Enabling a Sustainable Digital Future: Bridging environmental concerns, digital rights, and digital inclusion

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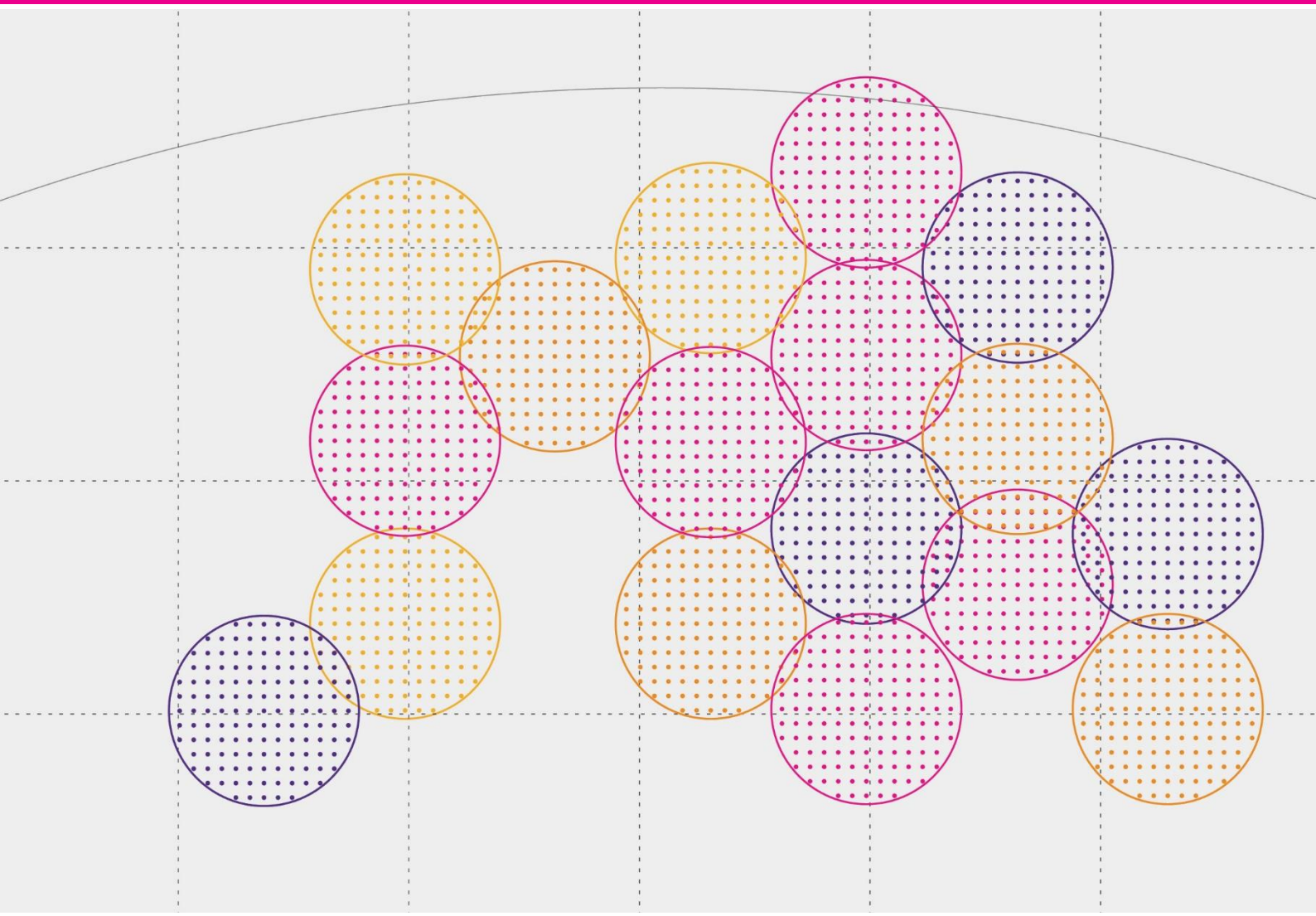

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Plum offers strategy, policy and regulatory advice on telecoms, spectrum, online and audio-visual media issues. We draw on economics and engineering, our knowledge of the sector and our clients' understanding and perspective to address challenges and opportunities across regulatory, radio spectrum, economic, commercial, and technology domains.

About this study

This paper proposes a definition of sustainable digital communications as the practice of designing, developing, and using communication technologies and systems in a way that minimizes negative impacts on the environment, promotes social inclusion, and upholds ethical principles and digital rights.

The purpose of this paper, through a descriptive approach, is to show the interplays nowadays existing between environmental sustainability, digital inclusion, and digital rights – whether correlations are positive or negative. When tackling policy issues in digital communications, it seems paramount to take a holistic approach on the three themes.

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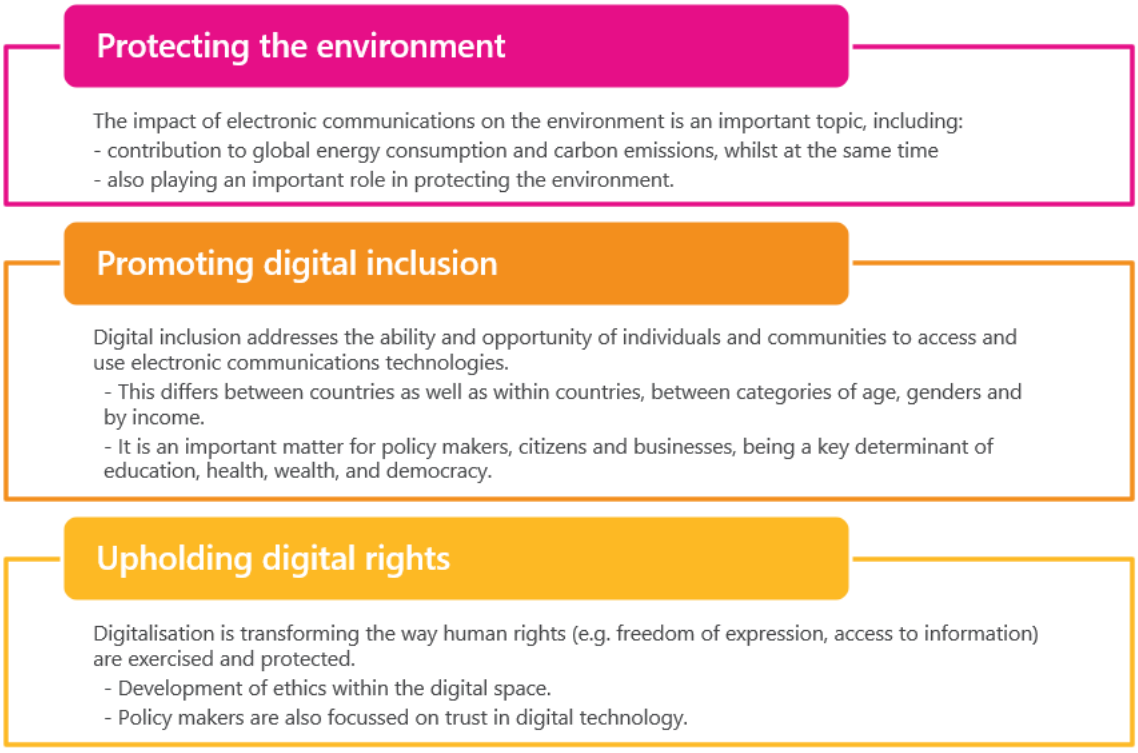
1 Towards sustainable digital communications

The digital revolution of the 21st Century has ushered in transformative changes that transcend traditional boundaries and reshape the fabric of human interaction, economic systems, and societal structures. Central to this transformation is the proliferation of digital communication technologies, which have not only accelerated the dissemination of information but have also redefined the ways in which individuals, communities, and nations engage with one another. The United Nations have identified the telecommunications, media and technology (TMT) sector as a critical enabler for achieving the Sustainable Development Goals (SDGs)[1].

As the digital landscape continues to evolve, so does the urgency to evaluate the sustainability of these advancements. The usual approach to sustainability in communications technologies focuses on the environmental aspect. Although the environment is a central consideration, sustainability should also encompass broader considerations.

In this paper, we propose a holistic definition of sustainable digital communications technologies[2] that involves three major challenges faced by our increasingly digital societies. These are shown in Figure 1.1 below:

Figure 1.1: Challenges of our modern digital societies



[1] The UN Commission on Science and Technology (2017). See: https://unctad.org/news/un-highlights-critical-role-science-technology-and-innovation-achieving-sdgs

[2] Digital Communication Technologies are defined as all the tools, systems and technologies that enable digital interaction, such as emailing, instant messaging, video conferencing, social media, Voice over Internet Protocol (VoIP) services and other forms of communication services delivered through internet connectivity. Communication technologies rely on the following components: The network infrastructure, the data centres and the user devices.

By amalgamating these three crucial dimensions, this study presents a comprehensive framework to navigate the intricate balance between technological progress and human welfare[3].

In some cases, progressing one of these three themes is aligned to the others, so progressing one will also progress one or both of the others. Sometimes though, they can also conflict, e.g. promoting digital inclusion by building or improving digital infrastructure can raise environmental costs through carbon emissions and the consumption of scarce resources.

It is therefore important for policy makers and other stakeholders who are working on progressing objectives across these areas to understand, manage and monitor these linkages. By doing so, it should be possible to move forward in all these essential areas while mitigating negative externalities.

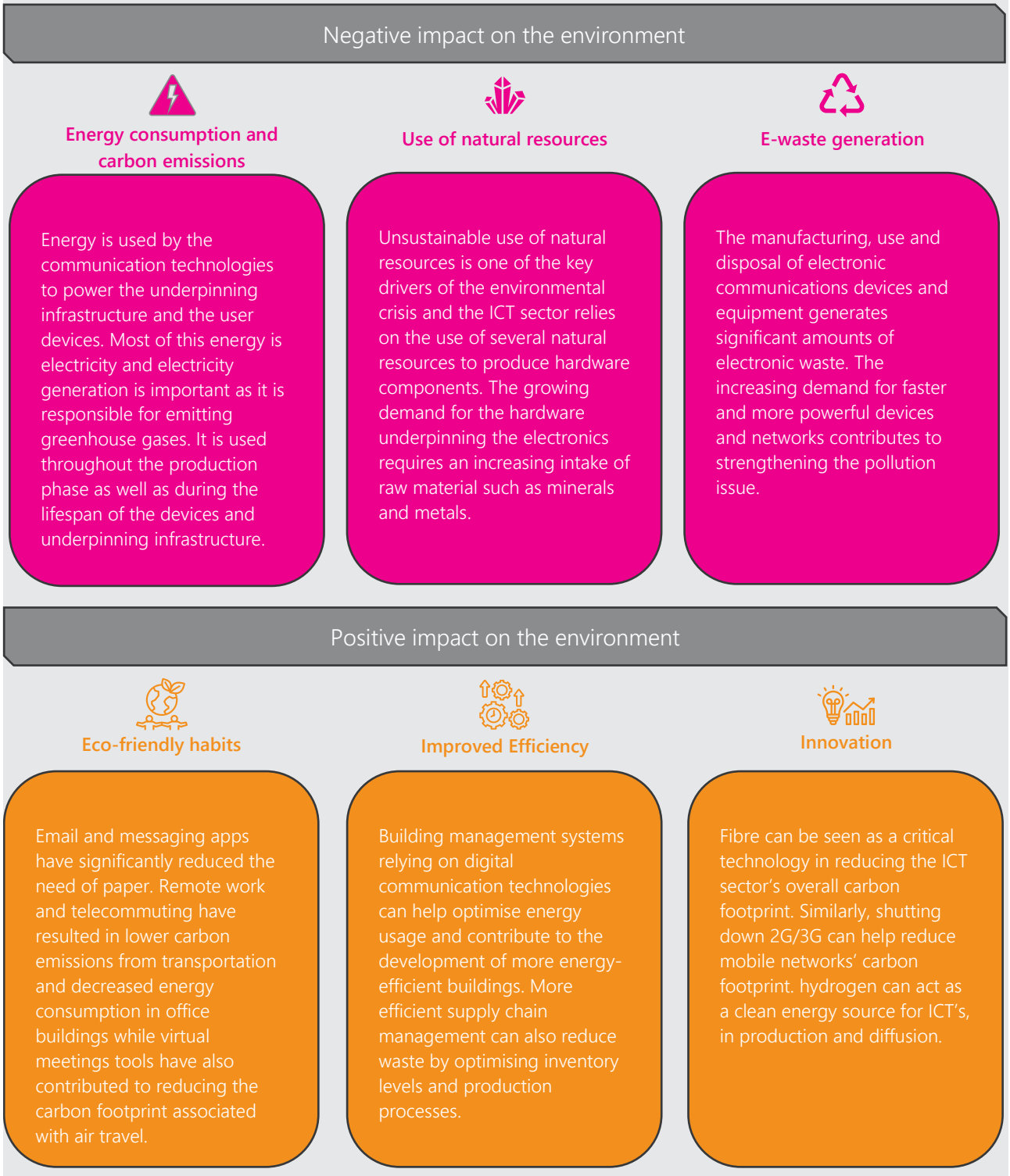
In light of this approach, we propose a definition of sustainable digital communications as the practice of designing, developing, and using digital communication technologies and systems in a way that minimizes negative impacts on the environment (Figure 1.2), upholds ethical principles and digital rights (Figure 1.3) and promotes social inclusion (Figure 1.4).

