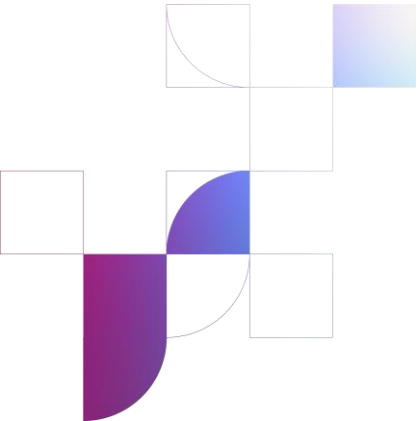
BEREC
Body of European Regulators for Electronic Communications

BoR (25) 68

Report on Infrastructure Sharing as a lever for ECN/ECS Environmental Sustainability



June 2025

Contents

Executive Summary

This report by the Body of European Regulators for Electronic Communications (BEREC) explores infrastructure sharing as a lever for environmental sustainability in electronic communications networks (ECN) and services (ECS), aligning with broader EU objectives to reduce the ICT sector's environmental impact. As a response to the EU Green Deal and the UN Agenda 2030, BEREC examines how regulatory tools might enhance the environmental performance of telecommunications by minimizing the footprint associated with network deployment and operation. It builds on previous publications of BEREC on infrastructure sharing and draws its analysis from a survey circulated among National Regulatory Authorities (NRAs) within BEREC and from a consultation with stakeholders during a technical workshop.

Infrastructure sharing in the telecommunications sector, which includes passive (e.g., towers, ducts) and active sharing (e.g., transmission equipment, antennas), holds the potential to reduce environmental impact through decreased infrastructure duplication, increased energy conservation, and reduced material consumption. By consolidating physical assets and technology, shared infrastructure can significantly lower carbon emissions (lower energy consumption), reduce land use and optimize the use of resources (e.g. raw material usage, waste generation) - creating a positive contribution to the environmental footprint of ECNs and ECSs. These infrastructure sharing practices can also raise technical, legal and regulatory issues in terms of quality of service, competition, and investments which are outside the scope of this and therefore not explored in any detail.[1]

The European regulatory framework for electronic communications offers several provisions to support infrastructure sharing – in specific and limited conditions – where environmental, public health, or planning objectives are prioritized. While voluntary infrastructure sharing is common, regulatory interventions vary widely among the EU states. Infrastructure sharing is part of the instruments of access regulation as foreseen by the European Code for Electronic Communications (EECC). Regulation related to civil engineering works has also introduced obligations regarding access to infrastructure aiming for to improve efficiency and reduce deployment costs (e.g. Broadband Cost Reduction Directive, which has been progressively amended and is now being repealed by the new Gigabit Infrastructure Act (GIA). The GIA will apply from 12 November 2025). Other provisions can be used to promote infrastructure sharing, notably in the frame of the right of way (EECC Article 44) and as part of spectrum allocation (EECC Article 47). The transposition of the current EU provisions on infrastructure sharing is complete, however, NRAs report that environmental sustainability was mostly not considered or addressed in this frame. For some of these tools (e.g. obligations based on Articles 44, 47 or incentives through guidelines regarding mobile operators agreements), NRAs reported only few cases when these tools were used to promote infrastructure sharing

[1] Some of the effects related to competition are analysed in the BEREC Report on the regulation of physical infrastructure access, BoR (25) 77 and in the BoR (19) 110, BEREC Common position on infrastructure sharing (2019)

and in most of the cases, environmental considerations were not part of the assessment or decisions. Most NRAs reported there were no additional incentives for infrastructure sharing in their country. Furthermore, the majority of BEREC members did not have access to comprehensive data on the rate number of shared sites and infrastructure. BEREC NRAs surveyed also reported limited inclusion of environmental aspects in their decisions on infrastructure sharing. BEREC NRAs surveyed, identified barriers, such as lack of mandate, limited expertise and data, the difficulty to balance these considerations with other regulatory/policy goals (e.g., competition, cost considerations, resilience), and the need for standardized methodologies for environmental assessments.

