‘relevance' of sustainability indicators. Hence, this does not pre-empt future work, including for competent bodies to conduct process of identification of the most

[52] https://www.globalreporting.org/how-to-use-the-gri-standards/gri-standards-english-language/

[53] https://eplca.jrc.ec.europa.eu/permalink/PEF_method.pdf

[54] It should be noted for this question that the 81 respondents also had the options to not provide an answer or to choose the option ‘N/A’. These two options are not detailed in the text nor displayed in the graph as their interpretation is subjective.

relevant environmental impacts of ECN/ECS as foreseen by the European Commission's PEF methodology.



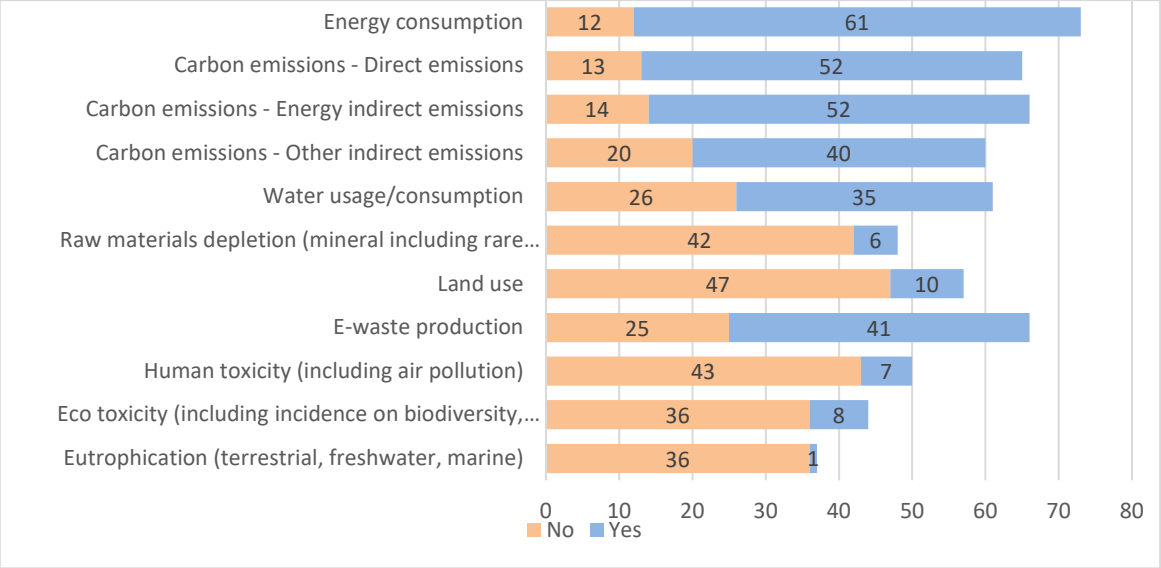
Graph 7 – Relevance of listed indicators for measuring the environmental impact of activities according to companies

Out of the specific set of indicators about, 'energy consumption' was regarded as being 'very relevant' by the largest number of respondents (71 out of 81). High agreement on 'very relevant' is also visible for 'carbon emission – direct emission' and 'carbon emission – indirect emission' with 49, respectively 48 respondents taking this choice and an additional 16, stakeholders still opted for 'somewhat relevant'. 'Carbon emission – other indirect emissions' was regarded to a lesser degree as 'very relevant' (40) and 'somewhat relevant' (13). A similar level of agreement is otherwise only observable for 'e-waste-production', which was often regarded as either 'very relevant' (36) or 'somewhat relevant' (27). In all these cases, only very few undertakings regard the indicator as 'not relevant'. Raw material depletion is still regarded as 'very relevant' by 14 and as 'somewhat relevant' by 21 undertakings. 'Land use', 'ecotoxicity' and 'human toxicity' were only regarded by 7, 5 and 4 undertakings as being 'very relevant', but 30, 26 and 22 undertakings still considered these indicators as 'somewhat relevant'. It should be acknowledged that for 'eutrophication' and 'human toxicity', the number of respondents assessing the indicator as 'not relevant' represent the majority of respondents. Therefore, it can be derived that these indicators in the view of the industry stakeholder play a lesser role for their business activities.

5.3.2. Use of listed impact assessment indicators for environmental data collection and/or reporting by the company

Stakeholders were asked whether their company collect/report on the indicators to evaluate their environmental footprint (i.e., energy consumption, carbon emissions, raw materials

depletion, land use, e-waste production, eutrophication, human and eco toxicity) to evaluate their environmental footprint data collection and/or reporting (Graph 8[55]).



Graph 8 – Use of listed indicators for environmental data collection and/or reporting by the company

The overall picture provided by the respondents bears some similarities to the responses to the question regarding the relevance of the indicators measuring the environmental impact of their activities. 'Energy consumption' is reported by far in the highest number of replies (61 out of 81), while 'carbon emissions - direct emissions' and 'carbon emissions - energy indirect emissions' are reported by a large number of respondents (52 each) as well. 'Carbon emissions – other indirect emissions' and 'e-waste production' have somewhat lower, but still fairly high relevance (40 and 36 companies stated these indicators respectively 'very relevant' and 13 and 27 'somewhat relevant'). Interestingly, 'water usage/consumption' is collected/reported by a similar number of stakeholders (35), even though it is only comparatively regarded as very relevant by 9 respondents in the question regarding measuring the environmental impact of their activities (and as 'somewhat relevant' by 35 respondents). 'Raw materials', 'land use', 'human toxicity' and 'ecotoxicity' are all reported by a lower number of stakeholders and only one respondent indicated reporting on 'eutrophication'.

On each indicator, the stakeholders were asked for further details on the reporting: whether they report them and if they do not report (yet), whether they plan to do so in the future. The analysis of these answers can be summarised as follows whereas a more detailed picture of the analysis is shown in Annex I. The indicators related to 'energy consumption' and to carbon-emissions were reported quite commonly. Reporting usually takes place on the level

[55] It should be noted for this question that the 81 respondents also had the options to not provide an answer or to choose the option 'N/A'. These two options are not detailed in the text nor displayed in the graph as their interpretation is subjective.

of the corporate group. Only some electronic communications operators report on the level on product/service level, but if they do, they usually report on all network elements in their possession. Undertakings, which do not report on indicators yet, but plan to in future, most commonly regard an available methodology and technical tools as beneficial. In the case of 'carbon emissions – indirect emission' and in particular 'carbon emissions – other indirect emissions' also resources and competencies begin to play a role, pointing at certain challenges in applying these indicators. On the metrics, MWh and CO_2 equivalents are commonly used, for the latter the challenge being in particular in data accuracy and availability and conversion factors. Data availability seems to be an issue of particularly high relevance in case of Scope 3 emissions. While water consumption is commonly reported, the metric being usually litres, it is most often not seen as relevant, even for data centres. Raw material depletion seems to be an issue which mostly originates at manufactures and for undertakings other than manufacturers, it appears within their supply chain.

It must be noted that for some of the least used indicators (such as eutrophication, land use or human toxicity), only a few industrial players plan to report them in the future, even though they consider them relevant to a certain extent.[56] This might be indicative of no direct or clear link with companies' business activities or of a lack of methodologies/resources to measure them as well as supporting data.

When applicable, the perception as 'not relevant' of certain indicators such as 'human toxicity', 'ecotoxicity' and 'eutrophication' was mostly explained by respondents as being due to the nature of their business activities. However, the interpretation of these results must be done carefully, as only a small number of equipment manufacturers responded, and other type of businesses sometimes pointed to issues in the remit of their supply chains. Besides, it should prevent additional work and quantitative assessment of these indicators to get further knowledge about the related environmental impact.

5.3.3. Any other indicators important to estimate environmental performance

For additional indicators, the results do not provide any clear picture as the few suggestions differ widely. When given the possibility to suggest any other indicator for environmental sustainability, not yet mentioned, the vast majority of respondents had no proposals. Only few respondents suggested indicators, such as 'the number of suppliers evaluated according to ESG criteria', the 'total consumption of renewable energy (KWh)', 'total waste and waste by type of treatment (t)', 'the ratio of the use of recycled and virgin materials', 'the rate of recovery and reuse of customer equipment in the fixed service' or the 'appropriate measurements of electromagnetic fields (V/m or W/m2)'. In addition, some respondents suggested potentially interesting topics to consider, such as the environmental footprint in space, the efficient use of infrastructure, the power consumption of households for internet service use or the

[56] The exception of 'raw materials depletion' could be outlined as 6 respondents did mention to plan to collect in the future.

enablement factor for customers using products and services. Some respondents used this question to stress that the monitoring of environmental indicators should be as simple as possible and that it is important to consolidate the existing set of indicators before adding new ones. One company informs that it reports through 'land use' indicator its reuse of old buildings because this practice limits land artificialisation. However, this is not the purpose of this indicator, so the company encourages the European authorities to conduct studies to find an appropriate indicator for this issue. Another undertaking shares their waste management process. They have implemented a reverse supply chain mechanism and a reuse policy for electronic components that are still functional. They publish the 'component reuse rate' which represents the proportion of non-new and reconditioned components used by the undertaking in its products.

5.4. Indicators measuring the environmental performance of organisations

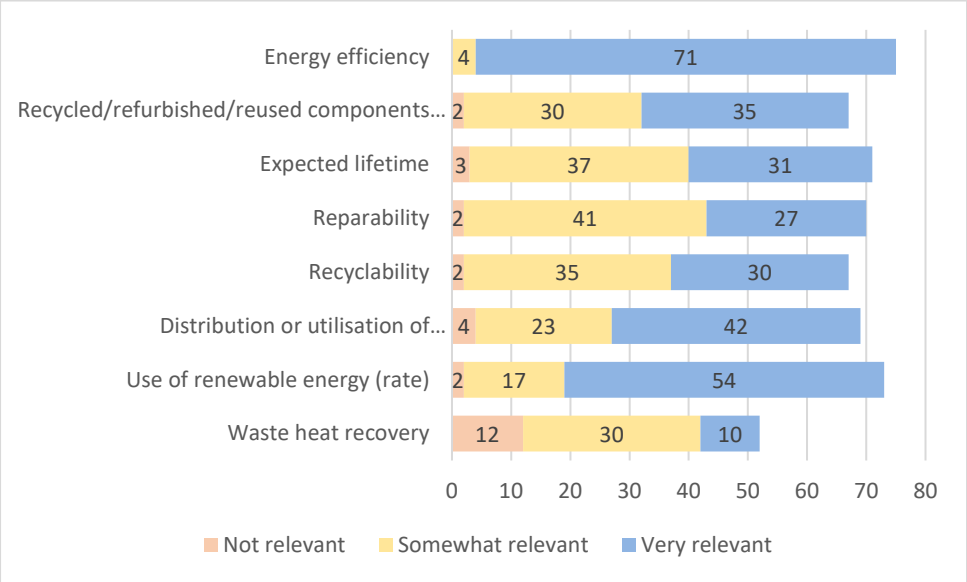
To complete its overview, BEREC also asked stakeholders to provide their views on a set of indicators related to the environmental and circular economy. This section presents the main feedback of the relevant part of the survey.

5.4.1. Relevance of specific indicators for measuring the environmental performance of organisation according to the respondents

Stakeholders were also asked to self-assess the relevance of the another set of indicators listed below in relation with the environmental performance of their organisation (Graph 9[57]).

As for section 5.3.1, it should be acknowledged that the information reflects industrial respondents' views on indicators 'relevance' but does not reflect BEREC assessment on possible differentiated 'relevance' of sustainability indicators and should not pre-empt future positions and evaluation from BEREC and other relevant bodies.

[57] It should be noted for this question that the 81 respondents also had the options to not provide an answer or to choose the option 'N/A'. These two options are not detailed in the text nor displayed in the graph as their interpretation is subjective.



Graph 9 – Relevance of specific indicators for measuring the environmental performance of your organisation

For industry players who replied to the survey, the most relevant indicator for measuring the environmental performance of organisations, is 'energy efficiency' followed by 'renewable energy (rate)'.[58] 71 out of a total of 81 respondents regard the 'energy efficiency' as very relevant for measuring their environmental performance, while four respondents regard it as somewhat relevant.[59] The rate of use of renewable energy is supported by 54 of respondents as 'very relevant' and by 17 companies as 'somewhat relevant'.

The distribution or utilisation of recycled/refurbished /reused products is also supported by the companies that did answer to questionnaire: 42 companies considered this indicator as 'very relevant', hence more than half of the respondents. As regards the indicators 'Recycled/refurbished/reused components (also excavated masses) used in products', 'expected lifetime', 'reparability', 'recyclability', 'distribution or utilisation of recycled/ refurbished/reused products', the overwhelming majority of respondents regard them as 'somewhat relevant' or 'very relevant' for measuring the environmental performance of organisations. It can be noted that the combined share of the answers 'somewhat relevant' and 'very relevant' is quite constant across those indicators. Only very few respondents (2-4 respondents per indicator) stated that those indicators would not be relevant.[60]

The lowest relevance of measuring the environmental performance of organisations was attributed to the indicator 'waste heat recovery' with only 10 respondents regarding it as 'very

[58] The rate of renewable energy as measured by the companies who replied to BEREC questionnaire may encompass both the energy is actually physically used (self-consumption) or owned (PPAs, GOs).

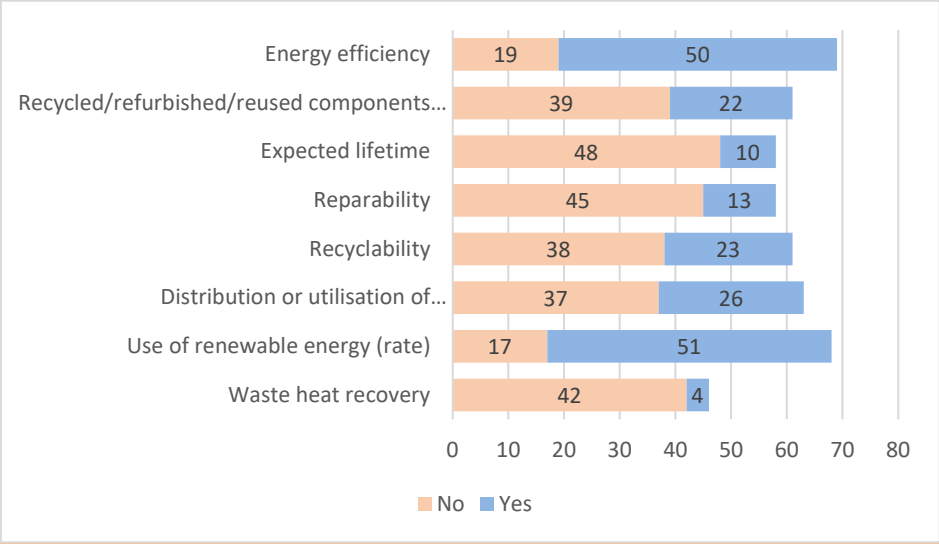
[59] No respondent gave a reason for why this indicator might not be important.

[60] And in that case, respondents justified their answers either because they are viewed as impossible to use in that specific business model or not applicable

relevant' and 30 as 'somewhat relevant'. However, this picture can be nuanced by the fact that half of the respondents did thus indicate that this indicator has a degree of relevance (40 out of the 81 respondents).[61]

5.4.2. Use of specific indicators for environmental data collection and/or reporting within a company

Stakeholders were also asked whether specific environmental and circular economy performance indicators are currently used by their organisation for the data collection and/or reporting (Graph 10[62]).



Graph 10– Use of specific indicators for environmental data collection and/or reporting within a company

The responses to the questionnaire suggest a clear focus on the indicators 'energy efficiency' and 'use of renewable energy (rate)', which are used by 50 and 51 out of 81 respondents. Still significant but to a lesser degree is the use of the indicators 'recycled/refurbished/reused components (also excavated masses) used in products' (22 out of 81), 'recyclability' (23 out of 81) and 'distribution or utilisation of recycled/refurbished/reused products (26 out of 81)'. The indicators 'expected lifetime' and 'reparability' are again used to a lesser degree (i.e., 10 and 13 out of 81 respondents). Finally, 'waste heat recovery' is the least used by

[61] The stated reasons for why waste heat recovery would be not relevant were: that it would be insignificant, not applicable, that it is currently not a priority, or that this would be an indirect contribution.

[62] It should be noted for this question that the 81 respondents also had the options to not provide an answer or to choose the option 'N/A'. These two options are not detailed in the text nor displayed in the graph as their interpretation is subjective.

surveyed companies with only four of the respondents indicating to use this indicator for their environmental data collection and/or reporting.

On each performance indicator, the stakeholders were asked for further details on the reporting: whether they report them and if they do not report (yet), whether they plan to do so in the future (Graph 10). More details of the analysis carried out here, is provided for in Annex I. With regards to the most collected indicators 'energy efficiency' and 'use of renewable energy', most respondents indicate to measure these indicators on company level. The metrics used to measure 'energy efficiency' vary among the respondents, however, most use an equivalent of Wh, sometimes compared to a certain amount of data usage. The fact that only 50 respondents measure 'energy efficiency' compared to 71 respondents, which deemed this indicator relevant, can be explained by the reported difficulties of low data availability and lack of comparability. The modelling of the relationship between data traffic and energy consumption in regard to energy efficiency emerges as one of the important methodological challenge to address in this regard. With regards to 'use of renewable energy', this discrepancy does not seem to be as significant.

The results of the indicators 'recycled/refurbished/reused components (also excavated masses) used in products', 'recyclability' and 'distribution or utilisation of recycled/ refurbished/reused products' also show a higher number of respondents that find the indicators relevant compared to the number of respondents that actually uses the indicators. Lack of systems or processes in place is mentioned as one of the difficulties for measuring all three of these indicators. However, around 10 respondents indicate to consider measuring these indicators in the future, which is aligned with the number of respondents considering these indicators relevant.

Regarding the less used performance indicators (expected lifetime, reparability, recyclability, use of second-hand components and waste heat recovery) a significant part of the respondents reported to plan to report them in the future (between 9 and 12 of the respondents who answered 'no' to the question depending on the indicator considered), in coherence with the answers provided by companies on the relevance of this indicator.

Respondents indicate that an available methodology or technical tools are needed to measure these indicators in the future.

5.4.3. Other indicators considered important by the respondents to estimate environmental performance by industry players

Up to this point, this Report analysed responses related to the mainly used indicators which BEREC proposed to reflect upon. At the same time, it is important to consider also other indicators mentioned by the respondents, such as:

- The development of international reporting standards by SBTi, biodiversity and use of raw materials (virgin/recycled/renewable).

- ESG KPIs 'carbon intensity' which shows the CO_2e emissions in proportion to the transmitted data volumes and 'energy intensity' regarding energy consumption in proportion to the transmitted data volumes.
- Performance metrics especially for data centres including 'power usage effectiveness' (PUE) for energy-efficiency enhancements in their data centres using the ratio between the total electrical energy consumed by the data centre, 'water usage effectiveness' (WUE) and the 'carbon usage effectiveness' (CUE).
- The KPIs to be developed by the European Green Digital Coalition to address challenges in terms of environmental transparency.