In the remainder of this paper we set our analysis and conclusions as follows.

- Section 2 explains the existing interplays between the three themes.
- Section 3 states the need for a holistic approach to enable sustainability of communications.
- Appendix A includes a glossary of acronyms used in the report.
- Appendices B to D offers a detailed view on each of the three themes.
- Appendix E provides examples of initiatives taken on these matters.

[3] It is considered that meeting the pressing need for ecological preservation, an equitable digital access, and individual empowerment would strongly improve human welfare.

Figure 1.2 Digital communication technologies and the environment



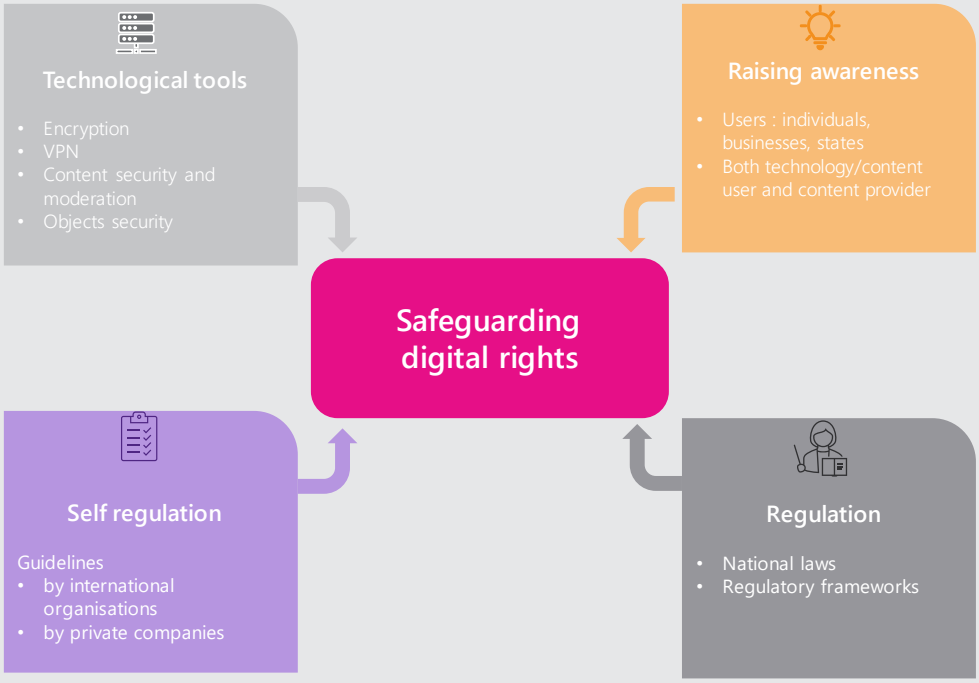
Further information on and analysis of the environmental axis is included in Appendix B.

Figure 1.3 Digital rights and trust

Digitalisation is transforming the way human rights such as freedom of expression and access to information are exercised and protected. In order to prevent violation of human rights in the digital space, ethics within the digital space have emerged as a topic for debate and policy development. These topics are considered to be important to social wellbeing, and hence there is focus on them within the sector and more broadly amongst policy makers. Digital rights include various aspects, including the following identified by the Council of Europe[4]:

- The right to access the Internet without any discrimination. This includes affordability of Internet services;
- Freedom of expression and information, including the duty of public authorities to protect it;
- Freedom of assembly, association and participation through the use of Internet;
- Right to privacy and data protection, including personal data being processed with consent, information of data transfer to third parties and control over their data;
- Right to online access to education; and
- Entitlement to special protection and guidance while using the Internet.

How to address digital rights



Further information on and analysis of digital rights is included in Appendix C.

[4] Guide to Human Rights for Internet Users. See: www.coe.int/web/internet-users-rights

Figure 1.4 Digital inclusion

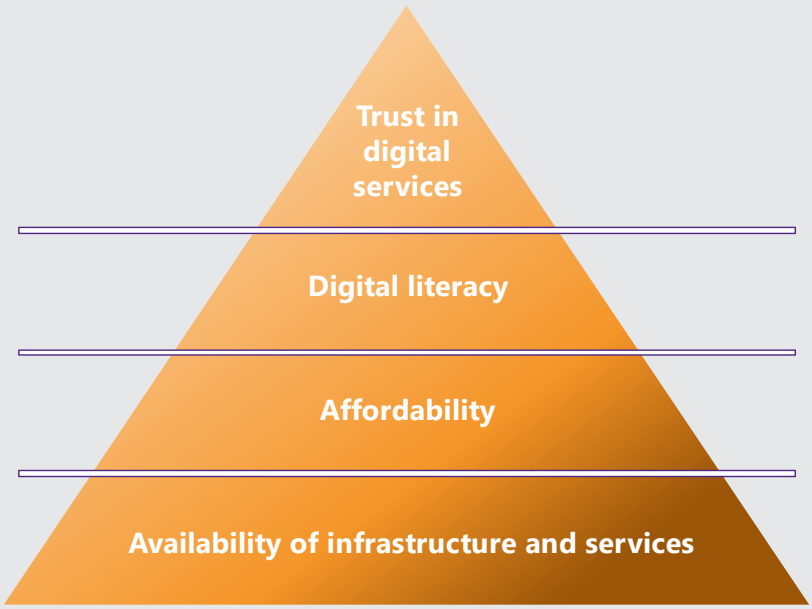
As digital services have become an indispensable feature of everyday life for a large part of the population, so the inability to access or use these services can put individuals at significant disadvantage. Digital exclusion can have damaging knock-on consequences, including in access to online health and education resources, government services, employment opportunities, online commerce and financial services.

Digital inclusion is not only about individual access to digital services – differences in inclusion can also be measured between communities, countries and regions of the world.

Exclusion can be the result of lack of or inadequate digital infrastructure available to connect. However, even where connectivity is available, exclusion is still evident driven by a range of factors, including affordability of connectivity, services and devices, digital skills gaps, and lack of trust in digital services.

Digital inclusion is a central concern for citizens, government and regulators. Because of the mix of causes of exclusion, policy interventions on both the supply and demand sides are needed to address it, depending on the circumstances in each individual case.

Barriers to digital inclusion



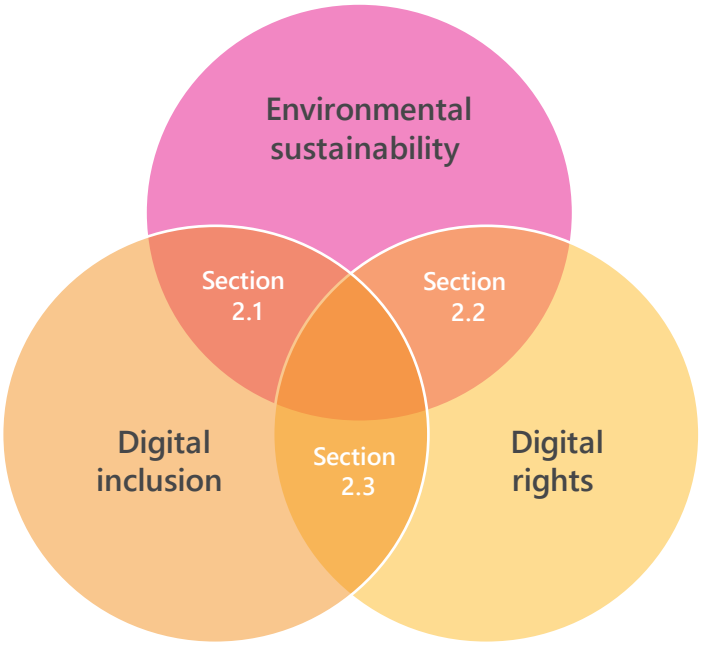
Further information on and analysis of digital inclusion is included in Appendix D.

2 The interplay of environmental sustainability, digital inclusion and digital rights

In the realm of digital communications, the issues related to the environment, inclusion and digital rights are often considered in silos. In reality, they are interconnected facets that together contribute to a sustainable path for digital communication technology. This section delves into the intricate relationship between environmental sustainability, digital inclusion and digital rights, emphasizing the synergetic dynamics and potential conflicts that emerge at their intersections.

These interplays, represented in Figure 2.1, have been explained in the sections below.

Figure 2.1: Relationship and overlap between the three themes



2.1 Environmental sustainability : Digital inclusion

In many cases the objectives related to environmental sustainability and digital inclusion policies are intertwined. Digital inclusion can be a catalyst for better environmental outcomes, because digital communications technologies are a key enabler to tackle environmental challenges. For example, the need for paper and printing has been significantly reduced by the wide adoption of email and messaging apps. Similarly, advancements in digital communication technologies, particularly video calls and online conferences have led to significant reductions in carbon emissions associated with travel, particularly in situations where physical presence was previously deemed necessary.

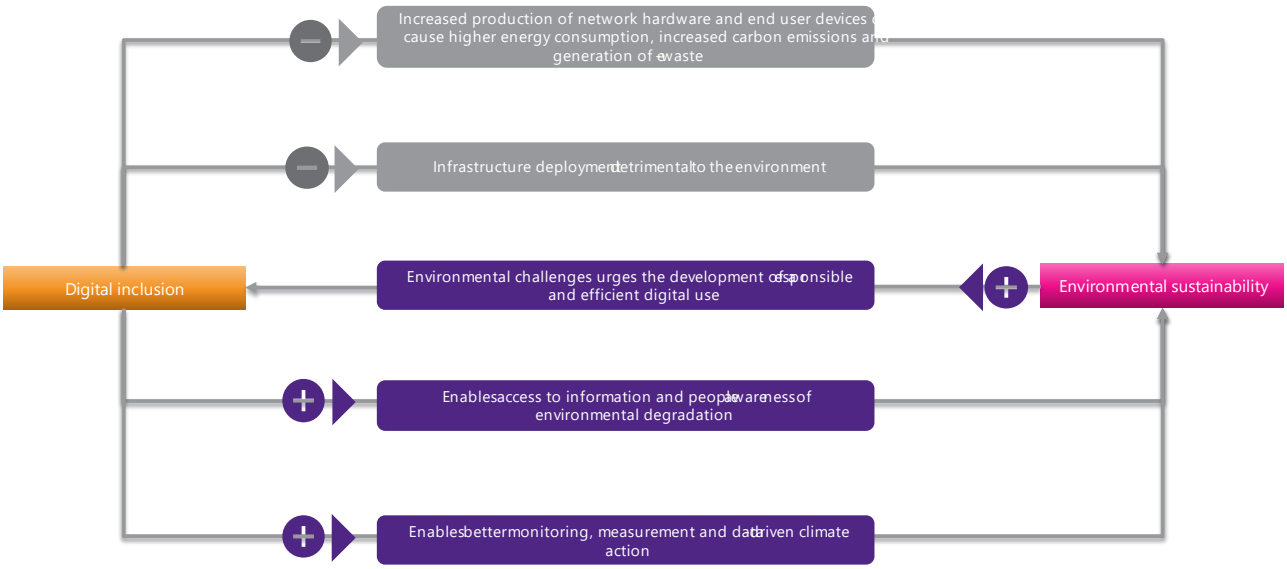
Digital communication technologies are also key in facilitating the widespread dissemination of crucial information aimed at educating and empowering individuals to actively participate in environmental conservation efforts. The internet is a powerful educational platform that contributes to raising awareness amongst the population and fostering a collective sense of responsibility for the protection and preservation of the environment. Bridging the digital divide between countries and within each country can in fact go a long way to bridging the awareness gap between different populations regarding current and future environmental

issues. This is a key first step to encourage the necessary behavioural shift that will enable us to tackle environmental challenges.