This BEREC report emphasizes the vital role infrastructure sharing can play in reducing the negative environmental impact of electronic communications networks by decreasing duplicative infrastructure, conserving energy, and optimizing use of resources. It outlines that NRAs should be enabled to include these environmental benefits in their decision-making process related to infrastructure sharing, while weighing these considerations in the context of other possible legal and technical effects of this form of agreement, e.g. on quality of service. To strengthen this approach, BEREC highlights its previous support for expanding the regulatory mandate of NRAs to explicitly include environmental sustainability objectives. In light of the ongoing review of the EECC, this report also suggests assessing the possibility to proportionally expand the capacity of NRAs to promote infrastructure sharing for environmental purposes in balance with other objectives, such as competition. Furthermore, BEREC would support the development of additional EU-level guidance on consistent standards for assessing the environmental impact arising from infrastructure sharing, while providing sufficient flexibility to adapt to national specificities. BEREC recommends encouraging data sharing and cooperation among competent authorities and stakeholders to encourage sharing of best practices. This data sharing could also support future quantitative studies investigating the potential negative environmental impact that may be avoided due to such infrastructure sharing.

In the future, BEREC will continue to examine the avenues through which NRAs can support environmental sustainability, which include infrastructure sharing.

1. Introduction and context

In its Strategy 2021–2025, BEREC outlined its commitment to incorporate an environmental focus into its activities, by supporting objectives related to Information and Communication Technology (ICT) objectives from the European Commission (EC)'s Green Deal and United Nations (UN) Agenda 2030. The ICT sector accounts for around 3% of global greenhouse gas (GHG) emissions[2] and is also responsible for other form of impacts such as energy consumption, abiotic resources depletion and water consumption. Networks represent 12-

[2] Joint Research centre, Identifying common indicators for measuring the environmental footprint of electronic communications networks (ECNs) for the provision of electronic communications services (ECSs) (2024)

24% of the ICT carbon footprint with emissions related especially to their energy consumption.[3] The manufacturing of telecom equipment and infrastructure also relies on the provision of raw materials, such as mineral, plastic and metal components – all of which have their own associated environmental footprint.[4]

The sharing of infrastructure in the electronic communications sector refers to different types of arrangements, whereby two or more operators share some network or infrastructure elements to deliver service(s). Infrastructure sharing can take different forms depending on the elements shared: for example, passive sharing involves sharing physical elements such as towers and ducts, while active sharing includes sharing transmission equipment like local network elements, antennas or base stations, and even spectrum in some cases. By reducing the number of infrastructures required for the provision of electronic communications services, infrastructure sharing can reduce ECN/ECS environmental footprint, in particular their carbon footprint, energy consumption and raw material and resources usage. This report aims to analyse the effect of infrastructure sharing on the environmental sustainability of electronic communications. These sharing practices can also raise technical, legal and regulatory issues in terms of quality of service, competition and investment,[5] which are outside the scope of this report.[6]

Thus, in its 2022 report "Assessing BEREC's contribution to limiting the digital sector's impact on the environment",[7] BEREC deemed it relevant to investigate how regulatory tools can be drivers for sustainability, including supporting the deployment of more energy efficient technologies (notably fibre rollout) and the promotion of infrastructures sharing. There are currently provisions on infrastructure sharing in the EECC and also in other relevant sectorial regulation, such as the Gigabit Infrastructure Act (GIA)[8] and Gigabit Recommendation,[9]. These provisions could be used to support environmental targets, by allowing competent authorities to impose co-location and sharing of fixed and mobile network elements and associated facilities for reducing the environmental footprint of ECN/ECS. BEREC has also published several reports and positions on infrastructure sharing, outside of this current report which focuses on environmental sustainability. These previous BEREC reports however do mention the possible environmental benefits of sharing infrastructure:

---

[3] BoR (22) 93, BEREC report "Assessing BEREC's contribution to limiting the digital sector's impact on the environment" (2022)

[4] BoR (22) 34, WIK-Consult and Ramboll, External Sustainability Study on Environmental impact of electronic communications (2022)

[5] This report should therefore not be understood as an endorsement of network sharing per se, but as a means for NRAs to better understand the environmental benefits of network sharing in various situations and to properly weigh those issues against other relevant aspects in the decision making.

[6] BEREC published other reports and opinions which covered some of the other aspects to consider while assessing infrastructure sharing agreements especially BoR (19) 110, BEREC Common position on infrastructure sharing (2019) regarding mobile infrastructure sharing.

