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BEREC Report on Sustainability:
Assessing BEREC's contribution to limiting the impact of the digital sector on the environment

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FOREWORDS

In September 2020, the European Commission'President, Ursula von der Leyen, gave her first 'State of Union speech', in which she set out the need for a green and digital transformation of Europe. In the backdrop of the Social Development Goals and '2030 Agenda' of the UN, President von der Leyen's statement has been supported by several Commission proposals, such as the European Green Deal – acting as a blueprint to make the green and digital transformation – and the 'EU fit for 55' package.

For BEREC, it is clear that electronic communication networks play an essential role in the enablement of this twin transition. Digitisation promises to bring major efficiency gains that translate into significant reductions of greenhouse gas (GHG) emissions. At the same time, the digital sector's environmental footprint is increasing with energy usage going up. Therefore, we deem it important to get a good understanding of the environmental impact that electronic communications networks and the digital sector as a whole can have.

That is why, in 2020, BEREC started to develop its knowledge regarding the topic of environmental sustainability within the digital sector. As most National Regulatory Authorities were confronted with this new experts' topic, we created a forum where NRAs can learn from each other, develop a knowledge base and deepen their insights on the subject, resulting in a high level of expertise.

BEREC's Strategy 2021–2025 spells out that it will assess ways to contribute constructively to environmental sustainability, both internally (in the running of BEREC as an organisation) as well as externally (by assessing the possible impact we can have as regulators).

This Report provides an overview of our assessment on what has been performed over the past years, with the aim to increase the understanding of the impact that the ICT (especially the electronic communications networks in the digital sector) can have on environmental sustainability. Throughout the process of preparing this Report, BEREC has organised several workshops, conducted bilateral meetings with various stakeholders and issued a study. These efforts and the vivid interactions between the members of the working group clearly showed that environmental sustainability certainly is and will continue to be an important topic of interest for all stakeholders, where much has already been achieved. It also shows that NRAs can contribute to strengthening the development towards greener digital markets. In particular, BEREC and NRAs could contribute with its expertise to develop effective and common indicators to measure the environmental impact of the digital sector. However, BEREC is aware that knowledge still needs to be gained in this area. Collaboration with relevant stakeholders is key for BEREC both to learn from their experiences in various areas related to green transition and to feed the discussion on environmental sustainability by providing specialized knowledge on the digital sector.

Following an overview of the main activities and the findings relevant to the work of BEREC and NRAs, this report also features an outline of future activities of BEREC and a summary of best practices and recommendations for NRAs. We are convinced these are merely a starting point towards implementing a truly sustainable strategy within BEREC and the NRAs.

In the coming years, BEREC will continue to work towards a sustainable strategy and create awareness on the environmental impact of the digital sector. To this end, BEREC plans to contribute to the assessment of environmental impact on the digital sector by identifying

relevant indicators that could help evaluate the environmental sustainability of electronic communications. Inputs from stakeholders will be collected during this process by organising a technical workshop. Additionally, BEREC will focus on deepening its knowledge on the role of the circular economy in the digital sector, more specifically focusing on the life cycle of devices and equipment. BEREC takes its role in the digital sector seriously and will continue to gain and share knowledge to support the sector in its green transition where possible.

Dan Sjöblom (BEREC Chair 2020)

Michel Van Bellinghen (BEREC Chair 2021)

Annemarie Sipkes (BEREC Chair 2022)

EXECUTIVE SUMMARY

In the light of the Paris Agreement's objectives to limit global warming to well below 2 degrees Celsius (°C) and preferably to 1.5°C, BEREC recognises the importance of environmental issues and decided to "engage in working on sustainability considering the ICT-related parts of the Green Deal and the Agenda 2030 targets to identify the sustainable development goals that could be relevant for BEREC" in its strategy 2021–2025. The strategy also foresees that BEREC could contribute to the assessment of the digital sector's impact on the environment and identifies raising awareness of the above-mentioned impact as a relevant lever for end users' empowerment.

Under this mandate, this first BEREC' Report on environmental sustainability aims at defining its potential contribution to liming the digital sector's impact on the environment. BEREC acknowledges digital solutions as critical enablers of achieving climate neutrality and environmental targets. More largely, BEREC notes the existence of indirect impacts (also called 'second order' impacts) of the ICT sector on the environment including positive enabling effects of digitalisation on other sectors' decarbonisation, as well as adverse rebound effects, even though this first Report focuses on the environmental footprint of the Information Communications Technology (ICT) sector (also called 'direct effect', 'first order effect'). This perimeter allowed BEREC to build a clear vision of the relative contribution of electronic communications within the environmental footprint of ICTs and to take into account possible relations between the environmental impacts of networks, data centres, devices, digital services and uses. Furthermore, BEREC considered the different types of environmental effects from ICTs, not only in terms of GHG emissions but also other relevant impacts, especially the sourcing of fossil energy resources and the depletion of minerals and metals (including rare earth elements).

Since 2020, BEREC has been working on developing its knowledge on environmental sustainability which constitutes a new subject for telecom regulators. Complementary to academic research and studies, BEREC interacted with external parties in order to gain knowledge and expertise across different aspects of ICT sustainability and identify existing initiatives. An external study to assess the effect of electronic communications on the environment was commissioned to map main sustainability-related actions in the sector and first initiatives lead by national regulatory authorities (NRAs) as well as to evaluate the levers available to minimise the adverse environmental effects of electronic communications. BEREC also provided inputs regarding the initiatives of the European Commission on the subject notably in the frame of the upcoming Broadband Cost Reduction Directive (BCRD) revision or the latest proposal recasting State Aid Guidelines for broadband. In this perspective, this Report compiles the key results of BEREC's groundwork on ICTs' sustainability and provides an outline of BEREC's approach to environmental sustainability.

In this Report, BEREC acknowledges the lack of available standardised data and the heterogeneity of methodologies to assess the digital sector's environmental footprint, including in terms of GHG emissions. According to different studies, the ICT sector represents an estimated share of 2–4% of total global GHG emissions, with 12–24% of this share attributed

to networks, 60–80% to devices and around 15% to datacentres.[1] Although the percentage of GHG emissions caused by the ICT sector could appear low compared to other sectors, the pace of the annual rise in digital consumption (data volume, number of devices, etc.) highlights the need to follow the trajectory of emissions closely and to act collectively to prevent an increase of GHG emissions in compliance with EU and international climate targets. Furthermore, other types of environmental impacts should be considered and remain largely undocumented, such as the depletion of metal and mineral resources and the exploitation of fossil resources.

Focusing on electronic communications networks (ECNs), their carbon footprint throughout their life cycle can be attributed to three phases: deployment, operation and decommissioning. Most of the emissions of ECNs is imputable to the operation phase, which according to estimations could take up to 90%. Over the past two decades, internet traffic rose significantly, but only led to a moderate increase in energy consumption of networks and data centres and associated emissions due to high efficiency gains. However, considering the intrinsic limits of energy efficiency gains and rebound effects, the rapid growth of data traffic and emerging technologies and uses (e.g. blockchain, IoT, metaverse) might have further impact on electronic communications networks' energy consumption and GHG emissions.

In this context, it appears that multiple initiatives have emerged to better understand and limit the environmental footprint of the digital sector from policy makers, regulators, digital players as well as from civil society and consumer organisations. While environmental sustainability is a new topic for NRAs, some regulatory actions under the European Electronic Communications Code (EECC) and sectorial directives seem to have positive impact limiting the sector's adverse effects on the environment particularly in terms of infrastructures' mutualisation, civil work coordination and spectrum management. Moreover, some NRAs have developed additional actions on sustainability in cooperation with other competent authorities when appropriate.

Bearing in mind the current EU regulatory framework and national specificities, the sharing of experiences and technical knowledge within BEREC could act as an instrument for NRAs to advance their work on sustainability and contribute to limiting the impact of the digital sector on the environment. Additionally, future work of BEREC on environmental sustainability will emphasise collaboration with other public bodies and relevant stakeholders.

Even though BEREC is still in a learning process in terms of environmental sustainability, BEREC will investigate how its expertise on electronic communications could be further used to improve environmental transparency and data accuracy on the ICT sector's environmental footprint in collaboration with other relevant bodies. For 2022 and 2023, BEREC included a new workflow in its Work Programme that will consider the indicators which might help evaluate both the environmental sustainability of electronic communication networks and services (ECSs). Furthermore, BEREC believes that end user awareness is a relevant tool to support greener digital solutions and considers data-driven approach as an important lever to improve user's information on devices and digital uses' environmental impacts while creating positive incentives in the sector. BEREC also envisages to contribute to the efforts to better identify and encourage potential environment-friendly practices developed by the ICT industry players with relevant authorities. With regard to the work achieved by other initiatives aiming to assess

[1] Extract from BEREC external study 'Environmental impact of electronic communications', WIK and Ramboll (2022), based on several studies https://berec.europa.eu/eng/document_register/subject_matter/berec/reports/10206-external-sustainability-study-on-environmental-impact-of-electronic-communications

the net impact of ICTs, including those led by the Commission, BEREC could also consider improving its knowledge on indirect or second order positive and adverse effects of the digital sector on the environment, in particular enabling effects on other sectors' decarbonisation and rebound effects

To sum up, BEREC will continue to build up its knowledge on the important topic of sustainability to be able to contribute with its expertise to limiting the ICT sector's environmental footprint and in the shaping of the twin green and digital transition.

1. INTRODUCTION

1.1. Background

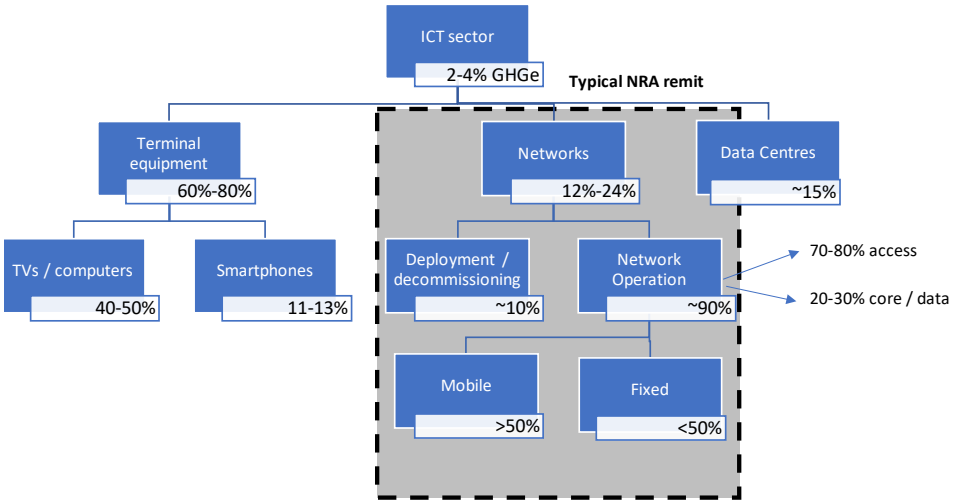
The Paris Agreement is the first-ever legally binding agreement setting out a common framework for keeping global warming well below 2°C and in particular to pursue efforts to limit it to 1.5°C above pre-industrial levels. Implementation of this agreement is closely related to the achievement of the UN's 2030 Agenda for Sustainable Development adopted three months before the COP21, relying on 17 Sustainable Development Goals (SDGs) for actions to cut Green House Gas (GHG) emissions and build climate resilience. New technologies will play an essential role in achieving these targets and tackling future societal challenges, highlighting the importance of promoting ICTs' development and connectivity as a pre-requisite for such development being a key enabler for the environmental transition.

However, the positive role of digital technologies in decarbonisation across the economy should not be a deterrent for the digital sector itself from complying with international and European environmental targets. The ICT sector contributes by an estimated share of 2–4% of total global GHG emissions,[2] with electronic communications networks responsible for approximately 12–24% of this as estimated by studies.[3] The contribution of devices is estimated to account for 60–80% and data centres for around 15% of the GHG emissions of ICTs depending on the studies. BEREC would like to underline that these values should be handled carefully as from one study to another, different methodologies or scopes of assessment may be applied and also data with fluctuating quality may be drawn on. Indeed, the lack of data sometimes involves necessary assumptions, the methodology of assessment (e.g. the way a given LCA is conducted) and the defined scope of study (e.g. including elements that can be considered out of the 'ICT scope' such as televisions) are varying and thus explain why we can find a relatively large range of values in the literature and why it should rather be seen as an overall estimate rather than a precise measurement.

[2] Studies referred by WIK and Ramboll external study (see footnote 6): Belkhir, L. & Elmeligi, A. (2018), 'Assessing ICT global emissions footprint: Trends to 2040 & Recommendations', Journal of Cleaner Production (estimates 3.5% by 2020). The Shift Project, (2019). 'Lean ICT – Towards Digital Sobriety': (estimates 4% by 2020) GreenIT.fr, 'ICT's global environmental footprint', September 2019; Arcep, 'Future Networks - Digital Tech's Carbon Footprint', October 2019; CGE, 'Reducing digital technology's energy consumption', December 2019; and Citizing, 'ICT's carbon footprint in France: are public policies enough to handle increasing usage?', June 2020. https://berec.europa.eu/eng/document_register/subject_matter/berec/reports/10206-external-sustainability-study-on-environmental-impact-of-electronic-communications

[3] See footnote 2.

Figure 1: Breakdown of contributions to GHG emissions within the ICT sector[4]



Moreover, although the percentage of GHG emissions within the ICT sector remains low compared to other sectors, the pace of the annual rise in digital consumption (data volume, number of devices, etc.) demonstrates the need to follow the trajectory of emissions closely.[5] Regarding the potential increase of the digital sector's carbon footprint, estimations tend to vary due to the lack of predictability of various perimeters including the absence of consensual methodologies and robust data as well as the fast evolutive nature of the digital economy. As an example, the Belkhir, L. & Elmeligi study predicts that increasing ICT emissions could account for up to 6–14% of global GHG emissions of the 2016-level worldwide by 2040 if no action is taken[6] (this figure does not take into account potential enabling or rebound effects[7]). BEREC notes potential shortcomings of this study but considered this analysis in line with other publications, including those published or commissioned by the European Commission, which also quote this study.[8]

Furthermore, BEREC acknowledges the energy efficiency gains made by digital infrastructures over the last decade which did allow to limit the increase of GHG emissions associated with data centres and networks despite the rise of data traffic.[9] As an example, concerning electronic communications, a study based on data transmitted made by a group of operators

[4] Extract from BEREC external study 'Environmental impact of electronic communications', WIK and Ramboll (2022), based on several studies. The different figures summarised in the diagram above are notably due to differences in the scope of the emissions captured and different interpretations of the boundaries between the different segments constituting the ICT ecosystem https://berec.europa.eu/eng/document_register/subject_matter/berec/reports/10206-external-sustainability-study-on-environmental-impact-of-electronic-communications

[5] Data Centres and Data Transmission Network -Tracking Report, International Energy Agency, Novembre 2021 https://www.iea.org/reports/data-centres-and-data-transmission-networks

[6] Belkhir, L. & Elmeligi, A. (2018)

[7] Bol, D., Pirson, T., Dekimpe, R. (2021). 'Moore's Law and ICT Innovation in the Anthropocene.' IEEE Design, Automation. The rebound effect occurs when improvement in energy efficiency are offset by other means (such as change of behaviour or more consumption of data) leading to steady state or an increase of the overall energy consumption. https://dial.uclouvain.be/pr/boreal/object/boreal:243578

[8] See : Supporting the Green Transition' infographic, available at: https://ec.europa.eu/commission/presscorner/api/files/attachment/862091/Supporting_the_green_transition_en.pdf.pdf or Study on Greening Cloud Computing and Electronic Communications Services and Networks: Towards Climate Neutrality by 2050, IDEA and Oko-Institute, March 2022 : https://digital-strategy.ec.europa.eu/en/library/study-greening-cloud-computing-and-electronic-communications-services-and-networks-towards-climate

[9] See footnote 5

during the period 2015–2018 seems to indicate that electricity consumption of their networks remained mostly stable over the period despite the rise of data volume.[10] In the long run, the monitoring of digital infrastructures' carbon footprint should also take into account the fast path of innovation within the sector as well as the intrinsic limits of energy efficiency that are associated, in terms of costs, to diminishing returns.[11]

Aside from GHG emissions, other environmental impacts associated with ICT infrastructures are relevant to be considered, in particular the raw materials and natural resources (fossil energy sources and minerals) required by manufacturers of devices, data centres and network equipment. It is estimated that 40% of the environmental impacts of digital technologies are due to the depletion of metal resources (including rare earth elements) and the use of fossil resources, mainly linked to the manufacturing of digital devices and equipment.[12] For instance, for some raw materials such as indium, gallium and germanium, which are of utmost importance in the manufacturing of semiconductors, the digital economy represents 80–90% of the total consumption. This could constitute a challenge for future sustainability policies in terms of supply chain security as these materials will probably also be required in the green energy transition (e.g., in solar panels and wind turbines).[13] In addition, the functioning of datacentres requires significant amount of natural resources, especially in terms of water extraction and energy consumption. These environmental impacts are notably addressed by the Energy Efficiency Directive recast proposal published by the European Commission (the Commission) in July 2021 as a part of the Fit-for-55 package.[14]

While connectivity is a critical enabler of other sectors' decarbonisation, it is clear that the ICT sector itself, just as any sector, should be aware of its own environmental footprint and should aim to limit it. As such, environmental sustainability is an area of growing interest for the sector and European public authorities, including the NRAs within BEREC.