More specifically, digital communications technologies are a powerful tool for monitoring the environment through the use of satellites, drones and sensors that can collect data on air and water quality. A wider adoption and usage of these tools has the potential to reinforce our understanding of the environment. Besides technological advancement in the telecommunication industry, such as the development of 5G and fibre networks can also help in reducing energy consumption.

That being said, digital inclusion efforts that aim at providing connectivity services to more people can also have negative externalities that can be detrimental to the environment. An expansion of the underlying infrastructure such as building telecommunications networks and data centres can have significant environmental impacts such as habitat disruption, deforestation and increased energy consumption. Furthermore, as more people gain access to digital technologies and get more engaged in the digital economy there will inevitably be a higher consumption of electronic devices and an increase in the production and disposal of electronic waste. The production of devices requires energy and if that energy comes from non-renewable sources, it can contribute to environmental degradation and climate change. It also often requires rare earth elements[5] which are mined in specific regions and such mining activities can lead to soil and water pollution, habitat destruction and have adverse effects on biodiversity.

Figure 2.2: Linkages between environmental sustainability and digital inclusion



2.2 Environmental sustainability : Digital rights

The linkages between environmental sustainability and digital rights are less obvious, but they are there. In this section we discuss two important links:

- the availability of ethical and trustworthy information on the environment; and
- responsible policies to minimise the impact of data consumption on the environment.

[5] The rare earth elements (REE) are a set of seventeen metallic elements that are necessary components of more than 200 products across a wide range of applications, especially high-tech consumer products, such as cellular telephones, computer hard drives, electric and hybrid vehicles, and flat-screen monitors and televisions.

2.2.1 Responsible treatment of data

Responsible data practices can also offset environmental impact. Whilst technology evolution has contributed to more efficient storage and processing of any given quantity of data, it is true that there are environment related costs to incremental consumption of data because networks and data centres consume natural resources for their construction and operation (e.g. electricity, water, minerals).

Understanding the environmental impact of data consumption is not straightforward. For example, some analysts have identified a potential rebound effect where expectations of a better environmental outcome leads to increased consumption, i.e. if digital services are perceived as greener, users are more inclined to consume them. This effect known as the Jevons Paradox.[6] Analysis is difficult because there is currently no standardised way of reporting on resource use by the digital sector. Most academic and industry analyses on energy and water consumption are extrapolations based on averages of a few examples, leading to large variations in estimates.[7]

Whilst work to quantify the environmental impact of data consumption and to standardise measurements is ongoing, it is not in question that incremental consumption will result in environmental impacts. A feature of work on digital rights should therefore be consideration of the need to ensure excessive demand for and consumption of data does not result in unnecessary environmental cost. This consideration will not be straightforward because, in some cases, the environmental cost of incremental data consumption will be more than offset by consequential benefits elsewhere, e.g. through reduced travel resulting from use of digital services. Stakeholders working on digital rights and trust should recognise and take account of this.

2.2.2 Ethical and trustworthy environmental information

Another aspect of digital rights and trust is the need for digital facilities to be used to source ethical and trustworthy information. The accuracy and provenance of information found online has sometimes been a source of discomfort to commentators and consumers. This is becoming more important as online and digital sources becomes more pervasive as sources of news and information. Governments around the world are therefore taking steps to protect consumers from harmful content, including misleading information[8] – for example through the UK Online Safety Act,[9] and EU Digital Services Act.[10]

Achieving good environmental outcomes depends to some extent on citizens, companies and public sector organisations having clear and accurate information on which to form judgments and take decisions. Put another way, dissemination of "fake news" about the environment can be damaging to good environmental outcomes. Studies have identified that people can (understandably) find it difficult to distinguish between real information and misinformation about climate change.[11] At the same time, digital channels, including social media, have been identified as sources of misinformation and online attacks about climate change.[12]

[6] In 1865, the English economist William Stanley Jevons observed that technological improvements that increased the efficiency of coal use led to the increased consumption of coal in a wide range of industries.

[7] David Mytton, Masaō Ashtine, Sources of data center energy estimates: A comprehensive review, Joule, Volume 6, Issue 9, 2022. Available at: https://doi.org/10.1016/j.joule.2022.07.011

[8] This is discussed in Plum's Insight paper on Trust and Confidence in Digital Services. Available at: https://plumconsulting.co.uk/trust-and-confidence-in-digital-services/

[9] Available at: https://www.legislation.gov.uk/ukpga/2023/50/enacted

[10] Available at: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/digital-services-act-ensuring-safe-and-accountable-online-environment_en

[11] See for example the results of a survey carried out in the UK by YouGov available at: https://theconversation.com/climate-change-misinformation-fools-too-many-people-but-there-are-ways-to-combat-it-170658#:~:text=Working%20with%20YouGov%20and%20The%20Conversation%2C%20we%20asked,Sun%20has%20impacted%20the%20Earth%E2%80%99s%20rise%20in%20temperature%E2%80%9D.

[12] Robin Mckie (2021). Climate fight is undermined by social media's toxic reports. The guardian. Available at: https://www.theguardian.com/environment/2021/mar/21/climate-fight-is-undermined-by-social-medias-toxic-reports

Because of the linkages between environmental sustainability and digital rights and trust, there is a need to manage the risk of misinformation about the climate and environment being disseminated through digital media, and to foster responsible data practices.

This has been recognised by the European Parliament in The European Declaration on Digital Rights and Principles of the Digital Decade[13] 2023. This declaration links the concepts of environmental sustainability, and the right to access clear information on environmental impacts in one place. It says:

> **"To avoid significant harm to the environment and to promote a circular economy, digital products and services should be designed, produced, used, repaired, recycled and disposed of in a way that mitigates their negative impact on the environment and on society and avoids premature obsolescence. Everyone should have access to accurate, easy-to-understand information on the environmental impact and energy consumption of digital products and services, their reparability and lifetime, allowing them to make responsible choices"**

Figure 2.3: Linkages between environmental sustainability and digital rights

2.3 Digital inclusion : Digital rights and trust

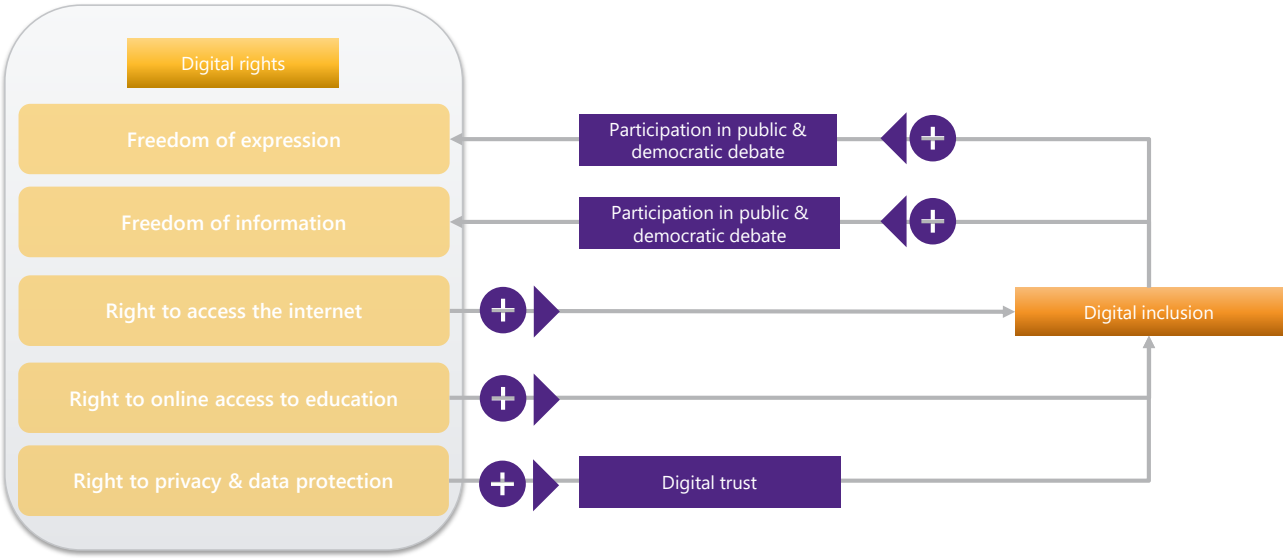
Digital inclusion as a driver for digital rights. Digital inclusion allows civil society, businesses and governments to participate in public debate, by having access to information, sharing data and opinions, and engaging with other stakeholders. As a result, digital inclusion allows the exercises of certain digital rights, such as freedom of expression and freedom of information. As detailed in Appendix D, digital inclusion can be hindered by different barriers (lack of connectivity, digital skills of the user, etc.). This obstacle also exists when governments deny access[14] to the internet in a country, a region or a city, or access to certain websites or social networks, putting forward national security justifications. According to a 2023 UN report, the impact of Internet access cuts is dramatic, "depriving millions of people from participating in democratic debates, and from accessing essential services linked to education, health, and work"[15].

Digital rights as a driver for digital inclusion. As mentioned in Section 1, the Council of Europe[16] includes in digital rights, among others, the right to access the Internet with any discrimination and the right to online access to education. Authorities ensuring these rights help contribute to digital inclusion. Furthermore, ensuring the right to privacy and data protection contributes to increased confidence in digital tools and in regulatory

[13] Available at : https://digital-strategy.ec.europa.eu/en/library/european-declaration-digital-rights-and-principles
[14] See: https://www.accessnow.org/campaign/keepiton/
[15] Agence Française de Développement (May 2023), Report on digital freedoms in French-speaking African countries. available at : https://www.afd.fr/en/ressources/digital-freedoms-french-speaking-african-countries
[16] Guide to Human Rights for Internet Users. Available at: www.coe.int/web/internet-users-rights

frameworks. "Controls or programmes that help to address consumers' concerns around online safety will drive digital inclusion, especially among vulnerable segments of the population"[17] Governments and policy makers are working to protect civil liberties online or online payment security; and ensure we are not exposed to criminal or inappropriate content. Increasing online safety and trust in digital services enables better digital inclusion.

Figure 2.3: Linkages between digital inclusion and digital rights



[17]GSMA (2022). ESG Metrics for Mobile White Paper. Available at: www.gsma.com/betterfuture/esg-metrics-for-mobile

3 The need for a holistic approach

The development of digital communications in the past thirty years has disrupted economic, social and political relationships between citizens, businesses and countries, and will continue to evolve at a fast pace. It is important then to recognise that analysis and policy development in the areas covered in this paper must be dynamic to enable policy frameworks that are adaptable and flexible as the landscape changes.

The paper aims to heighten awareness and sensitize policy makers and media about the causation effects and interplays – whether positive or negative – between environmental impact, digital rights and trust, and digital inclusion.

3.1 Recognising the link between digital inclusion, digital rights and sustainability

Addressing the issues in these three areas is a key challenge for policy makers across the globe and there are several targeted policies, regulations and public schemes that focus on one area or another. While these targeted policies and initiatives are important, it is nevertheless necessary to adopt a holistic approach that integrates environmental sustainability, digital inclusion and digital rights into a unified framework. Ignoring the dynamic relationships between these areas may inadvertently exacerbate existing disparities and hinder progress in one area while attempting to address another. In other terms, addressing these issues in silos could lead to unintended consequences and undesirable outcomes in one or two of these areas. A holistic approach is therefore paramount to ensure that existing trade-offs and potential externalities are taken into consideration before implementing policies and regulations.

Holistic policy initiatives aimed at addressing issues in these three areas together have yet to emerge. In fact, there are several existing frameworks that focus on two areas – Appendix E provides a non-comprehensive list. For example, the DSA and DMA adopted by the European Union ensure the safety of users online, establish a governance system for the protection of fundamental rights, and maintain a fair and open online platform environment. At the international level, organisations such as the ITU have set policy frameworks[18] that aim to address sustainability issues related to digital communications technologies as well as digital inclusion issues.

In the European Declaration on Digital Rights and Principles for the Digital Decade, the EU presents its commitment to ensure a secure, inclusive and sustainable digital society hence recognising the importance of developing sustainable digital communication technologies as defined in this paper. While this policy represents a considerable shift in the right direction, it does not comprehensively recognise the interplay between sustainability, digital inclusion and digital rights, and the importance of addressing these issues in a holistic manner.

On a similar view, the French National Commission for Information Technology and Liberties (CNIL, Commission Nationale Informatique et Libertés) recently published a report[19] linking environmental and data privacy issues, and calling for the inclusion of environmental dimension to CNIL scope of decisions.

3.2 Improving cross-border cooperation

The issues we face in the digital age are not confined by geographical boundaries. A holistic policy approach should also acknowledge the global nature of these issues, necessitating collaboration and coordination on an international scale. Policies that transcend borders are essential to effectively addressing the interconnected

[18] ITU CONNECT 2030 Agenda
[19] CNIL (2023). Data, footprint and freedoms. Available at : https://linc.cnil.fr/sites/linc/files/2023-09/cnil_ip9_data_footprint_and_freedoms.pdf

challenges of environmental sustainability, digital inclusion, and digital rights. International agreements and conventions can play a crucial role in facilitating such cooperation but policymakers at the national or regional levels must also collaborate to harmonise regulations and standards to ensure a cohesive and effective approach. International Organisations such as the International Telecommunications Union (ITU) can play a key role in fostering such cooperation by stating a clear vision that is aligned with the protection of the environment, the promotion of digital inclusion, and maintaining and furthering digital rights[20]. This also applies to international donors such as the World Bank that are heavily involved in the funding of digital infrastructure, capacity buildings and policy reforms worldwide. They have the potential to help shape a new paradigm of digital communications technologies that minimizes negative impacts on the environment, promotes social inclusion, and upholds ethical principles and digital rights.

3.3 Reinforcing cross-sectoral cooperation

Adopting a holistic approach to these issues is undoubtedly challenging, especially because of the large range of stakeholders affected by these issues. These include not only policy makers but also telecom operators, equipment vendors, content providers, data centres operators as well as researchers, the civil society and private companies that use digital communication technologies.

Each of these players have their own interests and approach to addressing these issues and it is important to raise awareness about the interplay of sustainability, digital inclusion and digital rights across all relevant stakeholders. There should be platforms to discuss these issues and how some players' initiatives can affect other players activities. Finally, policymakers should make sure that relevant stakeholders are consulted during the policy making process and provide flexible frameworks and guidelines that take into account the diversity of stakeholders and that integrate the aspects related to sustainability, inclusion and digital rights.

3.4 Strengthening the regulators' role

Telecommunications regulators across the world can also play an important role in promoting a sustainable digital communications sector. Their responsibilities span a wide range of areas to ensure the efficient functioning of the telecommunications sector, protect consumers, and promote fair competition and their action directly impact the accessibility, affordability and quality of digital communications services. While most regulators have a responsibility to drive digital inclusion (through universal service policies for example) as well as protect consumer's digital rights (through consumer privacy and data security regulations) they often don't address the issues related to environmental sustainability, mainly because this aspect is outside of their scope. Nevertheless, this is evolving and, in some countries, regulators are being more involved in environmental issues related to the ICT sector. In the UK for example, the National Infrastructure Commission, has recommended that Ofcom (Office of Communications), Ofgem (Office of Gas and Electricity Markets) and Ofwat (Water Services Regulation Authority) should have new duties to promote the achievement of net zero by 2050 and improve resilience.[21] In France, a legislative proposal was recently introduced[22] to give power to Arcep regarding climate issues, particularly by enabling Arcep[23] to establish an environmental barometer of digital market players. This is in line with the environmental strategy of the French government whose first axis is to "*measure, to get to know*

[20] The current ITU strategy (Connect 2030 Agenda) tackles sustainability and digital inclusion but doesn't have a strong focus on digital rights.
[21] https://nic.org.uk/news/utility-regulators-must-have-new-powers-if-uk-is-to-tackle-climate-change/
[22] Numerama (2021). Le gendarme des télécoms aura peut-être son sifflet pour réguler l'effet du numérique sur le climat. Available at: https://www.numerama.com/tech/741090-le-gendarme-des-telecoms-aura-peut-etre-son-sifflet-pour-reguler-leffet-du-numerique-sur-le-climat.html
[23] The case of Arcep currently remains an exception; there is no requirement, or indeed, allowance for most national regulatory authorities around the world to take account of environmental impact during their regulatory procedures.

in order to act better"[24]. Arcep's objective is to make environmental issues a new component of regulation, working in sync with France's Environment and Energy Management Agency (ADEME).

Whilst policy makers have understood the importance of clear and accurate information, and have taken steps to provide it at a general level,[25] information about the climate and environment and protection against misinformation are not subject to any particular requirements.[26]

At the European level, the Body of European Regulators for Electronic Communications (BEREC) is also becoming more involved in the issues related to sustainability in the ICT sector[27]. We believe this is a step in the right direction that could lead to empowerment of regulators across the globe to address these issues. Extending scope of activities of regulatory authorities to climate change and environmental impact would set the sector in the right path towards a sustainable future for digital communications.

[24] French Ministry of Ecological Transition (2021). Available at: https://www.ecologie.gouv.fr/feuille-route-numerique-et-environnement

[25] For example, information from the Government of Australia. See : https://www.climatechangeauthority.gov.au/publications/information-climate-change

[26] For example, legislative reform has not targeted misinformation about climate change – for example, the UK Online Safety Bill will tackle various types of harmful content, including some areas which are clearly aligned to UK government policy (like content related to illegal immigration), but does not explicitly address misinformation about climate change.

[27] See Berec's work programme 2023 available at: https://www.berec.europa.eu/system/files/2022-12/BoR%20%2822%29%20193%20BEREC%20Work%20Programme%202023_0.pdf

Appendix A Glossary

AI: Artificial Intelligence

Arcep: Autorité de régulation des communications électroniques et postales, French telecommunication regulator

ADEME: French Agency for Ecological Transition

ARCOM: Autorité de Régulation de la Communication Audiovisuelle et Numérique, French broadcasting and platforms regulator

BEREC: Body of European Regulators for Electronic Communications

CNIL: Commission Nationale de l'Informatique et des Libertés, French information and data regulator

DMA: Digital Markets Act

DOCSIS: Data Over Cable Service Interface Specification

DoH : DNS over HTTPS, internet protocol

DoT : DNS over TLS, internet protocol

DSA : Digital Services Act

CODES : Coalition for Digital Environmental Sustainability

FWaaS : Firewall as a Service

GHG : Green House Gases

ICT: Information and Communications Technologies

IT: Information Technology

LDC: Least Developed Countries

M2M: Machine to Machine

Mt: Million Tonnes

NGFW: Next Generation Firewall

NGO: Non-governmental organisation

REE: Rare Earth Elements

SRN: Shared Rural Network

TMT: Télécommunications, Média and Technology

TWh : Terawatt hour

UN: United Nations

UNCDF: United Nations Capital Development Fund

UNCTAD: United Nations Conference on Trade and Development

UNDP: United Nations Development Programme

VPN: Virtual Private Network

PGMs: Platinum-Group Metals

Appendix B Environmental dimensions

Our civilisation is currently facing an environmental issue that threatens life on Earth and this is influenced by multiple factors, such as industrialisation, population growth and rising urbanisation[28]. As electronic communications evolved and became integral parts of modern life and business, the question of their impact on the environment has become a topic of high interest. The answer to this question is not straightforward as electronic communications have an ambivalent effect on the environment. On one hand, they are responsible of a significant part of the global energy consumption and carbon emissions. Besides, electronic communications rely on hardware that requires the use of increasing use of limited natural resources and generate a significant amount of electronic waste that contributes to the pollution of the environment.

On the other hand, electronic communications also play an important role in protecting the environment. For example, the increasing use of virtual meetings have reduced the need for transportation. In addition, electronic communications can help us to raise awareness and take collective action to address climate change through social media and online petitions.

One of the key challenges facing researchers is how to measure both these negative and positive effects at a global scale. While there have been studies on the energy consumption and carbon emissions of the ICT sector as a whole, studies on e-waste and the use of limited resources are not as abundant. Besides, the methods, key assumptions and data sources differ from one study to another which can result in significant differences in the results. Finally, the rapid evolution of technology in the electronic communication sector means that estimates can quickly become unrepresentative.

Energy consumption and carbon emissions

Energy is used by the communication technologies to power the underpinning infrastructure (communications network and data centres) and the user devices. Most of this energy is electricity and electricity generation is important as it is responsible for emitting greenhouse gases and there are more or less sustainable ways of producing it.[29] For Communication technologies, energy is used throughout the production phase as well as during the lifespan of the devices and underpinning infrastructure. In fact, the production phase is responsible for most of the electric consumption and carbon emissions.[30]

A few academic studies attempted to quantify the global electric consumption and carbon emissions of electronic communications. These are shown in Error! Reference source not found. below. Overall, communication technologies accounted for an estimated 3.6-16% of global electricity use in 2020 and an estimated 1.4-4% of global carbon emissions. According to most academic literature, production of user devices is responsible for most of these emissions (60 – 80%), and electronic communications networks between 12-24%.[31].

It should be noted that there is no unique methodology to measure the electric consumption and carbon emissions of communication technologies, and this partly explains why the estimated results are different.

[28] Labelle R, Rodschat R, Perez-Chavolla L, Obiso M (2009). ITU E-Environment ToolKit and Readiness Index (EERI). Available at: https://www.itu.int/dms_pub/itu-d/opb/str/D-STR-ENV.E_ENV-11-2010-PDF-E.pdf

[29] UK Parliament Post (2022). Energy Consumption of ICT. Available at: https://researchbriefings.files.parliament.uk/documents/POST-PN-0677/POST-PN-0677.pdf

[30] ADEME France. See: https://impactco2.fr/

[31] BEREC external study (2021). Environmental impact of electronic communications. Available at : https://www.berec.europa.eu/sites/default/files/files/document_register_store/2022/3/BoR%20%2822%29%2034_External%20Sustainability%20Study%20on%20Environmental%20impact%20of%20EC.pdf

However, most studies agree on the fact that electric consumption and carbon emission are both expected to increase in the coming years.

Figure B.1: Studies on electronic communications electric consumption and carbon emissions (global)

Study	Scope	Electric consumption in (% global)	Carbon emission (%global)
The Shift Project (2018)	Telecom networks, datacentres, devices, IoT sensors – Production and usage	3500 TWh (16%)	1500 Mt (3%)
Belkhir and Elmeligi (2018)[32]	Telecom networks, devices – Production and usage	-	1300 Mt (3.6%)
Malmodin, J. and Lundén, D., (2018)[33]	Telecom networks, datacentres, user devices, enterprise networks - production and usage	805 TWh (3.6%)	730Mt (1.4%)
Andrae et Edler (2015)[34]	Network infrastructure, datacentres, consumer devices including TVs and home entertainment systems	3400 TWh (11%)	-
GreenIT (2019)[35]	All electronic equipment, including TVs, printers and Videos games	1300 TWh (5.5%)	1400 Mt (3.8%)

Note: estimates in this table are for 2020

[32] Belkhir, L. and Elmeligi, A. (2018). Assessing ICT global emissions footprint: Trends to 2040 & recommendations. Journal of Cleaner Production, 177, pp. 448-463. Available at: https://doi.org/10.1016/j.jclepro.2017.12.239

[33] Malmodin J, Lundén D. The Energy and Carbon Footprint of the Global ICT and E&M Sectors 2010–2015. (2018). *Sustainability*; 10(9):3027. Available at: https://doi.org/10.3390/su10093027

[34] Andrae ASG, Edler T. On Global Electricity Usage of Communication Technology: Trends to 2030 (2015). *Challenges*; 6(1):117-157. Available at: https://doi.org/10.3390/challe6010117

[35] GreenIT.fr Empreinte environnementale du numérique mondiale. Available at : https://www.greenit.fr/wp-content/uploads/2019/10/2019-10-GREENIT-etude_EENM-rapport-accessible.VF_.pdf

Figure B.2: Case study: France

In August 2020, the French telecommunications regulatory authority (ARCEP) and the Agency for Ecological Transition (ADEME) have been assigned a joint task of measuring the digital environmental footprint in France[36]. The two organisations delivered the first two volumes of the study, assessing the impact of ICT in 2020, and a third and final volume, providing a forward-looking assessment of the digital environmental footprint up to 2030 and 2050.

Key results of the study include the following:

- The digital sector in France is responsible of 2.5% of the total annual carbon footprint
- Devices account for 79% of the digital carbon footprint, compared to around 16% for data centres and 5% for telecommunications networks.
- Production of electronic devices accounts for 80% of their environmental impact
- An average person living in France generates 301 kg/year of e-waste and is responsible of 949 kg/year of resources used to produce devices (fossil fuels, materials, water and biomass)
- GHG emissions could increase by 45% by 2030 and triple by 2050 if no action is taken

In addition to the landmark study mentioned above, regulatory bodies in France have also published several studies on the communications technologies carbon footprint that address different aspects of the issue. These include:

- The content of a general policy framework for the sustainable design of digital services, published by Arcep and the media regulator (Arcom)[37]
- The Technical Experts Committee on measuring the digital environmental footprint published a report assessing the differences in the methodologies used to measure the digital environmental footprint[38]
- A study on the impact of introducing 5G in the 3.5 GHz band in terms of network energy consumption[39]
- A study assessing the carbon footprint impact of shutting down 2G/3G networks and migrating their voice/texting and M2M services to 4G/5G[40]
- A study by the data protection regulatory authority (CNIL) exploring the intersections between protection of data, freedoms, and the environment[41].

[36] See: https://en.arcep.fr/uploads/tx_gspublication/press-kit-study-Ademe-Arcep-lot3_march2023.pdf
[37] See: https://www.arcom.fr/fr/nos-ressources/espace-juridique/textes-juridiques/recommandation-de-larcom-sur-larticle-26-de-la-loi-visant-reduire-lempreinte-environnementale-du-numerique-loi-reen
[38] See Arcep's press release April 3, 2023. Available here: https://en.arcep.fr/news/press-releases/view/n/the-environment-030423.html
[39] See: https://www.arcep.fr/la-regulation/grands-dossiers-thematiques-transverses/lempreinte-environnementale-du-numerique/consommation-energetique-reseaux-mobiles-etude-comparee.html
[40] See Arcep's press release September 11, 2023. Available here: https://en.arcep.fr/news/press-releases/view/n/the-environment-110923.html
[41] Available here: https://linc.cnil.fr/sites/linc/files/2023-09/cnil_ip9_data_footprint_and_freedoms.pdf

The use of natural resources

Unsustainable use of natural resources is one of the key drivers of the environmental crisis and the ICT sector relies on the use of several natural resources to produce hardware components, from microchips to screens and other electronic components. There is undoubtedly a growing demand for the hardware underpinning electronic communications which is a natural consequence of an increasing use globally, and the production of this hardware requires an increasing consumption of raw material such as minerals and metals.

According to Hanski et al (2021)[42], a significant part of the periodic system of elements is used in digital technologies with a particularly high share in the consumption of elements such as copper, gallium, germanium, gold, indium, platinum-group metals (PGMs), rare earth elements (REE) and tantalum. In a 2021 study[43], UNCTAD have identified seven of these elements as "ICT elements". These include gallium, germanium, indium, rare earth elements (REEs), selenium, tantalum and tellurium and represent the "functional elements" that are essential raw materials for the building blocks of all ICT hardware such as microchips and integrated circuits.

The role of these seven elements in the production of digital communications hardware is critical, and for some of these the actual usage by the ICT sector accounts for 80-90% of worldwide usage.

As of now, the total production of these elements is very small according the UNCTAD study. The seven elements together amounted to 0.17Mt (of which REEs accounted for 95%) compared to the global metals production of 1,600 Mt. In other terms the ICT elements represent a tiny portion of total use of all metals. However, as the use of digital communications globally is expected to keep growing, it is likely that the mining and production of these elements will also become more important in the future. Additionally, as technology evolves, it is also highly likely that other elements could be used in the production of digital communications.

Generation of electronic waste

Electronic waste (also known as e-waste, e-scrap, or end-of-life electronics) is defined by the UN as "any discarded product with a battery or plug, and features toxic and hazardous substances such as mercury, that can pose severe risk to human and environmental health"[44]. In 2019, 53.6 million metric tons (Mt) of e-waste was generated globally which amounts to 7.3 kg per capita. The growth rate is estimated to be of 2Mt per year which means that by 2030, the global quantity of e-waste will exceed 74 Mt or 9 kg per capita[45]. Most of this e-waste is generated in Asia (24.9%) but Europe accounts for the highest amount of e-waste per capita (16.2kg).

It should be noted that 17% of the total e-waste was recorded as being collected and recycled. Even in the EU, which is the frontrunner on this issue, less than half of total e-waste is recycled. The vast majority of e-waste is therefore undocumented, and likely to be buried under the ground. The problem is that e-waste is not biodegradable and can even be toxic which means that its accumulation in the environment, in the soil, air and water can deteriorate the environment and even lead to health issues.

Region	Total e-waste generated in Mt(per capita in Kg))	e-waste documented to be collected and properly recycled
Africa	2.9 (2.5kg)	0.9%
Americas	13.1 (13.3 Kg)	9.4 %

[42] Hanski, Jyri & Horn, Susanna & Judl, Jáchym & Karhu, Marjaana & Päivi, Kivikytö-Reponen & Lintinen, P & Långbacka, B & Eilu, Pasi & Eerola, Toni. (2021). Digitalization and natural resources.
[43] UNCTAD (2020). Digital economy growth and mineral resources implications for developing countries. Available at: https://unctad.org/system/files/official-document/tn_unctad_ict4d16_en.pdf
[44] This definition means that e-waste includes other devices than just electronic communications devices.
[45] Forti V., Baldé C.P., Kuehr R., Bel G. The Global E-waste Monitor 2020. Available at : https://ewastemonitor.info/wp-content/uploads/2020/11/GEM_2020_def_july1_low.pdf

Region	Total e-waste generated in Mt(per capita in Kg))	e-waste documented to be collected and properly recycled
Asia	24.9 (5.6 Kg)	11.7%
Europe	12 Mt (16.2 Kg)	42.5%
Oceania	0.7 Mt (16.1 Kg)	8.8%

Source: The Global E-waste Monitor 2020[46]

The manufacturing, use and disposal of electronic communications devices and equipment also generates significant amounts of electronic waste. The increasing demand for faster and more powerful devices and networks contributes to strengthening the pollution issue and according to the UN, screens, monitors, small IT and telecommunications equipment represent 21.3% of total e-waste or about 11.4 Mt.

How environmental issues are addressed

Environmental issues related to the digital communications technology sector can be addressed in the following way:

By technology: New technologies such as fibre, clean hydrogen and 5G can serve as critical enablers to addressing some of the environmental issues. Fibre can be seen as a critical technology in reducing the ICT sector's overall carbon footprint. This is possible through direct energy improvements, and scaling of the digital economy. Fibre is efficient, with higher speeds for connectivity. The technology is scalable and reliable, according to Europacable, fibre networks consume 56KWh vs 88KWh for DOCSIS (Cable networks), this translates to 1.7 tons of Co2 per year/capita with fibre networks vs 2.7 tons per year/capita for cable networks. This energy efficiency can reduce the need for energy growth while the demand for data increases and traffic grows in the years ahead.
Similarly, 5G presents an opportunity to utilise a technology that has broader efficiency gains. With 5G this could be a product of direct efficiency gains or large scale take up of smart solutions across an economy. This includes smart electricity grids that help distribute and use power more efficiently, or that integrate renewable resources. According to Axon[47] utilising a case study for Belgium despite an initial increase in energy consumption, 5G is still estimated to consume up to 37% less energy than 4G.

While fibre and 5G can limit the environmental impact of the diffusion of electricity already produced, hydrogen can act as a clean energy source for ICT's, in production and diffusion. Clean hydrogen can act as a major facilitator in cutting the emissions of GHG and putting the ICT sector on a greener footing. This will however necessitate safe and reliable methods of converting, storing and using energy that can compete with hydrocarbon fuels extracted from the planet. In the clean hydrogen space however, the developments are non-uniform and progress is far from settled although there is immense potential.

By regulation: Regulation can play a crucial role in addressing environmental issues in the digital communications sector by establishing standards and incentivizing sustainable practices. Regulatory frameworks can enforce energy efficiency standards for data centres, network infrastructure, and electronic devices, fostering the development and adoption of eco-friendly technologies. Moreover, regulations can promote transparency and accountability, compelling companies to disclose their environmental impact and implement strategies to minimize it. Incentive programs, such as tax breaks for environmentally friendly practices or penalties for excessive energy consumption, can encourage businesses to prioritize sustainability.

[46] https://ewastemonitor.info/wp-content/uploads/2020/11/GEM_2020_def_july1_low.pdf
[47] Axon Partners Group (2021). Sustainability in the digital sphere: how green is ICT? Available at: Phttps://web.archive.org/web/20220520160436/https://www.axonpartnersgroup.com/wp-content/uploads/2021/07/20210727-Sustainability-Article.pdf

In Europe for example, the European telecom regulators, meeting within BEREC, have integrated the issues related to the environmental footprint of digital technology into their 2021-2025 strategy. *The "Sustainability"* working group brings together experts from national authorities and the European Commission and aims to raise awareness among European regulators, develop their expertise concerning the environmental impact of digital technology and identify good practices for acting in coherence with environmental issues. BEREC is moreover the privileged forum for dialogue and coordination to ensure the development and sharing of good practices adapted to the reality of the sector and an implementation commensurate with the environmental ambitions of the European Union

By self-regulation: Self-regulation in the digital communications sector can contribute to addressing environmental issues by fostering a sense of corporate responsibility and encouraging sustainable practices within the industry. It often involves industry-led initiatives and collaborations that establish best practices to adopt. Companies can implement self-regulatory measures such as adopting green data centre technologies, optimizing network infrastructure for energy efficiency, and designing products with a focus on longevity and recyclability. Establishing internal benchmarks and targets for reducing greenhouse gas emissions and electronic waste can be part of a self-regulatory approach.

Transparency is a key aspect of self-regulation, as companies can voluntarily disclose their environmental performance and progress toward sustainability goals. This not only enhances accountability but also enables consumers and stakeholders to make informed choices, supporting environmentally conscious businesses.

Self-regulation doesn't replace the need for external oversight, but it can complement formal regulations and demonstrate the industry's commitment to environmental stewardship. By embracing self-regulation, companies in the digital communications sector can proactively contribute to a more sustainable future while adapting to evolving environmental challenges.

By raising users' awareness and education: Electronic communications play a key role in education and dissemination of information. Users' awareness of the role they play as stakeholders in emissions reduction remains paramount. Reminding users to recycle, and repair products where they can is useful. Education about the dynamics of the circular economy can inform more responsible consumer choices. If consumers are aware that recycling processes separate precious metals found in electronics for reuse, and thus has the effect of lowering the demand for metal mining and extraction, which is a Green House Gases(GHG) intensive process.

Appendix C Safeguarding digital rights and trust

Digitalisation is transforming the way human rights such as freedom of expression and access to information are exercised and protected. Digital rights are those human rights and legal rights that allow individuals to access, use, create, and publish digital media or to access and use computers, other electronic devices, and telecommunications networks. In order to prevent violation of human rights in the digital space, development of ethics within the digital space has emerged in the debate and practices, and more broadly amongst policy makers, as these topics are considered to be important to social wellbeing.

Digital rights include various aspects which the Council of Europe[48] scopes as such:

- The right to access the Internet without any discrimination. This includes affordability of Internet services;
- Freedom of expression and information, including the duty of public authorities to protect it;
- Freedom of assembly, association and participation through the use of Internet;
- Right to privacy and data protection, including personal data being processed with consent, information of data transfer to third parties and control over their data;
- Right to online access to education; and
- Entitlement to special protection and guidance while using the Internet.

Discussion on trust in technology has been taken up by experts in the past few years. Trust in technology is important because most of technology users do not know – and do not need to know – how it operates. Even if more and more people and businesses use digital tools, communicate, create, buy and sell online, not everyone feels entirely comfortable. Plum's Insight "Trust & confidence in digital services"[49] discusses a number of areas on which people feel uneasy or distrust some digital services. This lack of trust could constrain digital inclusion.

Why digital rights and trust are important

Looking more closely at the different types of users of digital communication tools and services, digital rights and trust are important for various reasons.

For citizens. Citizens are at the centre of tech innovation: technology shall serve people and not the other way round. The need to protect individuals online has become a prominent topic in public debate. "Causes [of online harms] can be legal (e.g. exposure of individuals to content which they find distressing or addictive) or illegal (e.g. fraud, or misuse of personal data)"[50]. Examples of online harms include exposure to harmful content, risks to health, as well as fraud and scams[51]. Trust in technology and in policy frameworks that protect individuals will also be an important driver for digital inclusion. The February 2023 "European Declaration on Digital Rights and Principles for the Digital Decade"[52] was signed by the European Parliament, the Council and the Commission, and states that "Technology should serve and benefit all people [...] and empower them to pursue their aspirations, in full security and respect for their fundamental rights."

[48] Council of Europe. Guide to Human Rights for Internet Users Available at: www.coe.int/web/internet-users-rights
[49] Plum Insight, Trust & confidence in digital services (2023), available at: https://plumconsulting.co.uk/trust-and-confidence-in-digital-services/
[50] Plum Insight, Trust & confidence in digital services (2023), available at: https://plumconsulting.co.uk/trust-and-confidence-in-digital-services/
[51] Details and other examples of online harms are provided in Figure 2 of the Plum Insight paper mentioned in the footnote above.
[52] Available at :https://digital-strategy.ec.europa.eu/en/library/european-declaration-digital-rights-and-principles

For businesses. Companies all over the world have gradually understood that they need to incorporate a societal and environmental impact assessment to their business strategy. Beyond the aspect of running an ethical business, building trust from consumers is key to their business, as consumers' and investors' awareness and sensitiveness of social and environmental issues is increasing. Offering safe and secure technologies, as well as services that protect their privacy, is a key driver for success. Some businesses monitor their own data protection KPIs (e.g. number of data breaches, ratio of data breaches involving personally identifiable information, number of customers affected). Tech giants like Meta, Google, Microsoft, Amazon, TikTok and Dailymotion are joining researchers and NGOs to figure out best practices on issues ranging from privacy to digital literacy.

For states. States and governments have understood the strategic importance of the Internet access for their country, their citizens, as well as the potential drifts and harms deriving from it. Governance as well as political and regulatory frameworks are key in the domain of digital rights and user trust. The European Union has shown its political will to defend digital rights through the "European Declaration on Digital Rights and Principles for the Digital Decade" that was signed by the European Parliament, the Council and the Commission in February 2023. The UK government has tackled the issue of online harms[53] to improve citizens' online safety. Estonia and New Zealand are among countries that have joined the French government initiative "Children Online Protection Lab" to improve safety for minors online across the world. Under some circumstances, some governments[54] mandate to temporarily shut down or restrict access to internet, social media, or websites, stifling freedom of expression and information of their citizens. Also, the Internet in some countries like Russia and China tends to be a network separated from the rest of the world, dominated by governments and corporations that control what people see and what services they use. These practices lead to the splintering of the Internet limiting the access to a content that should be universal.

Regulation and self-regulation of digital rights and trust

As indicated above, certain states and regions have organized themselves to establish the legal and regulatory frameworks necessary to respect digital rights for their citizens.

The EU Digital Services Act (DSA, 2023) includes some articles that aims at protecting digital rights. Under the DSA, large platforms and search engines[55] are required to comply with a set of new obligations, among others[56]:

- **Empower users.** Users will be able to report illegal content easily and platforms will have to process such reports diligently. Advertisements will not be displayed based on the sensitive data of the user (such as ethnic origin, political opinions, or sexual orientation).
- **Protect minors.** Platforms will have to redesign their systems to ensure a high level of privacy, security, and safety of minors. Targeted advertising based on profiling towards children will no longer be permitted.
- **Reduce disinformation.** Platforms and search engines will need to take measures to address risks linked to the dissemination of illegal content online and to negative effects on freedom of expression and information.

[53] Ofcom Online Safety Act (2023). Available at: https://www.ofcom.org.uk/online-safety/information-for-industry/roadmap-to-regulation
[54] See: https://www.accessnow.org/campaign/keepiton/
[55] Including Google search, LinkedIn, Amazon store, Snapchat, and YouTube
[56] See for example: https://www.linkedin.com/pulse/more-responsibility-less-opacity-what-means-very-large-thierry-breton/?trackingId=e9VgW8xbqYb3WpukJoreQg%3D%3D

- **Reduce harmful content.** Platforms and search engines will need to take measures to address risks linked to the dissemination of harmful content.

- **Increase transparency.** Platforms will have to give access to publicly available data to researchers; later on, a special mechanism for vetted researchers will be established. They will need to publish repositories of all the ads served on their interface.

Net Neutrality principles have been enshrined in laws or regulations in the EU, in California, and in India for instance, in order to ensure non-discriminatory access to the Internet. Besides this, existing legal frameworks impose content moderation on Internet market stakeholders. A few examples include NetzDG in Germany[57], the Avia law in France[58], the Online Safety Act in Australia[59] and the Network Act in South Korea[60]. In the overall public policy debate, there are existing regulatory tensions on content moderation:

- Quality of information vs freedom of speech (organisations may be cautious in their application of content moderation, as they fear accusations of censorship[61])

- Liability and responsibility for policing.

On a more global scale, the Internet Society is working to protect the Internet from splintering into isolated networks that may not be able to interconnect or interoperate efficiently. The Society's Internet Impact Assessment Toolkit (IIAT) is a collection of practical tools helping users assess forthcoming policies and their potential effects on the Internet.

Self-regulation also contributes to protect digital rights. International organisations have published guidelines for self-regulation, like the UNDG (United Nations Development Group) Guidance Note on Data Privacy, Ethics and Protection. The OECD Committee on Digital Economy Policy provides policy advice to guide countries including on aspects of digital rights[62]. Besides international guidelines, some private companies in the electronic communication services and content sectors have developed internal guidelines related to ethical behaviour and compliance, privacy and digital rights, network and data security, as well as internal monitoring processes.

Raising users' awareness and education on their digital rights is a complementary way of fostering respect of digital rights, in a context where the user is both a technology and content user and a content provider.

Digital rights management

Regulation and guidelines allow countries and organizations to have a framework from which to think and legislate. In a more operational way, digital rights can be managed by certain technologies and tools which, for example, allow respect for private life or even contribute to user confidence.

Encryption for privacy and security

Encryption contributes to protect the confidentiality of digital data, either stored on computer systems or transmitted through the Internet. Encryption uses plain text from a text message or an email, and scrambles it

[57] See: https://webhelp.com/news/legal-frameworks-of-content-moderation-around-the-world-part-1/
[58] Available at: https://www.legifrance.gouv.fr/jorf/id/JORFTEXT000042031970
[59] Available at: https://www.legislation.gov.au/Details/C2021A00076
[60] Available at: https://elaw.klri.re.kr/kor_service/lawView.do?hseq=50484&lang=ENG
[61] See for example: How Online Content Providers Moderate User-Generated Content to Prevent Harmful Online Communication: An Analysis of Policies and Their Implementation (2020). Available at:https://onlinelibrary.wiley.com/doi/full/10.1002/poi3.239
[62] See: https://www.oecd.org/digital/rights/

into an unreadable format, a "cipher text." When the recipient accesses the message, the information is translated back to its original form, this is the decryption process. To unlock the message, a "secret" encryption key is used by both the sender and the recipient. The encryption key is a set of algorithms that scramble data then unscramble it back to a readable format.

International initiatives and organisations support encryption. For instance, the Internet Society 2023 Action Plan includes extending and strengthening encryption, as well as mitigating attempts of banning encryption. The Global Encryption Coalition promotes and defends encryption to maintain data private and secure. It supports efforts by companies to offer encrypted services to their users. Their website lists the attempts to ban encryption, for example in 2021 when some ITU member States suggested banning DoH[63] and DoT, which are important encryption Internet protocols. There are also initiatives from private companies offering user security protection to their users[64].

Virtual Private Network (VPN) for privacy and security

VPN services are for both end-users and organisations. They provide a secure and private network connecting one or more locations, local networks, or intranets together. These services also provide proxy servers to access restricted websites/content (for instance, some online content may not be accessible from all regions in the world for intellectual property rights reasons) and to keep their Internet activity private. Different forms of VPN services exist:

- Hosted/cloud VPN: the client connects through a web-based cloud VPN connection.
- Public VPN: VPN hosted and accessed using public networks or the Internet.

It enables to an end-user to protect their data and activity by keeping its Internet activity private. In typical Internet connections, packets are transported across the Internet in their native, unencrypted form. A VPN changes this so that only the two endpoints can "see" the content of the packets. For end-users that has value when connecting to unsecured public Wi-Fi hotspots and to access content that is geo restricted in its region of the world. In corporate settings, the VPN is valuable for keeping sensitive information private – the content of the traffic cannot be examined by those involved in transporting the packets from source to destination. VPNs are legal in most countries, but some Asian countries ban them (e.g. only approved VPNs can be used in China, while data related to online activity may be examined by the government)[65].

Content security and moderation

Content security and moderation services relate to preventing access to specific websites, deleting or flagging posts and content, and blocking users' accounts. They include screening, monitoring, and approving user-generated content – text, image, or video (created in many languages), through an automated or a manual process, or through a combination of both. Their main objectives are to allow only constructive content and identify inappropriate submissions (spammy, vulgar, hateful, predatory). This contributes to preventing cyber bullying, abuse, hate speech, violent threats, and child exploitation, among other harms.

Automated processes catch about 90 percent of inappropriate content[66]. It enables the protection of human moderators from violent or shocking content, and the ability to keep up with the overwhelming demand in

[63] DoH (DNS over HTTPS) and DoT (DNS over TLS) are both internet security protocols.
[64] See: https://www.apple.com/newsroom/2022/12/apple-advances-user-security-with-powerful-new-data-protections/]
[65] See: https://www.privacysharks.com/vpn/asia/
[66] See: https://www.aitrends.com/ethics-and-social-issues/content-moderation-becoming-a-big-business-with-ai-enlisted-to-help/

content moderation. Limitations of automated tools[67], being AI-based, are reported to include issues of accuracy and reliability, of contextual understanding, and of transparency, among others. Challenges related to content moderation include the emotional well-being of content moderators, a quick response time and cultural differences in what content is acceptable and what content is not.