[7] BoR (22) 93, BEREC report "Assessing BEREC's contribution to limiting the digital sector's impact on the environment" (2022)

[8] Regulation (EU) 2024/1309 on measures to reduce the cost of deploying gigabit electronic communications networks, amending Regulation (EU) 2015/2120 and repealing Directive 2014/61/EU (Gigabit Infrastructure Act)

[9] Commission Recommendation on the regulatory promotion of gigabit connectivity, C(2024) 523 final

- In its position on the Broadband Cost Reduction Directive (BCRD),[10] BEREC outlined that the EECC and the BCRD include tools that could support the reduction of the environmental footprint of ECN/ECS. BEREC recalls in this opinion that *"the coordination of civil works, the use of synergies between different network operators and the joint use of existing physical infrastructure might not only help to save investments, but might also reduce the environmental load by reducing the need for additional civil engineering works*".

- BEREC outlined in its Common Position on mobile infrastructure sharing[11] published in 2019, that sharing could also decrease energy consumption, thereby lowering the carbon footprint of the electronic communications sector and contributing to the fight against climate change.

- As early as June 2011, BEREC published, jointly with the RSPG, a report on mobile infrastructure[12] that briefly mentioned the environmental and health protection as a potential benefit to infrastructure sharing agreements.

BEREC included in its 2024 Work Programme a workstream to explore on the impact of infrastructure sharing on ECN/ECS sustainability and the role that regulation could play in this perspective. Specifically, the object of this workstream was to build a comprehensive overview of transposition and implementation of the relevant EU provisions related to network and infrastructure sharing regarding co-location and sharing of infrastructures, with a particular attention to measures that are based on, or which include, environmental considerations. This report also aims to explore the potential environmental benefits of these sharing practices. Finally, it explores the possible ways to assess the environmental benefits from network sharing (once they are identified/quantified), as well as the inclusion of these benefits in regulatory decision making.

This report capitalises on BEREC's previous work on infrastructure sharing and relevant regulatory provisions (chapter 2). This report is based on NRA responses to an internal questionnaire distributed to BEREC members (chapter 3). The views of stakeholders were collected through a technical workshop with sectorial associations, namely Connect Europe, ECTA and the European Wireless Infrastructure Association (EWIA) (chapter 4). Based on these inputs, this report also includes set of strategic conclusions regarding the possible benefits of infrastructure sharing, by enabling regulators to use this lever to encourage the deployment of more sustainable communications networks.

[10] 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, OJ L 155, 23.5.2014.
[11] BoR (19) 110, BEREC Common position on infrastructure sharing (2019)
[12] BoR (11) 26, BEREC-RSPG report on infrastructure and spectrum sharing in mobile/wireless networks (2011)

2. Regulatory framework

The European Union's regulatory framework for electronic communications enables competent authorities to impose or restrict infrastructure sharing in specific situations. Some of these provisions specifically mention the protection of the environment as a possible justification for infrastructure sharing. The EECC includes the following articles with respect to infrastructure sharing:

- According to Article 44 of the EECC, competent authorities may impose sharing in order to protect the environment, public health, public security or to meet town- and country- planning objectives, if the establishment of the infrastructure was based on rights of way.

- According to Article 47 of the EECC, when attaching conditions to individual rights of use for radio spectrum, competent authorities may provide for the following possibilities: (a) to share passive or active infrastructure which relies on radio spectrum, or radio spectrum, (b) to enter into commercial roaming access agreements, and (c) to jointly roll-out. Of particular importance here is the effective and efficient use of the spectrum, the promotion of coverage and the rapid deployment of networks (especially in less densely populated areas). In this regard, competent authorities shall not prevent the sharing of radio spectrum in the conditions attached to the rights of use for radio spectrum. Implementation by undertakings of conditions attached pursuant to this paragraph shall remain subject to competition law. This instrument may concern passive as well as active sharing.

- According to Article 61 of the EECC, national regulatory authorities may, upon reasonable request, impose obligations to grant access to cables and associated resources within buildings or up to the first concentration or distribution point, as determined by the national regulatory authority, when this point is located outside the building. This article also foresees that competent authorities will have the power to impose obligations either to share passive infrastructure and or to conclude localised roaming agreements. These obligations would be imposed only under the following conditions: First, passive sharing or localized roaming must be necessary directly for the local provision of services which rely on the use of radio spectrum. Second, no viable and similar alternative means of access to end-users is made available to any undertaking on fair and reasonable terms and conditions. Third, the possibility to impose sharing is clearly provided for when granting the rights of use for radio spectrum. Fourth, market-driven deployment of infrastructure for the provision of networks or services which rely on the use of radio spectrum is subject to insurmountable economic or physical obstacles and therefore, access to networks or services by end-users is severely deficient or absent. In those circumstances, where access and sharing of passive infrastructure does not suffice to address the situation, sharing of active infrastructure may be imposed. Upon failure of commercial negotiations, competent authorities shall resolve the dispute with a binding decision.