5.5. Proposals from companies on environmental transparency

5.5.1. Proposed ways to increase the level of harmonisation and comparability in terms of environmental transparency in the sector

55 out of 81 industry players that answered the questionnaire presented their views on the ways the level of harmonisation and comparability in terms of environmental transparency of electronic communications and digital sector could be increased. It can be noted that suggestions are quite diverse.

Various standards and initiatives such as GRI were referred by 3 operators, one of which also mentioned the European Financial Reporting Advisory Group (EFRAG),[63] the SASB[64] Standards and the Task Force on Climate-related Financial Disclosures (TCFD). The SBTi framework was mentioned by 2 operators. The Global Real Estate Sustainability Benchmark (GRESB) – Actionable ESG data and benchmarks for financial markets[65] was also mentioned.

The need to standardise the scope used, specifically Scope 3, for measuring the emissions of the sector was mentioned by five respondents. Waste reduction was also mentioned by four industry players. Six respondents expressed their expectation that new requirements under the coming CSRD, as well as the new EU Taxonomy, would be an opportunity for standardising environmental information across the communications sector.

The importance of transparency was highlighted by six respondents, one of which suggested the need for state intervention be it by law, regulation, or adoption of standards and self-regulating codes for partners, when doing day-to-day business.

Others expressed opinions regarding the need to collaborate with electronic communications operators' associations, the development of technical tools to increase harmonisation;

[63] https://www.efrag.org/Activities/2010051123028442/Sustainability-reporting-standards-roadmap
[64] https://www.sasb.org/about/
[65] https://www.gresb.com/nl-en/about-us/

harmonised definitions to support reporting efforts and reduce resource use intensity and workload in compiling the reports allowing for easier comparison of companies reporting. Also, concern against overcomplexity which might lead to reporting overburdening, poor data quality and low comparability were mentioned as well as the view that the current indicators used as per the GHG Protocol ICT Sector Guidance for network energy consumption cannot be used to evaluate the instantaneous impacts of changing data volumes since 'networks do not typically scale linearly with data consumption'.

Given that industry players would welcome the common adoption of a harmonised communications sector specific standard, the obstacles to action in this area arise from a lack of co-ordination amongst industry, NRAs and European institutions. It is in all stakeholders' interests to introduce credible metrics as soon as practicable to project the environment and the industry.

5.5.2. Limitations and difficulties in using common, harmonised, and comparable indicators in the electronic communications sector identified by respondents

45 out of the 81 industry players that answered the questionnaire offered their views on the limitations and difficulties, if any, in using common, harmonised, and comparable indicators in the electronic communications sector.

The limitations and difficulties identified are related to the very different business models of the industry players, different geographical areas; different networks (e.g., mobile vs fixed); different product portfolio; varying user equipment, technical architecture and solutions and a complex supply chain (for instance, accounting for emissions while buying / selling / renting capacity); different markets; company structures and very different level of ESG maturity in the industry. It was pointed out that 'one-size-fits-all does not need to work'.

The lack of harmonised reporting, difficulty in getting the data, integration in the business process or day-to day activities, a lengthy learning and 'very time consuming' process, were also mentioned, together with the lack of consensus as to long term sustainability targets and objectives; the lack of relevant legal regulations obliging the use of uniform indicators or the lack of guidance and methodology. Seven industry players mentioned limited use of standards, be it the lack of standards – namely for Scope 3 emissions, their state of early development, differences and possible interference between existing standards. Again, the need for common standards, notwithstanding the need for adaptation to business circumstances as stated in the previous paragraph, emerged.

It was noted that consumers, companies, and policy makers should make informed decisions considering that most of the energy consumption is related to consumer devices. Some mentioned that specific KPIs applied to manufacturers should not be applied to operators and that sensitive information related to the operator's commercial data would raise limitations and difficulties in practice.

In conclusion, it seems despite increasing efforts, the difficulties are still numerous to achieve greater environmental transparency in the electronic communications sector. Among other obstacles, different business models and the lack of harmonisation and common standards appear as particularly pressing to address.

6. BEREC preliminary assessment on sustainability indicators

For this Report, BEREC examined the existing framework, NRAs' first experiences on the topic as well as the views relevant public organisations, external experts and industrial players' views regarding relevant sustainability indicators for the electronic communications sector. This work aims to get a better understanding of current use and practices in terms of environmental reporting as well as to identify remaining challenges and technical difficulties in the assessment of the environmental footprint of ECN/ECS, and ICTs more largely. A related topic covered was the potential role of NRAs in this area and the possible ways BEREC to continue using its expertise to contribution to ICT-related environmental targets, especially towards increased environmental transparency in the sector. On the basis of these first findings, this BEREC's Report provide a preliminary assessment of main challenges and areas of interest in terms of sustainability indicators for ECN/ECS and should be read in the wider context of the work being carried out by the European Commission and other EU bodies in relation to measuring the environmental footprint of ICT.

6.1. Investing in the environmental transparency of electronic communications

Environmental transparency in the digital sector is an overarching interest in the European public-policy agenda. On the one hand, public decision-makers and regulators need substantiated information on the environmental footprint of economic actors to feed their decision-making processes. On the other hand, transparency is also a lever for monitoring decarbonisation and environmental footprint reduction efforts by economic players. However, challenges are numerous in this area due to multiple factors. GHG emissions from ICT are estimated to make up larger proportions of total emissions in the future.[66] The earlier the industry agrees on a suitable set of metrics for measuring the environmental impact, the better prepared stakeholders may be in the context of increasing importance of ECN/ECS in Europe's mitigation ambitions.

The complexity of Internet value chain raises technical challenges in terms of environmental accountability. For instance, there is not an explicitly and uniformly defined methodology to apply the framework of Planet boundaries when referring to the ICT sector or only to environmental impact of ECN/ECS, which cause significant variation in the results of different studies (even if these studies are applying the same indicators and/or standards as such and

[66] Freitag, Charlotte & Berners-Lee, Mike & Widdicks, Kelly & Knowles, Bran & Blair, Gordon & Friday, Adrian. (2021). The real climate and transformative impact of ICT: A critique of estimates, trends, and regulations. Patterns. 2. 100340, https://doi.org/10.1016/j.patter.2021.100340

even if the data is equally reliable).[67] The lack of available data, common standards, and harmonised methodologies for the sector, especially regarding electronic communications, seems to hinder the reliability and comparability of existing reporting and assessment.

Hence, following the objective of increased transparency in the digital sector set by the European Green Deal and the Commission's digital strategy, several projects and legal initiatives tackled the task to provide necessary tools to meet this target, including for electronic communications sector. At the same time, industry and stakeholders already started to make efforts to foster their environmental reporting. The indicators collected and published by companies could thus be strong signals for competent authorities but also for consumers and shareholders, who are increasingly demanding that companies take actions on these aspects. While financial data was predominant in the business choices for decades, Corporate Social Responsibility together with the Economic Social Governance are also increasingly considered by corporate decision makers. In this context, companies including those in the electronic communications sector, tend to publish a significant set of environmental indicators.

BEREC acknowledges the critical importance of environmental information and data to support public authorities' decision-making, encourage sustainable practices in the market and inform end users. This point was also highlighted in a recent OECD[68] publication, which concluded that the ability of regulators to carry out new functions, such as those related to environmental sustainability and especially in a context where regulatory approaches are increasingly data-driven, may depend on each regulator's ability and legal power to collect relevant data.

In terms of environmental assessment, it should be acknowledged that the development of multi-criteria and life cycle analysis is essential to have an exhaustive vision of the environmental footprint of a sector. To this end, the European Commission in cooperation with market participants and external experts is developing the PEF methodology for Europe. BEREC notes that at this stage, only one multi-criteria life cycle analysis was published on the ICT sector at European level, while the development of PEFCR for digital products and services is only starting. More detailed studies and better information on environmental impacts are needed in order to fully characterise the impact of the sector, and to progressively adopt a multi-criteria approach to assessing the environmental impacts. Therefore, collecting environmental impact data now is important to feed into these studies and thus strengthen their analytical capacity and avoid the use of assumptions. Furthermore, additional indicators linked to the environmental performance of companies (for example recycling, reuse, reconditioning, share of renewable energies in the energy mix) are also adopted in certain publications and promoted by the economic actors themselves.

[67] Pernilla Bergmark; Gustaf Zachrisson (Ericsson), Towards considering Planetary Boundaries in Life Cycle Assessments of ICT (2022) https://ieeexplore.ieee.org/document/9830102

[68] OECD, Governing Green: Gearing up government to deliver on climate and other environmental challenges; in: Building Trust and Reinforcing Democracy: Preparing the Ground for Government Action (2023) https://www.oecd-ilibrary.org/sites/45cc57a7-en/index.html?itemId=/content/component/45cc57a7-en

The data collection from stakeholders conducted by BEREC for this report provides elements to evaluate current environmental reporting practices and the level of adoption of some of the OEF/PEF environmental indicators and complementary environmental performance indicators in the electronic communications sector.

6.2. State-of-play and challenges in the electronic communications industry

In the sample of 81 companies studied by BEREC through its questionnaire, 56 companies confirmed reporting environmental data and 48 mentioned they also publish this data, including 20 respondents who do so as open data (and 7 companies only partially in open format).

The environmental impact assessment indicators mostly collected and published by companies are those related to their energy consumption (61 respondents) and carbon footprint (between 40 and 52). The monitoring of energy consumption indeed appears essential since currently 7% of European energy consumption is generated by the ICT sector and this share could go up to 13% by 2030 according to the recent EU action plan on digitalising the energy system.[69] In terms of carbon footprint, the majority of respondents collect and publish their direct emissions and those related to energy consumption[70] (Scopes 1 and 2). About half of the analysed companies claim they collect or publish information on their other indirect emissions despite the technical challenges that remain in calculating Scope 3. Two other indicators are also significantly used by respondents: generation of electronic waste (41 respondents) and water consumption/use (35 respondents). Land use, ecological and human toxicity, consumption of abiotic resources and eutrophication are the least collected indicators. It can be noted that, however, some of these indicators are still considered as very relevant or somewhat relevant by a substantial number of respondents, for instance raw materials depletion considered 'very relevant' by 14 companies and 'somewhat relevant' by 21 companies. The most used indicators have various levels of harmonisation which merit investing the means to build common definitions and standards where possible. The less used indicators could also merit close observation and efforts to develop further assessments. It should be acknowledged that the concept of 'relevance' was not specified with regards to the list of sustainability indicators provided in the BEREC questionnaire. Hence, the feedback on the 'relevance' of indicators from the responses received may encompass different definitions of 'relevance' from individual stakeholders, which notably depends on the respondent's context and business model.[71]

[69] Digitalising the energy system – EU action plan https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022DC0552&qid=1666369684560

[70] BEREC notes that calculation of the carbon footprint can defer depending on the emissions factors used to translate and energy consumption in carbon footprint.

[71] Standardised assessment of relevance of environmental impact indicators should be priorly based on scientific data-based multicriteria review, such as PEF/OEF methodology at EU level.

The monitoring of environmental performance indicators seems to be significantly supported and relatively widespread within the industry. The related indicators inquired in BEREC's questionnaire (i.e. use of renewables, waste heat recovery, distribution, or use of materials from the circular economy, use of second-hand materials, lifespan, recyclability and repairability) are perceived as 'somewhat relevant' or 'very relevant' by at least half of the respondents. The most collected performance indicators are the ones related to the energy performance of companies (i.e. energy efficiency collected by 50 companies and renewable energy rate reported by 51 respondents), followed by indicators related to circular economy performance including the distribution or use of recycled, reused, reconditioned products (26 respondents), recyclability (23), and the incorporation of materials from the circular economy in the manufacturing phase (22). These indicators are less used, by respondents even through some of them are 'planned in the future' by a significant number of respondents, such as circular economy performance including durability, reparability or the recyclability of products that are planned by 10 to 12 companies. In general, harmonised standards for the different indicators used to calculate ECS/ECN environmental footprint and performance could benefit from further work and from BEREC's expertise. Also, in this case, the notion of 'relevance' was not specified in BEREC questionnaire and could incorporate different meanings for each individual stakeholder.

Facing the development of multiple reporting practices, the role of standardisation bodies is crucial to support the reliable use of sustainability indicators and improve comparability. Following the analysis of the responses to BERECs call-for-input, the standards mostly used by electronic communications companies seem to be the ISO standards, the GHG Protocol standards and GRI standard (noting that the specific standards do not necessarily cover the same scope and can be complementary). In light of the current European Commission's recommendation regarding the PEF, technical work to address potential bridges between this frame and existing standards could be advisable to ensure that the most widely used standards in the industry are PEF-compliant.

The majority of respondents to BEREC's survey confirmed that they set their own environmental objectives in order to minimise the environmental impact of their activities. The SBTi methodology is mostly adopted in the sector. Related to methodologies to plan decarbonisation trajectories, there are still challenges to determine one common methodology for reducing GHG emissions including Scope 3 for electronic communications or digital companies. The significant work of ITU in this area[72] as well as initiatives from stakeholders, such SBTi, should be highlighted.

To summarise the challenges the industry is facing, it is evident that the availability of technical tools (such as standards, common metrics and unit of measurement, guidelines) to collect

[72] The ITU L.1450 (2018) recommends a methodology for defining a GHG emissions budget for the ICT sector considering a 2°C or lower trajectory. ITU L.1470 (2020) which is implemented in cooperation with GSMA/GeSI. The ITU. L.1450 also proposes a GHG emissions trajectories for the ICT sector compatible with the UNFCCC Paris agreement. There are already trajectories at a global level up to 2030 for the ICT sector and sub trajectories for mobile as well as fixed networks, data centres, equipment providers, and enterprise networks.

environmental data is crucial. The need to define a common methodology at EU level is also emphasised by stakeholders and seems to be the preferred way forward. A harmonised approach at the highest level possible could counter the complexity that arises from accumulating and comparing data in the case of multi-national or multi-purpose companies (i.e., varying circumstances, including different geographical areas, business models of the industry players, and the nature of the networks, e.g., mobile vs fixed, equipment used, etc.). This could also be the answer to the critical issues reported by involved parties regarding data accuracy, including the availability of environmental data, transparency, and comparability. Moreover, while some of the industry players publishing environmental data have declared that they are doing so in open data format, a significant number still provide this data only partially or not at all. Therefore, encouraging industry players to implement open data and open methods presents an opportunity to increase the level of harmonisation and comparability in terms of environmental transparency in the electronic communications and digital sector.

Based on the industry players' responses, the CSRD, as well as the EU Taxonomy, present opportunities for standardising environmental information across the sector, allowing better comparability between industry players. BEREC also underlines that the new European framework on eco-design requirements and on green claims could also be relevant to improving the harmonisation of the calculation of the environmental footprint and environmental transparency in the sector and in relation to the end users.

6.3. Potential role for national regulatory authorities

In recent years, the approach of NRAs regarding the environmental impact of ICTs has evolved and the use of environmental data on ECN/ECS is a topic of growing interest for BEREC. Today, there are no regulatory provisions at European level setting up a harmonised environmental data collection specifically for ECN/ECS, although several initiatives and regulations at EU level could support the development of the environmental data collection process and publication for data centres and terminals.[73]

The EECC provides the legal framework for data collection for different purposes. From its survey, BEREC notes that NRAs collect other data as part of their traditional mandate, which may be useful for environmental impact calculations (e.g., volume of data, number of existing sites, terminals in circulation). Therefore, NRAs could possibly investigate to what extent these data could contribute to enhance the environmental transparency of the ICT by assessing certain environmental parameters.

[73] Such as the Energy Efficiency Directive recast proposal regarding data centres or the new regulation on energy labelling for smartphones and tablets.

While the data collecting provisions (Article 20) in the EECC do not prevent NRAs from collecting environmental data, a clearer and harmonised mandate to collect information on the environmental impact of ECN/ECS would be a favourable development to examine, perhaps through the upcoming review procedure of the EECC (Article 122).[74]

Currently, as the vast majority of NRAs report not having a specific mandate to collect environmental data, it seems from the responses of NRAs and other public authorities that, in certain specific cases, national legislation or relevant initiatives provide NRAs with the competences to collect, assess and publish environmental data in order to inform the sector and end users.

Indeed, four NRAs report carrying out data collection regarding the environmental footprint of electronic communications (BE, ES, FR, FI). The implementation of data collection by NRAs seems to depend heavily on the national context and on the specific form chosen for the initiative. Some of the NRAs rely on national objectives (e.g. FI) and/or have recently been granted with extended competencies by national bills (e.g. FR), while others include environmental data indicators in the frame of their traditional mandate and/or adopted a voluntary approach or cooperate with other competent authorities (e.g. BE, ES). In this context, the format of the data collection and the indicators considered vary significantly from one authority to the other. These different approaches could be considered by other NRAs that are in the process of designing procedures related to environmental data collection on a voluntary basis or not, depending on their current legal framework and the scope they wish to cover.

At present, the sustainability indicators collected by the four NRAs mentioned above mostly relate to energy and electricity consumption, energy efficiency and GHG emissions, water consumption and the share of recycled/reused/refurbished products distributed.

The first experiences of NRAs on environmental data collection and the contributions of the industrial players detailed above allow a classification in three preliminary categories of indicators.[75] The first category includes indicators already collected by NRAs and are presented by the surveyed companies as relevant (high or medium), such as energy consumption, carbon emissions, water consumption or e-waste (Group A). A large part of these indicators tend to be characterised by a higher degree of maturity as they are already collecting and relevant methodologies and studies have been published, even if challenges remain, for instance in calculating Scope 3 emissions The second category includes indicators not yet collected by NRAs but with which benefit from a medium support from the industry (Group B). The third category gathers indicators with low support and adoption from the industry (Group C). It can be noted, that even for the category of indicators in Group C, some

[74] The procedure foreseen by EECC Article 122 is only an example of opportunities to discuss the possibility to provide a clearer mandate to NRAs that want to collect environmental data.

[75] The sample of 81 stakeholders which responded to the BEREC questionnaire may not give a full picture of the industry and that their views on ‘relevance” of indicators seems to depend to a significant extend on the concrete business model.

of these indicators could still be considered relevant for further research in the context of the EU's environmental targets.[76]

In general, the NRAs agree that it would be useful to have a single harmonised set of indicators based on a well-established methodology that would provide the means for assessing the environmental footprint of ICT while allowing sufficient flexibility for national specificities. The specific set of environmental indicators collected by NRAs or other relevant authorities as well the institutional design to implement such data collection, may vary across countries due to national circumstances – including the mandate of each NRA.

Hence, BEREC should also continue acting as a knowledge-sharing platform for NRAs, contributing to an increased level of expertise in applying the available methodologies and indicators of environmental sustainability. BEREC also acknowledges that these topics merit further discussions between electronic communications regulators and other competent authorities, within the context of the European Commission and other relevant bodies' (OECD, RSPG, ITU in particular) work. It also notes that the set of relevant sustainability indicators should be adaptative and build after quantitative, verifiable assessment and object of a vivid dialogue with relevant stakeholders (e.g., other relevant authorities, industrial players, environmental associations, academics, consumer/citizen representatives).

6.4. Pilot classification of sustainability indicators for electronic communications networks and services

Based on its current findings, BEREC compiled a preliminary classification of sustainability indicators reviewed to assess environmental footprint and performance of ECN/ECS solely based on NRAs' first environmental data collection and on stakeholders' feedback in relation to the most used and most relevant sustainability indicators (Table 4). The aim is to provide preliminary tool with necessary information on current use of sustainability indicators across BEREC members and first feedback from economic players as a basis for further reflections to support the national applications of sustainability indicators and the work of the European Commission or other relevant bodies on this topic.[77] As this table is not accompanied by a quantitative assessment and in a context where only 4 NRAs confirmed to already collect environmental data, BEREC likes to point out that this input can only be the basis on which

[76] This reasoning can be drawn for numerous indicators such as ecotoxicity and eutrophication indicators which are important parameters to sustain biodiversity, a topic which is part of the priority environmental target set by the European Commission. https://environment.ec.europa.eu/strategy/biodiversity-strategy-2030_en

[77] The European Commission notably considered BEREC work outcomes on sustainability indicators including this pilot classification to feed its work on sustainability indicators for the establishment of a EU Code of Conduct for ECN/ECSs.

BEREC will continue to build up its own analysis and evaluation in its future work in collaboration with other relevant bodies.

The following table is presenting the 19 indicators studied by BEREC in three separate groups depending on their level of maturity, use and support reported by NRAs and private respondents to BEREC questionnaires. In Group A, indicators already collected by NRAs and with high or medium relevance for surveyed companies were included. In Group B, indicators already collected by NRAs or with medium support from the industry and that are not in Group A were included. In Group C indicators with low support from the industry and not collected by any NRA were included. The number of surveyed companies using the specific indicators is used to rank the specific indicators within the same group.

	Name of the indicator	Collection by NRAs in BEREC	Level of support from the surveyed companies	Number of companies collecting this indicator	Relevant scope	Examples of data already collected
GROUP A * Collected by at least one NRA *High or medium support from companies	**Energy consumption**	Yes (FR, BE, ES, FI)	HIGH	61	Networks, data centres, company-wide	Energy consumption of different parts of the network (BE, FI, FR) Data centres and IT equipment energy consumption (BE, ES, FR)
	Carbon emissions - Direct emissions	Yes (FR, BE, ES)	HIGH	52	Company-wide	Scope 1 emissions (FR, BE, ES)
	Carbon emissions - Energy indirect emissions	Yes (FR, BE, ES)	HIGH	52	Company-wide (location based, and market based)	Scope 2 emissions (FR, BE, ES)
	Carbon emissions - Other indirect emissions	Yes (FR, BE, ES)	HIGH	40	Company-wide	Scope 3 emissions (FR, BE, ES)
	Energy efficiency	Yes (BE, ES)	HIGH	50	Networks, data centres	Consumption in function of data/clients/revenue (BE, ES) PUE (BE)
	Use of renewable energy (rate)	Yes (BE, FI)	HIGH	51	Company-wide	Production and use of renewable energy (BE, FI)

	Distribution or utilisation of recycled/refurbished/ reused products	Yes (FR, BE)	HIGH	26	Devices, equipment	Number of items recycled/refurbished (BE) Number of items collected in order to recycle or repackage them (FR) Number of items sold repackaged (FR)
	Expected lifetime	Yes (FR)	MEDIUM	10	Devices, equipment	Devices duration of use by year of commercialisation (FR) Number of items sold each year (FR)
	Water usage/consumption	Yes (FR, BE)	MEDIUM	35	Data centres and other infrastructures element	Water consumption by types of water (BE, FR) Water cooling systems used (FR) Reuse of water (BE) Water discharge areas and conditions (BE, FR)
	Raw materials depletion (mineral)	Yes (FR)	MEDIUM	6	Devices, equipment manufacturing	Use of rare earths and precious metals (FR)
GROUP B ***Not yet collected by any NRA** ***But MEDUM support from the industry**	**E-waste production**	Not at the moment	MEDIUM	41	Company-wide	
	Recycled/refurbished/ reused components (also excavated masses) used in products	Not at the moment	MEDIUM	22	Devices, network and data centres equipment	
	Recyclability	Not at the moment	MEDIUM	20	Devices, network equipment	
	Reparability	Not at the moment	MEDIUM	13	Devices, network equipment	
	Land use	Not at the moment	MEDIUM	10	Company-wide	
	Waste heat recovery	Not at the moment	MEDIUM	4	Datacentres	
GROUP C	**Eco toxicity (including incidence on**	Not at the moment	LOW	8	Company-wide	

*Not yet collected by NRAs *Low support from the industry	**biodiversity, water pollution…)**					
	Human toxicity (including air pollution)	Not at the moment	LOW	7	Company-wide	
	Eutrophication (terrestrial, freshwater, marine)	Not at the moment	LOW	1	Company-wide	

Table 4 – BEREC Preliminary classification of sustainability indicators for ECN/ECS based on the analysis of BEREC 2022 questionnaires

7. Conclusions and future work for BEREC

With the expertise of its member NRAs in collaboration with other relevant public bodies and stakeholders, BEREC will continue to contributing increasing environmental transparency in the electronic communications sector, to contribute to the harmonising support of the environmental indicators collected and to contributing to the improvement of the environmental performance of the ICT industry.

This Report constitutes a new step for BEREC activities supporting the implementation of ICT-related part of EU Green Deal, especially regarding the environmental transparency within the electronic communications industry, and more broadly in the digital sector. BEREC will continue to engage with EU institutions, international organisations, and standardisation bodies, to support with its expertise their projects and initiatives aimed at fostering the level of digital the ICT sector's environmental transparency. BEREC will also continue nurturing regular exchanges and dialogue with stakeholders, including industry players, academia, and civil society organisations.

In particular, in 2023 and 2024, BEREC is investigating the role of environmental information and data on digital goods and services for the empowerment of end users. This work will include workshops with environmental and consumer associations with the aim of developing initial conclusions on sustainable practices for users, in order to highlight ways to mitigate the environmental footprint of digital technologies.

BEREC also notes the strong interest of the industry regarding the positive indirect effects of digital technologies on other sectors, as well as the stakeholders' call to keep track of rebound effects in other industries related to ICT. Hence, BEREC is following the related work of other Standards Development Organisations (e.g., ITU) and competent authorities on that matter, especially by the European Commission including through the EGDC.

Glossary

Carbon disclosure project (CDP): An organisation that publishes data on the environmental impact of the largest companies.

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.

Do No Significant Harm (DNSH): The European Commission's DNSH-principle states that activities of member states or investors setting up new projects on the European market should not support or carry out economic activities that do significant harm to any environmental objective, where relevant, within the meaning of Article 17 of Regulation (EU) 2020/852. This applies to the entire life cycle of the projects. That is, from the extraction of raw materials to the processing of residual products at the end of the project's life.

Economic, Social and Governance (ESG): A framework that helps stakeholders understand how an organisation is managing risks and opportunities related to environmental, social, and governance criteria (sometimes called ESG factors).

Environmental Sustainability:[78] 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*.'[79] 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.

Global Reporting Initiative (GRI): The GRI Standards[80] aim to help organisations worldwide to report on their positive or negative contributions to sustainable development.[81] These standards are the most used ones globally. The standards are parted in 3 categories: (1) universal standards, (2) sector standards and (3) topic standards. Not all the sectors are yet covered by certain sectoral standards.[82]

Greenhouse Gas Protocol (GHG Protocol): The Greenhouse Gas Protocol is a framework for companies and other entities to measure and report on their GHG emissions. The GHG

[78] https://scholarworks.rit.edu/cgi/viewcontent.cgi?article=1007&context=jes
[79] United Nations Brundtland Commission http://www.un-documents.net/our-common-future.pdf
[80] KPMG – Big shifts, small steps: survey of sustainability reporting (October 2022). https://assets.kpmg.com/content/dam/kpmg/xx/pdf/2022/10/ssr-executive-summary-small-steps-big-shifts.pdf
[81] GRI – GRI Standards English Language (globalreporting.org) https://www.globalreporting.org/how-to-use-the-gri-standards/gri-standards-english-language/
[82] https://www.globalreporting.org/how-to-use-the-gri-standards/gri-standards-english-language/

Protocol includes standards, guidance and tools for emission accounting and calculating over different scopes.[83] The GHG Protocol therefore focuses only on indicators related to GHG, such as carbon dioxide and methane at Scopes 1, 2 and 3.

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.[84]

Metric: Unit of measurement.

Organisation Environmental Footprint (OEF): The OEF is a multi-criterial measure of the environmental performance of a goods/services providing organisation from a life cycle perspective. This includes companies, public administrative entities, territories, and other bodies. This document provides guidance on how to calculate an Organisation Environmental Footprint, as well as how to create sector-specific methodological requirements for use in Organisation Environmental Footprint Sector Rules (OFSRs).

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.

[83] https://ghgprotocol.org/standards

[84] 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

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: The increase of demand offsets the positive effects of efficiency improvements.

Science Based Targets initiative (SBTi): The initiative defines and promotes best practices in emissions reductions and net-zero targets in line with climate science and provides target-setting methods and guidance to companies to set science-based targets in line with the latest climate science. It includes a team of experts to provide companies with independent assessment and validation of targets. It serves as the lead partner of the Business Ambition for 1.5°C campaign, an urgent call to action from a global coalition of UN agencies, business and industry leaders that mobilises companies to set net-zero science-based targets in line with a 1.5° C future.

Scope 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.

Annexes

ANNEX I: Additional information on answers to BEREC questionnaire to industry players[85]

I. – Summary of stakeholders' feedback on main standards used

This table proposes a summary of main standards selected or mentioned by the 81 industry respondents to BEREC questionnaire in terms of environmental reporting. Only standards mentioned by at least 2 stakeholders regarding environmental performance/impact are represented.

Category	Name of the standard	Frequency	Type of impact	Range
	ITU-T L.1470 (01/2020): Greenhouse gas emissions trajectories for the information and communication technology sector compatible with UNFCCC Paris Agreement	6	Carbon impact	ICT Sectoral level
	ITU-T L.1420 (02/2012): Methodology for energy consumption and greenhouse gas emissions impact assessment of information and communication technologies in organizations	4	Energy/Carbon impact	ICT Organizational level
	ITU-T L.1330 (03/2015): Energy efficiency measurement and metrics for telecommunication networks	4	Energy	Radio site/mobile network system level
ITU Standards	ITU-T L.1310 (09/2020): Energy efficiency metrics and measurement methods for telecommunication equipment	3	Energy	ICT (network) equipment level
	ITU-T L.1331 (09/2020, new version on 01/2022): Assessment of mobile network energy efficiency	2	Energy	Mobile network system level
	ITU L.1410: Methodology for environmental life cycle assessments of information and communication technology goods, networks and services	2	Multicriteria	ICT goods, network systems and service level

[85] Only indicators that were collected by at least 20 respondents are summarised in a factsheet table additional to textual summary.

	ITU L.1471: Guidance and criteria for information and communication technology organizations on setting Net Zero targets and strategies	2	Carbon impact	ICT Sectoral level
	ETSI ES 203 228 V1.3.1 (2020-10) – new version V.1.4.1. (04/2022): Assessment of mobile network energy efficiency	5	Energy	Mobile network system level
	ETSI EN 303 215 V1.3.1 (2015-04): Measurement methods and limits for power consumption in broadband telecommunication networks equipment	2	Energy	ICT (network) equipment level
	ETSI EN 303 472 V1.1.1 (2018-10): Energy Efficiency measurement methodology and metrics for RAN equipment	2	Energy	Radio site level
ETSI Standards	ETSI TS 103 199: Life Cycle Assessment of ICT equipment, networks and services: General methodology and common requirements	2	Multicriteria	ICT goods, network systems and service level
	Protocol Corporate (Value Chain) Standard – not specific to ICT sector	24	Carbon impact	(Any) Organisational level
	Product Life Cycle Accounting and Reporting Standard – not specific to ICT sector	11	Carbon impact	(Any) Product level
	Product Life Cycle Accounting and Reporting Standard – ICT Sector Guidance[86]	7	Carbon impact	ICT product and service level
	GHG Protocol Corporate Accounting and Reporting Standard	5	Carbon impact	(Any) Organisational level
	GHG protocol calculation tool for emissions in Scope 2	3	Carbon impact	(Any) Organisational level
	GHG protocol calculation tool for emissions in Scope 3	2	Carbon impact	(Any) Organisational level
GHG Protocol Standards	GHG protocol calculation tool for emissions in Scope 1	2	Carbon impact	(Any) Organisational level
	ISO 14001:2015: Environmental management systems Requirements with guidance for use	36	Multicriteria	(Any) Organisational level
	ISO 50001: Energy management	25	Energy	(Any) Organisational level
	ISO 14064-1:2018: Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals	9	Carbon Impact	(Any) Organisational level

[86] ICT guidance of the GHG Protocol is an ICT sectoral guidance implementing the GHG Protocol Standard for a set of products including telecom network service, managed service, cloud and DC service, ICT hardware and ICT software.

ISO Standards	ISO 27001: Information Security Management System	4		(Any) Organisational level
	ISO 9001: Quality management system	4		(Any) Organisational level
	ISO 14040:2006 and related standards for Life Cycle assessments	2	Multicriteria	(Any) Organisational or product level
GRI Standards	GRI 305: Emissions 2016	10	Multiple (significant air emissions)	(Any) Organisational level
	GRI 302: Energy 2016	9	Energy	(Any) Organisational level
	GRI 306: Effluents and Waste 2020	8	Waste	(Any) Organisational level
	GRI 201: Economic Performance 2016	5	Green investment	(Any) Organisational level
	GRI 301: Materials 2016	5	Material	(Any) Organisational level
	GRI 308: Supplier environmental screening 2016	5	Multiple	(Any) Organisational level
	GRI 102: General Disclosures 2016	4	Multiple	(Any) Organisational level
	GRI 403: Occupational Health and Safety 2018	4	Toxicity	(Any) Organisational level
	GRI 103 Management Approach 2016	3	Multiple	(Any) Organisational level
	GRI 203: Indirect Economic Impacts 2016	3	Indirect impact	(Any) Organisational level
	GRI 303: Water and Wastewater 2018	3	Water consumption	(Any) Organisational level
	GRI 304: Biodiversity 2016	3	Biodiversity	(Any) Organisational level
	GRI 204: Procurement Practices 2016	2	Multiple	(Any) Organisational level
	GRI 206: Anticompetitive behaviour 2016	2	Multiple	(Any) Organisational level

	GRI 307: Environmental Compliance 2016	2	Multiple	(Any) Organisational level
	GRI 415: Public Policies 2016	2	Multiple	(Any) Organisational level

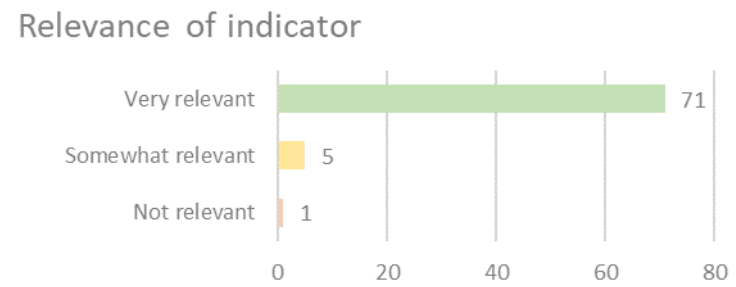
Table 5 – BEREC table of existing environmental standards based on the analysis of BEREC 2022 questionnaires

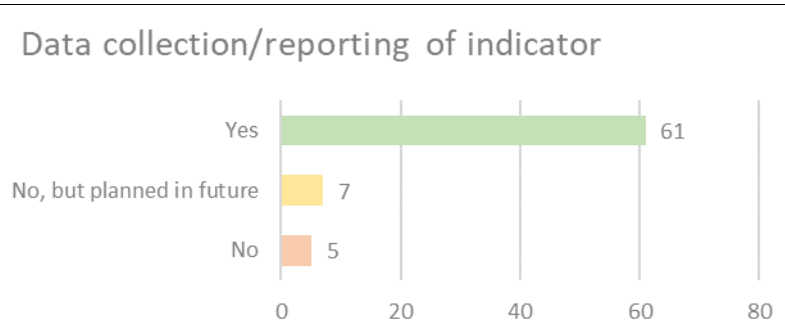
II – Stakeholders feedback on environmental impacts assessment indicators[87]

Energy consumption

Key facts: Energy consumption

Among the metrics used:
- KWh/MWh/GWh
- For liquid fuels (natural gas) - m3/Nm3
- Tons of CO_2e





Most common difficulties to collect and report indicator
1. Data availability, quality, and reliability
2. Time and human effort/resources.
3. Complexity of gathering data from the supply chain
4. Complexity of reporting

What are the needs to develop this indicator in future?
1. An available methodology
2. Technical tools to collect data
3. More resources and competencies

[87] It should be noted for the question related to relevance and use of environmental impact assessment indicators that the 81 respondents also had the options to not provide an answer or to choose the option 'N/A'. These two options are not detailed in the text nor displayed in the graph as their interpretation is subjective.

Other information:

For ‘energy consumption’, 49 out of 81 respondents replied that the geographic scope for reporting is on the company level (in all countries where the undertaking is active), 37 of these choosing this category exclusively. Only six undertakings report on national level and two on product or service level exclusively.[88]

13 of the 81 undertakings, among other indicators, report on product and service level, mostly for a combination of different business models. Eight of these companies report at least for mobile network elements, fixed network elements and data centres simultaneously. Six undertakings reporting on mobile network elements provided further details. All these report on base stations, while most of other network elements[89] also get a high attention. Notably, reporting on spectrum resources is only mentioned by one operator. Seven undertakings operating fixed networks provided further details, indicating that they all report on backbone elements and access network and mostly also on backhaul, while only three respondents report on local/personal networks.

Of the 58 undertakings providing details, 48 at least measure the power consumption over time in either kWh, MWh or GWh, rendering this by far the most common unit.[90] Only two also report on quantitative fuel consumption in litres or cubic metres. 30 undertakings reported difficulties on collecting data, most often referring to data quality and/or availability in rather general terms.

Of the undertakings not reporting data on ‘energy consumption’, seven indicated that they plan to report in the future and in three cases pointed out that technical tools to collect data and an available methodology would be beneficial. One company advocated for more resources and competencies is only mentioned once.

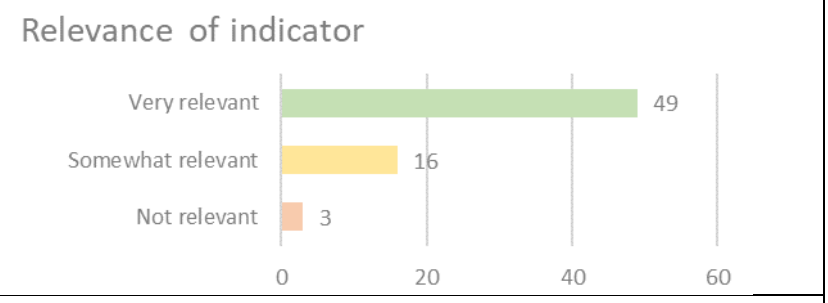
Given the low number of undertakings which did not regard energy consumption as either ‘very relevant’ or ‘relevant’, little explanations for lack of relevance are provided, referring to overall low use of energy in the business model, by very few individual undertakings.