1.2. ICT-related environmental goals at EU level

Steering ICTs' environmental footprint is considered a relevant lever to achieve the EU's environmental goals including climate neutrality. The Commission has set in its European Green Deal[15] the ambitious target to achieve zero net GHG emissions by 2050 and more recently, the target of cutting emissions by 55% by 2030 in its Fit-for-55 package. Digital technologies are identified as a critical enabler for achieving this objective, promising major reductions of GHG emissions among others in buildings, energy, transport, industry, and agriculture sectors, and helping to build climate resilience.[16] Notwithstanding, this enabling role of the digital sector regarding other sectors' environmental transition should lean on

[10] Lundén, D. (Telia company); Malmodin, J.; Bergmark, P. (Ericsson Research); Lövehagen, N.: Electricity Consumption and Operational Carbon Emissions of European Telecom Network Operators. Sustainability 2022, 14, 2637. https://doi.org/10.3390/su14052637

[11] Lovelace, R. Energy: efficiency gains alone won't reduce emissions. Nature 455, 460 (2008). https://doi.org/10.1038/455461a

[12] 'Digital technologies: an environmental lifecycle approach'. Study commissioned by the European Parliamentary group of the Greens/EFA headed by GreenIT.fr, with NegaOctet members (Demain, GreenIT.fr, LCIE CODDE Bureau Veritas, APL data center) https://groenlinks.nl/sites/groenlinks/files/2021-12/environmental-impact-technology.pdf

[13] Toni Eerola (ed.), Pasi Eilu (ed.), Jyri Hanski, Susanna Horn, Jachym Judl, Marjaana Karhu, Päivi Kivikytö-Reponen, Panu Lintinen and Bo Långbacka: 'Digitalization and natural resources', 2021, Finnish Geographical Survey report

[14] Catherine Banet , Michael Pollitt , Andrei Covatariu, Daniel Duma: 'Data centres and the grid', 2021,CERRE Report

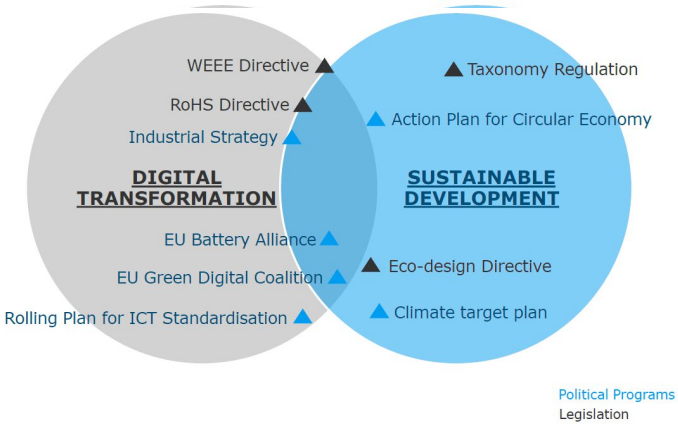
[15] COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS, The European Green Deal, 11.12.2019 COM(2019) 640 final

[16] EC Communication 'Forging a climate-resilient Europe - the new EU Strategy on Adaptation to Climate Change', (2021) https://ec.europa.eu/clima/eu-action/adaptation-climate-change/eu-adaptation-strategy_en

sustainable and carbon-neutral digital solutions. In that regard, the Commission in its Green Deal calls for "a digital sector that puts sustainability at its heart" and announced to consider measures "to improve the energy efficiency and circular economy performance of the sector itself, from broadband networks to data centres and ICT devices" and toward "more transparency on the environmental impact of electronic communication services."

Furthermore, the Commission's digital strategy[17] underlines the need for the ICT sector to "undergo its own green transformation" and postulates that until 2030, data centres and telecommunications "can and should become climate neutral." From a broader perspective, the EU sustainability policies and regulation relevant to ICTs also include the Ecodesign Directive (covering energy consumption and labelling requirements for certain electronic goods), the Waste of Electrical and Electronic Equipment Directive (WEEE Directive),[18] and potentially the Energy Efficiency Directive, currently under revision.[19] Moreover, the EU recovery plan to cope with the COVID-19 crisis, Next Generation EU,[20] puts heavy emphasis on fair climate and digital transitions. The Commission also leads voluntary initiatives such as Codes of Conduct covering broadband equipment and data centres and the European Green Digital Coalition, which gathers 26 digital companies notably committed to reach net-zero targets by 2040.[21]

Figure 2: Existing political frameworks and initiatives influencing the green digital transition[22]



The Commission also published in January 2022 a draft European Declaration on Digital Rights and Principles for the Digital Decade proposed for signature to the European Parliament

[17] COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE EUROPEAN COUNCIL, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS, Shaping Europe's digital future, 19.2.2020 COM(2020) 67 final

[18] DIRECTIVE 2012/19/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 4 July 2012 on waste electrical and electronic equipment (WEEE) https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02012L0019-20180704

[19] The European Commission published in July 2021 a recast proposal that includes new measures to promote data centers energy efficiency, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0558

[20] EC's webpage on EU's recovery plan "NextGenerationEU"https://ec.europa.eu/info/live-work-travel-eu/health/coronavirus-response/recovery-plan-europe_en#commission-proposal-may-2020

[21] Additionally, Member states agreed on the Union-wide Connectivity Toolbox in 2021 with sets of best practices, pursuant to the Connectivity Recommendation. It invites Member States to acknowledge the environmental footprint of electronic communications networks and to undertake initiatives with the aim to limit adverse environmental effects and to enhance the sustainability of networks. See the EC 'Common union toolbox for connectivity' pursuant to Commission Recommendation (EU) 2020/1307 (2021) https://digital-strategy.ec.europa.eu/en/news/connectivity-toolbox-member-states-agree-best-practices-boost-timely-deployment-5g-and-fibre

[22] Extract from BEREC external study 'Environmental impact of electronic communications', WIK and Ramboll (2022)

and the Council that insists on the need to minimise adverse environmental and social impacts of digitalisation and to develop digital solutions with positive effects on the environment.[23] The prioritisation of both green and digital initiatives and the need to steer ICTs' environmental impacts were also endorsed by the European Council in its conclusions to the Special meeting of the European Council (1 and 2 October 2020).[24] The European Parliament is also very proactive in this area and has adopted two reports in 2020 addressing the necessary means to balance the digital transition and environmental policies and the importance of reducing the digital sector's environmental footprint.[25]

1.3. BEREC's first approach to sustainability matters: how was the work set up?

In light of the above, BEREC has included sustainability as an important element to its strategy and work programmes.[26] As a result, on the one hand, BEREC started investigating its own environmental footprint as an organisation, considered to be the 'internal dimension'. On the other hand, BEREC initiated new workstreams to deal with the above-mentioned aspects of the ICT sector's impact on the environment and to develop an understanding of how regulatory actions of NRAs can influence the environmental footprint of the sector by assessing the 'external dimension' of BEREC's potential contribution to sustainability. Answering this will enable BEREC to better understand how NRAs could encourage the sector to move forward in line with both their mandate and the Green Deal's guiding principles. This Report is focused on the results of BEREC's work related to the 'external dimension' of sustainability, i.e. the impact of the digital sector (and especially electronic communications) on the environment.

In order to identify all relevant issues on sustainability that may arise across different aspects of telecoms regulation, BEREC set up a dedicated working group on sustainability (transformed into permanent working group in December 2021) and strongly linked this work on sustainability with the work of other BEREC working groups. A few months after the establishment of this new group addressing sustainability, transversal discussions were organised within BEREC aiming to develop a comprehensive and inclusive approach on environment-related matters.

To further BEREC's understanding of the digital sector's environmental footprint, BEREC commissioned extensive research and encouraged sharing of experiences and knowledge on the issues among NRAs. BEREC also interacted with external parties in order to gain knowledge and expertise in different aspects of sustainability for ICTs.

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[23] COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS of 26 January 2022 on establishing a European Declaration on Digital rights and principles for the Digital Decade, 26. 1. 2022 COM(2022) 27 final; https://digital-strategy.ec.europa.eu/en/library/declaration-european-digital-rights-and-principles#Declaration

[24] Conclusions – 1 and 2 October 2020 https://www.consilium.europa.eu/media/45910/021020-euco-final-conclusions.pdf

[25] 'Towards a more sustainable single market for business and consumers' (2020/2021(INI); rapporteur David Cormand) https://www.europarl.europa.eu/doceo/document/A-9-2020-0209_EN.html;
'Report on the New Circular Economy Action Plan' (2020/2077(INI); rapporteur Jan Huitema) https://www.europarl.europa.eu/doceo/document/A-9-2021-0008_EN.html

[26] BEREC Strategy 2021-2025: https://berec.europa.eu/eng/document_register/subject_matter/berec/annual_work_programmes/9281-berec-strategy-2021-2025; BEREC Work Programme 2020: https://berec.europa.eu/eng/document_register/subject_matter/berec/annual_work_programmes/8918-berec-2020-work-programme; BEREC Work Programme 2021: https://berec.europa.eu/eng/document_register/subject_matter/berec/annual_work_programmes/9728-berec-work-programme-2021

First, several workshops were organised, starting with two sets of expert-level webinars arranged on sustainability within the digital sector and the possible role of BEREC that were held in October 2020. These aimed to give the experts from the NRAs an opportunity to learn from and hear the viewpoints of relevant stakeholders on how telecommunications and (regulatory) policies can support sustainability and can align with other environmental and sustainability strategies at national and international level. In addition, a discussion was held at Heads' level in December 2020 to transcribe this prospective work into potential guidance for BEREC's future work addressing sustainability.

Secondly, meetings were organised to engage with stakeholders (public bodies, civil society organisation, industry associations) with expertise in or methodological work on environmental sustainability of ICTs. BEREC also provided inputs on sustainability in the framework of the Commission's initiatives touching upon environmental aspects of ECNs/ECSs, including the upcoming revision of the Broadband Cost Reduction Directive (BCRD) and the recast proposal of the State Aid Guidelines on broadband. The key results for BEREC were compiled into this Report as an input to form BEREC's approach to environmental sustainability. Furthermore, the topic of sustainability was featured prominently at BEREC's annual Stakeholder Forum in April 2021 that included a first presentation of BEREC's groundwork on sustainability.[27]

Finally, an external study assessing the effect of electronic communications on the environment was commissioned. This study provided BEREC more broadly with a structured literature review and key information on the state of research on ECNs and on digital technologies' sustainability. Furthermore, this work aimed at exploring different elements of environmental sustainability initiatives in Europe and set an extensive overview of the initiatives developed by the operators as well as of reporting methodologies used by them, and actions of public authorities (including NRAs) on the topic. This study also proposed an analysis of the potential levers to contribute to limiting the adverse environmental effects of the sector, bearing in mind the current regulatory objectives.

2. CASE STUDIES

Sustainability is a new area of expertise for BEREC and national authorities in general. Nevertheless, some NRAs within BEREC pioneered actions on this topic notably due to their national context. Starting from their expertise and initiatives, BEREC laid a first emphasis on the exchange of experience and on the discussion of their approach and findings. Case studies from Arcep, ComReg and Traficom are presented here as examples. In addition, a brief overview of some other NRAs' initiatives regarding sustainability is provided.

ARCEP

Arcep has always worked to develop networks as a 'common good' and in that sense, aims at integrating the environmental issue more widely into its scope of actions. While digital technologies, including networks, are essential levers for the ecological transition and the fight against global warming, the sector's environmental footprint must also be managed to comply with the Paris Agreement and EU's environmental targets.

[27] https://berec.europa.eu/eng/events/berec_events_2021/263-9th-berec-stakeholder-forum

As a first step, Arcep published a paper addressing the environmental footprint of digital technologies in the framework of a multi-players cycle of reflections named 'Future networks.'[28]

To advance the level of knowledge of the issue and to formulate first proposals to manage the sector's footprint, Arcep launched in June 2020 a platform 'Achieving digital sustainability'[29] and a series of dedicated events bringing together interested stakeholders (other administrative bodies, academics, think-tanks, NGOs, operators and other digital players, civil society representatives, etc.). More than 130 external experts got involved into this initiative which resulted in the 'co-edition' of a report in December 2020. The French regulator formulated a series of recommendations around three axes in this report based on Arcep's understanding of the issue and on 42 contributions from external stakeholders:

- **'Strengthening public policymakers' capacity to steer digital technologies' environmental footprint'**: through data production in order to provide objectivity in assessing digital technologies' footprint, implying agreeing on common standards and methodologies at the local, national, European and international levels;
- **'Incorporating environmental issues into Arcep's regulatory actions'** for instance by facilitating the transition from copper to fibre, encouraging network optimisation, and achieving more detailed analysis of the positive and negative impact of switching off 2G and 3G networks;
- **'Increasing incentives for economic, private and public sector stakeholders as well as consumers'**: with Codes of conduct developed together with interested stakeholders and with tools to increase users' environmental information level and aiding consumers' decisions (data-driven regulation).

The recommendations made in this report were taken into account by the French government which published in February 2021 a governmental roadmap named 'Digital and Environment'[30] led by the Ministry of Ecological and Solidarity Transition and the Secretary of state for Digital Affairs.

In this context, the French regulator has been working on the implementation of four workstreams provided by this national roadmap:

1. Building an environmental barometer for digital goods and services

Arcep has been mandated to build an environmental barometer/index considering the digital ecosystem. This was one of the main recommendations in Arcep's report on sustainability: regulators do possess the necessary expertise to collect, aggregate, and make available relevant and needed data regarding the footprint of the digital sector.[31] Since 2020, Arcep has been collecting environmental data from major telecom operators (carbon and energy

[28] https://en.arcep.fr/news/press-releases/view/n/future-networks-3.html

[29] https://en.arcep.fr/uploads/tx_gspublication/achieving-digital-sustainability-report-dec2020.pdf

[30] https://www.ecologie.gouv.fr/feuille-route-numerique-et-environnement

[31] At the moment of the edition of this report, legislative proposals are discussed in the French Parliament that might extend Arcep's data collection power in order to enable the French authority to build such a barometer. Besides, the protection of the environment is part of Arcep's objectives since 2010 as stated in the French code for postal and electronic communication Article L32-1 https://www.arcep.fr/fileadmin/reprise/textes/lois/article-L32-1-cpce-loi-2010-788.pdf

footprint, information on fixed and mobile devices, …) and published first indicators in 2022.[32]

In December 2021, a new law voted by the French Parliament extended Arcep's environmental data collection power to all market's players within the ecosystem in order to enable the French authority to build a barometer describing the digital sector more widely. The authority is currently working on this project, discussing the pertinent indicators, organising meetings with the concerned actors, and an event gathering all relevant stakeholders.[33]

2. Co-leading a study to build a methodology to assess digital technologies' environmental footprint

Arcep and ADEME (the French agency for Ecological transition) have conducted a multi-criterion (with 11 environmental metrics in addition to GHG emissions), multi-component (networks, devices, data centres) and multi-stage (life cycle approach from manufacturing to end of life) study to assess the environmental footprint of digital technologies. The first results of the study have been published in January 2022 and emphasised the substantial share in the global impact of the devices category followed by data centres and networks. It also allows to distinguish relevant environmental metrics to describe the environmental footprint of digital technologies.[34] The study represents a major step to improve and precise an assessment methodology. The two institutions are currently working on a prospective analysis (time horizon 2030 and 2050).