- According to Article 72, where an undertaking is designated as having significant market power on a specific market as a result of a market analysis carried out, a national regulatory authority may impose obligations on undertakings to meet reasonable requests for access to, and use of, civil engineering including, but not limited to, buildings or entries to buildings, building cables, including wiring, antennae, towers and other supporting constructions, poles, masts, ducts, conduits, inspection chambers, manholes, and cabinets, in situations where, having considered the market analysis, the national regulatory authority concludes that denial of access or access given under unreasonable terms and conditions having a similar effect would hinder the emergence of a sustainable competitive market and would not be in the end-user's interest.

- According to Article 73, where an undertaking is designated as having a significant market power on a specific market as a result of a market analysis carried out, a national regulatory authority may impose obligations on undertakings to meet reasonable requests for access to, and use of, specific network elements and associated facilities, in situations where the national regulatory authorities consider that denial of access or unreasonable terms and conditions having a similar effect would hinder the emergence of a sustainable competitive market at the retail level, and would not be in the end-user's interest.

Aside from the EECC, other regulatory provisions are relevant to cover infrastructure sharing, especially the BCRD which is now being replaced by the GIA[13].The GIA covers access to existing physical infrastructure, measures related to civil work coordination and infrastructure sharing with non-telco players (for instance electricity providers).

3. Analysis of existing practices from NRAs

This section depicts the result of a questionnaire distributed to BEREC members during the period of 9 April and 17 May 2024. In total, 26 responses were received, including 24 responses from the following EU Member states: Austria, Belgium, Croatia, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Poland, Portugal, Romania, Slovenia, Spain, Sweden, The Netherlands) and, as well as two responses from non-EU Member states (namely Norway and Serbia) who participated in the consultation.

BEREC members were asked to provide their feedback on five specific aspects, which are covered in the following subsections: i) implementation of EECC, Article 44; ii) implementation of other regulatory provisions with respect to infrastructure sharing; iii) environmental

[13] The BCRD aimed to "facilitate and incentivise the roll-out" with a view on reducing costs of deployment. The GIA now also specifically mentions the aim to "facilitate and stimulate the roll-out of very high capacity networks ('VHCNs') by promoting the joint use of existing physical infrastructure and by enabling a more efficient deployment of new physical infrastructure so that such networks can be rolled out faster and at a lower cost."

considerations in network operators agreement; iv) quantitative data, and v) strategic prospective assessment.

3.1. Implementation of Article 44 of the EECC

Article 44 of the EECC provides that "*1. Where an operator has exercised the right under national law to install facilities on, over or under public and private property, or has taken advantage of a procedure for the expropriation or use of property, competent authorities may impose co-location and sharing of the network elements and associated facilities installed on that basis, in order to protect the environment, public health, public security or to meet town- and country planning objectives*."

The BEREC members have already implemented Article 44 in their national legislation.[14]. Most BEREC members have transposed the article in a general way (as a general obligation), which allows the public authorities, mostly NRAs, to impose obligation on operators to co-locate and share infrastructure.

For the majority of BEREC members, the designated competent authority is the NRA, but there are also members where local authorities[15] or another authority[16] that is not an NRA has the power to issue decisions. In Ireland, the decisions on whether to grant licenses and planning permissions are made by the local authorities.

In most countries, NRAs are also the dispute resolution authorities in cases where operators do not reach a voluntarily agreement. NRAs may also have competencies to impose sanctions.[17]

In Spain, public electronic communications network operators may also voluntarily enter into agreements with each other and public administrations shall encourage the implementation of voluntary agreements between operators.

The implementation of environmental aspects in the national legislations is handled differently across competent authorities. In 18 out of 26 countries, environmental aspects are included in the transposed articles[18]. There are also requirements to carry out a public hearing by NRAs in Czechia, