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Environmental sustainability in the regulation of electronic communications[1]

The last moment?

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Abstract

Creating climate-neutral electronic communications is a shared responsibility for the industry and urgent action is needed in the face of warming trends due to global climate change. Despite this, environmental sustainability in the regulation of the electronic communications sector in Hungary has not yet received sufficient attention, nor has there been any related research, articles or studies. Therefore, the aim of this paper is to fill this gap, by reviewing the relevant international, EU and domestic regulatory situation and trends, to provide a comprehensive and high-level picture of sustainability initiatives in the electronic communications sector and evaluate it in order to suggest possible directions for domestic regulatory action. It is hoped that this will serve as a starting point for launching a discourse in the industry and for properly positioning the green transition in electronic communications regulation.

Keywords

electronic communications, networks, services, regulation, environmental sustainability.

1. Introduction – the last moment

Hardly any scientific research questions the fact that humanity has brought about very drastic changes on Earth and that this is not sustainable in its current form. Sustainability has become the most important long-term goal in every aspect of our lives today, and the electronic communications industry is no exception. Sustainability in general means choosing actions today that do not limit the economic, social and environmental opportunities of future generations (Brundtland, 1987).

The uniform scientific view is that the Earth is warming at an unprecedented rate. If current trends continue, the Earth's average temperature could be 2.8-3.2°C higher by the end of the century (Desjardins, 2020, 62–63; Climate Action Tracker, 2021, 4). According to the most re-

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cent data, humanity is within the last moment to reverse the Earth's harmful processes and the warming of the atmosphere (IPCC, 2022). In addition, the negative economic changes resulting from the current global political situation of war could cause the green transformation process, which has not been sufficient so far, to be reversed significantly.

It is no wonder that environmental sustainability is an increasingly pressing issue in electronic communications as well. Despite energy and operational efficiency being in the genes of the industry, the green transition is beginning to be seen as an explicit policy criterion and regulatory objective. Recently, there have been a growing number of regulatory initiatives specifically addressing the environmental sustainability of the electronic communications sector. The electronic communications industry, and digitalisation in the broader sense, is playing a key role in the environmental transformation of other industries and is facing further significant growth. However, this growth may even increase the overall environmental burden, making it particularly critical to strike the right balance in related policies. However, current decisions already determine the environmental burden in 2030 and beyond, due to the overall life cycles of electronic communications infrastructures. Therefore, making electronic communications climate-neutral is a responsibility to be shared among the industry, and global warming trends require urgent action.

Despite this, environmental sustainability has not yet been adequately addressed in the regulation of the Hungarian electronic communications sector and the related administrative framework, nor have there been any related research, articles or studies. Therefore, the aim of this paper is to fill this gap, to review the relevant international, EU and domestic regulatory situation and trends, and to provide a comprehensive and high-level overview of sustainability initiatives in the electronic communications sector. It is hoped that this will serve as a starting point for positioning the issue properly and launching an industry-wide discourse.

While sustainability is a global challenge that affects all industries, this paper focuses exclusively on the ICT sector, and within that, where possible, electronic communications services and networks in particular. It addresses only the economic, social and environmental aspects of sustainability, without addressing the direct physical and biological impacts on the environment and wildlife (e.g. the impact of radio waves on human health and the environment).

In line with the objective pursued, this paper does not evaluate or analyse in detail any individual initiatives or legislation, but only provides an overall picture. As such, it can be considered more as descriptive and partly as comparative research activity. However, the aim is that, by assessing this overall picture, this paper will set possible orientations for the representatives of the domestic industry, in particular the national regulatory authority, and other actors with an interest in or influence on regulation.

After an introductory section, the paper reviews the basic elements of the energy and resource management of electronic communications networks, describes the negative environmental pressures caused by the sector, and then looks at the digital industry's positive impact on the green transformation. It then reviews key industry practices and international and EU initiatives in this area. In the latter, it highlights the relevant elements of the sector-specific regulatory framework and the practices of national regulatory authorities. After outlining the situation in Hungary, the paper concludes by summarising the above and then suggests possible directions for domestic regulatory action.

2. Green genetics

The operation of electronic communications networks and services consumes a lot of energy and resources, so energy (and operational) efficiency is a key factor in service design. Accord-

ing to the laws of physics, a certain amount of energy is required to transmit a unit of data, and transmitting the data itself typically consumes more energy than processing that data (Tanenbaum & Wetherall, 2010, 100). The energy efficiency ("EE") of a communication link is usually expressed in terms of the ratio of the maximum data rate achievable to the energy required (bit per joule) (Hou, 2022, 3). The more favourable this ratio is, the more energy efficient a technology is, and operators will obviously prefer the most energy-efficient solutions.