The French regulator has collaborated with this agency on another workstream: Arcep has offered its expertise on networks regarding the implementation of the French Circular Economy Law[35] adopted in 2020 which provides that Internet providers must inform their subscribers of the quantity of data consumed and the corresponding GHG emissions starting 2022 and entrusts ADEME to manage the associated databases.

3. Assessing B2C commercial practices' influence on smartphones renewal frequency

Arcep published in July 2021 a study on mobile phones B2C distribution models and their potential impact on the renewal rate of terminals[36] foreseen by the 'Digital and Environment' roadmap. In this report, the authority insisted on the significant environmental impact of materials' production and life cycle of terminals. However, Arcep could not conclude that bundled or 'subsidised' offers, including the provision of a terminal with a subscription, does influence the renewal frequency of cell phones. To increase smartphones longevity, other levers such as reparability, fighting programmed obsolescence, developing second-hand acquisition models, or improving waste collection and recycling associated with terminals could help optimising smartphones life cycle and tackle the issue at stake.

[32] "Achieving digital sustainability: Arcep publishes the first edition of its annual inquiry" (English press release published in April 2022) https://en.arcep.fr/news/press-releases/view/n/the-environment-first-annual-inquiry-250422.html

[33] https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000044553569

[34] ARCEP-ADEME, 'Study on the environmental footprint of the ICT sector and prospective analysis', 2022. First deliverable : https://www.arcep.fr/uploads/tx_gspublication/etude-numerique-environnement-ademe-arcep-volet01_janv2022.pdf
Second deliverable: https://www.arcep.fr/uploads/tx_gspublication/etude-numerique-environnement-ademe-arcep-volet02_janv2022.pdf

[35] https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000041553759/

[36] https://www.arcep.fr/uploads/tx_gspublication/rapport-renouvellement-terminaux-mobiles-pratiques-commerciales-distribution-juillet2021.pdf

4. Investigating the consideration of environmental issues in spectrum allocation design

Arcep has been mandated by the government to start investigating potential means to better consider environmental issues by designing the criteria for the future allocation of spectrum, notably the 26 GHz band. Arcep delivered its first conclusions to the French government in January 2022.

Beyond the above mentioned workstreams, Arcep also lead its own studies and projects. The authority with the Mobile Technical Expert Committee, which Arcep created in 2018, conducted and published a technical study on energy assessment of 4G vs. 5G deployment, considering two scenarios: a brownfield deployment considering the introduction of 5G technology as a complement to the existing 4G network, to keep pace with increasing traffic of enhanced Mobile Broadband services; compared to a counterfactual, business-as-usual scenario based on 4G-only network and its evolution (i.e. without deploying 5G).[37]

In tandem with ADEME, Arcep set up in December 2020 a Technical Expert Committee to work on technical issues related to measuring the environmental impact of digital technologies; the Committee capitalises on the expertise of its members to foster a mutual technical understanding between ICT/telecom players and environmental players.

Arcep will also be involved on three additional projects in 2022 linked to new legislative assignments: an assessment of the environmental footprint of the audio-visual sector, a recommendation to content service providers and TV broadcasters and an eco-design recommendation together with Arcom (the audio-visual regulator) and ADEME.

COMREG

ComReg is interested in understanding how the electronic communications sector can reduce its own carbon footprint and how it can adapt to a changing environment. From tele-working and videoconferencing reducing GHG emissions from transport, to Internet of Things (IoT) devices improving efficiency in agricultural activities and energy consumption in the home, the sector can enable a more sustainable, inclusive economy in line with the European Green Deal.

Call for Inputs – Connectivity and Decarbonisation

In December 2019, ComReg launched a Call for Inputs (CFI) 'Connectivity and Decarbonisation'[38] to better understand the electronic communications sector's relationship with climate change, including how the sector can assist in facilitating decarbonisation across the economy, how the sector can reduce its own carbon footprint and how it can adapt to a changing environment. The four use cases identified in the CFI were: transport (e.g. traffic optimisation), agriculture (e.g. precision farming), electricity (e.g. smart grids) and industry (e.g. Machine to machine – M2M, and IoT).

ComReg has carefully considered the responses received in order to inform its own strategy, to shape a number of key projects and commitments, and to facilitate discussions with a range of stakeholders, including operators and other Irish agencies. The insights from the

[37] https://en.arcep.fr/news/press-releases/view/n/the-environment-140122.html
[38] https://www.comreg.ie/publication/call-for-inputs-connectivity-and-decarbonisation

CFI have also informed ComReg's contribution to national strategy and debate surrounding electronic communications. ComReg presented the findings of this CFI at the virtual 'Regulatory Approaches and Tools to meet the Decarbonization Challenge'[39] conference organised by the Dauphine Club of Regulators and the OECD Network of Economic Regulators (NER) in April 2020.

Spectrum for Smart Grids

ComReg has made efforts to ensure that it facilitates decarbonisation. Smart Grids are efficient utility network systems that typically use digital automation technology for monitoring, control, and analysis within the supply chain. In acknowledging the key role of Smart Grids as enablers in the reduction of GHG emissions, in 2019, ComReg assigned radio spectrum rights of use specifically for the provision of Smart Grid in a 400 MHz Award process.[40]

Where we are so far:

ComReg's Electronic Communications Strategy Statement 2021–2023[41] states that at all times, ComReg seeks to be an organisation that values environmental sustainability. ComReg has undertaken a number of green initiatives in recent years to lower its organisational carbon footprint, in line with best practice.

For the Q4 2021 'Confidence and Awareness' consumer survey, ComReg included questions relating to sustainability for the first time. These questions were aimed at capturing attitudes towards mobile service providers' environmental impact (e.g. carbon footprint) and sustainability concerns for mobile handsets.

Climate Change Adaptation

In 2021, ComReg launched a project in the Network Operations Unit (NOU) on 'Climate Change Impact and Adaptation of Electronic Communications Networks in Ireland'.

The electronic communications sector needs to consider its own impact on the environment. While other Irish agencies have a direct remit in this area, ComReg is interested in understanding if more can be done to minimise the carbon footprint of the electronic communications sector. ComReg is also interested in the role this sector can play for connectivity to be an enabling factor in technological innovations facilitating the carbon footprint of other sectors.

Next steps:

The recent Climate Action and Low Carbon Development (Amendment) Act 2021[42] calls on relevant bodies, including ComReg, to perform their functions in a manner consistent with a range of government policies, in so far as practicable. These policies include the most recent approved climate action plan, the most recent approved national long term climate action strategy, the most recent approved national adaptation framework and approved sectoral adaptation plans, the furtherance of the national climate objective, and the objective of mitigating GHG emissions and adapting to the effects of climate change in the State.

[39] https://www.youtube.com/watch?v=odn54MaAyZQ
[40] https://www.comreg.ie/comreg-completes-the-400-mhz-spectrum-award/
[41] https://www.comreg.ie/publication/electronic-communications-strategy-statement-2021-2023
[42] https://www.gov.ie/en/publication/984d2-climate-action-and-low-carbon-development-amendment-bill-2020/

TRAFICOM

The ministry of Transport and Communications appointed a working group to develop a climate and environmental strategy for the ICT sector in November 2019. The objective of the strategy was to form a common view about the impacts of the sector and provide recommendations for action. The working group consisted of multiple organisations including telecom operators, universities, research organisations, consumer unions, media providers, environmental organisations, and various public sector bodies. The final strategy was published in March 2021 and it includes an extensive list of recommendations, e.g. for telecom operators, data centres and government organisations.

Traficom was actively involved in this strategy work. It also commissioned two external studies for the strategy. One of the studies focused on the environmental impacts of emerging technologies like AI, blockchain, or robotics. The other was a consumer survey mapping the knowledge, attitudes, and behaviour of consumers concerning the environmental impact of ICT devices and services. In addition, a voluntary questionnaire was targeted at the largest telecom operators in Finland, aiming to getting preliminary data on the energy consumption and other environmental impacts of communications networks and also to get a view of the ability of the operators to provide data on this subject.

The ICT environmental strategy includes several recommendations involving Traficom. The need for more comparable and reliable data was one of the key findings of the strategy. Traficom has been mapping and reviewing existing international methodologies and indicators that could be used in the Finnish context. The objective is to come up with an initial set of indicators that will then also be discussed with relevant stakeholders. The intention is that in the near future, Traficom would be able to start collecting and publishing at least a limited set of data on the environmental footprint of communications networks.

Based on the BCRD, Traficom is promoting joint construction of communications networks as well as the shared use of infrastructure. In addition to other benefits of joint construction and shared use, these are also important aspects that can contribute to the sustainability of the communications sector.

Traficom will participate in relevant international cooperation in this field. Special emphasis will be put on cooperation in the European context, especially within BEREC as well as RSPG. Participation in the work of other international organisations (e.g. ITU) will be decided on a case-by-case basis.

One of the high-level goals in Traficom's own strategy is ‘sustainable environment.’ Among the objectives under this umbrella is to support Finland to take a leading role on the path towards not only carbon-free transport but also communications sector. The environmental aspects also in the communications sector can thus be expected to become even more important in the future.

In addition to these detailed case studies, the external study commissioned by BEREC[43] provided a general overview of the actions taken by NRAs based on the responses of 22

[43] BEREC external study ‘Environmental impact of electronic communications’, WIK and Ramboll (2022)

authorities[44] to a questionnaire. Based on the information presented in the external study, other relevant initiatives taken by NRAs in terms of sustainability are:

- "The Spanish NRA CNMC has included sustainability objectives in its Strategic Plan (2021–2026) and Action Plan (2021–2022);
- The Hungarian NRA NMHH is planning to include environmental questions in its 2021 annual online consumer survey and is considering a workshop and consultation with stakeholders;
- The Maltese authority MCA has consulted a number of stakeholders and in this context discussed with the Maltese Environmental Authority (ERA) the possibility of future collaboration, once there is a more developed holistic strategic direction on environmental matters;
- UK NRA Ofcom has included the topic of sustainability within its annual work programme and is planning to publish a paper on this topic [..],
- The Dutch NRA and competition authority ACM published draft Guidelines in Jan 2021 concerning sustainability agreements and the implications for competition.[45]"

Besides, other NRAs mentioned promoting passive or active infrastructure sharing and civil work coordination under the European Electronic Communication Code (EECC) and the BCRD, practices that could be considered as significant levers to limit the environmental footprint of telecoms infrastructures.

3. OUTCOMES OF BEREC'S PREVIOUS WORK ON SUSTAINABILITY

3.1. BEREC Workshops in 2020

In October 2020, two sets of workshops were organised for BEREC experts under the title 'Sustainability within the digital sector. What is the role of BEREC?'

The first set of workshops addressed the science behind assessing the environmental impact of the digital sector with stakeholders, namely DG Connect, Joint Research Centre (JRC), Council of European Energy Regulators (CEER), and the Radio Spectrum Policy Group (RSPG).

The second set of expert-level workshops focused on understanding the role of industrial stakeholders with contributions from the International Energy Agency (IEA), the Global Enabling Sustainability Initiative (GeSI), and Ericsson.

One of the main conclusions of the workshops concerned the level of energy consumption of the ICT sector and its role in a digitalised society. It was acknowledged that ICT will have an enabling role in the continuous digitalisation of the society, which can lead to significantly lower energy consumption in other sectors. However, we should be aware of the rebound effects as the efficiency gains might not keep track with the rapid growth of the sector and associated

[44] These were from Austria, Belgium, Croatia, Cyprus, Czechia, Finland, France, Germany, Greece, Hungary, Ireland, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and the UK.

[45] https://www.acm.nl/sites/default/files/documents/second-draft-version-guidelines-on-sustainability-agreements-oppurtunities-within-competition-law.pdf

emissions. Indeed, other sectors' feedback and literature suggest that in that respect, it was proposed to focus on the best available infrastructures and technologies in terms of efficiency. It was said that "regulators can help by staying technologically neutral, so that old technology can be replaced, and the most efficient technology can be chosen (e.g. 5G and fibre)".[46] A key concern regarding this is that there is currently a lack of standardised data collection and common measurement methodologies. Furthermore, the issue of e-waste and circular economy was addressed. As a conclusion, it was suggested that the role of the regulators could be to facilitate transparency of information on the environmental footprint of the different products and services, as this is within the scope of the NRAs' responsibilities.[47]

The findings of these internal workshops were taken as starting point for a discussion with the Heads of BEREC member NRAs. The Heads convened in a workshop in December 2020 to explore issues of sustainability pertaining to electronic communications and to prepare future discussions that will arise around the Commission's Green Deal and Digital Strategy related initiatives, and potential inputs and role of BEREC.

3.2. Main conclusions of the BEREC Opinion on the revision of the BCRD regarding sustainability-related issues

In the context of reflections regarding the revision of Directive 2014/61/EU on measures to reduce the cost of deploying high-speed electronic communications networks (BCRD) in 2020, the Commission asked for BEREC's opinion in order to understand the positions of NRAs regarding different areas that might be covered by this revision, including the sustainability of ECNs.

In its Opinion,[48] BEREC recalled that there is no common methodology and data collection standards for measuring, assessing and categorising the environmental impact of ECNs regarding their deployment or operationalisation at this stage. Accordingly, reflections on ECNs' environmental impact should be accompanied by data collection, measurement methodologies, and by adopting an approach which tackles all the links composing the digital sector's value chain. According to BEREC, "this means developing consensual metrics and having reliable environmental data. For that purpose, BEREC confirmed following the standardisation efforts initiated by other relevant authorities, notably the Commission and the ITU, as well as ETSI and CEN-CENELEC".[49]

Besides, BEREC stated that "carbon emissions are a significant analytical framework to assess to some extent ECNs environmental footprint but have to be completed by other types of variables and indicators of environmental impacts, such as water consumption linked to electricity consumption and cooling circuits, the artificialisation of soils through the mining of rare earths including fossil fuels and the consumption of abiotic resources".[50] BEREC also noted the importance of considering the entire life cycle of the ECNs starting from the design

[46] BoR (21) 39, Summary report from the workshops, p. 2.
[47] A more detailed summary of the workshops can be found in BoR (21) 39: https://berec.europa.eu/eng/document_register/subject_matter/berec/reports/9883-summary-report-on-berec-sustainability-eng-workshops-sustainability-within-the-digital-sector-what-is-the-role-of-berec
[48] BoR (21) 30 Opinion on the Revision of the Broadband Cost Reduction Directive
[49] BoR (21) 30 BEREC Opinion, p. 53
[50] BoR (21) 30 BEREC Opinion, p. 50

phase of networks, to their deployment and operation, and the re-use and recycling of the network components.

In this opinion, BEREC identified that making environmental information available to consumers is a potentially effective tool to create positive incentives for providers. Accordingly, BEREC stated that "an environmental data-driven regulation could provide precious and reliable information for end users allowing more enlightened choices so as to steer the market in the right direction".[51] Other types of tools were also presented but BEREC insisted on the need to launch complementary work to assess which actions are the most relevant, such as exchange of information and best practices implemented by national authorities or operators. This approach is noted by BEREC as "a mean of strengthening regulators' actions coordination and capitalizing on each other's experiences. This can also be a window to promote and value operators' voluntary initiatives aiming to reduce their environmental impact".[52]

3.3. BEREC response to the public consultation on the draft revised EC Guidelines on State aid for broadband networks

BEREC submitted its response to the Commission's public consultation regarding the draft revised EC Guidelines on State aid for broadband networks (Draft Guidelines).[53] In its response regarding sustainability, BEREC supported the approach of the Commission to reflect technological and market developments to best accompany the necessary investments in the coming years and welcomed that environmental aspects are considered in the Draft Guidelines.

In the response, BEREC supported that the re-use of existing infrastructure is encouraged in the Draft Guidelines in order to reduce the overall costs and limit the environmental impact of network deployment.

BEREC welcomed that in the Draft Guidelines, Member States are encouraged to include criteria related to environmental impacts in State aid granted projects. Analysis of these environmental impacts should consider energy efficiency of networks and the use of renewable energy sources, life cycle of investments, eco-design of network components as well as other environmental criteria, such as the use of harmful materials, water consumption and waste management, could also be considered. However, BEREC stressed that it is important that the Draft Guidelines assist in specifying indicators for network operators to report the environmental impact of the planned network deployment and the mitigating measures.

Stressing the importance of indicators, BEREC highlighted that they are very relevant for NRAs in terms of their possible future work related to the field of sustainability. Therefore, BEREC is of the view that BEREC's and NRAs' expertise on the sector should be taken into account when defining such indicators.

4. INPUTS FROM STAKEHOLDERS

In order to make relevant contributions to the increasingly important topic of sustainability, BEREC needed to clearly identify what has already been done by other competent authorities

[51] BoR (21) 30 BEREC Opinion, p. 53
[52] BoR (21) 30 BEREC Opinion, p. 53
[53] BoR (22) 16, BEREC response to the public consultation on the draft revised European Commission Guidelines on State aid for broadband networks

(OCAs), regulators and third-party bodies to avoid duplicating work. Therefore, BEREC initiated a dialogue on this new matter by leading a series of bilateral meetings with different stakeholders working on these issues. The main findings of these interviews are presented in this chapter and a detailed summary of interviewed stakeholders' initiatives on ICTs' sustainability is available in Annex 1 of this report. Moreover, BEREC's external study on sustainability also addressed some of the actions on sustainability developed in the industry that are presented in Chapter 5.

The details provided in this section and in the relevant annex are non-exhaustive outcomes collected based on the bilateral meetings' and does not constitute endorsement by or recommendations for/of BEREC.

4.1. The sustainability of the ICT sector appears to be a subject of growing importance on most stakeholders' agenda

There was consensus among the stakeholders that the environmental impact related to ICTs is an important topic to be included on the agenda of public authorities, vendors, operators, manufactures and end users. The enabling effect of digitalisation was acknowledged by most of the interviewees as well as the need to keep monitoring the digital sector's footprint.

The stakeholders' inputs show that they are well aware of the environmental impact of telecoms. Certain stakeholders were also at that time working on reports related to environmental sustainability in their own field of expertise.

The issue of growing energy consumption, which is already perceived as quite a challenge in Europe,[54] was highlighted as one of the main concerns to be addressed when evaluating environmental impacts of the digital sector. Accordingly, the analysis of electricity consumption issues related to digital usages is an important point to be considered. Furthermore, numerous parties outlined the need to examine all the environmental impacts associated with ICTs' life cycle, including material consumption and waste management or recycling rather than focusing only on GHG emissions.

Hence, stakeholders met by BEREC seem to consider sustainability to be a very important topic in general, and a key issue for telecoms regulators. Some parties highlighted the informative and supporting role that could be played by BEREC in that sense.

Sustainability and telecoms: example of OECD WPCISP

The OECD Working Party on Communication Infrastructures and Services Policy (WPCISP) has an upcoming report on 'Networks of the Future', which sets out the main trends in the next evolution of broadband networks as well as selected regulatory and policy implications (OECD, forthcoming). It looks at the evolution of fibre and 5G deployments, as well as the main four technological trends shaping the future of networks: 1) virtualisation, 2) the integration of cloud services, 3) the use of artificial intelligence (AI) systems, and 4) the shift towards openness in networks (including Open RAN). Finally, the report highlights that as networks evolve, regulation also needs to adapt to foster network upgrades and deployments. In particular, this report points to the increased interest from delegates on the

[54] Global electricity demand is growing faster than renewables, driving strong increase in generation from fossil fuels, 15 July 2021, IAE https://www.iea.org/news/global-electricity-demand-is-growing-faster-than-renewables-driving-strong-increase-in-generation-from-fossil-fuels

topic of the environmental sustainability of networks, highlighting that communication regulators recognise the importance of this issue, as made evident in the OECD Council Recommendation Broadband Connectivity adopted in February 2021 [OECD/LEGAL/0322].[55] This legal instrument also gives the Working Party a mandate to explore this issue in its future work.

4.2. Initiatives to develop the understanding and evaluation of the digital sector's environmental impacts

Among the initiatives presented by stakeholders, one of the key targets is to better evaluate the environmental impact(s) of ICTs. Consequently, data gathering, and information sharing were two activities mentioned in the meetings as being crucial to support the decisions of public authorities and to increase transparency for consumers. In these areas, collaboration with BEREC was evoked as potentially helpful by OCAs and some civil society and industry representatives.

Sustainability and indicators: example of the 'European Green Digital Coalition' and European Commission's initiatives on environmental transparency

The European Commission is leading multiple initiatives in the field of ICTs' sustainability notably in terms of indicators and transparency of information in line with its targets related to the digital Strategy 'Shaping Digital Europe targets',[56] such as the circular electronic initiative, the upcoming eco-design recast, goal for data centres to be climate neutral by no later than 2030 and transparency measures for electronic communications.[57] The Commission is notably coordinating the European Green Digital Coalition[58] on Digital Day 2021, organised in partnership with **the Council of the EU**. This coalition was established with 26 CEOs of ICT companies, committed to becoming climate neutral by 2040. These ICT companies are about to develop, in cooperation with experts, science-based methodologies to measure the positive impact (i.e. emission reduction) of digital solutions and calculate digital solutions' net impact, taking into as the environmental footprint of ICTs with the help of external experts, ETSI and ITU standards (see following box). First results are expected in 2022. Besides, with regard to ECNs/ECSs, DG Connect is conducting an external study to explore (i) a possible transparency mechanism on the environmental footprint of electronic communications networks and services towards end users and (ii) criteria for the assessment of the environmental sustainability of new electronic communications networks. The Commission's work on the field of sustainability is ongoing so the list of initiatives above is not exclusive.

[55] The OECD Council Recommendation on Broadband Connectivity [OECD/LEGAL/0322] states the following: "**IV. RECOMMENDS** that Adherents minimise negative environmental impacts of communications networks by: 1. Supporting and promoting smart and sustainable networks and devices. 2. Encouraging communications network operators to periodically report on their environmental impacts and initiatives."

[56] Details in Part 1.1 of this Report.

[57] EC's communication « Shaping Europe's Digital Future" (2020) https://ec.europa.eu/info/sites/default/files/communication-shaping-europes-digital-future-feb2020_en_4.pdf

[58] EC's webpage on the European Green Digital Coalition: https://digital-strategy.ec.europa.eu/en/policies/european-green-digital-coalition

Numerous stakeholders outlined the lack of available and standardised data and the difficulty of comparing existing networks and their energy efficiency, since this depends on traffic and coverage and varies due to geographical differences. Several initiatives organised by public authorities and third-party bodies to develop standards as well as harmonised methodologies to evaluate the environmental impacts of ICTs were identified and presented during these bilateral meetings.

Three examples of standardisation efforts initiatives: ETSI, ITU and CEN-CENELEC

ETSI's Environmental Engineering Committee (TC EE) manages various engineering aspects of Information Communication Technology equipment. ETSI is working closely with the Commission on different aspects of standardisation. These topics are related to environmental engineering, energy efficiency determination, management and monitoring, environmental impact assessment and energy efficiency management for ICT, Life Cycle Assessment (LCA) and Circular Economy. They are providing measurement methods to assess the energy efficiency of ICT equipment and networks, a methodology to determine the environmental impact for ICT products/networks/services, best practices and guidelines to improve/monitor ICTs' energy efficiency and a set of standards for designing and building efficient ICT networks. ETSI TC EE is working with the European Committee for Standardization and the European Electrotechnical Committee for Standardization (CEN-CENELEC) on various topics like material efficiency, energy efficiency, Green Data Centres, and adaptation to climate change within joint working/coordination groups.

ITU-T Study Group 5 (SG5) is responsible for studies on methodologies for evaluating ICTs' effects on climate change and publishing guidelines for using ICTs in an eco-friendly way. ITU-T SG5 also works to reduce the adverse environmental effects of ICTs, such as e-waste, and support the transition to the circular economy. In addition to its climate-focused activities, ITU-T SG5 is working on Electromagnetic Compatibility (EMC), lightning protection, and Electro Magnetic Field (EMF) related issues as well. This Report primarily focuses on ITU-T SG5's climate activities.

ITU-T SG5's latest standards (also known as ITU-T Recommendations of the L series) provide authentic guidance for improving the energy efficiency of mobile network. They contain energy efficiency metrics and measurement methods for telecommunication equipment, sustainable realisation of 5G radio, data centre and telecommunication room and method for circular economy scoring.

ITU-T SG5 is also actively working towards supporting the achievement of a sustainable digital transformation and aligning the ICT sector with the climate targets set in the Paris Agreement and the United Nations Sustainable Development Goals.

The transparency of environmental information to all parties, particularly to end users, was outlined as an interesting lever in regard to sustainability by several authorities and private stakeholders. Besides efforts made on the production of common indicators and public databases, complementary tools were mentioned which could be used to form environmental criteria to facilitate consumers' purchase decision process and create positive incentives to the providers and the industry. For instance, digital product passports and environmental traceability of products are being investigated within EU as potential tools.

Consumers and sustainability: example of European Parliament's report 'Towards a more sustainable single market for business and consumers'

In the European Parliament, the **Committees on Internal Market and Consumer Protection (IMCO) and on the Environment, Public Health and Food Safety** (ENVI) share certain competences on the subject of ICTs' sustainability, such as the availability of information or the right to repair, among others. IMCO's main recent work addressing the topic of digital sustainability is the report of rapporteur MEP David Cormand 'Towards a more sustainable single market for business and consumers' (November 2020).[59] Among the main recommendations of this report regarding the digital sector from a consumer protection perspective are the following: encouraging economic operators to consider product lifetime and repairability from the design phase, introducing a mandatory labelling requirement (of the expected lifetime of products), promoting data standardisation, launching product passports, compiling a digital index, providing information on the supply chain's environmental footprint (including networks), and introducing obligations for digital advertisement. Complementary to this report, the Greens/EFA also published in December 2021 the study 'Digital technologies: a life cycle approach (LCA)' assessing ICTs' environmental footprint with the support of external experts.[60] According to this report, the greatest proportion of the environmental impacts of ICTs is related to terminals: the end user devices represent between 90% and 54% of the impacts depending on the indicator considered.

4.3. Solutions mentioned by stakeholders to steer ICTs' environmental footprint

In addition to the issue of quantifying ICTs' environmental impact, other instruments and principles were presented to contribute to a better balance between sustainability and digitalisation.

Regarding the telecoms sector, energy efficiency of data centres and networks is one of the areas investigated by stakeholders in coherence with ICT-related targets defined by the Commission's Green Deal.

Initiatives tackling digital infrastructures' energy efficiency: example of the IEA report

In 2020, the **International Energy Agency (IEA)** published an annual report 'Tracking Clean Energy Progress' assessing the progress of over 40 energy technologies and sectors towards net-zero goals, including data centres and data transmission networks. In the most recent update in November 2021, the report recognised data centres and networks' strong progress on energy efficiency and renewable energy, but that "more efforts were needed" for the sector to align with a net-zero by 2050 pathway. It showed that global data centres

[59] European Parliament resolution of 25 November 2020 "Towards a more sustainable single market for business and consumers" https://www.europarl.europa.eu/doceo/document/TA-9-2020-0318_EN.html

[60] Bordage, F., de Montenay, L., Benqassem, S., Delmas-Orgelet, J., Domon, F., Prunel, D., Vateau, C. and Lees Perasso, E., 'Digital technologies in Europe: an environmental life cycle approach', GreenIT.fr, 2021.

workloads had increased by a factor of 9 over the last decade while energy usage has increased by only 10% due to efficiency improvements, contrary to some earlier studies that had projected a rapid growth in energy use. Another analysis by the IEA examined that although the energy intensity of 5G is likely to be lower than of the previous generations, it is not clear whether widespread 5G deployment will lead to a net increase or decrease of total network energy consumption. There is a need to further develop and use robust methodologies to assess the energy impact of digitalisation, including effects on other services and sectors (e.g. the impact of teleworking on energy use in transport and buildings). The report includes several recommended actions for government and industry, such as policies and actions to improve the energy efficiency of data centres and data transmission networks and reduce life cycle environmental impacts.

Besides, spectrum management and infrastructure sharing were evoked by some stakeholders as practices that could contribute to EU targets in that matter.

Sustainability and spectrum management: example of the RSPG initiatives

The **Radio Spectrum Policy Group (RSPG)** supports the fight against climate change and believes that tackling the negative consequences of climate change is of utmost importance. Therefore, in its Programme of activities for the years 2020 and beyond, the RSPG responded by establishing a work item to focus on spectrum policy aspects which are closely related to the efforts of ensuring climate-neutrality. In particular, under the Climate Change work item, the RSPG initiated a debate amongst its Members, as well as with the relevant stakeholders, on how spectrum policy can help to combat climate change, RSPG.

The June 2021 'RSPG Report on the role of radio spectrum policy to help combat climate change'[61] gathers information related to the definition of climate change-related aspects within spectrum management, the ways in which spectrum management can help to combat climate change and which concrete actions at EU-level can RSPG recommend.

The report sets out possible options in radio spectrum policy in order to help combat climate change, and the Annexes complement the information presented by introducing some background material on standardisation and work in standards development bodies regarding energy efficiency, circular economy, and e-waste.

Subsequently to this report, RSPG issued in November 2021 an Opinion containing 28 recommendations as to what concrete actions can be taken at EU level in order to address climate changes through the radio spectrum policy.[62]

Regarding production of equipment and devices, the management of material consumption and eco-design requirements are also parameters that are considered by some of the public authorities interviewed by BEREC. For example, repairability is one of the key concepts that was mentioned by stakeholders to achieve climate neutrality, especially since terminals as a

[61] https://rspg-spectrum.eu/wp-content/uploads/2021/06/RSPG21-026final_RSPG_Report_on_Climate_Change.pdf
[62] https://rspg-spectrum.eu/wp-content/uploads/2021/11/RSPG21-041final-RSPG_Opinion_on_climate_change.pdf

specific category of devices contribute the majority of the digital sector's environmental footprint (estimated to 70–80% of the digital sector environmental footprint).[63]

During interviews with associations, sustainable finances was recognised as a mean to create positive incentives for greener ICTs bearing in mind the need to define the common criteria. Moreover, the principle of 'digital sobriety' was mentioned in an interview with a civil society organisation as a principle that could help address the environmental impact of the digital sector by a collective citizen-centric reflection on the differentiated societal gains from digital uses. Finally, on a wider policy level, some parties outlined the need to consider the other two dimensions of SDGs, namely the social and economic dimensions.

5. KEY FINDINGS OF THE EXTERNAL STUDY: *Environmental impact of electronic communications*

BEREC decided to support its work on sustainability with an external study 'Environmental impact of electronic communications' conducted by WIK and Ramboll. This external study report aimed at determining the impact on the environment of the digital sector in general, and of the electronic communications' sector in particular. The external study report provides factual knowledge about initiatives of operators within the sector that could best contribute to limiting the adverse environmental effects of the sector, taking into account the current regulatory objectives, and provides information on the regulatory work of NRAs, with the aim to feed BEREC's further work on sustainability.

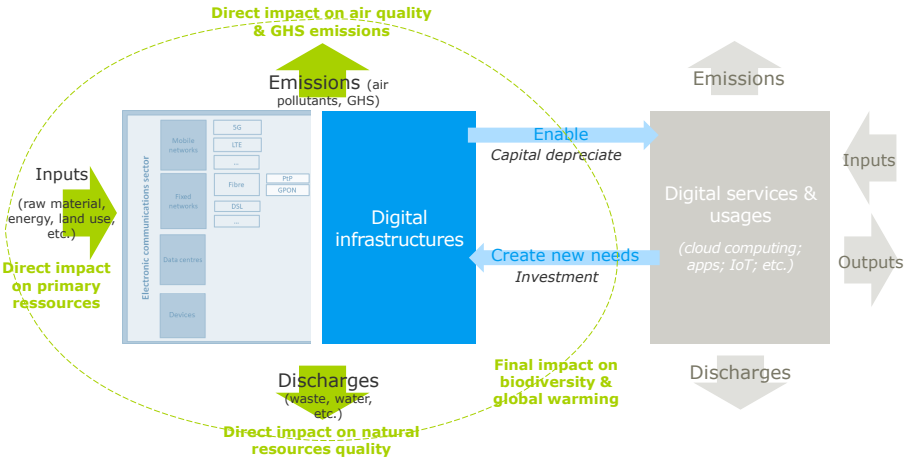
The information provided in this section summarises the main results from the external study and does not constitute endorsement by or recommendation for BEREC.

5.1. Evaluation and impact assessment methodology

According to the external study, that tracing of environmental impacts of electronic communications networks is complicated because of the variety of methodologies available and in use, as well as because of the fact that the majority of the literature focuses on GHG emissions and fails to examine other environmental impacts. According to the study, the future GHG emissions from the ICT sector will be correlated with two counteracting effects: on one hand, increased emissions caused by increased data consumption and the proliferation of devices, and on the other hand, increased energy efficiency and reliance on renewable energy. The focus of the study however lies on the environmental footprint of electronic communications networks (ECNs).

[63] BEREC external study 'Environmental impact of electronic communications', WIK and Ramboll (2022) https://berec.europa.eu/eng/document_register/subject_matter/berec/reports/10206-external-sustainability-study-on-environmental-impact-of-electronic-communications

Figure 3: Overview of environmental impacts linked to ECNs[64]



In that perspective, based on the life cycle approach, the consultants identified three main phases in which ECNs have distinct environmental impacts:

The deployment phase includes amongst others the manufacturing of network components and civil works related to installing equipment, with the latter requiring taking into consideration the impacts of different construction/deployment methods in different contexts (built environment/green space).

The operation phase, including amongst others the day-to-day operation of the network as well as maintenance, is responsible for the largest share of GHG emissions of networks. The study reported that some manufacturers estimate the operation phase to account for up to 90% of GHG emissions of ECNs. Accordingly, both the technology of the network itself as well as the usage of the network play a significant role in determining the impact of this phase on the environment, and this phase is relatively well-captured by existing standards (which, however, require further harmonisation to ensure comparability). The study outlines that energy efficiency gains in the operation phase seems to have limited the increase of energy consumption of digital infrastructures and associated GHG emissions. However, the consultants also noted the relative lack of predictability of the future trajectory of GHG emissions and of the current debates on the potential effect of emerging digital usages on energy consumption and the potential limits of energy efficiency gains.

The decommissioning phase, including amongst others the extraction of network components and waste management, requires consideration of the amount and the quality of waste (i.e., whether it can be recycled).

5.2. Identified sustainability-related initiatives of operators

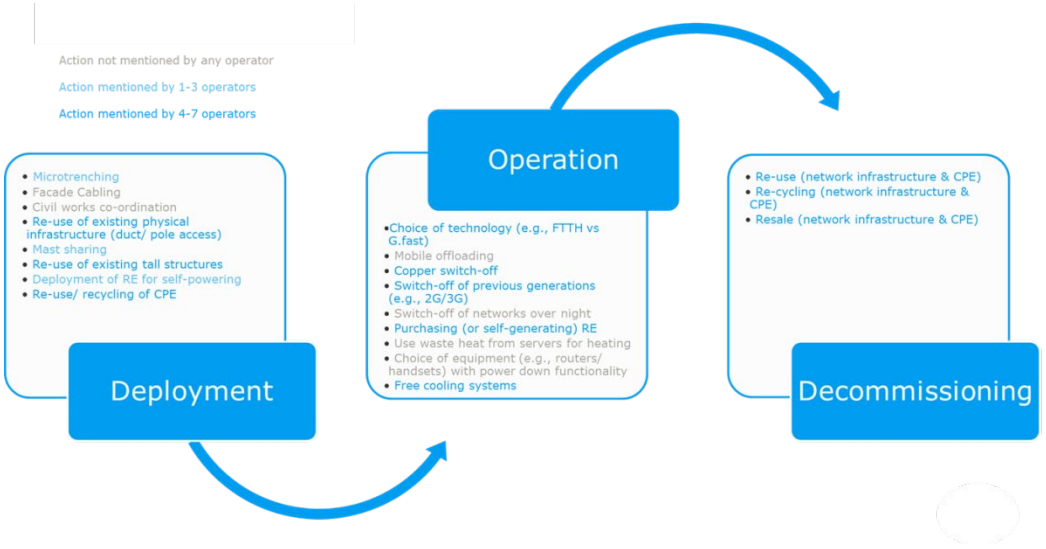
WIK/Ramboll interviewed a number of operators and most of them have set some environmental targets to be reached by 2030–50. Their focus is on decreasing GHG emissions and other environmental impacts by a variety of means, such as increasing energy efficiency and including renewable energy resources, waste management aiming for zero waste operations, sustainable use of water, or avoiding the use of toxic substances. While these targets are quite ambitious, all the operators follow a large range of methodologies making it

[64] This figure contains a reference to GHS emissions, which should actually be read GHG emissions.

difficult to compare and assess the effects of these measures. Despite this heterogeneity, two main comprehensive trajectory methodologies seem to be widely used across industries: Science Based Targets (SBTi) and the Life Cycle Assessment (LCA). In terms of reporting methods, GHG Protocol, Bilan Carbone, ISO and ITU standards were the most used methods mentioned by the stakeholders interviewed by the consultants.

The external study report outlines actions taken by telecommunications providers to limit GHG emissions and other environmental impacts, across the three phases mentioned further above. The relevant actions in the deployment phase include microtrenching, the reuse of excavated masses,[65] network sharing between operators and the eco-design of modems/mobile phone equipment. In the operation phase, the actions highlighted include decommissioning of older technologies and optimising the energy efficiency of networks, alternative/innovative cooling techniques, and switch-off at night. For the decommissioning phase, re-using, refurbishing, and recycling equipment were found to be the main actions. Reduction of waste in general was identified as an important goal during this phase, for the management of which standards can already be drawn on. Beyond these three phases, stakeholders mentioned initiatives such as increasing customer awareness of devices' environmental impact and setting environmental targets for suppliers.

Figure 4: Sustainable initiatives mentioned by operators interviewed for the external study[66]



5.3. The potential levers available to limit the sector's environmental footprint

The consultants concluded the study with the presentation of potential levers available to NRAs to act on sustainability depending on their national context and current capabilities.

[65] If the construction standards or (local) authorities or the environmental law allow for their use.
[66] CPE refers to 'customer premise equipment'.

5.3.1. Potential area of actions in the context of the EECC and sector-specific directives (e.g. BCRD) according to the study

Firstly, the study noted that NRAs could promote the re-use of existing physical infrastructures (PIA), and co-ordination of civil works in accordance with the BCRD as well as co-location or sharing of network elements and facilities as foreseen in Article 44 of the EECC, depending on the remit of NRAs under the national texts transposing these directives. In that perspective, the most significant environmental impact associated with the deployment of fixed broadband infrastructure is linked to cable laying in asphalt, which could be limited through the re-use of physical infrastructure or through microtrenching techniques, while mast sharing could limit the environmental footprint associated with the deployment of mobile networks. Accordingly, NRAs could consider also promoting network sharing in the frame of Article 61(4) of the EECC when appropriate. However, the consultants outlined that network sharing could impact the regulatory objective to promote infrastructure competition and might decrease incentives for alternative fixed and mobile operators to invest in their own infrastructure to achieve higher coverage and/or quality, and undermine the ability of operators to innovate.

Secondly, the study noted that NRAs could play an important role in facilitating the switch-off of legacy copper by potentially lifting some obligations, when relevant, considering other regulatory objectives in light of switch-off plans, when and where more future proof technologies are in place. In that sense, regulators could also promote the deployment of more energy efficient technologies (per Gbit) such as FTTH (and potentially 5G[67]) and the switch-off of legacy technologies which could significantly decrease the energy consumed within the operation phase of ECNs. On that matter, the study raises the issue that NRAs must comply with the principle of technological neutrality and the requirements set out in the EECC for NRAs to promote VHCN, which includes not only FTTH but also cable and G.fast.

5.3.2. Potential levers outside NRAs' traditional mandate outlined by the consultants that could be considered in cooperation with other competent authorities when relevant

The study suggested that BEREC and NRAs could support efforts of public bodies to increase the level of data available to evaluate the environmental sustainability of ECNs/ECSs and towards harmonising standards and methodologies. It was further found that different content distribution methods, technologies, and network deployment methods have clear differences in terms of GHG emissions, but it is not possible to quantify these effects precisely due to the wide range of different metrics and methodologies that have been used to estimate environmental impacts. Article 20 of the EECC sets out that ECN operators must provide information necessary for NRAs and BEREC only when it is related to ensuring conformity with the EECC. Thus, at this stage, gathering data specific to the environmental impacts of ECNs/ECSs could only be conducted on a voluntary basis in the vast majority of countries, according to the study.

[67] The consultants noted that: "Some studies suggest that 5G is significantly more efficient than earlier generations of mobile technology. For example, Köhn, Gröger and Stobbe (2020) find that 5G networks consume around 5 grams, with 13 grams for 4G and 90 grams CO_2 for 3G network per hour of video streaming. However, the overall energy and emissions impacts of 5G, are still uncertain, as studies carried out in Switzerland (https://www.ifi.uzh.ch/en/isr/news/news/5G-study-published.html) and France (https://www.hautconseilclimat.fr/wp-content/uploads/2020/12/rapport-5g_haut-conseil-pour-le-climat.pdf) indicate. While a 5G antenna currently consumes around three times more electricity than a 4G antenna, power-saving features such as sleep mode could narrow the gap to 25% by 2022 (https://www.iea.org/reports/data-centres-and-data-transmission-networks)"

Furthermore, the consultants identified the following subjects on which NRAs could potentially contribute at EU or national level in cooperation with OCAs such as environmental agencies, depending on their interest, capacities and resources: building awareness amongst consumers and ECN operators, developing Codes of Conduct with stakeholders, supporting eco-design and recycling programmes, encouraging research on ICTs' sustainability, and incentivising sustainability solutions in the context of spectrum awards, Rights of Way and State aid.

6. CONCLUSIONS AND OUTLINE FOR BEREC'S FUTURE WORK ON SUSTAINABILITY

6.1. Key learnings

Digital technologies are considered to be key elements for responding to the climate challenge and achieving international and European environmental goals including the Paris Agreement and the European Green Deal. In that respect, connectivity would be a critical enabler for the decarbonisation of other sectors including energy, transportation and agriculture. Certain estimations from ICT industry players state that digital solutions could allow reducing around 15–20% of global GHG emissions from other sectors.[68]

To comply with the ambitious environmental standards, a 'twin transition' is needed, where digitalisation and greening go hand in hand. Thus, despite this enabling role of digital solutions, the sector should also be aware and minimise its own environmental footprint in alignment with the European Green Deal's targets. The main components of this footprint are related to the depletion of metal resources (including rare earth elements) and the use of fossil resources and associated GHG emissions. For the latest, it is currently estimated that the ICT sector contributes 2–4% of the total GHG emissions (ECNs are responsible for approximatively 12–24% devices for 60–80%, and data centres contributes to around 15% of the overall ICTs' carbon footprint).

The lack of available data and of a common methodology as well as the fast-evolving and innovative nature of the digital sector make it hard to predict ICTs' environmental footprint including in terms of GHG emissions. One study conducted in 2018 estimated that increasing ICTs' emissions could represent between 6–14% of global emissions by 2040 if left unchecked (this figure does not take into account potential enabling or rebound effects). While the exact figures contained in studies may vary, there is a general agreement in the academic community that ICTs' GHG contribution could significantly increase if no action is taken. Improved data accuracy and definition of common calculation methodologies could contribute to building a comprehensive and holistic view of ICTs' environmental footprint and providing the relevant public authorities with more granular and reliable information to support their decision-making.

According to the WIK/Ramboll external study published in 2022,[69] GHG emissions of electronic communication networks throughout their life cycle can be attributed to three phases: deployment, operation and decommissioning. Most of the emissions of ECNs are imputable to

[68] https://www.gesi.org/research/smarter2030-ict-solutions-for-21st-century-challenges

[69] BEREC external study 'Environmental impact of electronic communications', WIK and Ramboll (2022) https://berec.europa.eu/eng/document_register/subject_matter/berec/reports/10206-external-sustainability-study-on-environmental-impact-of-electronic-communications

the operation phase, which according to estimations could take up to 90% of this share due to high power demand. Energy efficiency gains in this operation phase seem to have limited the increase of energy consumption of digital infrastructures and associated GHG emissions in recent years.[70] As an example, a study based on data transmitted by a group of operators during the period 2015–2018 seems to indicate that electricity consumption of their networks remained relatively stable over the period despite data volume rise.[71] However, energy efficiency gains have intrinsic limits and are associated, in terms of costs, to diminishing returns[72]. Furthermore, projected increased data traffic, and emerging technologies, new digital uses and devices as well as potential rebound effects might have further impact on the energy consumption and associated emission of networks in the long run.

Multiple initiatives have emerged to contribute to the steering of ICTs' environmental footprint. Actors from the telecom industry have started taking actions to promote sustainability while deploying networks. Additionally, consumers and civil society organisations have significantly contributed to raising the level of knowledge on the digital sector's environmental impact. A number of relevant public bodies are tackling this challenge including, at EU level, the European Commission, the Council, the European Parliament, RSPG and the standardisation organisations ETSI and CEN-CENELEC. The much-needed green transition of the digital sector is also an area of work at international level, with for example initiatives lead by ITU, IEA, and OECD. While sustainability is a new subject for telecom regulators at the margin of their traditional mandate, some regulatory actions under the EECC and sectorial directives seem to have had positive effects on the environment (e.g. Article 44 of the EECC, and the BCRD). Moreover, some NRAs – such as Arcep, ComReg and Traficom, among others – have pioneered additional actions on sustainability in cooperation with other competent authorities when appropriate. Bearing in mind the current EU regulatory framework and national specificities, the sharing of experiences and technical knowledge within BEREC could act as an instrument for NRAs to advance their work on sustainability and contribute to limiting the impact of the digital sector on the environment.

6.2 Outline of future work

BEREC will continue to build up knowledge on the important topic of environmental sustainability and to contribute with its expertise to the green and digital twin transition. This section aims to provide an outline of possible activities for BEREC to limiting the impact of the digital sector on the environment.

Primarily, standardised data and analysis were identified as essential for understanding the digital markets' environmental footprint and to determine relevant indicators related to the sustainable provision of services and development of networks. In coherence with the EU's objectives on ICTs' sustainability including greater transparency on the environmental footprint of electronic communications, BEREC wants to take part, in collaboration with other relevant bodies, in the process of identification and definition of such indicators and set a basic

[70] Data Centres and Data Transmission Network - Tracking Report, International Energy Agency, Novembre 2021 https://www.iea.org/reports/data-centres-and-data-transmission-networks

[71] Lundén, D (Telia Company).; Malmodin, J. (Ericsson Research); Bergmark, P.; Lövehagen, N.: Electricity Consumption and Operational Carbon Emissions of European Telecom Network Operators. Sustainability 2022, 14, 2637. https://doi.org/10.3390/su14052637

[72] Lovelace, R. Energy: efficiency gains alone won't reduce emissions. Nature 455, 460 (2008). https://doi.org/10.1038/455461a

framework, if possible, for a common and harmonised EU assessment methodology for the environmental sustainability of ECNs/ECSs, even though BEREC is still in a learning process in terms of environmental sustainability.

For 2022 and 2023, BEREC included a new workflow in its Work Programme that will consider the indicators which might help evaluate both the environmental sustainability of electronic communication networks and services and related initiatives from the sector.[73] This work item aims to examine the sustainability of ECNs/ECSs, covering the life cycle of networks and services, and to adopt a comprehensive multi-criteria analysis including GHG emissions and other types of relevant environmental impacts. The EU methodology "Product Environment Footprint" (PEF) to calculate the environmental footprint of products and services could be used as key analytical framework in that sense[74]. BEREC should also look into the standards elaborated by the ITU, ETSI and CEN-CENELEC when appropriate. Technical inputs from stakeholders (public institutions, economic players, think-tanks, consumer/civil society organisations, academic and research bodies) will be collected by BEREC for a Report on the topic to be published in 2023.

Furthermore, BEREC will investigate how its expertise on electronic communications could be further used to improve data accuracy on the ICT sector's environmental footprint. BEREC already has extensive experience in collecting data on ECNs/ECSs and believes that, together with its member NRAs, it can contribute to improving the quality of environmental data available based on its technical expertise.[75] This sectoral knowledge would be complementary to the work of relevant and competent bodies working on horizontal environmental aspects (such as environmental agencies), in order to assess which data is optimal for collection and how to analyse such data correctly. Such a cooperation could lead to the establishment of common goals and the harmonisation of data collection, which could in turn enhance the level of coordination and avoid extra administrative burden on providers and operators. 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. As mentioned in other BEREC work involving data-driven regulation,[76] sharing of regulatory practices in terms of a data-centric approach should be enhanced.

In addition to its contribution to the evaluation of ICT sector's environmental impacts by harmonised indicators and standardised data, which will be a core priority for BEREC with regard to sustainability work in 2022 and 2023, BEREC and NRAs could consider other tools under the current regulatory framework to promote sustainable networks. For instance, Article 44 of the EECC could be used to support environmental targets allowing competent authorities to impose co-location and sharing of fix and mobile network elements and associated facilities in order to protect the environment. Moreover, access to physical infrastructure under the BCRD could be used to avoid emissions when deploying networks and its upcoming revision could bring new possibilities to limit the sector's environmental footprint. Also, future State Aid schemes could take into account environmental aspects of network deployment in the light of the proposed recast of State Aid Guidelines for broadband. While

[73] BEREC Work Programme 2022, chapter 5.3.3.

[74] Product Environmental Footprint guide, European Commission, Join Research Centre and Institute for Environment and Sustainability https://ec.europa.eu/environment/eussd/pdf/footprint/PEF%20methodology%20final%20draft.pdf

[75] For instance, at this stage, energy consumption of networks was identified as one of the relevant information to consider evaluating the carbon footprint of the telecommunication sector.

[76] Including BEREC's own strategy for 2021 - 2025

keeping in mind its goals of promoting competition, connectivity and end user empowerment, BEREC could also address migration to next-generation technologies and switch-off more energy-intensive legacy technologies, considering the implied environmental benefits and potential drawbacks.[77]

Spectrum management functions held by some NRAs may offer possibilities to promote environmental sustainability objectives as well. In this regard, attention should be paid to the work developed by RSPG in 2021, which is continuing in 2022–2023, regarding the 'Role of Radio Spectrum Policy to help combat Climate Changes'. The possibility to consider sustainability-related issues when assigning spectrum could be further investigated by relevant authorities.[78] Moreover, BEREC and NRAs could also aim to gather additional knowledge on the most suitable way for the energy sector – considering its key role for combating climate change through the development of green energies and irrigating the efforts of other verticals through the use of sustainable solutions such as Smart Grids[79] – to access to radio spectrum either through the awarding of radio spectrum licences or any other best-fit approaches for capacity/spectrum access provisioning (use of public networks through network slicing, spectrum leasing, etc.). In that sense, certain NRAs have already awarded spectrum for use in these Smart Grids. Member NRAs of BEREC could also facilitate wider cross-sectoral discussions with energy regulators to foster exchanges of information on related issues in the digital and energy sector.

BEREC also envisages to work further on ways to encourage environment-friendly practices and the adoption of high environmental standards by digital players. BEREC could in that sense collaborate with other relevant bodies and stakeholders to participate to the assessment of potentially relevant practices and common targets for limiting the environmental footprint of the ICT sector. BEREC could also contribute to the establishment of Codes of Conduct on ECNs/ECSs in cooperation with stakeholders, the Commission and other competent bodies in the light of the positive example that has emerged from a similar Code of Conduct for data centres. BEREC could also investigate other potential levers, while simultaneously supporting existing efforts by the sector, such as guidelines, recommendations, etc. In coherence with its analysis regarding the Internet Ecosystem,[80] BEREC could also investigate to what extent the openness of digital markets in terms of device neutrality and open source solutions could be considered as levers for environmental sustainability, notably to extend digital products' lifespan and promote eco-design of digital services. BEREC could assist in developing such tools in close cooperation with other relevant bodies and seek to gain more knowledge from actors vertically in the ICT sector as well (e.g., content and application providers, data centres, devices manufacturers and in general, all entities and industries involved in various stages of digital services). BEREC could also use its expertise to contribute to the upcoming horizontal environmental legislations that could have significant effect on the impact of telecommunications and digitalisation on the environment, such as the recast of the Ecodesign Directive and the potential evolution of the WEEE Directive.

[77] BoR (21) 30 BEREC Opinion

[78] For instance, some NRAs in BEREC are exploring the potentiality to include sustainability-related matters in the design of licenses' conditions.

[79] Efficient utility network systems that typically use digital automation technology for monitoring, control, and analysis within supply chains, thus playing a key role in reducing GHG emissions.

[80] BoR (21) 75 BEREC Work Programme 2022, Item 2.

Furthermore, BEREC believes that end users' awareness on environmental issues may be a relevant tool to support greener digital solutions.[81] Many end users have no access to environmental data and indicators about digital equipment and services they are using. BEREC may consider supporting communication campaigns addressed to end users with the aim to raise awareness in terms of environmental information about most sustainable practices to reduce the impact of devices and certain uses. This data-driven approach of end users' empowerment could create positive incentives to digital players and limit risk of green washing. In general, BEREC could support and encourage recycling and re-use of network terminal equipment and of end user devices and can help promote more sustainable consumer behaviour by making them aware of their consumption patterns. With respect to raising environmental awareness among end users, collaboration with consumer associations, civil society organisations as well consumer and environmental protection agencies could prove to be valuable partnerships for BEREC to ensure a consistent message on the green transition in the digital sector.

BEREC will thus pursue its knowledge building regarding the environmental footprint of the digital sector and could also consider investigating subsequently the indirect or 'second order' environmental impacts of ICTs both positive (enabling effects on other sectors' decarbonisation through optimisation and substitution) and adverse ones (such as rebound effects) with regard to the work achieved by other initiatives, including related projects lead by the European Commission. Hence, BEREC could assess to what extent its expertise on digital markets could contribute to the existing efforts to elaborate a methodology to measure the net impact of ICTs, meaning both first and second effects of the digital sector on the environment.

In terms of other potential research questions, BEREC will pursue its work on environmental sustainability and could further explore other dimensions of sustainability in terms of economic and social impacts, notably in continuity with its ongoing work on the digital divide.[82] Finally, BEREC noticed that some NRAs and stakeholders are working on the adaptation to climate change to prepare for and adjust to both the current effects of global warming and the predicted impacts in the future. In this respect, a potential research question for BEREC could be how digital infrastructures could be affected and also constitute a lever for a more resilient society while facing the consequences of climate change.

To conclude, in application of its strategy 2021–2025 and in the light of its first findings on ICT environmental footprint, BEREC will continue to build up its knowledge on the important topic of sustainability to be able to contribute with its expertise to shaping the green and digital twin transition.

[81] In line with BEREC's Strategy 2021-2025
[82] BoR (21) 75 BEREC Work Programme 2022

ANNEX I – GLOSSARY

Bilan Carbone method: developed in 2004 by the French Environment and Energy Management Agency (ADEME), to quantify organisations' GHG emissions. It is promoted by the Association Bilan Carbone (ABC).

Climate neutrality: a concept of a state in which human activities result in no net effect on the climate system. Achieving such a state would require balancing of residual emissions with emissions (CO_2) removal as well as accounting for regional or local bio-geophysical effects of human activities that, for example, affect surface albedo or local climate.[83]

Enabling effect (on the environment): refers to the indirect or second order positive impact of one sector on the environment due to its capacity to enable the reduction of the environmental footprint of another (other) sector(s). Applied to the ICT sector, adoption of digital solutions has been proven to have the potentiality to support the decarbonisation of other sectors due to substitution and optimisation effects.[84]

Environmental effect: it is the result of environmental impacts on human health and welfare. The term is also used synonymously with environmental impact.

Environmental footprint: a multi-criteria measure of the environmental performance of a product or goods/services providing organisation based on a life cycle approach.[85] The term derives from the academic notion 'ecological footprint' that refers to the land (and water) area of the planet or particular area required for the support either of humankind's current lifestyle or the consumption pattern of a particular population. It is the inverse of the carrying capacity of a territory.

Environmental impact: it refers to the direct effect (also called first order effect) of socio-economic activities and natural events on the elements of the environment.

GHG Protocol:[86] The Greenhouse Gas Protocol Initiative is a multi-stakeholder partnership of businesses, non-governmental organisations (NGOs), governments, and others convened by

[83] PCC, 2018: Annex I: Glossary [Matthews, J.B.R. (ed.)]. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)].

[84] Lorenz M. Hilty, Bernard Aebischer, ICT Innovations for Sustainability, Springer international (2015)

[85] European Commission, 2013. Communication from the Commission to the European Parliament and the Council. Building the Single Market for Green Products. COM(2013) 196 final. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52013DC0196 (accessed 20 September 2013)

[86] ghg-protocol-revised.pdf (wbcsd.org)

the World Resources Institute (WRI), a U.S.-based environmental NGO, and the World Business Council for Sustainable Development (WBCSD), a Geneva-based coalition of 170 international companies. Launched in 1998, the initiative's mission is to develop internationally accepted GHG accounting and reporting standards for business and to promote their broad adoption.

Green House Gas (GHG) emissions: greenhouse gases refer to carbon dioxide, nitrous oxide, methane, ozone and chloro-fluorocarbons occurring naturally and resulting from human activities (production and consumption) and contributing to the greenhouse effect (global warming).

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

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.[87]

Paris Agreement: a legally binding international treaty on climate change. It was adopted by 196 parties at COP21 in Paris, on 12 December 2015 and entered into force on 4 November 2016. Its goal is to limit global warming to well below 2°C, preferably to 1°C, compared to pre-industrial levels. The Paris Agreement is a landmark in the multilateral climate change process because, for the first time, a binding agreement brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects.

Rebound effect (or take-back effect): the reduction in expected gains from new technologies that increase the efficiency of resource use, because of behavioural or other systemic responses. These responses diminish the beneficial effects of the new technology or other measures taken. The rebound effect is generally expressed as a ratio of the lost benefit compared to the expected environmental benefit when holding consumption constant.[88]

Science Based Targets (SBTs): provide a clearly defined pathway for companies to reduce GHG emissions, helping prevent the worst impacts of climate change and future-proof business growth. Targets are considered 'science-based' if they are in line with what the latest climate science deems necessary to meet the goals of the Paris Agreement – limiting global

[87] https://sustainabledevelopment.un.org/content/documents/846Why_take_a_life_cycle_approach_EN.pdf#:~:text=A%20life%20cycle%20approach%20identifies%20both%20opportunities%20and,to%20comprehensive%20quantitative%20approaches%20%28life%20cycle%20assessment%20studies%29

[88] Grubb, M.J. 'Energy efficiency and economic fallacies', Energy Policy, 1990

warming to well-below 2°C above pre-industrial levels and pursuing efforts to limit warming to 1.5°C.

Science Based Targets initiative (SBTi): 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 mobilizes companies to set net-zero science-based targets in line with a 1.5° C future.

Sustainable Developments Goals (SDGs): also known as the Global Goals, adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet, and ensure that by 2030 all people enjoy peace and prosperity. The 17 SDGs are integrated – they recognise that action in one area will affect outcomes in others, and that development must balance social, economic and environmental sustainability.

The Fit-for-55 package: a package presented by the EU for revision of its climate, energy and transport related legislation in order to align current laws with the 2030 and 2050 ambitions. As a part of the European Green Deal, with the European Climate Law, the EU has set itself a binding target of achieving climate neutrality by 2050. As an intermediate step towards climate neutrality, the EU has raised its 2030 climate ambition, committing to cutting emissions by at least 55% by 2030.

Main sources:[89] Glossary of Environment Statistics, Studies in Methods, Series F, No. 67, United Nations, New York, 199.

[89] If not specified in a footnote.

ANNEX II – SUMMARY OF INITIATIVES OF STAKEHOLDERS INTERVIEWED BY BEREC IN 2021/2022

Bilateral meetings with stakeholders were organised by BEREC in the first half of 2021 in order to collect information for this report and to identify relevant initiatives on ICTs' sustainability and other regulators' approach on sustainability. The initiatives and main views of these stakeholders regarding sustainability in the digital sector are summarised in the following section.

1. EU bodies and institutions

1.1. The European Commission

In the upcoming years, the environmental sustainability of ICTs is expected to continue to gain a significant interest by the Commission. The Green Deal is impacting all aspects of the current Commission's activities.

BEREC met with three of the Directorates-General (DGs) that are investigating the topic: The Directorate-General for Communications Networks, Content and Technology (DG Connect), Directorate-General for the Internal Market, Industry, Entrepreneurship & SMEs (DG GROW), and The Directorate-General for Energy (DG Energy).

i. DG CONNECT

Digital solutions are powerful enablers for the sustainability transition. They can advance the circular economy and reduce the environmental footprint of products placed on the EU market. They can also support the decarbonisation of other sectors like agriculture, energy and transport, which benefit from innovative technologies to become smarter and greener. At the same time, the energy and material efficiency need to be significantly improved in order to allow the ICT sector to lead the transition to carbon neutrality by 2050.

DG Connect is leading several initiatives in the field of ICT and sustainability, such as the circular electronic initiative, goal for data centres to be climate neutral by no later than 2030, and transparency measures for electronic communications.[90] Others include the European Strategy on data (a common European Green Deal data space), and the Circular Economy Action Plan.[91] Regulatory measures for tablets, mobiles and possible software are being envisaged through Ecodesign directive.[92] DG Connect has been instrumental in setting up partnerships such as the European Green Digital Coalition (EGDC) and is following other initiatives lead by the industry such as the Climate Neutral Data Centre Pact.

The EGDC was established by 26 CEOs of major ICT companies that are committed to be climate neutral by 2040, including Vodafone, Orange, Deutsche Telekom, Telefonica, Telia, KPN, Proximus, Liberty Global, NOS and others. These ICT companies are about to develop,

[90] https://ec.europa.eu/info/sites/default/files/communication-shaping-europes-digital-future-feb2020_en_4.pdf

[91] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0066&from=EN

[92] The Ecodesign Directive provides consistent EU-wide rules for improving the environmental performance of products, such as household appliances, information and communication technologies or engineering. (for more information see: https://ec.europa.eu/growth/industry/sustainability/sustainable-product-policy-ecodesign_en)

in cooperation with experts, science-based methodologies to measure the positive impact of digital solutions (i.e. emission reduction), with connectivity / 5G being an integral aspect.[93]

With regard to electronic communications networks and services DG CONNECT has conducted an external study to explore (i) a possible transparency mechanism on the environmental footprint of electronic communications networks and services towards end users and (ii) criteria for the assessment of the environmental sustainability of new electronic communications networks.[94] The Commission's work on the field of sustainability is ongoing and, so the above list of initiatives is not exclusive.

ii. DG Grow

The Commission is currently running a study on CO_2 footprint of parcel delivery. It will mostly focus on e-commerce, the number of air polluters and the transport chain of e-commerce. Also, it will consider the impact of brick-and-mortar stores (not focused on warehouses) and take into regard possible returns of goods by the customers. It will examine the critical factors in the chain and provide more information about them, e.g. how they might evolve. The assessment should examine how the e-commerce and logistic models are going to change and will cover both European and international e-commerce volumes. The final report is expected in April 2022.

iii. DG Energy

DG Energy is leading several initiatives to support the Commission's ambition to further the twin green and digital transition. In that sense, ICTs in the energy system are identified as a significant driver of change regarding the way in which we supply, purchase and interact with energy, as well as the pathways we can take towards decarbonising the system. While the benefits of integrating digital technologies in the energy system are certain, the increased energy demand for ICT equipment, networks and services needs to be adequately managed in the context of an integrated energy system. In that sense, DG Energy is working on the Action plan on the digitalisation of the energy sector that was under public consultation by January 2022. This roadmap is elaborated in the context of the European Green Deal objectives and considers 5 levers for action, including one relevant to BEREC's work on sustainability: "Supporting the development and uptake of climate neutral solutions for the Information and Communication Technologies sector as complementing in the European Digital Strategy focussing on measures that promote cooperation between the energy sector and the digital sector'.[95]

In that perspective, DG Energy is also working in close collaboration with DG Connect on new instruments to work toward ICT-related goals from the European Green Deal, such as the revision of the Ecodesign Directive,[96] and the energy efficiency of data centres, which is

[93] DG Connect launched and funded an EP Pilot project which aims in setting up governance and cooperation mechanisms to support the EGDC in its commitments to make the net benefit of digital solutions measurable and thus to incentivise investors, procurers, and individuals to prioritise investments in such technologies. The project's consortium includes Global Enabling Sustainability Initiative (GeSI), European DIGITAL SME Alliance, DIGITALEUROPE, ETNO, GSMA, Carbon Trust, Deloitte, and Sustainable ICT Consulting.