Network and digital objects security

Traditional appliance-based firewalls were developed to protect business networks. They provide packet inspection capabilities to filter network traffic based on a set of rules. The intent of the rules is to protect the network from internal and external threats and avoid malicious or unauthorized access to the network. These rules include domain and IP address access rules, web and URL filtering, advanced malware detection, logging, identity management, intrusion detection and prevention.

Because more and more companies have moved their infrastructure, apps and data to the cloud, firewall services have been transitioning into a virtualized service, often called FWaaS (Firewall as a Service). Systems are also now able to predict external threats based on its examination of the patterns of incoming traffic. FWaaS also are able to protect remote connections and often provide VPN and access control applications. This means that the FWaaS application can support a geographically dispersed network – far beyond the devices operating in physically connected offices (as was the case for traditional firewalls).

NGFW (Next Generation Firewall) combine the capabilities of traditional firewalls – packet filtering, address translation, URL blocking and VPN – with features of quality-of-service management, as well as features typically absent from firewalls (including intrusion prevention, SSL and SSH inspection, deep packet inspection (DPI), reputation-based malware detection). Next Generation Firewalls often move beyond traditional rule-based approaches to access control to AI-based traffic examination. Identifying patterns in traffic provides protection against denial-of-service attacks and other exploits that rules-based approaches might not be able to deal with effectively.

It is also interesting to note global initiatives like MANRX (Mutually Agreed Norms for Routing Security), which aims at reducing most common routing threats and sharing global routing security best practices. Blockchain is another technology that is seen as a tool to enhance trust by securing and proving the integrity of digital objects.

[67] See: https://www.newamerica.org/oti/reports/everything-moderation-analysis-how-Internet-platforms-are-using-artificial-intelligence-moderate-user-generated-content/the-limitations-of-automated-tools-in-content-moderation/

Appendix D Digital inclusion

In Appendix D we explore the concept of digital inclusion and its relevance to our central theme of sustainability in electronic communications markets.

Digital inclusion is a concept that addresses the ability and opportunity of individuals and communities to access and use information and communication technologies (ICTs).

Gaps in digital inclusion (the digital divide)

Policy makers and regulators around the world are concerned to address gaps in digital inclusion. These gaps are sometimes referred to as the "digital divide". The digital divide is a loose term covering a number of different gaps in digital inclusion. It can be seen within communities, in each nation, between countries, and globally. Drivers are:

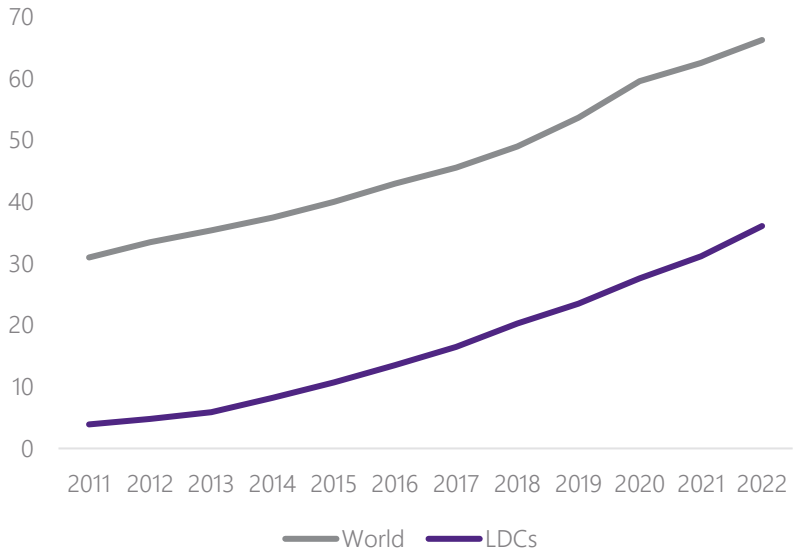
- Connectivity, and the availability of infrastructure to support it.
- Take-up and usage of digital service. Where good quality connectivity is available, there are barriers to take up and use, for example arising from:
  - Low digital skills.
  - Difficulties affording digital services.
  - Attitudinal barriers. This means resistance to adoption of digital services because of concerns about them. This can result from a mix of factors, including worries about security of personal data, or resentment about the pervasiveness of the digital economy.

The widening digital divide between developed and developing countries

A problem for policy makers seeking to drive digital inclusion globally is that, whilst ICT has the potential to deliver benefits to developing countries, the rate of progress in addressing digital exclusion is greater in developed countries. There are understandable reasons for this – for example, capital to fund infrastructure projects is more freely available in developed economies. Therefore, whilst initiatives are in place to boost connectivity and take-up in developing countries, developed countries continue to move ahead, so the digital divide between developed and developing countries is widening.

ITU data show the relative position of least developed countries (LDCs) compared to global trends. See data below (33 of global 46 LDCs are in Africa).

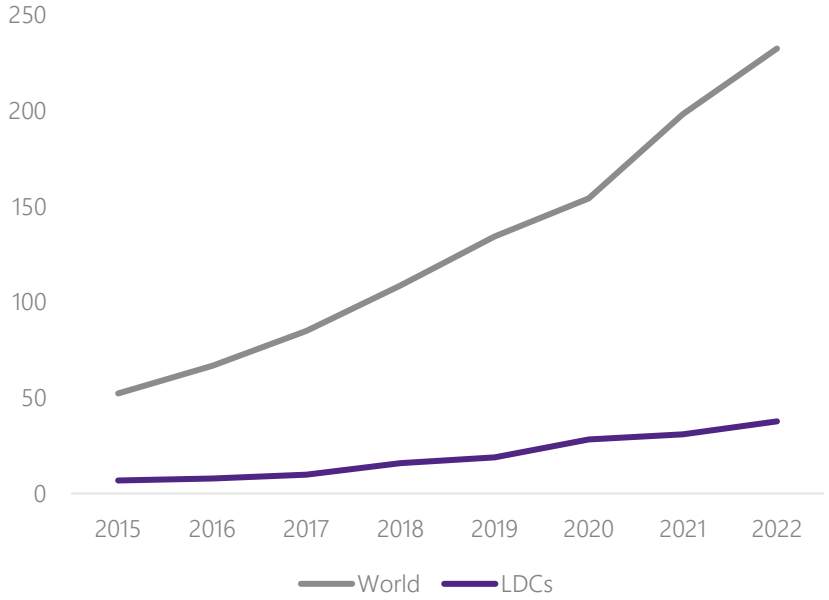
Figure D.1: Percentage of individuals using the Internet



Source: ITU[68]

Whilst connectivity is growing in both globally and in developing countries (from a lower base in developing countries), the digital divide is widening as usage grows in developed countries (see Figure C2). Figure C3 shows the relative penentraion of 4G globaly and in LDCs to further illustrate the netwok coverage and quality gap.

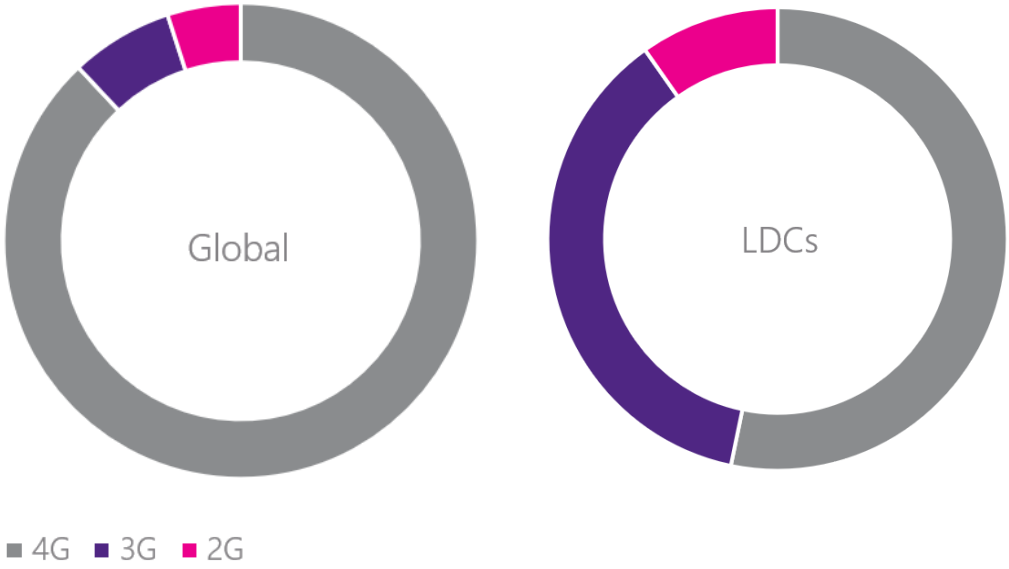
Figure D.2: Individual bandwidth use per individual user (kbt/s)



Source: ITU[69]

[68] See: https://www.itu.int/itu-d/reports/statistics/facts-figures-for-ldc/
[69] *Ibid*

Figure D.3: Mobile coverage comparison between the World and LDCs



Source: ITU[70], Plum analysis

This accelerated development of connectivity, take-up and use in developed countries is due to a combination of growing demand for, investment in and availability of higher capacity and higher quality connectivity, and the development of innovative new use cases and content. This can create a viruous circle between supply and demand of digital connectivity and services (see Figure C4).

Figure D.4: The virtuous circle of connectivity and take-up

Source: Plum analysis

[70] *Ibid*

The digital divide is not just between countries

There are also connectivity and take-up/usage gaps within each country, for example between:

- age
- income
- employment status
- gender (which is more pronounced in developing countries)[71]
- disability

Why digital inclusion is important

Inclusion is an important priority for political leaders, policy makers, citizens and businesses. It is a key determinant of education, health, wealth, and democracy.

Digital inclusion provides private benefits to all of us who use digital services. These benefits are many and varied, and depend on individual patterns of consumption. They can come in the form of access to services and facilities which can transform an individual's prospects in life. For example, access to online education can lead to better employment prospects.

Digital inclusion also delivers public benefits. These are benefits felt across society as a result of more people being users of digital services. In other words, individual consumption of digital services creates positive externalities because it delivers benefit to other users of services and society more broadly. Some illustrative examples of private and public benefits are provided in Figure C5.

Figure D.5: Examples of private and public benefits of digital services

Service type	Type of benefit	Examples of benefits
Digital healthcare	Private	Easier and quicker access to services, including 24/7
	Public	Improved outcomes for public health, education, and employment Lower cost of delivery
Digital education	Private	Distance learning Learn at your own pace Learn when you like, 24/7 access
	Public	Improved outcomes for public health, education, and employment Lower cost of delivery
AI	Private	Faster and cheaper access to some services and facilities More reliable results for some interactions

[71] ITU data show that, in 2022, 93% of men and 92% of women use the Internet whilst the corresponding figures for LDCs were 43% and 30%.

	Public	Improving reliability and accuracy for some public services, e.g. road traffic management Lower cost of delivery

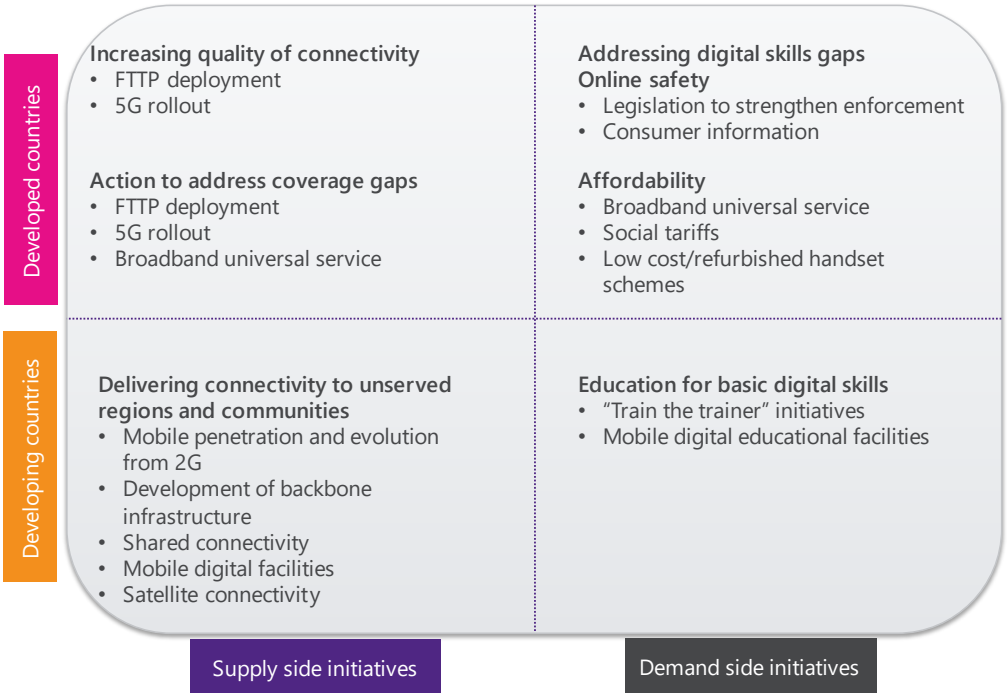
How are stakeholders addressing digital inclusion gaps?

The response to digital connectivity and engagement gaps is different in each country, reflecting the different starting points and policy approaches.

For example, developed countries are pursuing initiatives on both supply and demand sides aimed at improving digital infrastructure and driving take-up and use. Developed countries start from a position of relatively high availability of infrastructure and levels of digital engagement. Least developed countries typically have poorer infrastructure and lower levels of engagement.

We illustrate this in Figure C6 which shows examples of the types of initiatives being pursued in developed and developing countries.

Figure D.6: Illustrative examples of approaches to address barriers to connectivity, take up and use of digital services



Comparative case studies – Bangladesh and the United Kingdom

We can build on these illustrative examples by looking at two case studies. We have chosen Bangladesh and the UK for this analysis.

Analysis of these two countries demonstrates the different conditions and approaches taken between developed and developing countries. For example:

- A minority of people use the Internet in Bangladesh whereas Internet use in the UK is close to universal. Policy interventions are designed to address the different levels of engagement in each country.
- Mobile penetration is >100% in both countries. In Bangladesh there is greater reliance on mobile connectivity for data and Internet access than in the UK where high-quality fixed Internet connectivity is also available.
- Interventions to improve connectivity in Bangladesh are targeted at unserved communities to provide facilities which are sometimes shared. UK interventions are targeted to provide very high-speed connectivity to individual premises.
- More granular data is available for the UK than for Bangladesh, and this is an important tool for analysts and policy makers.

Key information and data are shown in the table at Figure C7. Note that this is a high-level analysis, consistent data between the two countries are not available and so direct comparisons should be approached cautiously.

Figure D.7: At a glance comparison between Bangladesh and the UK

	Bangladesh	UK
Overview	Bangladesh is listed as a Least Developed Country (LDC) by the UN.[72] However, Bangladesh has a strong track record of growth since its creation in 1971. GDP has been on a growth trajectory and grew 7% between 2020 – 2021. Bangladesh has ambition and is on course to climb out of the LDC category.	The UK is a developed market economy and in 2022 was measured as the fifth largest economy in the world.[73]
Population[74]	167.2m (2023)	68.1m (2023)
GDP[75]	$1.00 trillion (2021)	US$3.14 trillion (2021)
GDP per capita[76]	$5,900 (2021)	$45,000 (2021)
% of population using the Internet[77]	39 (2021)	97 (2021)
Mobile subscriptions per 100 inhabitants[78]	107 (2021)	120 (2021)

[72] See: https://unctad.org/topic/least-developed-countries/list
[73] See: https://www.investopedia.com/insights/worlds-top-economies/
[74] CIA World Factbook https://www.cia.gov/the-world-factbook/
[75] *Ibid*
[76] *Ibid*
[77] *Ibid*
[78] *Ibid*

Supply side digital divide indicators	We have not identified fixed infrastructure data. 7% of people have a "fast" Internet connection.[79] In 2021, 4G networks covered 95% of the population. 28% of mobile connections were 4G, 25% 3G and 47% 2G.[80]	Superfast fixed broadband is available to 97% of homes. Direct fibre to the home is available to 48% of UK homes. 99% of UK homes have 4G coverage.[81]
Examples of policy response	Over 5,000 Digital Centres have been set up to improve reach of digital services. The Digital Island initiative is connecting remote island communities.[82]	Project Gigabit is a government programme to fund connectivity in hard-to-reach locations.[83] The Shared Rural Network (SRN) is a partnership between government and the four mobile network operators to improve mobile coverage to deliver reliable mobile broadband to 95% of the UK.[84]
Demand side digital divide indicators	In 2021, 61% of the population did not have access to the Internet.	20% of adults lack "foundation level" digital skills meaning they cannot perform basic tasks online.[85]
Examples of policy response	Digital Centres provide access to digital skills. Digital skills learning is available to jobseekers.[86] The UNCDF and UNDP are supporting the development of digital and financial skills.[87]	Coordination of government and private sector action on digital skills through the Digital Skills Council[88] and Digital Skills Partnership.[89]

[79] https://www.worlddata.info/asia/bangladesh/telecommunication.php. Also reported 6.58% of people had a fixed broadband subscription in 2021 https://www.statista.com/statistics/516242/fixed-broadband-subscriptions-per-100-inhabitants-in-bangladesh/#:~:text=Fixed%20broadband%20subscriptions%20per%20100%20inhabitants%20in%20Bangladesh%202007%2D2021&text=There%20were%206.58%20fixed%20broadband,per%20100%20reported%20for%202020

[80] GSMA (2021). Achieving mobile enabled digital inclusion in Bangladesh. Available at: https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2021/03/Achieving-mobile-enabled-digital-inclusion-in-Bangladesh.pdf

[81] All data from Ofcom Connected Nations Spring 2023 update is available here: https://www.ofcom.org.uk/__data/assets/pdf_file/0026/261548/spring-2023-connected-nations-update.pdf

[82] https://www.weforum.org/agenda/2020/02/digital-inclusion-made-bangladesh-stand-out/

[83] https://www.gov.uk/guidance/project-gigabit-uk-gigabit-programme

[84] https://srn.org.uk/about/

[85] Lloyds Bank UK Consumer Digital Index https://www.lloydsbank.com/banking-with-us/whats-happening/consumer-digital-index.html

[86] https://bdskills.gov.bd/about-us

[87] https://bangladesh.un.org/en/197455-uncdf-and-undp-commit-advancing-inclusive-digital-economy-digital-financial-skills-and

[88] https://www.gov.uk/government/groups/digital-skills-council

[89] https://www.gov.uk/guidance/digital-skills-partnership

Appendix E Existing initiatives

Stakeholders (including industry and policy makers) have to some extent recognised the overlap between these important issues and put in place policies and measures to address them in a joined-up way. However, our research suggests current initiatives covering two of the themes discussed in this paper or the three of them are rare.

This section provides a non-comprehensive list of existing initiatives which target two of the three themes.

Environmental sustainability and digital inclusion

The need to link policy development and initiatives in the areas of sustainability and digital inclusion has been recognised by some stakeholders. For example:

- The Coalition for Digital Environmental Sustainability (CODES), an international alliance of stakeholders, including the United Nations (UN) established to advance the deployment of digital technologies to accelerate environmentally and socially sustainable outcomes and mitigate risks of unintended consequences.[90]

- The ITU Connect 2030 Agenda for global telecommunication/information and communication technology for sustainable development has specific goals and targets, and envisages *"an information society, empowered by the interconnected world, where telecommunications/ICTs enable and accelerate social, economic and environmentally sustainable growth and development for everyone*".[91]

- Network operators have issued green bonds to finance sustainable network development.[92] For instance, the Orange group *"presented in December 2019 its new 5-year strategic plan called Engage 2025, stating that its operator model will be reinvented and aligned with two strong commitments: the first towards digital and social inclusion, and the second towards the fight against climate change.*"

Environmental sustainability and digital rights

- An example of how the themes are linked in electronic communications policy can be found in Chapter VI "Sustainability" of "European Declaration on Digital Rights and Principles for the Digital Decade"[93] signed by the European Parliament, the Council and the Commission in February 2023. This extract (below) from the declaration includes the following text which covers the concepts of environmental sustainability, and the right to access clear information on environmental impacts in one place. "To avoid significant harm to the environment and to promote a circular economy, digital products and services should be designed, produced, used, repaired, recycled and disposed of in a way that mitigates their negative impact on the environment and on society and avoids premature obsolescence. Everyone should have access to accurate, easy-to-understand information on the environmental impact and energy consumption of digital products and services, their reparability and lifetime, allowing them to make responsible choices. We commit to:

[90] https://www.sparkblue.org/codesactionplanlaunch
[91] https://www.itu.int/en/action/environment-and-climate-change/Pages/ITU-in-the-UN-Environmental-Agenda.aspx#:~:text=ITU%20adopted%20Connect%202030%20Agenda%20for%20global%20telecommunication%2Finformation,environmentally%20sustainable%20growth%20and%20development%20for%20everyone%20%22.
[92] For example: Orange https://www.orange.com/sites/orangecom/files/2020-09/PR_Orange_inaugural_sustainability_bonds.pdf
[93] https://digital-strategy.ec.europa.eu/en/library/european-declaration-digital-rights-and-principles

- supporting the development and use of sustainable digital technologies that have minimal negative environmental and social impact;
- incentivising sustainable consumer choices and business models, and fostering sustainable and responsible corporate behaviour throughout global value chains of digital products and services, including with a view to combating forced labour;
- promoting the development, deployment and active use of innovative digital technologies with a positive impact on the environment and climate, in order to accelerate the green transition;
- promoting sustainability standards and labels for digital products and services"

Digital inclusion and digital rights

Current initiatives to improve online safety should also improve the trustworthiness of data and content online, and this may improve engagement and inclusion. These initiatives include:

- Across the European Union, the Digital Services Act[94] and Digital Markets Act are acting on these issues.[95] The Data Act contains rules on fair access to and use of data as well as on interoperability and data portability[96]. Also, more ethical use of data will build trust, thus engagement and inclusion. The EU Artificial Intelligence Act also cover some of these issues[97].
- In the European Union, digital inclusion is recognised as a digital right in Chapter II "solidarity and inclusion" of "European Declaration on Digital Rights and Principles for the Digital Decade"[98] (signed by the European Parliament, the Council and the Commission in February 2023). This text covers connectivity, digital education, training and skills, and digital public services online.
- In the UK, the Online Safety Bill[99] and the Digital Markets Consumer and Competition Bill[100] are progressing through Parliament.
- The Australian Government is undertaking a major review of markets for digital services and platforms consulting on proposals for regulatory reform.[101]
- The United Nations has a programme of work on digital development and is preparing for its Summit of the Future in 2024 which includes digital engagement as an area of potential action[102].

[94] https://digital-strategy.ec.europa.eu/en/policies/digital-services-act-package
[95] https://competition-policy.ec.europa.eu/dma_en
[96] https://ec.europa.eu/commission/presscorner/detail/en/ip_23_3491
[97] https://eur-lex.europa.eu/resource.html?uri=cellar:e0649735-a372-11eb-9585-01aa75ed71a1.0001.02/DOC_1&format=PDF
[98] https://digital-strategy.ec.europa.eu/en/library/european-declaration-digital-rights-and-principles
[99] https://www.gov.uk/guidance/a-guide-to-the-online-safety-bill#types-of-content-that-will-be-tackled
[100] https://www.gov.uk/government/consultations/a-new-pro-competition-regime-for-digital-markets/outcome/a-new-pro-competition-regime-for-digital-markets-government-response-to-consultation
[101] https://www.gov.uk/government/consultations/a-new-pro-competition-regime-for-digital-markets/outcome/a-new-pro-competition-regime-for-digital-markets-government-response-to-consultation
[102] https://www.un.org/en/common-agenda/summit-of-the-future

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