[88] One operator reporting on national level explained that it reports also to the (corporate) group. This might be also the case for other undertakings, as at least some of the undertakings reporting ‘nationally” are at the same time part of an international corporate group.

[89] Masts/sites, backhaul elements, network backbone and other radio equipment.

[90] A few undertakings use Joule as an indicator, but rarely without being accompanied by xWh.

Carbon emissions – Direct emissions

<table>
<tr><th colspan="2">Key facts: Carbon emissions – Direct emissions</th></tr>
<tr><td rowspan="2">Among the metric used:
- t CO_2e
- $tCO_2/M€$ (intensity using million-euro revenues)
- L, M3
- $KgCO_2e$</td><td> 
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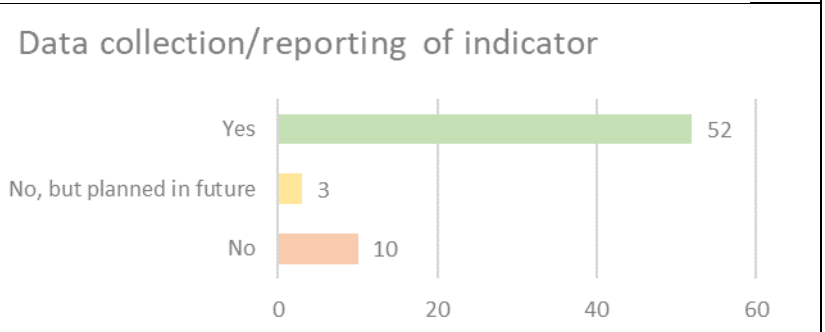
<tr><td> 
</td></tr>
<tr><td colspan="2">Most common difficulties to collect and report indicator
1. Data accuracy, availability, availability of suitable conversion factors
2. Complexity of data collection and quality of data
3. No real time gathering possible</td></tr>
<tr><td colspan="2">What are the needs to develop this indicator in future?
1. An available methodology
2. Technical tools to collect data
3. More resources and competencies</td></tr>
</table>

Other information:

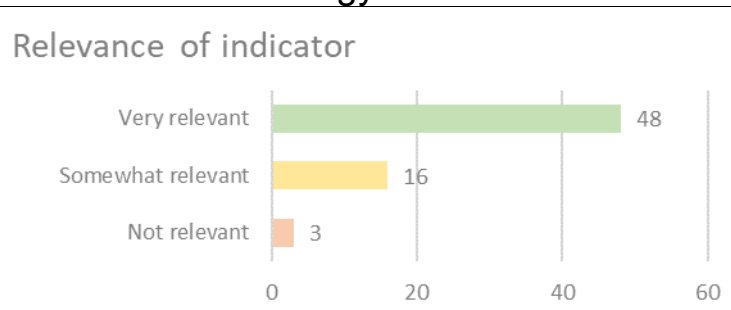
As for 'carbon emissions – direct emissions', the picture is quite similar to 'energy consumption' 38 participants reporting on company level, 31 of these doing so exclusively. 10 undertakings reporting on product/service level shared further details, mostly providing a variation of services with mobile networks, fixed networks and data services being predominant.

For mobile network operators, all network elements are very commonly reported. In contrast, spectrum is never mentioned. The six undertakings active in fixed networks also report almost on all network elements, here usually also including local/personal networks.

Regardless of the business model, the metric used in almost all cases is metric tons of CO_2e. 20 out of 81 undertakings reported difficulties to collect and report data, mostly related to data accuracy and availability. Some indications point to challenges deriving from the complexity of the companies (multi-national). Three undertakings specified that problems are in particular related to suitable emission conversion factors. One undertaking specifically highlighted that

a common methodology defined at EU level would be useful to increase comparability and transparency. All three undertakings, which plan to report in the future, would regard an available methodology as beneficial.

Carbon emissions – Energy indirect emissions

<table>
<tr><th colspan="2">Key facts: Carbon emissions – Energy indirect emissions</th></tr>
<tr><td rowspan="3">Among the metric used:
- t CO_2e
- $tCO_2/M€$ (intensity using million-euro revenues)
- Kg CO_2e
- Kg CO_2e /year
- KWh& CO_2e</td><td> 
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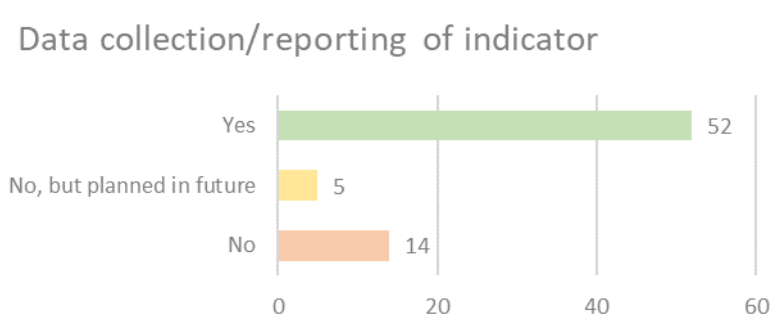
<tr><td> 
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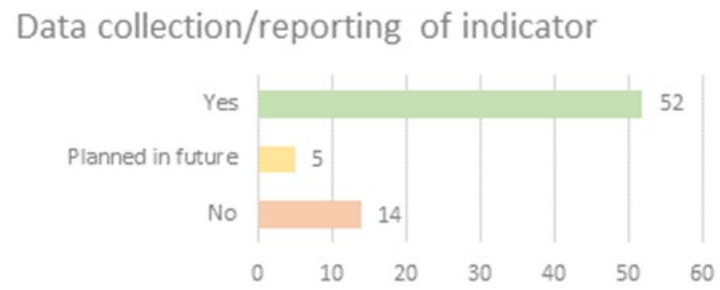
<tr><td> 
</td></tr>
<tr><td colspan="2">Most common difficulties to collect and report indicator
1. Data availability, accuracy
2. Hard to find suitable emission factors specific to particular country
3. Timely information from suppliers
4. Complexity of data collection, lack of standard methodologies</td></tr>
<tr><td colspan="2">What are the needs to develop this indicator in future?
1. An available methodology
2. Technical tools to collect data
3. More resources and competencies</td></tr>
</table>

Other information:

For ‘carbon emissions – indirect emission’ the predominance of company level reporting remains unchanged (35) and again, in (only) some cases combined with national and/or

product or service level. Furthermore, 10 undertakings report on product or service level, with mobile network elements, fixed network elements and data centres being most commonly named in different combinations. Both mobile network operators and fixed network operators usually report on almost all network elements except for spectrum.

Also, in line with the question regarding 'carbon emissions- direct emissions', metric tons of CO_2 equivalents are the regular metric for measurement, sometimes in conjunction with kWh/MWh. Slightly more undertakings informed about limits and difficulties (35), but the reasons provided remain largely the same (data accuracy, availability, lack of conversion factors). Data provision by suppliers and consumers for Scope 3 is, with some variations, mentioned often.

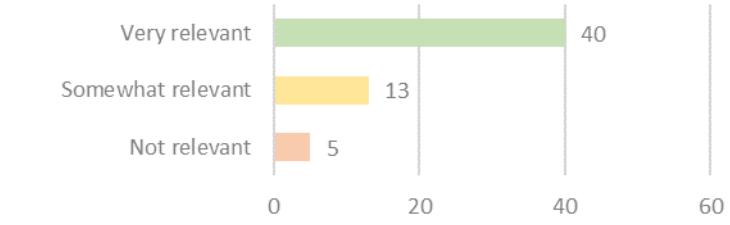
In this case, five undertakings plan to measure in the future, again, in three cases, the availability of a methodology and in two cases technical tools would be considered beneficial.

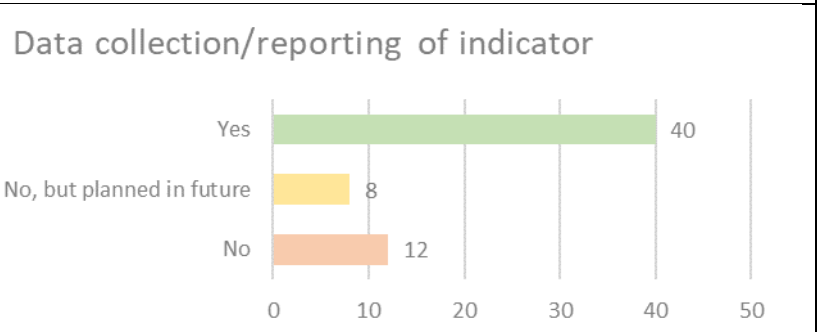
Carbon emissions – Other indirect emissions

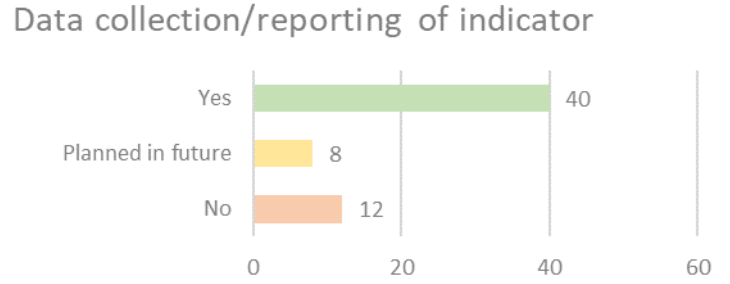
Key facts: Carbon emissions – Other indirect emissions

Among the metrics used:

- t CO_2e
- t CO_2/M€ (intensity using million-euro revenues)
- Kg CO_2e
- Kg CO_2e /year
- GHG emissions per unit of viewership
- (MT CO_2e / hour for video streaming)







Most common difficulties to collect and report indicator

1. Complexity of data collection

2. Availability and accuracy, relevance of the data, comparability 3. To define reporting boundaries, very wide category 4. Lack of public, approved and free of charge emissions factors in some countries 5. Lack of common regulation, methodology on EU level.
What are the needs to develop this indicator in future? 1. Technical tools to collect data 2. An available methodology 3. More resources and competencies 4. Other - Maturity and quality of company processes and data, processes for vendor and contract management etc.

Other information:

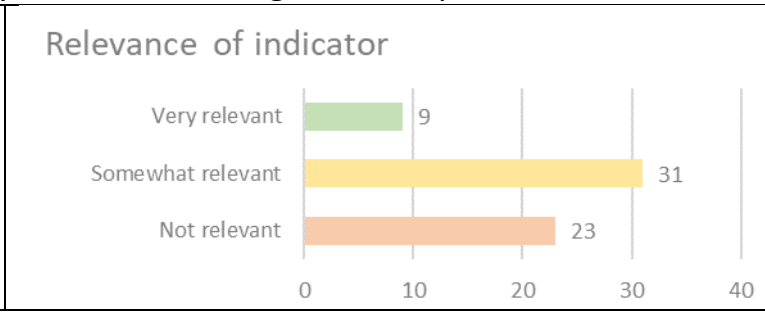
'Carbon Emissions – other indirect emission' were reported on company level by 28 undertakings, 25 are reporting on company level exclusively. Only five undertakings report on product or service level, predominantly in case of mobile networks, fixed networks and data centres.

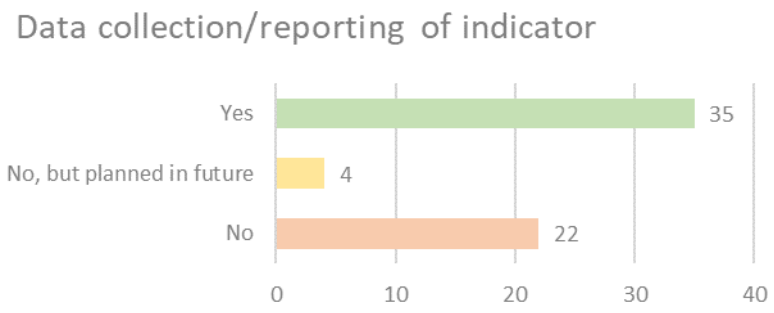
Mobile network and fixed network operators report for mostly all network elements, masts/sites and local/ personal networks getting lesser attention then for 'carbon emissions – Indirect emissions' and spectrum remaining excluded.

Regardless of the level of reporting, the common metric remains CO_2 equivalents in metric tons. 28 undertakings report difficulties, some pointing out that this category provides the largest difficulties.

Eight operators plan to report in the future and almost all of them either regard an available methodology or a technical tool to collect data as beneficial. Four undertakings now also mention more resources and competencies as relevant.

Water usage/consumptions

Key facts: Water usage/consumptions	
Among the metrics used: - m^3 - Megalitres - Litres - Tons - Units - WUE	



Most common difficulties to collect and report indicator

1. Not very relevant to a sector- specific activities
2. Data availability, accuracy
3. Manual data collection

What are the needs to develop this indicator in future?

1. Technical tools to collect data
2. An available methodology
3. More resources and competencies

Other information:

'Water consumption' is reported on company level by 26 undertakings, 22 of these only reporting on this level. For this indicator, only four undertakings report on product or service level. In addition, buildings/offices are mentioned three times, in one case being the only relevant cause for water consumption. Out of the four companies reporting on product or service level, most report for data centres and/or company buildings, regardless, whether the latter encompass electronic communication facilities. For this indicator, reporting on network element basis is irrelevant.

Out of the 32 undertakings providing details on the measurement unit, 22 refer to cubic meters (m3), whereas only 5 mention litres. 9 undertakings report difficulties, mostly related to lack of real-time data, the necessity to derive data from bills, or having no access at all to the water consumption of their suppliers. One undertaking insisted on preferring performance metric, such as water usage effectiveness (L/kWhIT) for cooling performance.

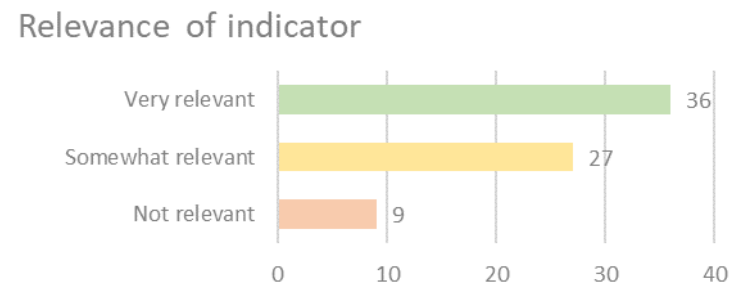
Out of four undertakings intending to report in the future, mostly technical tools and an available methodology is regarded as relevant. Out of the four companies not intending to report on water consumption in the future, three are electronic communications operators and one is a network equipment manufacturer deploying fibre. Except for one electronic communications operator, the others regard water consumption as irrelevant for their business.

On 'water usage/consumption', 21 industry players[91] expressed rather similarly that water is not a significant resource to their business. Most of these companies are either electronic

[91] It must be noted that there is one stakeholder included here, which provides a tool measuring energy consumption and CO_2 emissions for its clients. This stakeholder informed that it regards all other impacts as not

communications operators or data centre operators or both, while some are also service providers, network equipment vendors and/or devices providers/vendors. Only one of the respondents is a device manufacturer and two are network equipment/facilities manufacturers.

E-waste production

<table>
<tr><th colspan="2">Key facts: E-waste production</th></tr>
<tr><td rowspan="2">Among the metrics used:
- Kg, Tons, Megagram
- Kg/yearly
- (Mg)
- Waste in network
- Periodic check
- m^3</td><td> 
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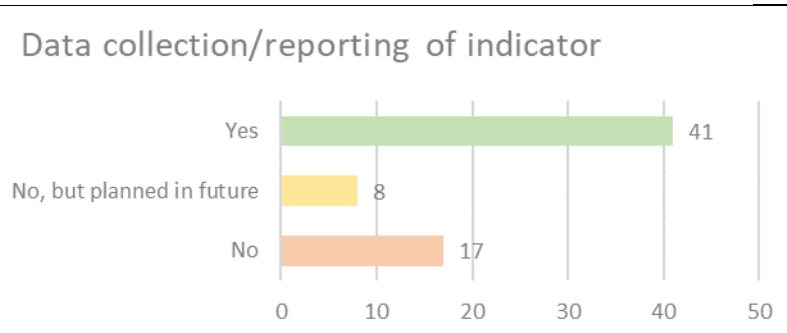
<tr><td> 
</td></tr>
<tr><td colspan="2">Most common difficulties to collect and report indicator
1. Data accuracy
2. Process issues, timely and regular availability of data from recycling service providers
3. Conversion of e-waste pieces into tons</td></tr>
<tr><td colspan="2">What are the needs to develop this indicator in future?
1. Technical tools to collect data
2. More resources and competencies
3. An available methodology</td></tr>
</table>

Other information:

41 of the 81 respondents use this indicator in their environmental reporting. Most do so at the company level (which may be at the national level when the company is only active in one country). Three companies which are present in several countries report data only at the national level and nine undertakings do so at product and service level.

Among companies reporting data at product and service level, five respondents report for mobile network elements, fixed network elements and data centres simultaneously and some

relevant, because of its business model. As also the view on relevance of indicators by other stakeholders is at least partly depending on the respective business models, BEREC did not exclude this reply from the number of respondents.

of them also report for e.g., end user devices, software/services, other services/data storage services and/or terminal equipment. Two respondents added extra products in the category ‘other’.

Out of the five undertakings reporting on mobile and fixed network elements, four provided further details on the network elements. Regarding mobile network elements, three report on masts/sites, base stations, other radio equipment, backhaul elements and network backbone simultaneously. Regarding fixed network elements, all of them report on backbone elements and access. Concerning the metrics used to measure ‘e-waste production’, most companies report data in weight, the most mentioned units are tons and kilograms.

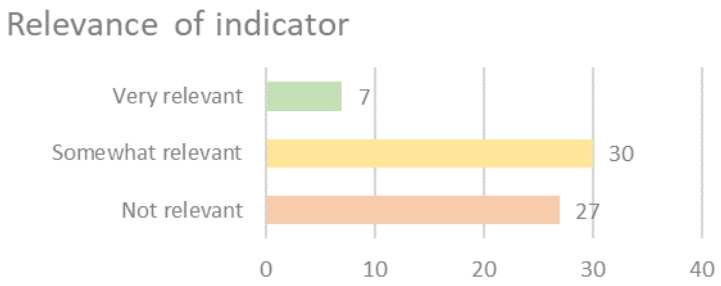
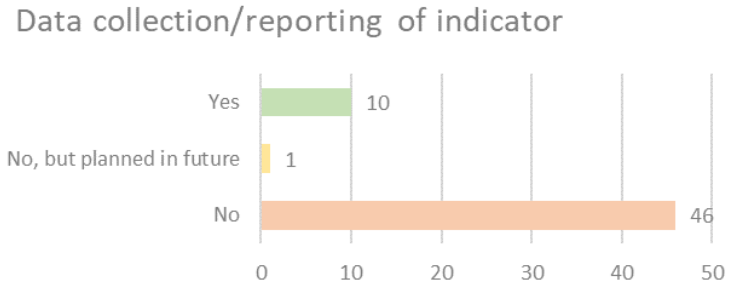
Finally, 14 undertaking share some limits or difficulties in collecting e-waste data. Regarding the timely availability of data and the guarantee of its accuracy, six companies mention the dependence of data on recycling and reconditioning providers as an obstacle, and one mentions in this regard the use of estimates for product traceability when companies are not the producers. Two companies also emphasise the coordination difficulties encountered by international companies or when data is collected from multiple sources. Another limitation mentioned is that the amount of e-waste collected through the product take-back system depends on the choices made by equipment owners. Finally, one undertaking share their waste management process. They have implemented a reverse supply chain mechanism and a reuse policy for electronic components that are still functional. They publish the ‘component reuse rate’ which represents the proportion of non-new and reconditioned components used by the undertaking in its products.

Out of the undertakings not reporting data on ‘e-waste production’, two do not plan to implement reporting, 10 do not know if they will implement one and eight indicate that they plan to do so in the future, five need technical tools to collect data for that purpose, five need more resources and competencies and two need an available methodology.

Reasoning for ‘e-waste-production’ not being relevant was provided by seven undertakings. Six of these express the view that their business model does not produce a relevant amount of e-waste, while one network components manufacturer deploying fibre points at an environment-friendly strategy. Among electronic communications and data centre operators, the first group also includes one more network equipment/facilities manufacturer.

Land use

<table>
<tr><th colspan="2">Key facts: Land use</th></tr>
<tr><td rowspan="2">Among the metrics used:

- Building area – size of land occupied
- m2
- units</td><td> 
</td></tr>
<tr><td> 
</td></tr>
<tr><td colspan="2">Most common difficulties to collect and report indicator
1. Data availability, low relevance for electronic communications service providers
2. The indicator is not significantly relevant to the sector specific operations
3. To limit soil artificialisation, there might be a need to find a common indicator and methodology on EU level</td></tr>
<tr><td colspan="2">What are the needs to develop this indicator in future?
1. Technical tools to collect data
2. An available methodology</td></tr>
</table>

Other information:

10 out of 81 respondents report using this indicator and 47 report not using it. Out of the 47 undertakings that do not report 'land use' data, only one respondent plans to do so in the future, 23 do not know if they will, and 10 do not plan to report it. According to eight of these 10, their activity does not have a material impact on land use, according to the other two, they lack the data and expertise to measure this indicator.

Out of the 10 respondents reporting 'land use' data, most do so at the company level[92] and two measure this indicator at the product or service level: one at the level of its data centres and the other one at the level of its office buildings according to the ISO 14001 standard. Finally, five respondents measure this indicator in units of area, in square metres for four of them. As a limitation, one company informs that it reports through this indicator its reuse of old

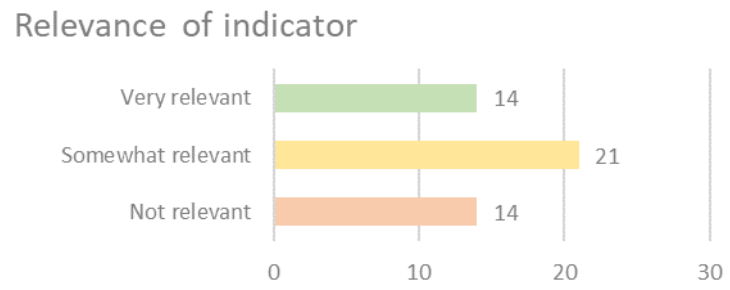
[92] What can be considered as at the national level when the company is only active in one country.

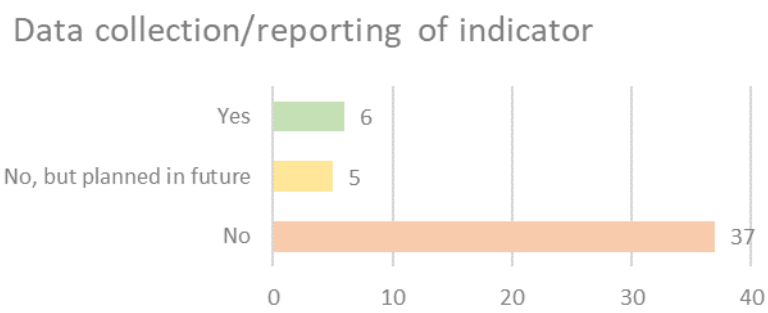
buildings because this practice limits land artificialisation. However, this is not the objective of this indicator, so the company encourages the European authorities to conduct studies to find an appropriate indicator for this issue.

All the 23 respondents providing reasoning on 'land use' are of the opinion that 'land use' is in principle very limited indicator for activities related to electronic communications. Efficient network planning, use of existing infrastructure, deployment restricted by local construction and environmental legislation are each mentioned once as examples further limiting the land use.

Raw materials

<table>
<tr><th colspan="2">Key facts: Raw materials depletion</th></tr>
<tr><td>Among the metrics used:

- Kg
- tCO_2e</td><td> 


</td></tr>
<tr><td colspan="2">Most common difficulties to collect and report indicator
1. Obtaining relevant and correct data from supply chain
2. Lack of data, limitation of what can be measured
3. Low relevance for electronic communications service providers, however it is important for the value chain</td></tr>
<tr><td colspan="2">What are the needs to develop this indicator in future?
1. An available methodology
2. Technical tools to collect data
3. More resources and competencies</td></tr>
</table>

Other information:

For 'raw materials depletion', the picture changes drastically, with only four undertakings providing details on the reporting. Two of these are network equipment/facilities manufacturers, which in the question on relevance regarded this indicator as very relevant.

Given the little number of replies, there is no clear picture on which level of reporting is usually carried out. Nevertheless, one equipment manufacturer and one electronic communications operator report on product or service level. The equipment manufacturer reports on all mobile network elements except masts/sites and spectrum, while the fixed network operator reports for all elements except backhaul networks.

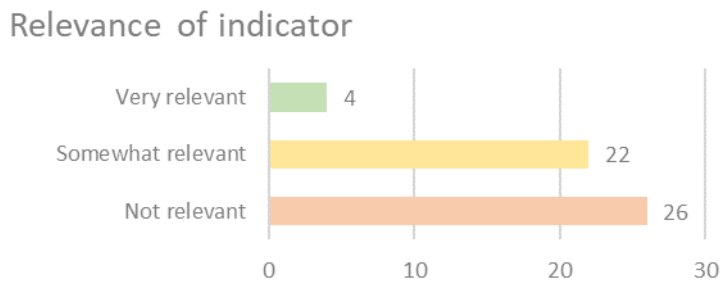
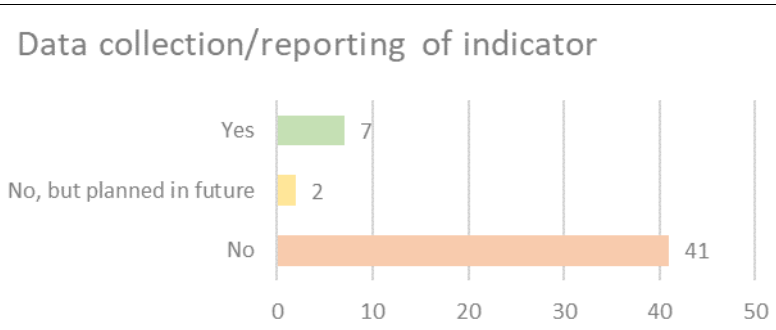
Only three undertakings report on metrics used, in two cases metric weight (kg/tons) and in one instance tons of CO_2. Two of these undertakings report that obtaining data proves to be difficult.

Eight undertakings refrain from reporting on 'raw materials depletion' in the future, six of these stating lack of relevance as a reason, sometimes combined with lack of data, while one electronic communications operator specifies a low relevance for its direct operation, but a high relevance for its value chain. Five undertakings with variations of business models intend to report in the future and all of them regard an available methodology as required and, in some cases, also technical tools to collect data and/or more resources and competencies.

'Raw materials depletion' was not considered relevant by eleven stakeholders with varying business models. These indicated that raw materials are not significantly used, because the production itself is not part of the respective business model. In addition, one equipment manufacturer deploying fibre networks indicated a significant use of recovered and recycled materials.

Human toxicity

<table>
<tr><th colspan="2">Key facts: Human toxicity</th></tr>
<tr><td rowspan="2">Among the metrics used:

- Tons of air pollutants (e.g., NOx, SO2, etc.) emitted, EMF measurements
- Kg
- tCOe
- miles, km
- concentration units</td><td> 
</td></tr>
<tr><td> 
</td></tr>
<tr><td colspan="2">Most common difficulties to collect and report indicator</td></tr>
</table>

1. Not very relevant for electronic communications sector 2. Data availability
What are the needs to develop this indicator in future? 1. Technical tools to collect data 2. An available methodology 3. More resources and competencies

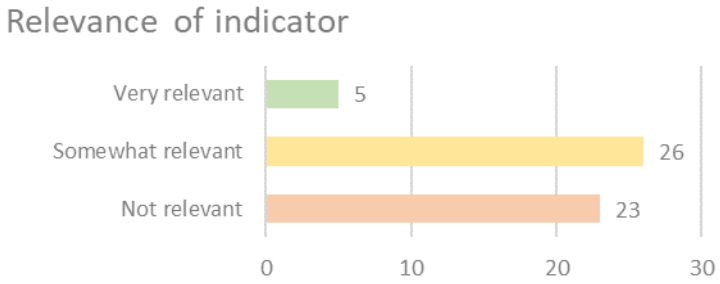
Other information:

Seven of the respondents indicate that they report data on 'human toxicity', while 43 answer that they do not report data. Out of the undertakings reporting data on 'human toxicity', most do so at least at the company level, one also reports at the product or service level, and one at the national level. The company that reports product-level data, reports on mobile and fixed network elements, data centres, buildings, and warehouses. A wide variety of metrics were mentioned by companies reporting 'human toxicity' data, including concentration, miles, tons of CO_2e, kilograms, or tons of air pollutants emitted. The only measure mentioned more than once (two respondents) was electromagnetic frequencies for mobile networks. Respondents did not indicate any limitations or difficulties in collecting this indicator.

Out of the undertakings not reporting data on 'human toxicity', two indicated that they plan to do so in the future, while eight do not and 18 do not know if they will. Out of the companies that do not plan to report data, two need technical tools to collect data and one needs more resources and competencies and an available methodology. Seven companies do not plan to report data because their activity does not have a material impact on 'human toxicity'.

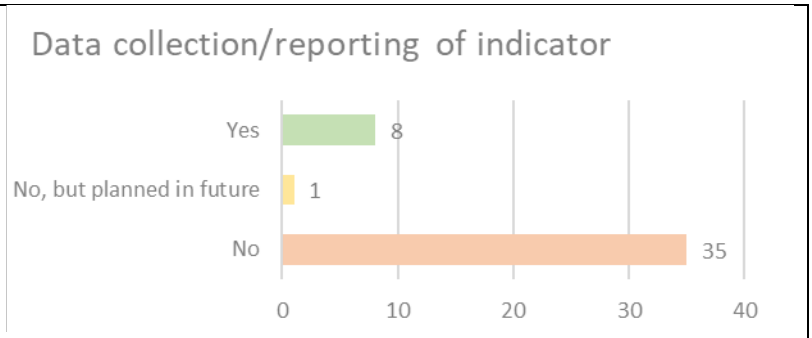
Concerning 'human toxicity', 20 respondents mostly confined their reasoning to lack of a significant role of this impact. Two electronic communications operators highlight that EMF emission are compliant with levels regarded as non-toxic, while one company active in many business segments follows the Restriction of Hazardous Substances Directive (RoHS).

Eco toxicity

Key facts: Eco toxicity	
Among the metrics used: - % of sites in protected areas - m2 of installations in areas of high biodiversity value (e.g., NATURA sites) - msa.km	

<table>
<tr><td>

- Cubic metre [m3] for sewage and hectare [ha] for biodiversity and protection of habitats
- Units
- Concentration units
- Number of base stations on certain area
- % of base stations compared to the rest of territory (outside the preserved areas)

</td><td> 
</td></tr>
<tr><td colspan="2">Most common difficulties to collect and report indicator
1. Low relevance for electronic communications sector
2. Dara availability, gathering process, if company has a global/ worldwide presence</td></tr>
<tr><td colspan="2">What are the needs to develop this indicator in future?
1. An available methodology
2. Technical tools to collect data
3. More resources and competencies</td></tr>
</table>

Other information:

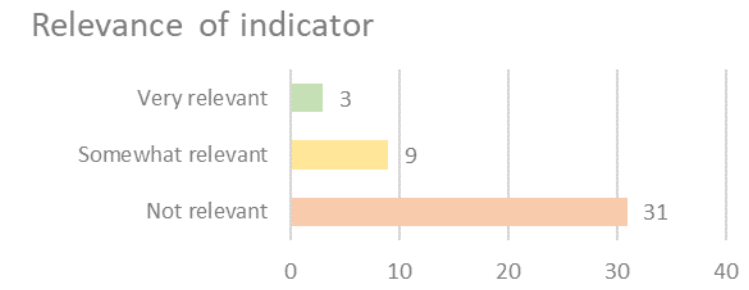
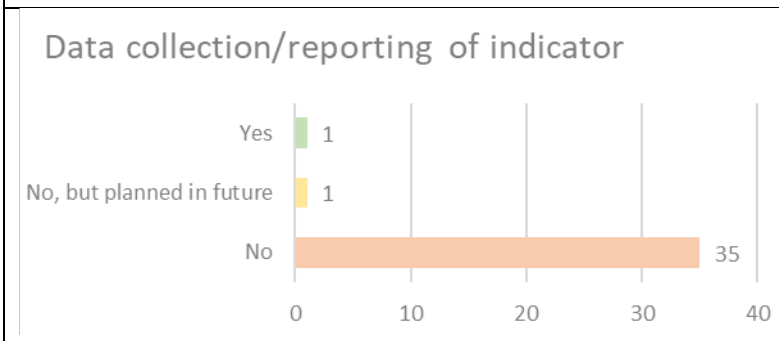
Eight out of 81 respondents report using this indicator and 36 report not using it. Out of the undertakings reporting data on ‘eco toxicity’, seven do so at the company level, one reports also at the product or service level, and one reports only at the national level. Companies that report ‘eco toxicity’ data use different metrics for their reporting. Three of them calculate their occupancy of protected areas, two in terms of the percentage of sites located in these areas and one in terms of the number of square meters of facilities in these areas. One respondent also uses the cubic meter for wastewater. One respondent proposes the Natura 2000 network of Europe's most valuable and threatened species and habitats as a basis.

Out of the undertakings not reporting data on ‘eco toxicity’, one indicated that they plan to do so in the future, but they require an available methodology, technical tools to collect data and more resources and competencies to do so. 18 undertakings do not know if they will implement reporting in the future and five do not plan to do so because their activity does not have a material impact on ‘eco-toxicity’.

‘Eco toxicity’ is disregarded as not having a relevant impact on the sector by 17 undertakings.

Eutrophication

<table>
<tr><th colspan="2">Key facts: Eutrophication</th></tr>
<tr><td rowspan="2">Among the metrics used:

- pH, BOD, COD,
- Dissolved oxygen,
- Total nitrogen, total phosphorus, suspended solid (mg/L)</td><td> 
</td></tr>
<tr><td> 
</td></tr>
<tr><td colspan="2">Most common difficulties to collect and report indicator
1. Data related to this indicator are not relevant for the electronic communications sector activities</td></tr>
<tr><td colspan="2">What are the needs to develop this indicator in future?
1. An available methodology
2. Technical tools to collect data
3. More resources and competencies</td></tr>
</table>

Other information:

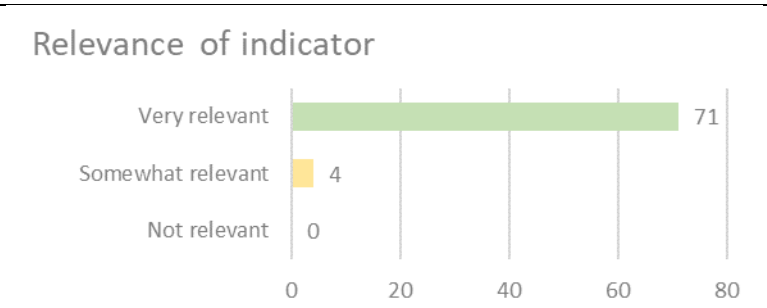
Only one respondent reports data on ‘eutrophication’. They report it at the company level, and they use pH, biochemical and chemical oxygen demand, dissolved oxygen, total nitrogen, and phosphorus and suspended solid (mg/L) as metrics. 36 respondents do not report data on this indicator. One plan to do so in the future but needs available methodology, technical tools to collect data and more resources and competencies. 14 undertakings do not know if they will implement reporting in the future. Seven do not plan to so, out of which four explain that it is because their activity does not have a material impact on ‘eutrophication’.

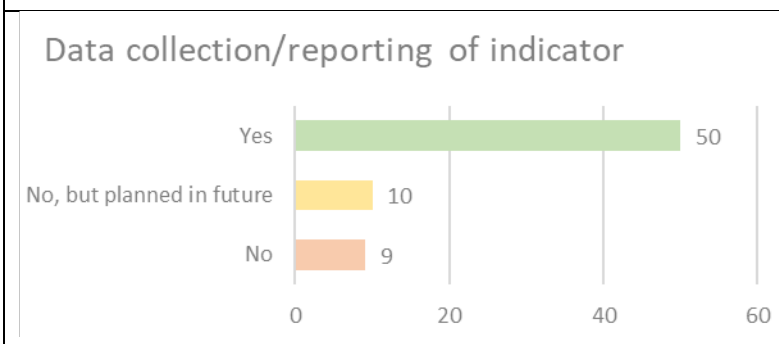
With different nuances in the respective statements, 21 companies with a variation of business models (mostly including electronic communications and data centre operators) point out that water usage is very limited and the sectors contribution to ‘eutrophication’ can be regarded as minimal.

III – Stakeholders feedback on environmental performance indicators[93]

Energy efficiency

<table>
<tr><th colspan="2">Key facts : Energy efficiency</th></tr>
<tr><td>Among the metrics used:

- kWh/MWh saved
- Energy per data transf.
- PUE
- W, Battery time
- Energy consumed per connected real estate
- Percentage reduction in energy consumption
- MWh, L M^3
- Floor space (MWh/m)
- Tone of oil equivalent
- tCO_2eq, tCO_2eq/million revenue
- Percentage decrease compared to data usage
- TB of data/ GWh
- kWh/year
- kg or grams of CO_2 emitted per subscriber
- TeraJouls per million euros of revenue
- % Percentage
- Petabyte/kWh, Mb/kWh</td><td> 


</td></tr>
<tr><td colspan="2">Most common difficulties to collect and report indicator
1. Data availability, accuracy, dedicated resources
2. Lack of comparability, lack of definitions how to measure and were to measure
3. Complexity of reporting</td></tr>
<tr><td colspan="2">What are the needs to develop this indicator in future?
1. An available methodology
2. Technical tools to collect data
3. More resources and competencies</td></tr>
</table>

[93] It should be noted for the question related to relevance and use of environmental performance indicators that the 81 respondents also had the options to not provide an answer or to choose the option 'N/A". These two options are not detailed in the text nor displayed in the graph as their interpretation is subjective.

Other information:

For 'energy efficiency', 35 out of 50 indicate that they measure at company level, of which 26 indicate to measure exclusively on company level. The others measure energy efficiency also on other levels (such as national level, products, or services level, or other).

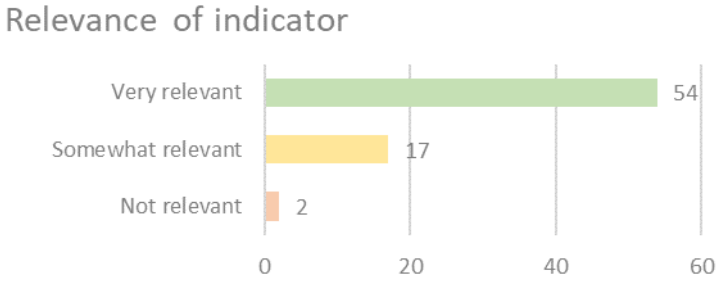
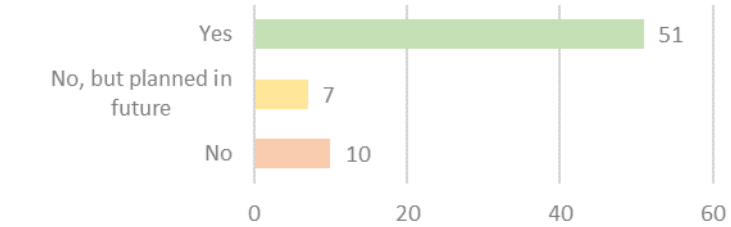
28 Respondents use W, kW, MW, kWh, MWh or GWh to measure energy efficiency. A couple of respondents also mention Power Usage Effectiveness as the used metric for energy efficiency, which specifically focuses on energy consumption of data centres.

15 respondents encounter limits or difficulties regarding the collection and reporting on this indicator, most often referring to data availability and comparability of data as being problematic.

Out of the companies that do not measure 'energy efficiency' yet, 10 respondents consider monitoring or collecting data on this indicator in the future. These respondents indicate that they either need an available methodology or technical tools to collect data in order to measure this indicator in the future.

Use of renewable energy (rate)

<table>
<tr><th colspan="2">Key facts: Use of renewable energy (rate)</th></tr>
<tr><td rowspan="2">Among the metrics used:

- kWh/ MWh saved
- Total renewable energy consumption in KWh
- Source and consumption of renewable energy
- % RES
- MWh, % of renewable electricity out of total
- % and CO_2e
- CO_2e /kWh
- GWh, %
- GJ, %
- Kg CO_2e /kWh
- GWh/year or kWh/year
- Installed solar energy capacity kWp
- Percentage measured by the REF (renewable energy factor)</td><td> 
</td></tr>
<tr><td> 
</td></tr>
<tr><td colspan="2">Most common difficulties to collect and report indicator
1. Not efficient regulation, complex regulation, and variety of tools (GOs, PPA...)
2. Gather real time data, data availability
3. Timeline and quality of proofs</td></tr>
</table>

What are the needs to develop this indicator in future?
1. Technical tools to collect data 2. More resources and competencies 3. An available methodology

Other information:

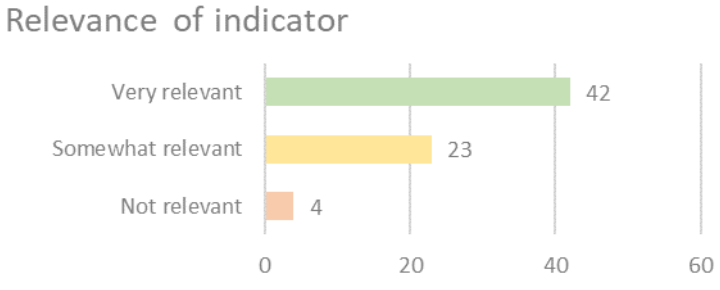
51 respondents collect data on the 'use of renewable energy'.). Most of them (37) report it at least at the company level, 31 of which only at the company level. The remainder measure this indicator at national level or products or services level. Most respondents who provide data at the products or services level do so at least on network elements (6 out of 7).

46 respondents indicate metrics to measure the 'use of renewable energy'. 27 of them measure the quantity of renewable energy consumed or purchased in W or Wh and 18 respondents advocate to report it as a percentage, such as the proportion of renewable energy in total energy consumed or purchased.

24 companies responded to the question about the measurement and reporting limits for this indicator. 9 specify that there are none, while some respondents indicate that timely availability and accuracy of data can be problematic, particularly because the data collected depends on the transparency of the renewable energy claims of suppliers and value chain partners. In addition, 2 respondents see regulation as a limitation, for one it is not effective, for the other one it is complex due to the variety of tools it offers (GOs, PPAs, etc.).

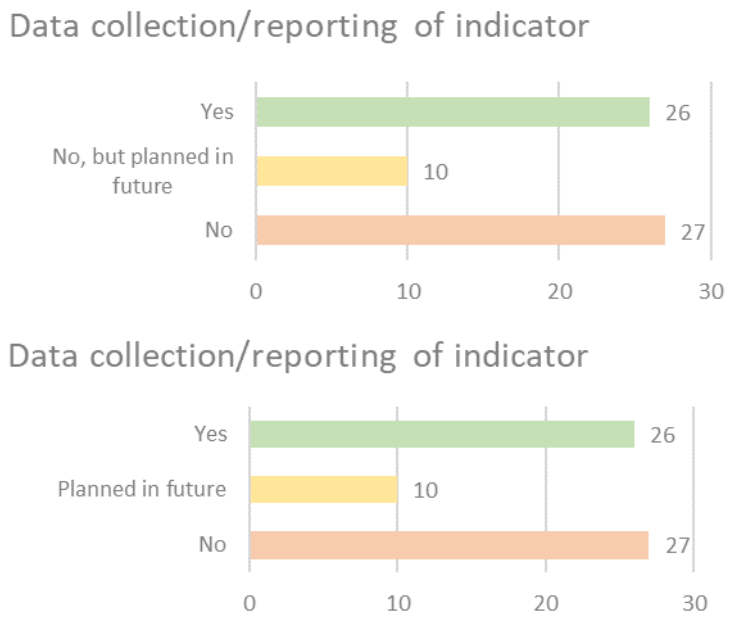
17 respondents do not report data on the 'use of renewable energy'. 7 of them indicated that they plan to do so in the future and 10 do not know if they will. Out of the 7 respondents that consider measuring this indicator in the future, 5 require technical tools to collect data to do so, 3 require an available methodology and 3 need more resources and competencies.

Distribution or utilisation of recycled/refurbished/reused products

Key facts: Distribution or utilisation of recycled/refurbished/reused products	
Among the metrics used: - Kg/ number of second-hand equipment items - number of recycled devices - number of items collected/refurbished units of reused products	

<table>
<tr>
<td>

- tons
- % waste recycled
- % from total units
- kg and %
- number of devices+ CAPEX avoided in m€
- % of products which returned back for reuse/recycle
- share in % of refurbished from total sold devices
- share (%) of refurbished customer premise equipment compared to total delivered customer premise equipment

</td>
<td>


</td>
</tr>
<tr>
<td colspan="2">Most common difficulties to collect and report indicator

1. Lack of systems/processes
2. Data collection, conversion of pieces to tons
3. Suitability of refurbished items given technological advances

</td>
</tr>
<tr>
<td colspan="2">What are the needs to develop this indicator in future?

1. An available methodology
2. More resources and competencies
3. Technical tools to collect data

</td>
</tr>
</table>

Other information:

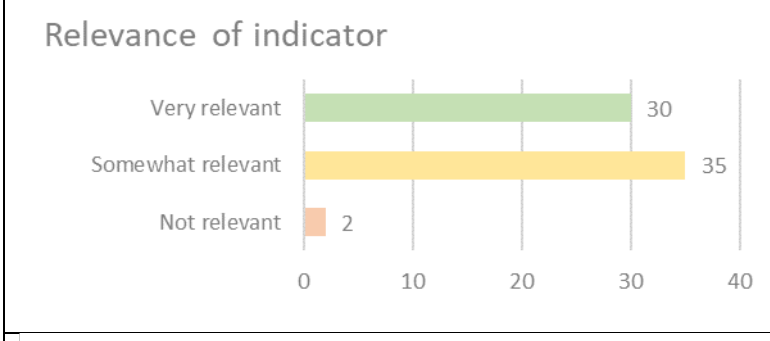
26 respondents indicate that they measure ‘distribution or utilisation of recycled, refurbished or reused products’. The majority (16) of them reports this indicator on at least company level, 14 of which solely on company level. Seven respondents measure (also) on product and services level, all of them for at least end user devices. 17 respondents use number of pieces as a metric. Other mentioned metrics are weight and share (%).

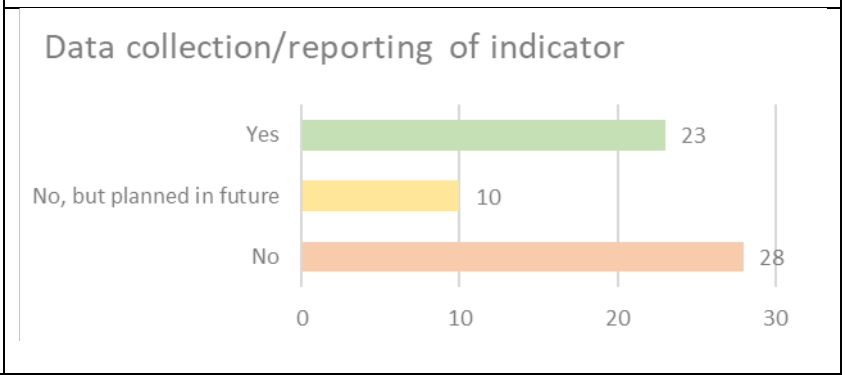
8 respondents encounter limits or difficulties using this indicator, such as: data collection for different business operations, data collection among different countries, data collection among stakeholders or lack of processes.

Out of the respondents who do not measure this indicator, 10 are considering collecting and reporting on ‘distribution or utilisation of recycled/ refurbished/ reused products’ in the future and 19 do not know. All respondents answering this question indicate that they need at least an available methodology to collect and report on this indicator in the future. 5 respondents also need technical tools to collect data and four more resources and competencies.

Recyclability

<table>
<tr><th colspan="2">Key facts: Recyclability</th></tr>
<tr><td>Among the metrics used:

- Number of recycled devices
- Number of units /% of total units
- Periodic check
- kg of recycled waste
tones
- % of total waste</td><td> 


</td></tr>
<tr><td colspan="2">Most common difficulties to collect and report indicator
1. Lack of system/processes
2. Practical feasibility of recycle
3. Waste treatment</td></tr>
<tr><td colspan="2">What are the needs to develop this indicator in future?
1. An available methodology
2. Technical tools to collect data
3. More resources and competencies
4. Other - Supplier (device manufacturer) data</td></tr>
</table>

Other information:

For ‘recyclability’, 8 respondents indicated to measure this indicator on company level, 9 on national level and 7 on product or services level (including combinations of these categories). Out of the respondents measuring on products or services level, most (6) measure at least the end user devices. 11 respondents indicated that they measure the number of pieces, but also two indicated they measure weight.

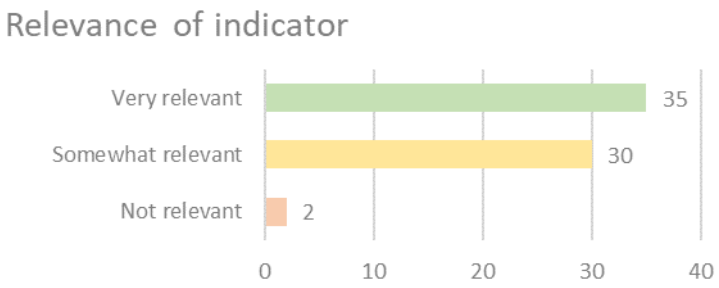
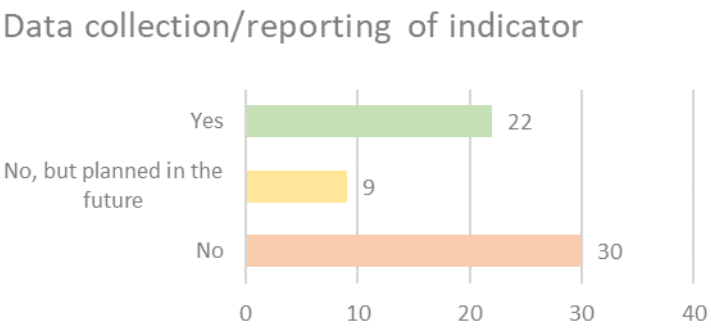
6 respondents encountered limits and difficulties using this indicator, such as process issues, lack of system, scale of operations in varying businesses, identification and access to Scope 3 data, and alignment of data collected from various sources.

10 respondents consider collecting and reporting on ‘recyclability’ in the future, while 20 do not know. To the question what respondents need to collect and report on this indicator in the

future, 9 respondents indicated an available methodology (among others) and 6 indicated technical tools to collect data.

Recycled/refurbished/reused components (also excavated masses) used in products

<table>
<tr><th colspan="2">Key facts: Recycled/refurbished/reused components (also excavated masses) used in products</th></tr>
<tr><td rowspan="2">Among the metrics used:

- Items collected; items refurbished
- Number of units/%of total units
- units
- refurbishment quote
- m3
- number of devices and weight
tons
- total tons or % of product components /mass</td><td> 
</td></tr>
<tr><td> 
</td></tr>
<tr><td colspan="2">Most common difficulties to collect and report indicator
1. Good database and appropriate process
2. Technical tools to collect data as well as resources to do the collection
3. Suitability of refurbished items given technological advance</td></tr>
<tr><td colspan="2">What are the needs to develop this indicator in future?
1. An available methodology
2. Technical tools to collect data
3. More resources and competencies</td></tr>
</table>

Other information:

Out of the 22 respondents that measure the 'recycled/ refurbished/ reused components (also excavated masses) used in products', 13 respondents measure this indicator at least on company level and nine at least on product or service level (combinations are also reported). 7 respondents who measure on product or service level report 'recycled/ refurbished/ reused components' for end user devices.

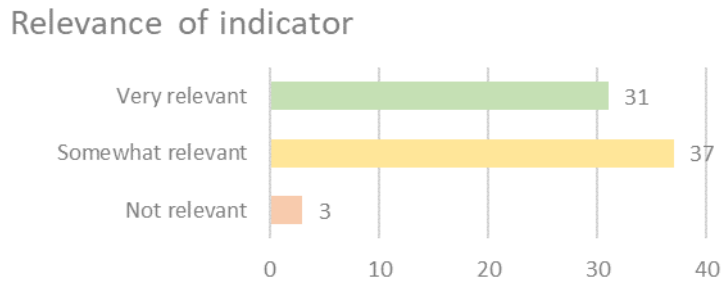
The used metrics vary between respondents; however, number of units, weight or percentage of total seem to be frequently mentioned as ways of measuring this indicator.

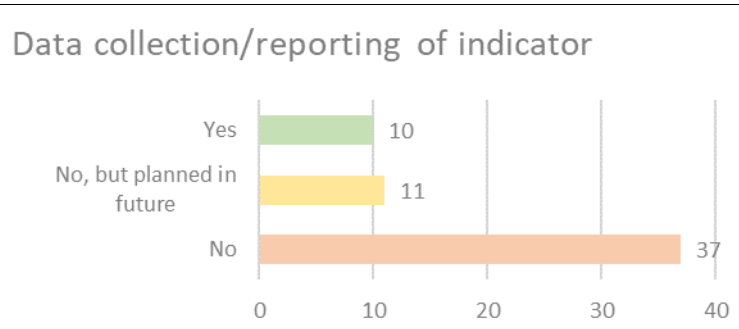
Only five respondents encounter limits or difficulties collecting and reporting on 'recycled/ refurbished/ reused components (also excavated masses) used in products'. However, two respondents indicate lack of (measurement/ reporting) process as one limitation of measuring this indicator. Additionally, lack of technical tools and resources and technological advances are mentioned as experienced difficulties.

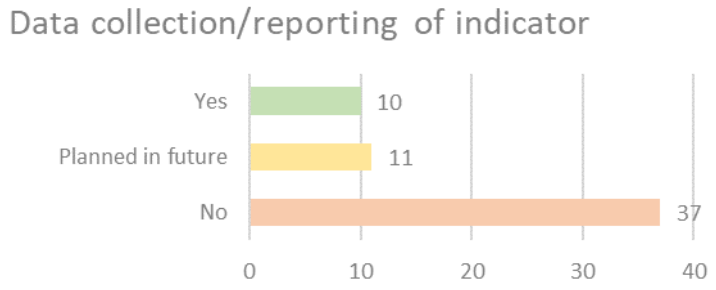
Nine respondents indicate that they would consider collecting and reporting on this indicator in the future, whereas 21 of the respondents do not know. Out of those nine respondents, seven need at least an available methodology and also seven need at least technical tools to collect data.

Expected lifetime

<table>
<tr><th colspan="2">Key facts: Expected lifetime</th></tr>
<tr><td>Among the metrics used:

- Years
- Months
- Lifetime of the satellite system
- Useful life(years)</td><td> 




</td></tr>
<tr><td colspan="2">Most common difficulties to collect and report indicator
1. Depends on the different equipment, very specific
2. Granularity of the data
3. Obsolescence criteria</td></tr>
<tr><td colspan="2">What are the needs to develop this indicator in future?</td></tr>
</table>

1. An available methodology 2. Technical tools to collect data 3. More resources and competencies

Other information:

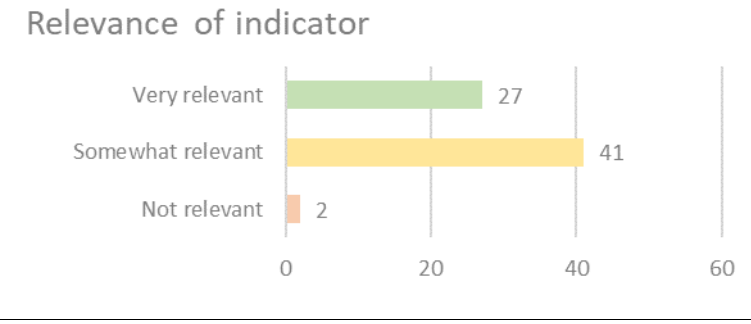
Out of the 10 respondents that measure the 'expected lifetime', six report this indicator on product and service level, out of which four indicated to report at least for end user devices and four at least for mobile network elements. The most used metric to measure the lifetime is years.

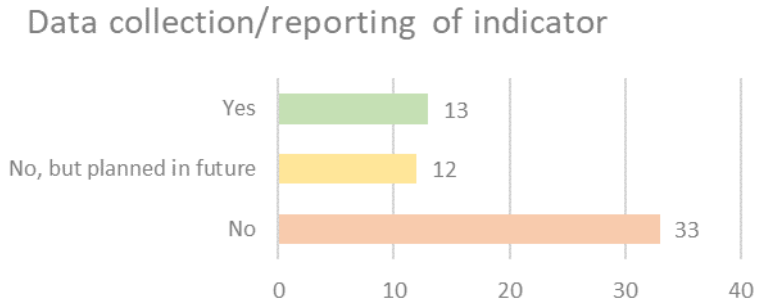
Limitations that four respondents experience are lack of criteria, granularity of data required, and the variety of products and specific elements.