[94] Study on Greening Cloud Computing and Electronic Communications Services and Networks: Towards Climate Neutrality by 2050, IDEA and Oko-Institute, March 2022 : https://digital-strategy.ec.europa.eu/en/library/study-greening-cloud-computing-and-electronic-communications-services-and-networks-towards-climate

[95] Digitalising the energy sector – EU action plan https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/13141-Digitalising-the-energy-sector-EU-action-plan_en

[96] Sustainable products initiative (revision of EU Ecodesign Directive) https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12567-Sustainable-products-initiative_en

notably addressed by the Commission's proposal recasting the Energy Efficiency Directive published on 14 July 2021.[97]

1.2. Council of the EU (Portuguese Presidency)

The environmental footprint of ICTs is identified as important subject of the European Council. The Council adopted ambitious conclusions in November 2020 inviting the Commission to take measures to limit the digital sector's environmental footprint. In this decision, the Council recognised the need to continue the deployment of digital infrastructure while emphasising the importance of ensuring the application of eco-design and energy efficiency criteria. The body also addressed the lack of information available on the net environmental impact of new technologies and invited the Commission to develop indicators to better guide actions aimed at reducing the environmental footprint (not only carbon but also in terms of energy, water consumption, extraction, or waste). The Council congratulated the Commission for its "new carbon neutral objectives for data centres and enjoined the European executive to take regulatory and non-regulatory measures without delay to support the efforts on the transparency and the reduction of the environmental footprint of data centres and electronic communications networks".[98] In these conclusions, the Council also acknowledged that 5G deployment could lead to a new generation of compatible terminals highlighting the need for an ambitious plan for collecting and recycling devices. Thus, the Council also requested the Commission to set up in 2021 an action plan on the repair of digital equipment.

Besides, on Digital Day 2021 under the Portuguese presidency in 2021,[99] the biggest European companies also pledged to develop a methodology on counting the handprint of ICT (positive impact on another sector and the sector's own environmental footprint). The project is coordinated in partnership with the Commission and first results are expected in 2022.

1.3. European Parliament

In the European Parliament, Committees on Internal Market and Consumer Protection (IMCO) and on the Environment, Public Health and Food Safety (ENVI) share certain competences on the subject of the environmental sustainability of ICTs, on issues such as the availability of information, the right to repair, etc.

i. ENVI Committee and Renew Europe group

One of the main relevant inputs on digital technologies' sustainability within ENVI committee was the report on the New Circular Economy Action Plan[100] led by the rapporteur Jan Huitema (Renew Europe) that addressed the question of ICTs' environmental footprint. This report notably "urges the Commission, therefore, to put forward the corresponding regulatory and other necessary measures without delay, and to implement governance and market instruments to support the creation of standardised documentation and transparency about the circularity, environmental and climate footprint of data centres and communication [sic]

[97] Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on energy efficiency (recast)https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52021PC0558

[98] https://www.consilium.europa.eu/en/press/press-releases/2020/12/17/digitalisation-for-the-benefit-of-the-environment-council-approves-conclusions/ https://www.consilium.europa.eu/en/press/press-releases/2020/12/17/digitalisation-for-the-benefit-of-the-environment-council-approves-conclusions/

[99] https://digital-strategy.ec.europa.eu/en/news/companies-take-action-support-green-and-digital-transformation-eu

[100] https://www.europarl.europa.eu/doceo/document/A-9-2021-0008_EN.html

networks". More generally, the report supports the general ambition of the Commission's Circular Economy and ICT-related targets, particularly on electric and electronic waste and the importance of reuse. It insists on the need to apply eco-design requirements on devices as well as implementing certification for recycling processes and securing a sufficient level of information for consumers.

ENVI committee also adopted in November 2021 an opinion on 'A European Strategy for primary raw material', which focused on handling of rare metals essential to the manufacturing of digital technologies.[101]

ii. IMCO committee and Greens/EFA group

In parallel, the report 'Towards a more sustainable single market for business and consumers'[102] of the rapporteur MEP David Cormand (Greens/EFA group) from the IMCO committee also includes important principles for steering the digital sector's environmental footprint. The IMCO report states that the greatest proportion of the environmental impact of products happens during their manufacturing: for example, more than 80% of the environmental impact of a smartphone comes from its production phase. Repairability of products needs to be a central goal to achieve climate neutrality. In addition, resource consumption and device lifetime need to be considered. The main recommendations of this report regarding the digital sector from a consumer protection perspective are: product lifetime and repairability, a mandatory labelling requirement to communicate the expected lifetime of products, standardisation, a product passport, a digital index assessing the environmental impact of digital technologies, information on the supply chain environmental footprint (including networks) and obligations for digital advertisement. Accordingly, it was outlined as of particular importance to integrate environmental goals into businesses' strategies and targets.

Complementary to this report, the Greens/EFA also published in December 2021 a report 'Digital technologies: a life cycle approach (LCA)'[103] assessing ICTs' environmental footprint with the support of external experts such as Bureau Veritas, APL Data center, or Green IT. The main goal of this study is to take into account "the impacts generated during all stages of the life cycle of equipment or services, from the extraction of resources that are often not easily accessible to the production of waste, including installation processes, energy consumption during the use phase" with a multi-criteria LCA framework. This study proposes a robust methodology in assessing the environmental footprint of the digital sector with the aim of making such assessments common practice in future technological decisions and investments.

1.4. Environmental Engineering Committee

ETSI's Environmental Engineering Committee (TC EE) manages various engineering aspects of Information Communication Technology equipment. These include environmental conditions (temperature, humidity, mechanical, chemical, etc.), physical requirements (including thermal) of equipment racks and cabinets, power supply aspects and grounding,

[101] ENVI Opinion on a European Strategy for primary raw material (2021/2011 INI) https://www.europarl.europa.eu/doceo/document/A-9-2021-0280_EN.html

[102] https://www.europarl.europa.eu/RegData/etudes/ATAG/2020/659357/EPRS_ATA(2020)659357_EN.pdf https://www.europarl.europa.eu/doceo/document/A-9-2020-0209_EN.html; https://www.europarl.europa.eu/RegData/etudes/ATAG/2020/659357/EPRS_ATA(2020)659357_EN.pdf

[103] https://extranet.greens-efa.eu/public/media/file/1/7388?utm_source=POLITICO.EU&utm_campaign=9f38af9d6c-EMAIL_CAMPAIGN_2021_12_07_05_59&utm_medium=email&utm_term=0_10959edeb5-9f38af9d6c-189780953

Circular Economy (including life cycle analysis), and energy performance measurement and assessment methods for different ICT equipment and radio access networks. ETSI is working closely with the Commission on different aspects of standardisation. These topics are related to environmental engineering, energy efficiency determination, management and monitoring, environmental impact assessment and energy efficiency management for ICT, LCA and Circular Economy. They are providing measurement methods to assess the energy efficiency of ICTs equipment and networks, methodology to determine the environmental impact for ICT products/networks/services, best practices and guidelines to improve/monitor ICTs' energy efficiency and a set of standards for designing and building efficient ICT networks. ETSI TC EE is working with CEN-CENELEC on various topics like material efficiency, energy efficiency, Green Data Centres and adaptation to climate change within joint working/coordination groups.[104]

ETSI has developed a set of teaching materials on standardisation. With the support of the Commission and the EFTA Secretariat, ETSI has developed a comprehensive textbook, 'Understanding ICT Standardisation: Principles and Practice.'[105]

1.5. European Regulators Group for Postal Services

The European Regulators Group for Postal Services (ERGP) set a work stream on environmental sustainability of the postal sector in 2021. They were exploring the extent to which they can incorporate the topic. As well as in the telecom sector, the NRAs do not have often enough knowledge and experience in this field and are aware that they lack the powers and possibilities to incorporate any measures yet.

The report of ERGP[106] describes which sustainability goals the postal sector can have and how it could be incorporated into the regulatory framework in coherence with the Commission's potential decision on these matters. The report investigates the impact of the postal sector on the environment and explores measures that postal operators undertake to reduce their environmental impact. The report pays special attention to the assessment, prevention and mitigation by the postal operators of adverse environmental impacts arising during operators' activities.

ERGP's 2022 Work Programme deems that environmental sustainability topics will become an essential element in the development of not only the postal industry but of the different economic sectors. The ERGP Work Program 2022 created a specific Working Group on Sustainability. In 2022, it will work on a report considering the outcomes of the study ordered by the Commission to assess and analyse the impact of e-commerce driven transport and parcel delivery on air pollution and CO_2 emissions, , and the outcomes of the ERGP work during 2021. The ERGP report will seek to assess the sustainability measures implemented by postal operators in the field of CO_2 emissions reduction, cleaner delivery and emission-free city logistics, the availability of different tools to promote sustainability in the postal sector, as well as the potential impacts of sustainability measures in the postal sector, e.g. on quality, customer experience, competition, performance and economic viability. Furthermore, the

[104] Further information can be found at: https://www.etsi.org/technologies/energy-efficiency and https://www.etsi.org/technologies/environmental-aspects
[105] www.etsi.org/standardisation-education
[106] https://ec.europa.eu/docsroom/documents/46255

report would keep monitoring the measures implemented by operators to become more sustainable and identify good practices.

1.6. Radio Spectrum Policy Group

Under the Climate Change work item, the Radio Spectrum Policy Group (RSPG) initiated a debate amongst its Members, as well as with the relevant stakeholders, on how spectrum policy can help to combat climate change.

The 2021 report[107] gathers information on the climate change-related aspects within spectrum management, the possible options in radio spectrum policy and spectrum management can help to combat climate change and which concrete actions at EU-level can RSPG recommend. The Annexes complement the information presented by introducing some background material on standardisation and work in standards development bodies regarding energy efficiency, circular economy and e-waste.

The 2021 opinion,[108] subsequent to the Report, contains recommendations as to what concrete actions can be taken at EU level.

1.7. European Environment Agency

The European Environment Agency (EEA) is an EU agency tasked with providing sound, independent information on environment and climate. It operates as a major information source for those involved in developing, adopting, implementing and evaluating environment and climate policy, and also for the general public. EEA's mandate is to help the EU and its member countries to make informed decisions about improving the environment, integrating environmental considerations into economic policies, moving towards sustainability, and to develop and coordinate Eionet, the network of national environmental bodies set up to help the agency.

The EEA has not yet any specific research on ICTs' sustainability but it published some work related to circular economy, energy consumption and waste management in that matter, notably a report published in June 2020 on 'Electronics and obsolescence in a circular economy' and the related briefing: 'Europe's consumption in a circular economy: the benefits of longer-lasting electronics' as well as a briefing on 'Digital technologies will deliver more efficient waste management in Europe' in January 2021.[109]

The EEA is also playing a leading role in the EU Agencies Network, chairing it in 2021, with the focus on improving the environmental performance in the affiliated organisations by promoting the adoption of environmental management systems that are based on EMAS, the EU Eco-management and audit scheme.

[107] https://rspg-spectrum.eu/wp-content/uploads/2021/06/RSPG21-027final-Draft_RSPG_Opinion_on_Climate_Change.pdf
[108] https://rspg-spectrum.eu/wp-content/uploads/2021/11/RSPG21-041final-RSPG_Opinion_on_climate_change.pdf
[109] https://www.eea.europa.eu/publications/europe2019s-consumption-in-a-circular/benefits-of-longer-lasting-electronics
https://www.eionet.europa.eu/etcs/etc-wmge/products/electronics-and-obsolescence-in-a-circular-economy
Digital technologies will deliver more efficient waste management in Europe — European Environment Agency (europa.eu)

1.8. European Committee for Standardisation and the European Committee for Electrotechnical Standardisation

The European Committee for Standardisation and the European Committee for Electrotechnical Standardisation (CEN and CENELEC) have published a policy paper on technical standards to support the Commission's Green Deal strategy. Standards can help to achieve these policy goals as they are meant to clarify commonly accepted definitions, to provide methods for measuring and testing, and to open markets to the safe use of new technologies. There are around 300 technical committees that develop standards and their aim is to use the experts' knowledge in the most efficient manner. There is also a 'green helpdesk' made available by CEN and CENELEC. Finally, they are also focusing on smart cities, with reference to sustainable and smart mobility.

2. International organisations and other authorities

2.1. Organisation for Economic Co-operation and Development (OECD)

i. Network of Economic Regulators

The OECD's Network of Economic Regulators (NER), a subsidiary body of the OECD's Regulatory Policy Committee, brings together more than 70 regulators from across OECD and non-Member countries overseeing utility sectors such as e-communications, energy, transport and water. It collects and disseminates comparative data and good practices, providing rigorous analysis and offering a platform for policy dialogue related to the governance and performance of regulators and emerging trends and challenges for economic regulation.

Recognising the important role of network sectors in countries' efforts to decarbonise, the NER co-organised a seminar with Dauphine University's Club of Regulators on regulatory approaches to meet the decarbonisation challenge. The seminar brought together academics and practitioners from regulators and regulated companies to explore challenges and opportunities faced by economic regulators when advancing decarbonisation.

The NER explores the economic regulator's role in decarbonisation in its ongoing peer review of the price-setting process in the Scottish water sector. The peer review (expected publication in 2022), details how the economic regulator of the sector (the Water Industry Commission for Scotland), working in collaboration with the state-owned service provider and other sector stakeholders, put into place new mechanisms to advance an ambitious net-zero goal from the Scottish government.

ii. Working Party on Communication Infrastructure and Services Policy

The OECD Working Party on Communication Infrastructures and Services Policy (WPCISP) has an upcoming report on 'Networks of the Future', which sets out the main trends in the next evolution of broadband networks as well as selected regulatory and policy implications (OECD, forthcoming). It looks at the evolution of fibre and 5G deployments, as well as the main four technological trends shaping the future of networks: i) virtualisation, ii) the integration of cloud services, iii) the use of artificial intelligence (AI) systems, and iv) the shift towards openness in networks (including Open RAN). Finally, the report highlights that as networks evolve, regulation also needs to adapt to foster network upgrades and deployments. In particular, this report points to the increased interest from delegates on the topic of the environmental

sustainability of networks, highlighting that communication regulators recognise the importance of this issue, as made evident in the OECD Council Recommendation Broadband Connectivity adopted in February 2021.[110] This legal instrument also gives the Working Party a mandate to explore this issue in future work.

With regard to what communications regulators can do to promote sustainability, a range of instruments exists, according to the Working Party. For example, spectrum management can be considered as one useful tool: more mid-band spectrum allocated for 5G could be more energy efficient according to a GSMA study.[111]

In terms of future trends to look at, the use of AI systems and virtualisation of networks could be considered when assessing the environmental impact of communications networks. Infrastructure sharing can also be an important aspect, in particular when looking at co-investment projects and 'dig-once' policies to reduce the environmental impact (e.g. negative impact on biodiversity). In addition, fostering smart devices, such as the Internet of Things (IoT), may have a positive impact on the environment.

2.2. International Energy Agency

The International Energy Agency (IEA) is an autonomous intergovernmental organisation providing analysis, data, policy recommendations, and real-world solutions to help countries provide secure and sustainable energy for all.

The agency's annual 'Tracking Clean Energy Progress' report assesses the progress of over 40 energy technologies and sectors towards net-zero goals, including data centres and data transmission networks.[112] In the most recent update in November 2021, the report recognised data centres and networks' strong progress on energy efficiency and renewable energy, but that "more efforts were needed" for the sector to align with a net-zero by 2050 pathway. It showed that global data centres workloads had increased by a factor of 9 over the last decade while energy usage has increased by only 10% due to efficiency improvements, contrary to some earlier studies that had projected a rapid growth in energy use. Another analysis[113] by the IEA examined the energy use and carbon emissions from streaming video and found that another earlier study (widely cited by the media) had overestimated the carbon footprint by a factor of 50 due to technical errors and outdated assumptions. It also found that the majority of end-to-end energy for streaming is used by consumer devices and hardware such as TVs and home modems and routers, instead of wide area networks or data centres.