Another important consideration is that electronic communications infrastructure typically has multiple redundancy. While this was often fortunate in the past in terms of competition and security of service, it is hardly sustainable in increasingly expensive and complex networks. As it is not always economically rational or feasible to build redundant or competing networks, it has become increasingly important, under regulatory pressure or whether market-driven, to share or provide access to individual infrastructure elements (Bartóki-Gönczy, 2013, 114–115; Lapsánszky, 2021, 314–320). The 6G vision, for example, envisages a large-scale autonomous network system, covering space, air, land and water (Matinmikko-Blue, 2021), which obviously cannot be deployed repeatedly and completely in parallel.

Although the first initiatives to reduce the carbon neutrality of telecommunications networks first emerged more than 20 years ago (British Telecom, AT&T and Sprint were among those at the forefront), environmental sustainability as a focus area has only recently begun to appear in this sector (Mester, 2020). This is partly because climate change is becoming a more prominent topic in general, and the results associated with it present a positive image for consumers. On the other hand, the green developments that have been launched in the past, often driven mainly by cost savings from lower energy consumption and by positive marketing, are now starting to deliver actual results in electronic communications networks. This is because trends are much slower to ripen where the natural and logical life cycle of infrastructure is up to 10-20 years. Third, efficiency, encouraging joint investments, promoting cost-effective network construction, increasing access and sharing (which also facilitates the integration of environmental sustainability considerations over competition or innovation) have recently become increasingly important regulatory objectives.

Therefore, as communication technologies, networks and services have evolved, increasingly energy-efficient (and cost-effective) solutions have emerged, and the need to avoid duplication of infrastructure has become increasingly important (just think of the development of mobile phones or mobile networks, or the growing role of infrastructure companies). Both processes have clear benefits for environmental sustainability. Moreover, environmental sustainability aspects are increasingly playing a role in network design decisions (for example, ICT companies are among the largest global buyers of renewable energy), which could further strengthen the green trend. Hence, as operational and energy efficiency are by no means new phenomena for the industry, sustainable development is essentially "in its genes".

2.1. Negative impacts

Nevertheless, assessing the environmental footprint of the electronic communications sector requires a comprehensive approach. First, the carbon footprint of the sector is itself significant, with most of it coming from the power supply and production of network devices and systems. However, in many cases, a significant proportion of the networks is made up of elements designed and built decades ago (think of copper networks, or the 3G network, which is now being switched off in many places, where one of the most important aspects, in addition to reducing fixed costs, is the resulting increase in energy efficiency, which in the case of 5G can be as

much as 100 times higher) (Shurdi et al., 2021, 325). At the same time, pervasive technological developments are increasingly blurring the boundaries of the systems that enable digitalisation. Networks are slowly reaching everywhere and because all communication is IP-based, data (and its storage and processing) is becoming the focus of interconnected systems. The biggest challenge is therefore that, even if the network is more energy-efficient, if the growth in data traffic is exponential then the development of the service will require a much denser infrastructure and the use of more and more devices (Mester, 2020).

In light of all this, it may come as a surprise, but the ICT sector is one of the most energy-efficient industries. While the volume of Internet traffic has grown exponentially over the last two decades, the energy consumption of networks and data centres, and the associated greenhouse gas (GHG) emissions, have increased only modestly (Malmodin & Lundén, 2016, 217). However, there is a real risk that, despite energy efficiency gains, the digital transformation will trigger a "rebound effect": despite energy and material savings, the rapid growth in data traffic and new technologies and uses (e.g. blockchain, IoT, metaverse) will only further increase the overall energy consumption and GHG emissions of electronic communications networks. (Canfora et al., 2020, 259; Skouby & Windekilde, 2010, 13).

While in the early 2000s the ICT industry was responsible for 1% of global GHG emissions, by the end of the decade it accounted for 2-2.5%, of which telecommunications in the narrow sense accounted for 30% (Beton et al., 2008, 13; Sutherland, 2009, 63). Today, this could be as high as 4% (BEREC, 2022). Moreover, if we do not take action, the industry's emissions could rise to 14% of the global value by 2040 (Belkhir & Elmeligi, 2018).

According to the most recent data, 12-24% of emissions are attributable to networks, 15% to data centres and around 60-80% to devices (BEREC, 2022, 5). In addition, the depletion of metals and minerals and the exploitation of fossil resources are currently neglected, even though they are equally critical to the functioning of the digital sector. For example, the carbon emissions from smartphone use alone account for 15% of total emissions (32 kg of raw materials are needed to produce a 2-gram microchip) (BEREC, 2021, 3). Given this, it is not surprising that 40% of the environmental impact of digital technologies is mainly due to the depletion of metal resources, including rare-earth metals, and the use of fossil resources in the manufacture of digital devices and equipment (Bordage et al., 2021, 36). For some raw materials and base materials that are crucial for semiconductor manufacturing, such as indium, gallium and germanium, the digital economy accounts for 80-90% of total consumption. This is a major challenge, because they will also be needed in the energy transition to green energy (e.g. in solar panels and wind turbines), meaning that supply chain security could be seriously compromised (Eerola et al., 2021, 5). In addition, data centres also require significant amounts of natural resources and energy because they are operated using water-cooled systems and run almost continuously (BEREC, 2021, 8). However, it is also important to note that calculations of the current carbon footprint of the ICT sector and estimates for the future are quite different in different studies, which makes a consistent evaluation difficult (mainly due to different methodologies, different data over time and different interpretations of the scope of the sector).