11 respondents consider collecting and reporting on 'expected lifetime' in the future and 27 respondents do not know. To measure this 'expected lifetime' in the future, 9 respondents need at least an available methodology or at least technical tools to collect data (7).

Repairability

<table>
<tr><th colspan="2">Key facts: Repairability</th></tr>
<tr><td>Among the metrics used:

- Calculated score
- No. of units / % of total units
- Units
- Pieces
- Reparability index
- Number of devices repaired
- Rate (%)</td><td> 


</td></tr>
<tr><td colspan="2">Most common difficulties to collect and report indicator
1. Different calculation methods in different countries
2. Complexity of the process
3. Need to maintain records of information across the company</td></tr>
<tr><td colspan="2">What are the needs to develop this indicator in future?
1. Technical tools to collect data
2. An available methodology</td></tr>
</table>

3. More resources and competencies 4. Other – supplier (device manufacturer) data

Other information:

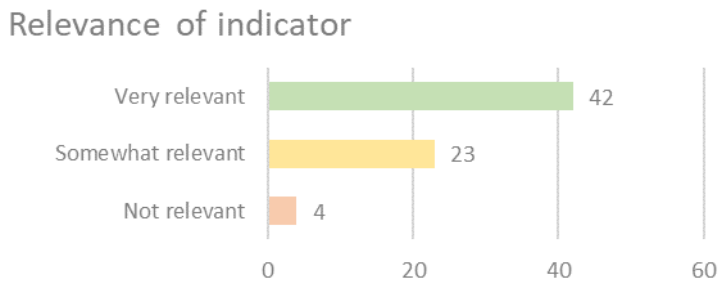
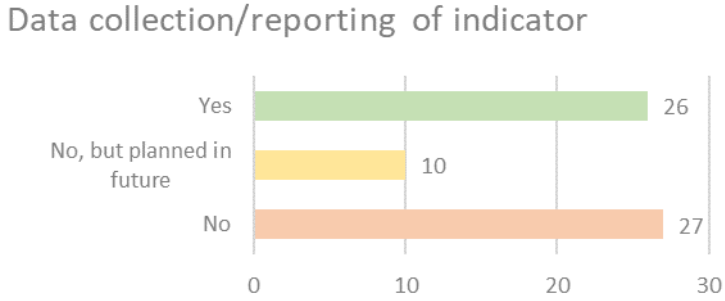
13 respondents measure the 'repairability'. Most of them (8) report on 'repairability' at least on product or service level, out of which six report for end user devices. 6 respondents use number of units/pieces as a metric.

Only three respondents encountered limitations and difficulties in the use of this indicator, highlighting different calculation in different countries, process issues and record keeping across the company.

12 respondents that do not already report on 'repairability', consider collecting and reporting on this indicator in the future, while 21 of them answered that they do not know. Out of the 12 respondents that consider measuring this indicator in the future, 10 need at least technical tools to collect data to do so, nine need at least an available methodology and five need at least more resources and competencies.

Distribution or utilisation of recycled/ refurbished/ reused products

<table>
<tr><th colspan="2">Key facts: Distribution or utilisation of recycled/refurbished/reused products</th></tr>
<tr><td rowspan="2">Among the metrics used:

- Kg /number of reused equipment items
- number of recycled devices
- number of items collected/refurbished units of reused products
- tons
- % waste recycled
- % from total units
- kg and %
- number of devices+ CAPEX avoided in m€
- % of products which returned back for reuse/recycle
- share in % of refurbished from total sold devices
- share (%) of refurbished customer premise equipment compared to total</td><td> 
</td></tr>
<tr><td> 
</td></tr>
</table>

delivered customer premise equipment	
Most common difficulties to collect and report indicator 1. Lack of systems/processes 2. Data collection, conversion of pieces to tons 3. Suitability of refurbished items given technological advances	
What are the needs to develop this indicator in future? 1. An available methodology 2. More resources and competencies 3. Technical tools to collect data	

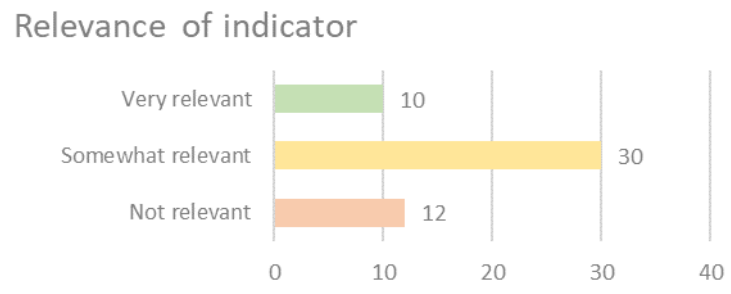
Other information:

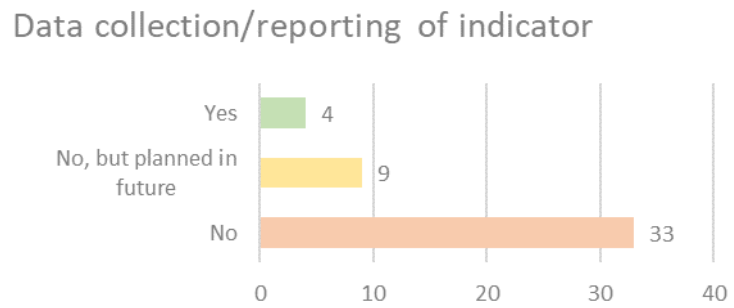
26 respondents indicate that they measure 'distribution or utilisation of recycled, refurbished or reused products'. The majority (16) of them reports this indicator on at least company level, 14 of which solely on company level. Seven respondents measure (also) on product and services level, all of them for at least end user devices. 17 respondents use number of pieces as a metric. Other mentioned metrics are weight and share (%).

Eight respondents encounter limits or difficulties using this indicator, such as: data collection for different business operations, data collection among different countries, data collection among stakeholders or lack of processes.

Out of the respondents who do not measure this indicator, 10 are considering collecting and reporting on 'distribution or utilisation of recycled/ refurbished/ reused products' in the future and 19 do not know. All respondents answering this question indicate that they need at least an available methodology to collect and report on this indicator in the future. Five respondents also need technical tools to collect data and four more resources and competencies.

Waste heat recovery

Key facts: Waste heat recovery	
Among the metrics used: - Tons of carbon dioxide equivalent [(tCO_2e] - kWh - Tons of waste going to waste to energy treatment	



Most common difficulties to collect and report indicator

1. Appropriate process for data gathering and reporting
2. Gathering of data in different countries
3. Identification of user for waste heat and formalisation of agreements with users

What are the needs to develop this indicator in future?

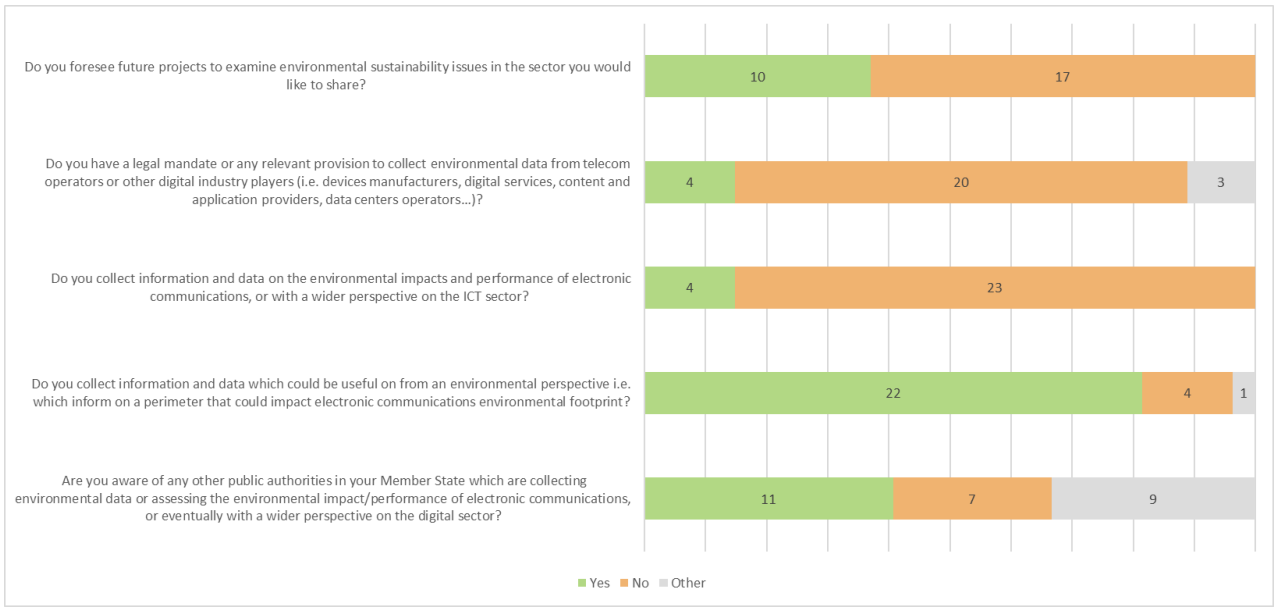
1. Technical tools to collect data
2. An available methodology
3. More resources and competencies

Other information:

Four respondents measure the 'waste heat recovery', two at the company level and two at the product or service level, specifically at the data centre level for one of them. The metrics used by these respondents are tons of waste going to energy treatment, tons of CO_2e, and kWh. As limitations to the use of this indicator, one respondent indicates that collecting raw data and ensuring its accuracy can be problematic for companies with activities in multiple countries. Another pointed out that this indicator is only relevant for data centres, and only in certain specific contexts. According to this respondent, the current challenge lies more in identifying users of waste heat and formalising agreements with them than in reporting on this indicator.

42 respondents do not measure the 'waste heat recovery', nine of them indicate that they plan to do so in the future, five do not, and 20 do not know if they will. Out of the nine respondents who are considering measuring this indicator in the future, most of them need technical tools to collect the data and/or an available methodology. One respondent adds that the context of each data centre needs to be considered, such as the level of heat generated, the location of the data centre, and the presence of heat re-users.

ANNEX II: Additional information and graphs on answers to BEREC questionnaire to national regulatory authorities



Graph 5 – NRA inputs to the questionnaire

The summary of NRAs answers is provided in Chapter 3. 11 of the NRAs have responded that they have taken measures or actions regarding the environmental sustainability of the electronic communications industry. An overview of the initiatives that are not directly related to indicators can be found below:

- Engaging with the electronic communications operators to discuss the environmental sustainability of the sector and the actions they are taking or are intending to take (MT, CY);
- Setting up cooperation with local authorities in charge of sustainability matters to discuss and coordinate further actions (CY, PT, IE);
- Taking into account environmental considerations in specific provisions such as passive or active network sharing (PT, IT), the roll out of 5G (PT) or the facilitation of copper switch off (ES);
- Annual survey on questions pertaining to consumer confidence and awareness on environmental sustainability of electronic communications networks, services and devices (HU, IE);
- Engaging in a university research project on investigating the connections between digitisation and decarbonisation (HU).

Future projects include:

- Taking greater account of the environmental impact of certain technology rollouts, granting of permits, allocation of spectrum frequency usage rights, granting State Aid (where compatible with existing regulatory frameworks) (PT), decisions and disputes (ES) and of the microgeneration at base stations (IE) in the next market analysis (ES) or in future exploratory projects (NL);
- Raising awareness of environmental impact among consumers (PT, BE, AT, ES) and operators (PT).

ANNEX III: List of respondents to BEREC questionnaires

Name of NRA or authority	Country
ACM	The Netherlands
AGCOM	Italy
Agency for Data Supply and Infrastructure	Denmark
AKOS	Slovenia
ANCOM	Romania
ARCEP	France
Autoridade Nacional de Comunicações / ANACOM	Portugal
BIPT	Belgium
BNetzA	Germany
CNMC. Comisión Nacional de los Mercados y la Competencia. ****This response includes the contribution of the Ministry of Economic Affairs and Digital Transformation*.	Spain
Communications Regulation Commission	Bulgaria
Communications Regulatory Agency of Bosnia and Herzegovina	Bosnia and Herzegovina
ComReg	Ireland
Croatian Regulatory Authority for Network Industries (HAKOM)	Croatia
Czech Telecommunication Office	Czech Republic
Danish Business Authority	Denmark
EETT	Greece
Environmental Protection Agency	Ireland
Finnish Transport and Communications Agency, Traficom	Finland
Fjarskiptastofa – ECOI	Iceland
Institut Luxembourgeois de Régulation	Luxembourg
Malta Communications Authority	Malta
Nkom	Norway
NMHH	Hungary
OCECPR	Cyprus
Office of Electronic Communications	Poland
Rundfunk und Telekom Regulierungs-GmbH (RTR-GmbH)	Austria
SPRK	Latvia
Swedish Post and Telecom Authority	Sweden

Table 5 – List of NRAs and other public authorities having answered to the questionnaire for regulatory authorities

Name of company/organisation	Countries/Area of activities
A1 Hrvatska d.o.o.	North Macedonia, Serbia, Belarus
A1 Slovenija, d.d.	North America, Europe (EU - Austria, Croatia, Slovenia, Bulgaria and Serbia, Belarus, Macedonia)
AFR-IX TELECOM SAU	Member states, African countries and USA
Altice Portugal/ MEO	Portugal
Altitude	Single member state
AMERICAN TOWER ESPAÑA	All around the world (25 countries, including Spain)
BITĖ Group	Lithuania, Latvia, Estonia
Bornfiber	Denmark
Bouygues Telecom	France
Cablenet Communication Systems Plc	Cyprus
Carnstone (DIMPACT)	United Kingdom
Cellnex Telecom	Spain, Italy, France, Switzerland, Netherlands, United Kingdom, Ireland, Portugal, Austria, Denmark, Sweden and Poland
Colt Technology Services	Austria, Belgium, China, Denmark, France, Germany, Hong Kong, India, Ireland, Italy, Japan, Netherlands, Portugal, Romania, Singapore, Sweden, United Kingdom, United States, South Korea & Poland.
Cyclop Net	Portugal
CYTA	Cyprus
Deutsche GigaNetz GmbH	Germany
Deutsche Glasfaser Group	Germany
Deutsche Telekom AG	Member State(s) and European non-member state(s)
Doro AB	Sweden, France, Germany, Norway, UK and Hong Kong
Družba za avtoceste v Republiki Sloveniji (DARS d.d.)	Motorway company – utility company limited on providing the services inside the country
Eircom Limited	Republic of Ireland
Ellalink	Ireland, Portugal, Spain, Brazil

Emitel	Poland
EPIC LTD	Cyprus
Ericsson	Globally, approximately 180 countries
euNetworks Group Limited	Member State(s) and European non-member state(s)
Fastweb S.p.A.	Italy
Fiberby	Denmark
freenet AG	Germany
GO plc	Malta
Google	Global
GSMA EUROPE	GSMA Europe represents and leads mobile network operators in Europe, Russia and Commonwealth of Independent States (CIS)
Hellenic Telecommunications Organisation S.A. (OTE)	Multiple member states
Hrvatski Telekom d.d.	Croatia
Iliad	France, Italy, Poland
Kabelska televizija Nova Gorica	a small part of a state
Kalundborgegnens Antennelaug	Denmark
Komax Kosiorek Jacek Kosiorek	Poland
LIGAT TELECOM SOCIEDADE UNIPESSOAL LDA	Portugal
Markoja d.o.o.	Former Yugoslavia states
Microsoft	Member states and European non-member sates
MOG Yechnologies	Portugal
Multikomunikacije d.o.o.	Croatia
NLconnect	Netherlands
Nokia	Globally in more than 120 countries. Headquarter is in Finland.
Norlys Fibernet	Denmark

NOS SGPS	Portugal
OneWeb	Global
Open Fiber S.p.A	Italy
Orange	France
OVHcloud	EU and outside the EU. The group operates datacentres in France, Germany, Poland, United-Kingdom, Canada, The United States, Singapore, and Australia.
PPF Telecom Group	Czech Republic, Slovakia, Hungary, Bulgaria, Serbia
PRIMETEL	Cyprus
Prysmian Group	America, Asia, Europe, Oceania, China (50 countries spread across)
Rabona	Italy
Redox d.o.o. Portorož	Slovenia
Ren Røros Digital as	Norway
SES S.A.	Worldwide
Softnet d.o.o.	China, Vietnam, Singapore, Philippines
Sousa Pinheiro telecomunicações, Lda	Portugal
Studio Proteus d.o.o.	Slovenia
Tele Columbus AG	Germany
Telefonica S.A.	Spain, Germany, UK, Brazil, Argentina, Uruguay, Chile, Ecuador, Peru, Colombia, Mexico, Venezuela
Telekom Slovenije, d.d.	Slovenia
TELEMACH d.o.o.	Slovenia
Telenabler	Denmark, Sweden, Poland and Brasil
Telenor	Norway, Denmark, Sweden, Finland, Bangladesh, Pakistan, Malaysia and Thailand
Telia Company	Sweden, Finland, Denmark, Estonia, Lithuania and Norway
TELPROM d.o.o.	Slovenia

Three Ireland	Europe and Asia
Thy-Mors Energi Fibernet A/S	Denmark
TIM SpA	Italy, Brazil, and direct presence in 32 countries
TRANSMITTERS AND COMMUNICATIONS L.T.D.	Croatia
Turk Telekom Group including Türk Telekomünikasyon A.Ş, TT Mobil A.Ş. and TTNET A.Ş	Türk Telekom Group reports its sustainability activities on a consolidated basis including Türk Telekom, TTNET and TT Mobil. These companies operate in Türkiye.
Turkcell	Türkiye
Türksat Uydu Haberleşme Kablo TV ve İşletme A.Ş.	Türkiye + Europe, Asia and Africa.
Uitvoeringsorganisatie Breedbandnetwerk Rivierenland (UBR)	Netherlands
Vodafone Albania	EU, Albania, Turkey, Australia, Africa
VodafoneZiggo	Netherlands
WINDTRE S.P.A.	Italy

Table 6: List of industry players[94] having answered to the questionnaire for companies

[94] One company asked their contribution to be kept confidential are thus not mentioned in the list.

ANNEX IV: Questionnaire sent to national regulatory authorities

With this questionnaire, BEREC invited its members, and if relevant and appropriate, other competent authorities to provide information on their potential ongoing and planned activities and work on sustainability indicators.

Identification of the respondent authority

*1. Please enter your name and surname

*2. State

*3. Contact person/email

*4. Name of the authority

*5. Are you a member of BEREC?

- ○ Yes
- ○ No

*5.1. Do you want to inform BEREC about measures or actions you may have taken regarding the environmental sustainability of the electronic communications industry (or more broadly regarding of the ICT sector) and that BEREC is not yet aware of?

- ○ Yes, please specify
- ○ No
- ○ N/A

*5.2. Do you foresee future projects to examine environmental sustainability issues in the sector you would like to share?

- ○ Yes, please specify
- ○ Not at this stage

Questions on data collection and environmental indicators

*5.3. Do you have a legal mandate or any relevant provision to collect environmental data from electronic communications operators or other digital industry players (i.e., devices manufacturers, digital services, content and application providers, data centre's operators…)?

- ○ Yes
- ○ No
- ○ Don't

5.3 Please specify the legal mandate and the conditions of implementation

*5.4. Do you collect information and data on the environmental impacts and performance of electronic communications, or with a wider perspective on the ICT sector?

- ○ Yes, please specify
- ○ No

*5.4.1. What is the precise scope of your environmental data collection in the digital sector?

*5.4.2. What type of sustainability indicators do you collect? (e.g.: GHG emissions, energy consumption, resource use, energy efficiency, recyclability, use of renewable energy…)

5.4.3. Do you publish this data?

- ○ Yes
- ○ Partly
- ○ No

5.4.3.1. Do you publish this data under an open license?

- ○ Yes, please provide relevant links
- ○ Partly, please provide relevant links
- ○ No

*5.4.3.2. Are the data individualized by players/company (i.e., not published in aggregated version)?

- ○ Yes, please provide relevant links
- ○ Partly, please provide relevant links
- ○ No

5.4.3.3. Do you use existing standards or methodologies (for instance ITU, ETSI or ISO standards, 'Product Environmental Footprint' methodology from the European Commission…)?

- ○ Yes, please specify
- ○ No

5.4.3.4. Do you foresee to collect other sustainability indicators in the near future on electronic communications or more broadly, regarding the ICT sector?

- ○ Yes, please specify
- ○ Partly, please specify
- ○ No

5.4.3.5. What main technical challenges you encounter or had to overcome to develop your environmental data collection on the electronic communications / ICT industry?

*5.5. Do you collect information and data which could be useful on from an environmental perspective i.e., which inform on a perimeter that could impact electronic communications environmental footprint (for instance: sales volumes, data consumption on mobile or fixed lines, number of sites, devices distribution/usage, etc)?

- ○ Yes, please specify
- ○ No
- ○ Don't know

*5.6. Are you aware of any other public authorities in your Member State which are collecting environmental data or assessing the environmental impact/performance of electronic communications, or eventually with a wider perspective on the digital sector?

- ○ Yes
- ○ No
- ○ Don't know

5.6 Please specify the name of the authority and the nature of the task/project (ad hoc or recurrent study, relevant publication, and link…).

5.7. In your view, how to foster environmental transparency in the electronic communications sector, or more largely in the ICT industry, and increase comparability of figures among economic players?

a. Please indicate any comment you may have or document you would like to share to BEREC regarding sustainability of electronic communications and IT products and services

*5.9. What is the perimeter of your authority activities? Which sector(s) do you regulate?

*5.10. Do you have a legal mandate to collect environmental data from electronic communications operators or other digital industry players (i.e., devices manufacturers, digital services, content and application providers, data canter's operators…)?

- ○ Yes, please specify the legal mandate and the conditions of implementation
- ○ No
- ○ Don't know

*5.11. Do you collect information and data which could be useful from an environmental perspective i.e. which inform on a perimeter that could impact electronic communications environmental footprint (for instance: sales volumes, data consumption on mobile or fixed lines, number of sites, devices distribution/usage, etc)?

- ○ Yes, please specify and provide any relevant link
- ○ No
- ○ Don't know

*5.11.1. What is the precise scope of your environmental data collection in the electronic communications /digital sector?

*5.11.2. What type of sustainability indicators do you collect? (Ex: GHG emissions, energy consumption, resource use, energy efficiency, recyclability, use of renewable energy…)

*5.11.3 Do you publish the data?

- ○ Yes, please specify and provide the link to the publication
- ○ Partly, please specify and provide the link to the publication
- ○ No

*5.11.3.1. Do you publish this data under an open license?

- ○ Yes, please specify
- ○ Partly, please specify

- ○ No

*5.11.3.2. Are the data individualized by player/company?

- ○ Yes, please specify
- ○ Partly, please specify
- ○ No

5.12. Do you use specific standards and existing methodologies to this aim (for instance ITU, ETSI or ISO standards, 'Product Environmental Footprint' methodology from the European Commission JRC…)?

- ○ Yes, please specify
- ○ No

5.13. Are you aware of any other public authorities in your state, which are collecting environmental data or assessing the environmental impact/performance of electronic communications, or eventually with a wider perspective on the digital sector?

- ○ Yes
- ○ No
- ○ Don't know

5.13 Please specify the name of the authority and the nature of the task/project (ad hoc or recurrent study, relevant publication, and link…).

5.14. In your view, how to foster environmental transparency in the electronic communications sector, or more largely in the ICT industry, and increase comparability of figures among economic players?

5.15. Please indicate any comment you may have or document you would like to share to BEREC regarding sustainability of electronic communications and IT products and services.

ANNEX V: Questionnaire sent to industry players (only questions related to environmental transparency are included)

Context

With this questionnaire, BEREC invited all industry stakeholders, including electronic communications operators, service providers, devices manufacturers, and other ICT industry players, to share their practices in terms of environmental reporting and to help identify which indicators are deemed feasible and useful according to the existing methodologies for the purpose of sharing environmental information to relevant parties, assessing the sector's environmental footprint at the European level and improving the comparability of electronic communications industry players' environmental impact and performance.

Presentation of the respondent and the organization

***1. Name and Surname**

***2. Name of the company/organization:**

***3. Email:**

***4. Where is your organization active in Europe and/or in the rest of the world?**

Please specify when applicable answer is ticked.

4.1. Single Member state

4.2. Multiple Member states

4.3. Member State(s) and European non-member state(s)

4.4. Other

***5. For which geographic area are you providing responses?**

Please specify answer option, if it is ticked.

5.1. Companywide (all the states in which you are active, both - European Member States and non-member states)

5.2. European wide (all the members states in which you are active)

5.3. Only some of them

5.4. Other

***6. What economic activities do you carry out?**

6.1. Electronic communications operator

6.2. Data Centre operator

6.3. Network equipment/facilities manufacturer

6.4. Network equipment/facilities provider/vendor

6.5. Devices (mobile phones, televisions, computers, etc.) manufacturer

6.6. Devices (mobile phones, televisions, computers, etc.) provider/vendor

6.7. Service provider (content and application provider, software provider, cloud service provider etc.)

6.8. Other, please specify

Questions to identify the environmental data collection and reporting procedure

***7. Does your company report information and data on environmental impacts (such as energy consumption, greenhouse gas emissions, and water/land use) and environmental performance (such as energy efficiency, reparability, recyclability rate)?**

Please chose one answer

- ○ Yes
- ○ No

***8. Does your company publish information and data on environmental impacts (such as energy consumption, greenhouse gas emissions, and water/land use) and environmental performance (such as energy efficiency, reparability, recyclability rate)?**

- ○ Yes
- ○ No

IF YES, please provide links to relevant publications:

IF YES to question 8

8.1. Are these sets of data published in an open data format?

- ○ 8.1.1. Yes, please provide links to the relevant data set
- ○ 8.1.2. Partly, please provide links to relevant data set
- ○ 8.1.3. No

IF YES to questions 7 or 8

8.2. Are there regulations or legal requirements framing your environmental collecting/reporting at national or European level?

- ○ Yes
- ○ No

IF YES, please name the regulation and provide relevant links.

8.3. In which form do you publish environmental data/indicators on your company?

Please chose as many answers as applicable.

- ☐ 8.3.1. Annual report, such as Corporate Social Responsibility report
- ☐ 8.3.2. A sub-section of annual corporate report
- ☐ 8.3.3. Web page on a company website

- ☐ 8.3.4. CDP publication or other third-party reporting
- ☐ 8.3.5. Direct customer information within invoices or customers' accounts or documents
- ☐ 8.3.6. Other, please specify

8.4. Please provide relevant links to access the reports mentioned in question 8.3.

9. Have you set objectives/targets aimed at limiting the environmental footprint (or improving environmental performance) of your economic activity?

- ○ Yes
- ○ No

IF you answered YES to question 9

9.1. Are these objectives/targets based on a specific framework (e.g., science-based targets initiative (SBTi), national strategies) or company-defined goals/strategy?

- 9.1.1. Yes, on specific framework, please specify
- 9.1.2. Yes, on company-defined goals/strategy, please specify
- 9.1.3. Other
- 9.1.4. No

9.2. Please describe those objectives/targets (timeline scope, measurement, ambition level, et.)

9.3. Are those objectives/targets monitored and how?

- 9.3.1. Yes, through a third-party audit/verification
- 9.3.2. Yes, they are self-check
- 9.3.3. Other, please specify
- 9.3.4. No

10. Do you use any of these standards, protocols, or guidelines to monitor the sustainability of your company or of your electronic communications? Please be as specific as possible.

Multiple-choice answer.

- ☐ 10.1.IEC TR 62725:2013: Analysis of quantification methodologies for greenhouse gas emissions for electrical and electronic products and systems
- ☐ 10.2. ITU-T Standards
- ☐ 10.3. ETSI Standards
- ☐ 10.4. GHG Protocol Standards
- ☐ 10.5. ISO Standards
- ☐ 10.6. Global Reporting Initiative Standards, please specify
- ☐ 10.7. Others (e.g., Bilan Carbone, standards specific to data centres, devices…), please specify

Please specify ITU-T standards:

- ☐ 10.2.1. ITU-T L.1420 (02/2012): Methodology for energy consumption and greenhouse gas emissions impact assessment of information and communication technologies in organizations
- ☐ 10.2.2. ITU-T L.1470 (01/2020): Greenhouse gas emissions trajectories for the information and communication technology sector compatible with UNFCCC Paris Agreement

- ☐ 10.2.3. ITU-T L.1310 (09/2020): Energy efficiency metrics and measurement methods for telecommunication equipment
- ☐ 10.2.4. ITU-T L.1330 (03/2015): Energy efficiency measurement and metrics for telecommunication networks
- ☐ 10.2.5. ITU-T L.1331 (09/2020): Assessment of mobile network energy efficiency
- ☐ 10.2.6. ITU-T L.1332 (01/2018): Total network infrastructure energy efficiency metrics
- ☐ 10.2.7. ITU-T L.1350 (10/2016): Energy efficiency metrics of a base station site
- ☐ 10.2.8. ITU-T L.1361 (11/2018): Measurement method for energy efficiency of network functions virtualization
- ☐ 10.2.9. Other(s), please specify

Please specify ETSI Standards:

- ☐ 10.3.1. ETSI ES 203 228 V1.3.1 (2020-10): Assessment of mobile network energy efficiency
- ☐ 10.3.2. ETSI ES 203 539 - V1.1.1 - Environmental Engineering (EE): Measurement method for energy efficiency of Network Functions Virtualisation (NFV) in laboratory environment
- ☐ 10.3.3. ETSI EN 303 215 V1.3.1 (2015-04): Measurement methods and limits for power consumption in broadband telecommunication networks equipment
- ☐ 10.3.4. ETSI EN 303 472 V1.1.1 (2018-10): Energy Efficiency measurement methodology and metrics for RAN equipment
- ☐ 10.3.5. ETSI EN 305 200-2-2 V1.2.1 (2018-08): Access, Terminals, Transmission and Multiplexing (ATTM) Energy management; Operational infrastructures; Global KPIs; Part 2: Specific requirements; Sub-part 2:
  Fixed broadband access networks
- ☐ 10.3.6. ETSI EN 305 200-2-3 V1.1.1 (2018-06): Access, Terminals, Transmission and Multiplexing (ATTM); Energy management; Operational infrastructures; Global KPIs; Part 2: Specific requirements; Sub-part 3: Mobile broadband access networks
- ☐ 10.3.7. ETSI ES 201 554 V1.2.1 (2014-07): Measurement method for Energy efficiency of Mobile Core network and Radio Access Control equipment
- ☐ 10.3.8. ETSI ES 202 706-1 V1.6.0 (2020-11): Metrics and measurement method for energy efficiency of wireless access network equipment
- ☐ 10.3.9. ETSI ES 203 136 V1.2.1 (2017-10): Measurement methods for energy efficiency of router and switch equipment
- ☐ 10.3.10. ETSI ES 203 184 V1.1.1 (2013-03): Measurement Methods for Power Consumption in Transport Telecommunication Networks Equipment
- ☐ 10.3.11. ETSI TS 102 706-2 V1.5.1 (2018-11): Metrics and Measurement Method for Energy Efficiency of Wireless Access Network Equipment; Part 2: Energy Efficiency - dynamic measurement method
- ☐ 10.3.12. ETSI EN 305 174-8 V1.1.1 (2018-01): Access, Terminals, Transmission and Multiplexing (ATTM); Broadband Deployment and Lifecycle Resource Management; Part 8: Management of end of life of ICT equipment (ICT waste/end of life)
- ☐ 10.3.13. ETSI TS 103 199: Life Cycle Assessment of ICT equipment, networks and services: General methodology and common requirements
- ☐ 10.3.14. Other(s), please specify

Please specify GHG Protocol Standards

- ☐ 10.4.1. Product Life Cycle Accounting and Reporting Standard – not specific to ICT sector
- ☐ 10.4.2. Protocol Corporate (Value Chain) Standard – not specific to ICT sector
- ☐ 10.4.3. Product Life Cycle Accounting and Reporting Standard – ICT Sector Guidance

☐ 10.4.4. Other(s), please specify

Please specify ISO Standards:

☐ 10.5.1. ISO 14064-1:2018: Greenhouse gases — Part 1: Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals

☐ 10.5.2. ISO 14001:2015: Environmental management systems Requirements with guidance for use

☐ 10.5.3. ISO 50001: Energy management

☐ 10.5.4. ISO/IEC DTR 30133 Standards

☐ 10.5.5. Other(s), please specify

Questions to identify feasible and useful indicators to describe the different categories of environmental impacts

***For this part of questionnaire, BEREC is considering a list of indicators to estimate environmental impact based on the European Commission's 'Product Environmental Footprint' and 'Organization Environmental Footprint' methodologies.

For each indicator above, the same set of questions were proposed:

*** Energy consumption**
*** Carbon emissions – We consider ISO 14064-1 emissions classification – Ask the questions below for each scope**
-> Direct emissions
-> Energy indirect emissions
-> Other indirect emissions
*** Water usage/consumption**
*** Raw materials depletion (mineral including rare earth element (RE) and metals use)**
*** Land use**
*** E-waste production**
*** Human toxicity (including air pollution)**
*** Eco toxicity (including incidence on biodiversity, water pollution…)**
*** Eutrophication (terrestrial, freshwater, marine)**

11. Please state the relevance of this indicator for measuring the environmental impact of your activities.

- Very Relevant
- Somewhat Relevant
- Not relevant

N/A

If you answered 'not relevant' to indicator X, could you please, explain why?

12. Does your company use this indicator for its environmental data collection and/or reporting?

- YES
- NO
- N/A

If ‘YES’

12.1.1. What is the level/geographic scope of the measurement?

12.1.1.1. Company level (in all countries where you have an activity)
12.1.1.2. National level
12.1.1.3. Product or service level
12.1.1.4. Other, please specify

12.1.1.3. Please specify the relevant products or services:
12.1.1.3.1. Mobile Network elements
12.1.1.3.2. Fixed Network elements
12.1.1.3.3. Data centres
12.1.1.3.4. Other servers / data storage devices
12.1.1.3.5. Terminal equipment
12.1.1.3.6. End user devices (smartphones, tablets, computers, TVs…)
12.1.1.3.7. Software / services
12.1.1.3.8. Other, please specify

12.1.1.3.1. Please specify Mobile Network elements:

a) Masts/sites
b) Base stations
c) Spectrum resources
d) Other radio equipment
e) Backhaul elements
f) Network Backbone
g) Others, please specify

12.1.1.3.2. Please specify Fixed Network elements:

a) Backbone elements
b) Backhaul
c) Access network
d) Local/Personal network
e) Others, please specify

12.1.2. What is/are the used metric(s)/unit(s) of measurement?

12.1.3. What are the limits and difficulties to collect and report this indicator if any?

12.1.4. Do you consider monitoring or collecting data with this indicator in the future?

- ○ Yes
- ○ No, please explain why
- ○ Don't know
- ○ N/A

12.1.5. What could you need to develop this indicator in the future?

- ☐ 12.1.5.1. An available methodology
- ☐ 12.1.5.2. Technical tools to collect data
- ☐ 12.1.5.3. More resources and competencies
- ☐ 12.1.5.4. Other, please specify

13. Please state any other indicators you consider important to estimate environmental impacts/footprint of your activities. Explain if necessary.

Questions to identify feasible and useful indicators to monitor the environmental performance of the company

****Please note that for this section of questionnaire, some of indicators are non-applicable to services.*

For each indicator above, the same set of questions were proposed:

Energy efficiency
*** Recycled/refurbished/reused components (also excavated masses) used in products**
*** Expected lifetime of**
*** Reparability**
*** Recyclability**
*** Distribution or utilisation of recycled/refurbished/reused products**
*** Use of renewable energy (rate)**
*** Waste heat recovery**

14. Please state the relevance of this indicator for measuring the environmental performance of your organization:

- ○ Very Relevant
- ○ Somewhat Relevant
- ○ Not relevant

N/A

If you answered 'not relevant' to indicator X, could you please, explain why?

15. Does your company use this indicator for its environmental data collection and/or reporting?

- ○ YES
- ○ NO

- N/A

If 'YES'

15.1.1. What is the level/geographic scope of the measurement?

- ☐ 15.1.1.1. Company level (in all countries where you have an activity)
- ☐ 15.1.1.2. National level
- ☐ 15.1.1.3. Product or service level
- ☐ 15.1.1.4. Other, please specify

15.1.1.3. Please specify the relevant products or services:

- ☐ 15.1.1.3.1. Mobile Network elements
- ☐ 15.1.1.3.2. Fixed Network elements
- ☐ 15.1.1.3.3. Data centres
- ☐ 15.1.1.3.4. Other servers / data storage devices
- ☐ 15.1.1.3.5. Terminal equipment
- ☐ 15.1.1.3.6. End user devices (smartphones, tablets, computers, TVs…)
- ☐ 15.1.1.3.7. Software / services
- ☐ 15.1.1.3.8. Other, please specify
- ☐

15.1.1.3.1. Please specify Mobile Network elements:

a) Masts/sites
b) Base stations
c) Spectrum resources
d) Other radio equipment
e) Backhaul elements
f) Network Backbone
g) Others, please specify

15.1.1.3.2. Please specify Fixed Network elements:

a) Backbone elements
b) Backhaul
c) Access network
d) Local/Personal network
e) Others, please specify

15.1.2. What is/are the used metric(s)/unit(s) of measurement?

15.1.3. What are the limits and difficulties to collect and report this indicator if any?

15.1.4. Do you consider monitoring or collecting data with this indicator in the future?

- ○ Yes
- ○ No, please explain why

- ○ Don't now
- ○ N/A

15.1.5. What could you need to develop this indicator in the future?

- ☐ 15.1.5.1. An available methodology
- ☐ 15.1.5.2. Technical tools to collect data
- ☐ 15.1.5.3. More resources and competencies
- ☐ 15.1.5.4. Other, please specify

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16. Please state any other indicators you consider important to estimate environmental performance. Explain if necessary.

Open questions on environmental reporting and transparency

17. In your view, how could the level of harmonisation and comparability in terms of environmental transparency of electronic communications and digital sector in general be increased?

18. From your perspective, what are the limitations and difficulties, if any, in using common, harmonised, and comparable indicators in the electronic communications sector?