These examples demonstrate how rapid changes in technologies (and how they are used) combined with a lack of up-to-date data make it difficult to accurately estimate the current and future energy impact of digital technologies, particularly for emerging technologies such as 5G. Although the energy intensity of 5G is likely to be lower than previous generations, it is not clear whether widespread 5G deployment will lead to a net increase or decrease of total network energy consumption. There is a need to further develop and use robust methodologies, taking a full LCA approach, to assess the energy impact of digitalisation,

[110] The OECD Council Recommendation on Broadband Connectivity [OECD/LEGAL/0322] states the following: "**IV. RECOMMENDS** that Adherents minimise negative environmental impacts of communications networks by: 1. Supporting and promoting smart and sustainable networks and devices. 2. Encouraging communications network operators to periodically report on their environmental impacts and initiatives.

[111] https://www.gsma.com/spectrum/wp-content/uploads/2021/07/5G-Connectivity-%E2%80%93-Meeting-IMT-Mid-band-Spectrum-Needs.pdf

[112] https://www.iea.org/reports/data-centres-and-data-transmission-networks

[113] https://www.iea.org/commentaries/the-carbon-footprint-of-streaming-video-fact-checking-the-headlines

including effects on other services and sectors (e.g. the impact of teleworking on energy use from transport and buildings).

The report includes several recommended actions for government and industry, such as policies and actions to improve the energy efficiency of data centres and data transmission networks and reduce life cycle environmental impacts. It also highlights the need for better data collection and transparency, including data on the energy consumption of telecoms networks.

2.3. International Telecommunication Union

The ITU-T Study Group 5 of the Standardisation Sector of the International Telecommunication Union (ITU-T SG5) is responsible for studies on methodologies for evaluating ICTs' effects on climate change and publishing guidelines for using ICTs in an eco-friendly way. ITU-T SG5 also works to reduce the adverse environmental effects of ICTs, such as e-waste, and support the transition to the circular economy. In addition to its climate-focused activities, ITU-T SG5 is working on Electromagnetic Compatibility (EMC), lightning protection, and Electro Magnetic Field (EMF) related issues as well. This report primarily focuses on ITU-T SG5's climate activities.

ITU-T SG5's latest standards (also known as ITU-T Recommendations of the L series) provide authentic guidance for improving the energy efficiency of mobile network. They contain energy efficiency metrics and measurement methods for telecommunication equipment, sustainable realisation of 5G radio, data centre and telecommunication room and method for circular economy scoring. ITU-T SG5 is also actively working towards supporting the achievement of a sustainable digital transformation and aligning the ICT sector with the climate targets set in the Paris Agreement and the United Nations Sustainable Development Goals.

The 'Assessment methodologies of ICTs and CO_2 trajectories' series is composed by 11 different standards covering the assessment of GHG emissions in products, sectors, projects, cities but also the GHG reduction trajectory for ICT sector to respect Paris agreement and setting the net-zero targets and strategies.

There is a set of questions[114] related to environmental issues that is currently being studied by ITU-T SG5. These questions deal with climate change mitigation, resilience of digital technologies, circular economy, sustainable cities and the assessment of digital technologies in light of the SDGs, best practices for net-zero and their GHG assessment, and GHG emission indicators for networks.

ITU-T SG5 carries out its own research and develops reports and case studies such as the 'Frontier technologies to protect the environment and tackle climate change'.[115] This report highlights the latest work carried out by ITU-T SG5, including the latest topics covered by the group, updates to its work, and recent publications.

2.4. The Office of Communications (UK)

[114] https://www.itu.int/net4/ITU-T/lists/loqr.aspx?Group=5&Period=16

[115] https://www.itu.int/en/action/environment-and-climate-change/Documents/frontier-technologies-to-protect-the-environment-and-tackle-climate-change.pdf

While the current statutory functions (objectives, duties and powers) of the UK's Office of Communications (Ofcom) do not cover environmental matters, Ofcom considers that it is vital that communications companies invest to put themselves on a sustainable footing so that their networks and services are fit for the long term. Achieving that outcome requires communications companies to consider their own environmental footprint and how they deliver services and networks in a sustainable matter. Going forwards, Ofcom will continue to engage with regulated firms on these matters.[116]

As part this work, Ofcom has been undertaking research to better understand the CO_2 emissions produced in Ofcom's regulated sectors and how regulated firms are working towards a net-zero target. This work has been done through internal and commissioned research together with engagement with communications companies which have voluntarily shared information about their environmental initiatives.[117]

Ofcom is also a member of the UKRN (UK Regulators Network)[118] which brings together regulators from the UK's utility, financial, transport and professional service sectors, for the benefit of consumers and the economy. UKRN established a Working Group on Climate Change in 2020 which seeks to understand (i) how regulators can enable effective planning of, and investment in climate mitigation, (ii) how to enable the fair distribution of costs and benefits to consumers in climate mitigation and (iii) explore how regulators could monitor and/or report progress on climate risks using a balanced set of measures.

3. Consumer and civil society representatives

3.1. European Environment Bureau

The European Environmental Bureau (EEB) is Europe's largest network of environmental citizens' organisations. They advocate for progressive policies to create a better environment in the European Union and beyond.

Concerning digital sustainability, they focus on resource use, energy efficiency and eco-design. In these areas, the EEB helps to lead two relevant campaigns, the Cool products and the Right to Repair campaigns. They claim there is a need to achieve absolute reductions in the material and ecological footprint resulting from a growing number of devices. This global perspective on the footprint from technology is often overlooked. In short, energy efficiency gains per bit of data are not sufficient and global impacts needs to be considered, including production and waste management. In that respect, the EEB is contributing to the sustainable products initiative at the EU level, right to repair legislation, as well as the existing eco-design framework for energy using products.

Further, the EEB argues that sustainability also contains other dimensions than energy consumption alone, such as social justice. For instance, the need to consider the positive impact of digitalisation in increasing transparency and data transfer in a circular economy, while at the same time controlling how data and algorithms are used today (e.g. big data for marketing is not sustainable and drives over consumption). The EEB also recognises the need

[116] https://www.ofcom.org.uk/__data/assets/pdf_file/0023/229640/Consultation-Ofcoms-proposed-plan-of-work-2022-23.pdf
[117] https://www.ofcom.org.uk/__data/assets/pdf_file/0035/229688/connected-nations-2021-uk.pdf
[118] https://www.ukrn.org.uk/publications/ukrn-annual-report-and-multi-year-work-plan-2021/

to tackle due diligence issues, such as conflict minerals, labour rights and exposure to toxic chemicals throughout the value chain of technology.

3.2. Bureau Européen des Unions de Consommateurs

Bureau Européen des Unions de Consommateurs (BEUC) is the umbrella group for 46 independent consumer organisations from 32 European countries. There are several different divisions/teams within BEUC working on different aspects of policy areas that include sustainability. In the view of the upcoming recast of the Ecodesign Directive, BEUC is working on the perspective of hardware, but also on the users' perspective to ensure they can use the devices securely and sustainably touching upon software obsolescence. Their dedicated paper[119] on the upcoming Sustainable Products Initiative includes recommendations for a revision of the Ecodesign Directive. BEUC notably defends eco-design requirements that go beyond the sole criteria of energy efficiency to systematically cover also lifetime and repairability requirements, including software aspects. Both functionality and security updates should be provided for the entire lifespan of the product.

In a paper issued on the topic,[120] BEUC recommends that both the producer and the seller would be liable (jointly and severally liable) towards the consumer for the time period indicated on the EU guaranteed lifespan label. This paper also touches upon the longer availability of updates for software and operating systems, which run on digital devices, to tackle the so-called software obsolescence. BEUC also published a position paper[121] on 'green washing' and the need to restore consumer confidence in green claims. In that paper, BEUC calls on the EU to be ambitious and introduce measures that can effectively clean up the market from all misleading green claims and labels. It also recommends establishing a pre-approval scheme for all green claims by an EU authority (e.g., the EEA) which could be inspired by the scheme already in place for the health and nutrition claims in food since 2006.

In another paper on the IoT,[122] BEUC recognises the need to tackle 'premature obsolescence', the widespread early failure of connected devices. That includes practices of planned obsolescence where connected devices could be rendered obsolete when manufacturers stop providing vital software updates and the lack of product repairability. BEUC considers that the lack of product repairability is one of the key aspects contributing to premature obsolescence, as consumers face many barriers to repairing their connected products, such as the lack of repair information and availability or affordability of services.

3.3. SHIFT Project

The Shift Project published a report in 2021[123] on digital technologies' environmental impact, especially 5G and its governance as an update to the scenarios presented in their first publications on ICTs' sustainability, particularly 'Lean ICT: Towards digital sobriety' (2019).[124]

[119] BEUC, Making more sustainable products the new normal: Consumer recommendations for a meaningful EU Sustainable Product Initiative, https://www.beuc.eu/publications/beuc-x-2021-075_making_more_sustainable_products_the_new_normal.pdf

[120] BEUC, Durable and repairable products : Changes needed for a successful path towards the green transition, 2021 https://www.beuc.eu/publications/beuc-x-2021-061_durable_and_repairable_products_beuc_position_paper.pdf

[121] BEUC, Getting rid of Green Washing : Restoring consumer confidence in green claims (2021) https://www.beuc.eu/publications/beuc-x-2020-116_getting_rid_of_green_washing.pdf

[122] BEUC, *Protecting European Consumers in a world of connected devices* (2021) https://www.beuc.eu/publications/beuc-x-2021-091_protecting_european_consumers_in_the_world_of_connected_devices.pdf

[123] https://theshiftproject.org/wp-content/uploads/2021/03/Note-danalyse_Numerique-et-5G_30-mars-2021.pdf

[124] https://theshiftproject.org/wp-content/uploads/2019/03/Lean-ICT-Report_The-Shift-Project_2019.pdf

There are two main conclusions in their newest report in the terms of environmental impact of the digital sector particularly relevant to electronic communications. Firstly, it is important not to focus only on utilization of electricity, rather also on the device production process (which represents almost 50% of the environmental impact). Secondly, that the impact of data centres and networks on electricity consumption should not hide the impact of devices (in their estimate, consumer devices represent 60% of the digital electricity consumption). In addition, it is more difficult to address what billions of consumers are doing on their devices.

According to the Shift Project, it is therefore important to find a way not to produce much more equipment. One worrying trend is the rising energy consumption of TV sets as their environmental footprint is growing due to the increase of the size of the screen. Regarding data centres, the Commission procured a study in 2020[125] which confirms that electricity consumption is increasing, more in the most developed countries, and that the volume of data centres is also increasing. For the net result, it is likely 5–6% growth in electricity consumption (realistic estimation of worldwide electricity consumption of data centres in 2018 is around 400 TWh). On the network side, fibre is replacing copper, which decreases the impact. However, electricity consumption due to mobile networks is simultaneously increasing by 10%. Overall, the estimation of network impact by the Shift Project is an increase of around 5%. Regarding devices, although smartphone production had been decreasing in the past three years, the Shift Project predicts that it will rise by 3% a year until 2025 as a consequence of the introduction of 5G. The growth of IoT is 21% per year, leading to 25 billion devices in 2025. In addition, crypto currency and bitcoin have become a new cause for concern given the pace at which their electricity consumption is increasing (30 to 40% a year).

The Shift Project claims that the digital sobriety principle is needed to contain and reduce the environmental impact of the digital sector. Digital sobriety means both that we need to ensure the growth of our digital usage does not exceed the rate of technological progress and that we should prioritize digitalisation initiatives against their net environmental outcome. Environmental impact must be on the agenda of vendors, operators, manufactures and consumers, with a focus on energy consumption without neglecting other environmental impacts, according to the Shift Project.

4. Industry associations

4.1. European Competitive Telecommunications Association

The European Competitive Telecommunications Association (ECTA) works to support the regulatory and commercial interests of telecom operators, ISPs & equipment manufacturers. It aims to promote a fair regulatory environment that allows all electronic communications providers to compete on level terms. ECTA members have understood they need to act on the environment and are committed to act for years. Companies (operators) take very strong commitments to reduce carbon footprint. They are following the Commission's initiative on methodology to assess the environmental impact and they also recommend code of conduct as a good tool for companies to achieve their environmental sustainability goals.

ECTA members point out that the carbon footprint of networks is directly linked to the ever-increasing data traffic. According to them, the Commission should assess the appropriate way

[125] https://ec.europa.eu/info/news/green-and-digital-study-shows-technical-and-policy-options-limit-surge-energy-consumption-cloud-and-data-centres-2020-nov-09_en

to incentivize content providers to decrease their environmental impact. The members also choose various strategies of controlling their own impact on environment while ensuring the quality of digital technologies. E.g. they are introducing innovative technological solutions to decrease consumption of energy and carbon emissions, preventing programmed obsolescence, or re-use or recycle the equipment. They also follow sustainability objectives like SBTs or engage in various initiates on circular economy, sustainable energy procurement, etc.

4.2. Global System for Mobile Communications Association

The GSMA agreed an ambition for the mobile sector to be net-zero carbon emissions by 2050 at the latest and encourages it members to set targets in line with limiting global heating to 1.5C. It supported the creation of the European Green Digital Coalition with its accelerated commitment of net-zero by 2040, and half of the founding signatories were GSMA members. To supports its net-zero ambition, the GSMA created a Climate Action Taskforce, which now has more than 50 of the largest operators globally as members. The Taskforce collaborates on key issues to reduce climate impacts such as energy efficiency, renewable electricity, supply chain engagement and the circular economy.[126]

4.3. European Telecommunications Network Operators' Association

European Telecommunications Network Operators' Association (ETNO) represent Europe's main telecom operators. It defines its sustainability priorities through its Sustainable Development Working Group, the Sustainable Finance workstream and the Green Deal Task Force[127]. In addition to that, ETNO sits in the Board of GeSI, the global e-Sustainability initiative.

In 2021, ETNO together with the Boston Consulting Group (BCG) published a report 'Connectivity and Beyond: How Telcos Can Accelerate a Digital Future for All'.[128] According to the BCG findings, the enabling potential for ICTs and a widespread uptake of digital solutions can reduce carbon emissions by up to 15%. In the view of ETNO, building gigabit networks and innovative digital services can help increasing productivity and generating a smarter way of working, in line with the Commission's Recovery Plan. Also, ETNO believes that ECNs are the core enablers helping to reduce CO_2 emissions across many other sectors, and the whole economy. Therefore, 11 CEOs from ETNO's member operators joined others to co-sign a declaration to take action to support the green and digital transformation of the EU that lead to the founding of the European Green Digital Coalition lead by the European Commission.[129] Hence currently, many ETNO members are participating to the definition on indicators of ICT enabling effects in this frame.

ETNO members continue investing heavily to innovate and become greener. The focus is particularly on green and renewable resources, decreasing the energy consumption of their networks and data centres, on 5G networks deployment and fibre roll out, which are the most

[126] www.gsma.com/betterfuture/climate-action
[127] https://etno.eu/working-groups.html#:~:text=ETNO%27s%20Working%20Groups%20(WGs)%20and,the%20European%20and%20national%20level
[128] https://etno.eu/library/reports/96-connectivity-and-beyond.html
[129] https://digital-strategy.ec.europa.eu/en/news/companies-take-action-support-green-and-digital-transformation-eu

suitable for green transition, or introducing measures to increase circularity principles within their activities. ETNO members also support green financial aspects relevant to sustainability, for example by issueing green bonds or sustainability-linked bonds.

In January 2022, Frontier Economics has prepared a study for ETNO on policies to support investment in VHCNs.[130] The study suggests a series of recommendations for policy makers to consider while setting up green objectives. Finally, in the view of ETNO, spectrum policy management could help reaching the environmental targets[131] and increase the quality of services for consumers.

[130] https://etno.eu/news/all-news/721:etno-technical-regulatory-reports.html

[131] https://www.etno.eu/library/441-etno-comments-to-the-draft-rspg-opinion-on-the-role-of-radio-spectrum-policy-to-help-combat-climate-change.html