2.2. Positive effects

On the other hand, digitalisation and the electronic communications networks and services that form the backbone of it enable the complete transformation of entire industries, economies and societies ("enabling effect"). A number of solutions will be adopted in the future that will

increase operational efficiency and significantly reduce harmful emissions, thus contributing to the preservation of the environment.

Connecting all people and things through the electronic communications sector could already reduce global GHG emissions by 15-20%, a volume that is itself ten times higher than the sector's own emissions (BEREC, 2021, 3). Other studies suggest that the digital solutions already available could reduce global carbon emissions by 15% (Malmodin & Bergmark, 2015, 44). This is almost one-third of the global target set for 2030 (Ericsson Consumer & IndustryLab, 2020, 9).

There is a growing number of ICT solutions that also bring environmental benefits to other sectors. For example, by adopting 5G technology, the most polluting industries could reduce their carbon footprint by up to 50% by 2030 (MIT, 2021, 14) and, for instance, digitalisation and dematerialisation will enable the replacement and elimination of products and processes that consume huge amounts of energy and resources (transport, printed documents, etc.). Data collection and communication also enable real-time data analysis and feedback to streamline decision-making, reduce risks and improve coordination with stakeholders (suppliers, consumers, etc.). System integration helps to manage resource use by facilitating the use of low-carbon energy sources and reducing energy consumption at system (building, company, network, etc.) level. Process, activity and functional optimisation, as well as simulation, automation, redesign or control of processes, activities and services also improves energy efficiency. (Canfora et al., 2020, xiv). At the same time, telecommunications companies themselves see digitalisation and solutions based on it as key to their own sustainability (Niehoff, 2022, 7). Solutions such as these will therefore be critical for the green transformation of the economy and society.

2.3. Complex impact system

This duality of the electronic communications sector, namely solving its own sustainability challenges and the positive effect of the sector in achieving the sustainability goals in general, requires careful analysis and strategic action (Ojala & Oksanen, 2021). However, perhaps the most important consideration is the aggregate climate impact of the overall emissions from the digital and ICT sectors, which are developing at a dizzying pace. Even if efficiency increases by a factor of ten, the increase resulting from large-scale development may negate or even exceed the positive effects (i.e. the rebound effect mentioned earlier kicks in).

Finally, environmental sustainability is fundamentally a cross-cutting issue that penetrates all aspects of life. Accordingly, it is most typically addressed through global and horizontal initiatives or regulations, to which the ICT sector, and within it, the electronic communications industry, must adapt. Therefore, while there is a case for examining the e-communications sector on its own, given the impacts mentioned above, the extent to which its separate examination, assessment and development would be measurable or feasible can be questioned.

All in all, therefore, the electronic communications sector is a double-edged sword that must be used to save the planet. This must be done not only by renewing the entire sector and, through it, other industries, but also by aligning it with global objectives and expectations.

3. Relevant sustainability initiatives and regulations

3.1. Industry initiatives

As industry players have dealt with environmental sustainability for a long time, they are accordingly a lot more advanced in related actions. On the one hand, it is good practice for the

largest companies to launch corporate responsibility or sustainability programmes and to publish related reports in accordance with their chosen international guidelines. But, on the other hand, it is also becoming increasingly common for companies to issue green bonds, which enable them to raise external funds for improvements or projects aimed at bringing about positive environmental change. (Paemen et al., 2019). While most firms have set very ambitious environmental targets for the period 2030-50, different actors seem to follow different reporting standards (GRI, GeSI, CDP, GHG Protocol, Bilan Carbon, ISO and ITU standards), typically using two different methodologies (SBTi, LCA) to analyse future impacts. In addition, these methodologies do not take into account a number of adverse environmental factors (such as indirect impacts on the whole value chain). This practice makes it significantly more difficult to compare and assess the impacts of individual company efforts or measures (Godlovitch et al., 2021, 35). However, this fragmented approach has been a known problem for at least two decades, and no real progress has been made since then (Sutherland, 2009, 73).

Of course, there is also often a perception that there is little actual substance behind some of the initiatives undertaken by business actors, and that they are driven primarily by marketing objectives and the opportunity for positive communication ("green washing"). Nevertheless, there are many practical methods used by operators trying to reduce their emissions. In the deployment phase, this includes minimising construction activities (e.g. micro-trenching or overhead cables), reusing excavated materials, sharing networks between operators and using more sustainable network equipment. In the operational phase, operators typically achieve significant savings by decommissioning older technologies and optimising the energy efficiency of networks, using alternative or innovative cooling techniques and by switching off network devices at intervals (e.g. at night). The most common measures in the decommissioning phase are equipment reuse, refurbishment and recycling. It is also where the overall reduction of waste, for which there are now standards to rely on, comes in. In addition, service providers often devote energy to raising customer awareness of the environmental impact of the equipment and services they use, and set environmental requirements for suppliers (BEREC, 2022, 26–27; Godlovitch et al., 2021, 48–51).

In addition to individual service initiatives, companies are of course also prioritising sustainability at the level of industry organisations. Both the GSM Association (GSMA) and the European Telecommunications Network Operators' Association (ETNO) are setting their sustainability priorities through different working groups (GSMA, 2022; ETNO, 2021). Both organisations are founding members of the European Green Digital Coalition, which has set a target for its members to achieve full climate neutrality by 2040 (half of the founding signatories were GSMA members) (European Commission, 2021a). Similarly, the members of the European Competitive Telecommunications Alliance (ECTA) have been committed to reducing their environmental footprint for years (BEREC, 2022).

Green objectives are also naturally reflected in the latest technological developments. On the one hand, all network equipment manufacturers have already been committed to environmental sustainability for years (as it is naturally linked to increased energy and operational efficiency), and most related developments will directly improve the energy efficiency of networks and network equipment (optical network development, and in mobile networks MiMo, Beamforming, AI, OpenRAN, smart and autonomous networks) (Ericsson, 2020; Huawei, 2016; Nokia, 2021; Samsung, 2021). However, sustainability, for example, has also been an emerging dominant element in 6G R&D from the very beginning of development. Part of this is to link 6G development targets directly to the United Nations (UN) Sustainable Development Indicators, including how wireless networks can help collect the data needed to achieve the SDGs (Latva-aho & Leppänen, 2019; Hexa-X, 2021).

3.2. Initiatives by international organisations

While environmental sustainability has long been a high priority in global politics, the 2016 Paris Agreement on Climate Change (Paris Agreement) was the first binding agreement to set a common framework to keep global warming below 2°C (or, more precisely, to aim for a maximum of 1.5°C compared to pre-industrial levels) (UNFCC, 2016). Implementation of the Convention is closely linked to the implementation of the UN 2030 Agenda for Sustainable Development, which was adopted a few months earlier (UNDP, 2015).

It is generally accepted in these international environmental initiatives that new technologies will play a crucial role in achieving sustainability goals and addressing future social challenges. ICT developments and connectivity are a prerequisite for the necessary development and a key tool for environmental transition.

Global conventions are not, of course, enforceable by the industry per se, but they directly influence the functioning and actions of international professional and standardisation organisations. The sustainability objectives of the UN and the Paris Agreement have been translated into industry goals through the International Telecommunication Union's (ITU) Connect 2030 programme and related standardisation initiatives, which are driving telecom operators towards more sustainable solutions (ITU, 2020). The ITU's objective is for the ICT sector to reduce GHG emissions by 45% by 2030 compared to 2020. The target was developed by the ITU in collaboration with the industry measurement methodologies (GeSI and SBTi) and the GSMA, as mentioned above, and other standards to support the industry's greening efforts. In addition, several standardisation efforts by other major standardisation bodies (ISO, ETSI, CENELEC) have also addressed sustainability, and the Organisation for Economic Co-operation and Development (OECD) and the International Energy Agency (IEA) have also addressed the issue in a number of documents (BEREC, 2022, 42–44).

3.3. Horizontal initiatives of the European Union

In the European Union, the green transition has long been a priority horizontal regulatory policy objective. Think of environmental standards for cars, rating and labelling schemes for the energy consumption of electronic equipment, eco-design rules and the management of WEEE.[2] However, there have also been several recent horizontal regulations on business reporting that directly affect environmental sustainability objectives and indirectly influence the methodologies used to measure them (Venturelli, 2017, 409; Kozma & Bosnyák-Simon, 2022, 153).

At the same time, there is an increasing emphasis on environmental sustainability at all levels of EU policies. On the one hand, the European Commission's European Green Deal aims to reduce EU countries' GHG emissions to zero by 2050 (European Commission, 2021b). Under the recently published Fit-for-55 climate change package, it intends to reduce emissions by 55% by 2030 (European Commission 2021c). Moreover, the European Commission has launched the Destination Earth initiative, which aims to create a high-precision digital model of the Earth to facilitate the monitoring, modelling and forecasting of natural and human activ-

[2] See Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products ("Ecodesign Directive") and Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE Directive – Waste from Electrical and Electronic Equipment).

ities, and the development and testing of possible scenarios for more sustainable development (European Commission, 2022a). In addition, the Next-Generation EU package in the COVID post-crisis recovery plan has also placed a strong emphasis on climate and digital transformation (European Commission, 2020a), and the European Parliament has adopted two reports on this subject (European Parliament, 2020b; European Parliament, 2020a).

In the above horizontal initiatives, digital technologies are typically identified as an important means of achieving environmental goals, but the need for a green transformation of the digital sector is also raised increasingly often. For example, in the European Green Deal, the European Commission is already calling for a digital sector that focuses on sustainability. In addition, it proposes to improve the energy efficiency and circular economy performance of the sector, from broadband networks to data centres and ICT devices, and calls for greater transparency on the environmental impact of electronic communications services.

3.4. The EU regulatory environment for the sector

Against this backdrop, it is not surprising that the European Commission's recent Digital Agenda also emphasises that the ICT sector needs to undergo its own green transformation, including making data centres climate-neutral and the environmental burden of electronic communications transparent by 2030 (European Commission, 2020b). In addition, the European Commission has launched a number of dedicated industry initiatives, such as the Digital Decade package of proposals (European Commission, 2021d) and the European Data Strategy (European Commission, 2022b), which include environmental sustainability as a priority regulatory objective, but also the Circular Economy Action Plan (European Commission, 2020c), the Broadband and Data Centre Action Plan (European Commission, 2000) and the European Green Digital Coalition mentioned earlier. In addition, a paper on reducing the environmental impact of cloud services and electronic communications services and networks (Bilsen et al., 2020) was prepared, initiated by the European Commission, and a collection of best practices to limit the environmental footprint of the ICT industry (Canfora et al., 2020) have taken place.

In the Joint EU Toolkit for post-crisis recovery from the COVID crisis, the European Commission already encouraged Member States to develop best practices to promote the deployment of electronic communications networks with a reduced environmental footprint and, where EU legislation requires impact assessment, Member States are encouraged to share best practices where environmental impacts can already be identified and assessed (e.g. during the authorisation of networks) (European Commission, 2020d, 3–4). However, in the collection of best practices, Member States have been very general and have mainly made suggestions for measures in the areas of infrastructure construction and sharing, in connection with the energy consumption of networks and optimising the use of available resources and raw materials. Member States' practice also varies widely with regard to environmental impact assessments for spectrum usage rights, and in quite a number of Member States no such practice exists at all. Although the installation of transmission towers is usually subject to some form of environmental regulation, it is not generally subject to an EIA unless required by other regulations (Connectivity Special Group, 2020, 10–11).

Although the above would suggest that sustainability issues are being addressed in a relatively wide area by EU organisations, the issue has been almost absent from the direct regulatory environment of the electronic communications industry. The European Electronic Communications Code, which provides the regulatory backbone for the sector (hereinafter the EECC), for example, addresses environmental sustainability only indirectly, mainly in terms of infra-

structure sharing, coordination of construction works and spectrum management.[3] While the Broadband Cost Reduction Directive (hereinafter: the BCRD), in terms of its practical impact, provides a number of measures to promote more efficient network deployment (thus reducing the environmental burden), apart from a few indirect references (in the preamble), however, environmental sustainability is not addressed in the legislation.[4]

Nevertheless, this trend appears to be reversing, as the impact assessment proposal of the BCRD revision already notes that the growing environmental footprint of the electronic communications sector needs to be kept within appropriate limits to make the EU climate-neutral by 2050, and that appropriate measures in the revised BCRD could provide positive incentives for more sustainable deployment and operation of electronic communications networks (European Commission, 2021e). Environmental sustainability is also reflected in the new draft Recommendation on State aid for the development of broadband networks (European Commission, 2022c). On the one hand, the document identifies the reusability of existing infrastructure as one of the key determinants for reducing the overall cost of deploying new broadband networks and mitigating their negative impact on the environment. On the other hand, the draft would already encourage Member States to consider environmental and sustainability criteria in tendering procedures. Such criteria could include the climate and environmental impact of the network or the compliance of the measure with national and EU climate and environmental standards. It is also proposed that Member States could impose obligations on the selected bidder to implement risk mitigation measures where the network could have a negative impact on the environment.

The Radio Spectrum Policy Group (RSPG) has also recently started to work on this topic and has compiled sustainability considerations and information within spectrum management in a separate report. It has also looked at how spectrum management can help to combat climate change and how this can be translated into concrete actions at EU level (RSPG, 2021b). It also issued a separate opinion on these measures following the report, containing 28 measures (RSPG, 2021a). Initiatives on spectrum management are revolutionary, as wireless communications are particularly characterised by green trade-offs arising from the theoretical relationships between spectrum efficiency, energy efficiency, deployment efficiency, latency, and performance and bandwidth (Matinmikko-Blue, 2021; Csaba, 2020). Radio spectrum, on the other hand, is an essential tool for sustainable development, enabling the data connectivity behind key wireless technologies, universal broadband coverage and the resulting digital transformation.

3.5. The BEREC report

Keeping up with these trends, in 2020 the Body of European Regulators for Electronic Communications (BEREC) also started to expand its knowledge base specifically on environmental sustainability. It set up an ad-hoc expert working group, consulted stakeholders in a series of meetings and workshops, as well as in the two most recent annual industry forums, and commissioned an external study on the subject. As a result, the Body has recently adopted a draft report which has also been submitted for public consultation (BEREC, 2022). The draft report

[3] Recitals (105), (106), and Article 44 of Directive (EU) 2018/1972 of the European Parliament and of the Council of 11 December 2018 on the European Electronic Communications Code (EU) 2018/1972.

[4] Directive 2014/61/EU of the European Parliament and of the Council of 15 May 2014 on measures to reduce the cost of deploying high-speed electronic communications networks.

provides an overview of the extent and trends in GHG emissions from electronic communications, the sources of emissions and possible measurement methods. The main focus is on GHG emissions, as this is the area where most data and knowledge is available. It also covers the overall impacts on natural resources (e.g. fossil energy sources, minerals and metals, including rare-earth metals) and reviews the related initiatives and industry practices already presented above.

From this perspective, this draft report summarises the main results of BEREC's groundwork on sustainability in the ICT sector and outlines the body's approach to environmental sustainability. In addition, the report provides a detailed analysis of the issues that are also presented in this paper. As such, it covers the negative and positive environmental impacts of the ICT industry, the related calculations and estimates, and takes stock of related initiatives. It also highlights the main issues related to the sustainability of the digital sector (methodological divergences, rebound effects, use of natural resources) and the resulting challenges for BEREC or for the industry in general (further research, development and standardisation of measurement methodologies, increased industry and regulatory cooperation and information sharing). Furthermore, the BEREC draft report also recognises the indirect positive impact of digitalisation on decarbonisation in other sectors and that digital solutions are a critical factor for climate neutrality.

The paper prepared in support of the BEREC draft report also made several important findings. On the one hand, it highlighted the positive impact of the relevant provisions of the BCRD and EECC as described above, but also pointed out that, above a certain level, network sharing can be detrimental to infrastructure-based competition, investment and innovation. At the same time, the paper suggests that national regulators can use a number of instruments to facilitate the replacement or decommissioning of less energy-efficient technologies (e.g. copper networks, 3G networks) (which in some cases may be hampered by the basic requirement of technology neutrality laid down in the EECC). In addition, an important finding of the paper is that NRAs can only collect data from operators in the context of the application of the EECC, which limits the collection of adequate data on environmental sustainability (and which would therefore be best obtained on a voluntary basis or in cooperation with other authorities). Nevertheless, the study also suggests that there are a number of potential regulatory measures that can be used to take meaningful action: raising awareness among consumers and network operators, developing codes of conduct with stakeholders, promoting eco-design and recycling programmes, encouraging research on sustainability in the ICT sector and promoting sustainability solutions (Godlovitch et al., 2021, 9–12).

BEREC believes that the above findings, and sharing related experience and technical knowledge, as well as the report itself, can serve as a tool for national regulators to further their work on sustainability and thereby reduce the negative environmental impacts of the digital sector. Perhaps even more importantly, BEREC will work with other relevant organisations in the coming period to ensure that the sector's environmental footprint is as transparent as possible and that the indicators are based on accurate data. BEREC has also included a new work-stream in its work programme for 2022 and 2023. The body also intends to contribute to the development of best green practices with stakeholders in the ICT sector and competent authorities. In other words, BEREC will in future place greater emphasis on improving its knowledge and activities in the field of sustainability, in order to contribute its expertise to reducing the environmental footprint of the ICT sector and to bring along the dual transition to a green and digital economy.

3.6. National regulatory authorities (NRAs)

Although the BEREC draft report is a major step forward, some NRAs were already actively addressing environmental sustainability before its publication and, where appropriate, developing dedicated measures in cooperation with other competent authorities (and best practices are presented in the BEREC report). The French (ARCEP), Irish (COMREG) and Finnish (Traficom) authorities have done the most significant work in this area so far. In particular, ARCEP is at the forefront of sustainability initiatives and its activities have served as a model for BEREC. The French authority already started collecting data in 2020 to assess the environmental impact of networks and equipment and has set up a cooperation platform with major industry players. As a result of this work, ARCEP, together with one of the main French environmental organisations, has prepared a report for the French government on the footprint of digital environmental technology (which has been taken into account by the government in its related measures and has also identified specific tasks for ARCEP) and has recently published a specific study on the environmental impact of 5G networks (ARCEP, 2019, 2020, 2022).

COMREG launched a public consultation on the issue at the end of 2019 and presented the results and main findings at an OECD event. Moreover, there were also spectrum sales where COMREG specifically took into account the positive impact of the relevant service on environmental pressures. In addition, environmental sustainability has become a core value of COMREG's 2021-2023 strategy and was included in its regular consumer research at the end of 2021. Finally, an internal project was launched at the Irish authority to understand the impact of Irish networks on climate and identify possible courses of action (COMREG, 2021; BEREC, 2022, 15).

The Finnish regulator, Traficom, in addition to being involved from the outset in the government's strategic work on assessing the environmental impacts of the ICT sector, launched in 2019, has commissioned two studies on the subject and has used a questionnaire to assess the current environmental impacts of operators and networks and the available data. In future, Traficom plans to collect and publish data on a regular basis on the environmental pressures on the sector. Finally, Traficom's strategy identifies the Authority's contribution to a sustainable environment as a key objective (BEREC, 2022, 16).

As regards the other countries, the Spanish national regulatory authority (CNMC) has also set specific sustainability targets in its current strategy and action plan. The Malta Competitiveness Authority (MCA) has consulted a number of stakeholders, including the Environmental Protection Authority of Malta (ERA), with which it intends to work in future to identify potential tasks as a more developed, holistic strategic direction on environmental issues develops. The UK national regulator (Ofcom) has also included sustainability issues in its annual work programme and plans to publish a White Paper on the subject, and the Dutch national regulator and competition authority (ACM) has published draft guidelines on sustainability agreements and their effects on competition (BEREC, 2022, 17; ACM, 2020).

3.7. Hungarian status report

Domestic environmental sustainability policy, regulation and company practices are, of course, well integrated into the international and EU context. At the same time, there is a noticeable growing focus on environmental issues and sustainability in Hungary. In addition to the general environmental rules, the National Sustainable Development Framework Strategy, the basic document for sustainable development in Hungary, which is still valid today, was adopted by

the National Assembly in March 2013 with a mandate until 2024 (NFFT, 2013). This document contains all the UN goals and targets to which Hungary can make an effective contribution to global implementation. It also serves as a long-term concept for the public policy decision preparation and decision-making system and establishes the necessary indicator, monitoring and follow-up system. In addition to these, in 2020 a dedicated climate protection law was introduced in Hungary aiming to decrease the carbon emission of the country by 40% (to the base of 1990).[5] Following that, a National Clean Development Strategy was adopted (NCDS, 2020) However, none any of these laws and documents mention or refer to the ICT industry or electronic communications as relevant in any respect, except the National Clean Development Strategy recognising the positive impact of digitalisation of (other, non ICT) industries (NCDS, 2020; NFFS, 2021).

If we look at the regulatory environment for electronic communications, we see essentially a replication of the EU environment. The backbone of the sector's regulatory framework, Act C of 2003 on Electronic Communications, mentions among its objectives and principles the enforcement of environmental requirements in the context of electronic communications,[6] but environmental considerations appear with practical importance in the areas of interim measures, authorisation, siting and sharing of installations (similar to the corresponding article of the EECC), radio equipment and general rules relating to life and physical health, and are predominantly intended to ensure compliance with nature conservation, environmental, health and urban planning legislation outside the sector.

Beyond this, however, sustainability considerations are not explicitly reflected in the domestic legal environment, including in the activities or strategies of the national regulatory authority. Although the National Media and Infocommunications Authority's (hereinafter NMHH) latest (2021-2025) radio spectrum strategy includes social engagement and a more liveable environment among the areas to be supported, this is not yet reflected in the level of targets and indicators (except for supporting the early deployment of modern, innovative technologies and phasing out obsolete technologies, which will result in significant energy savings, for example through phasing out 3G) (NMHH, 2020, 56). It is a positive sign that, according to the BEREC draft report, the NMHH has already asked questions on sustainability in the 2021 consumer survey and is expected to consult on sustainability challenges with relevant stakeholders (including in a workshop) (BEREC, 2022, 17).

In line with international and parent company trends, the majority of domestic operators have been actively addressing the environmental sustainability of networks and services for a very long time; in other words, industry players in the Hungarian market are significantly ahead in this area. Magyar Telekom has had a sustainability strategy for more than fifteen years and was the first large Hungarian company to go carbon-neutral in 2015. Its primary goal remains a continuous increase in its energy efficiency, a significant reduction in the use of fossil energy sources and at the same time an increase in the use of renewable energies (Magyar Telekom, 2019).

Vodafone, in line with its Group, is committed to reducing its global carbon emissions to net zero by 2040 and is running its network 100% on renewable wind and hydro energy since July 2021. It also aims to reduce its environmental footprint by recycling network waste and halving its other carbon emissions (Vodafone, 2021). Vantage Towers' sustainability commitments are fully in line with this, with the infrastructure company also powering all its base stations exclu-

5 Act of XLIV of 2020 on Climate Protection.

6 See Section 2 (j) of Act of XCII of 2003 on Electronic Communications.

sively from renewable energy sources. In addition, the company's model has a number of environmental benefits, as its operations require fewer base stations in total (Verebély, 2020, 48).

According to the company, the Yettel office building was one of the largest environmentally conscious investments in Central Europe when it was opened, and even today is one of the most modern and environmentally friendly corporate headquarters in Hungary (Yettel, 2022). The service provider's environmental policy is in line with international standards (Yettel, 2021) and the same is found for CETIN, part of the Group (Get-Energy, 2020; CETIN, 2021; SGS, 2022). Yettel also supports its customers' efforts to reduce their environmental impact through a number of actions.

4iG, which has a growing role in the sector, and also TARR have been certified to international standards (FERRCERT, 2019; Group Energy, 2020; 4iG, 2021). DIGI and Antenna Hungária do not have a published environmental sustainability strategy or report, but both have launched related corporate initiatives (DIGI, 2022).

Although this list is far from exhaustive, it reflects one of the fundamental problems already described above: the real performance of domestic operators and network operators is as difficult to compare as that of international companies due to differences in specific targets and the methodologies and timeframes used to measure them (in addition, there are hundreds of smaller cable operators in the domestic market). However, as with international trends, sustainability is gaining increasing attention in the country and is being addressed by a growing number of industry organisations and national events (e.g. HTE Infokom in 2021 and SZIE World Telecom Day in 2022).

4. Summary

Thanks to the genetics of the industry and a number of mutually reinforcing effects, the electronic communications sector can be one of the most effective examples of a green future. The ICT sector, and within it the electronic communications sector, can make a significant contribution to the digitalisation of other sectors and society, and thus to increasing environmental sustainability. The positive impact of digital technologies on other industries is not self-evident and therefore appropriate regulation is needed to ensure that they contribute to the carbon neutrality of other sectors. There is consensus in the literature that digital technologies have an important role to play in achieving global sustainability goals. However, this places an even greater burden on the sector: they must avoid a rebound effect and ensure that overall emissions and environmental pressures remain at sustainable levels.

However, the lack of a single, agreed methodology for monitoring environmental impacts at industry level and the impact of specific services and individual consumption patterns on the environment (although good practices can be found, such as the inclusion of the carbon footprint of current consumption on the bill) makes it significantly more difficult to assess and transform the sector (Sutherland, 2009, 72; Ericsson Consumer & IndustryLab, 2020; French Parliament, 2021). Fortunately, despite this has been being a known problem for at least two decades, regulators seem to have finally started to recognise its importance and, in addition to mapping possible regulatory actions, have begun to develop possible monitoring methods (see ARCEP, Traficom, BEREC and related projects of the European Green Digital Coalition). There is no question that this requires appropriate data, but such data collection under EU rules is not currently possible directly, unless authorised by national regulation in the Member State concerned.

Another complicating factor is that the sector's significant international embeddedness also has an impact in this area. Environmental sustainability is also influenced by different levels of

regulation (international organisations, industry initiatives, standards, EU and national regulations) and there are many examples of parallel initiatives. On the other hand, most sustainability problems are complicated and therefore require equally complex action, with both general and industry-specific elements. Accordingly, industry is affected by both horizontal (e.g. European Green Deal) and specific (e.g. ITU standards) rules, not to mention that the industry is often not easily defined (digital sector, ICT or electronic communications) and although industry players are typically much more advanced in their own environmental sustainability, both they and regulators are in a particularly difficult position to shape their respective actions. They may find it challenging to find the right and coherent directions and to filter the essence out the "noise". However, as in most cases, the most important and most difficult thing to do is to raise awareness, to get the widest industry cooperation possible and to develop measurements, solutions and practices that are acceptable to all, and to avoid duplication (and, of course, green washing). In this process, regulatory initiatives, and in particular national regulators, have a critical role to play.

5. Quo Vadis?

Although the legislative framework is currently limited in many respects, there are a number of available tools that can be used for effective action by Hungarian regulators to achieve these objectives. Of course, traditional regulatory approaches and current economic policy directions (e.g. promoting competition, fostering innovation, encouraging investment and development policy objectives) must be taken into account in the decision-making process, but it is clear that action is needed.

To this end, it would be worthwhile to choose a regulatory policy direction (and if possible a measurement methodology) that is aligned with the environmental sustainability of the sector (in the domestic context, it is worth following EU trends, as appropriate), taking best practices into account. As ARCEP is explicitly at the forefront of sustainability initiatives, its activities could serve as a model for the Hungarian regulator. It should also be remembered that industry players are much further ahead in understanding the environmental sustainability challenges on which they have to build. In addition, particular attention needs to be paid to raising consumer awareness, based on international examples (and the image of a national regulator committed to green transformation can send a positive message to consumers anyway).

It would be at least as important not only to follow and necessarily replicate EU processes with a phased lag, but also to go a little further and take domestic action. This could be, for example, organising a dedicated industry consultation or workshop on environmental sustainability issues; setting up an expert working group to assist the NRA in its work; developing partnerships with relevant peer institutions; integrating sustainability considerations into upcoming NRA strategies, spectrum management, licensing processes and data collection; assessing the environmental status of domestic networks and services; commissioning studies; launching consumer awareness programmes and actions as highlighted above; and exploring related regulatory instruments and legislative options or needs (either at statutory or regulatory level). In any case, a general principle of sustainability must apply here too: if everyone does just a little for the future, we can make a significant impact. We hope to see more and more such minor steps in the regulatory and industry actions of the domestic electronic communications sector. We may be just in time.

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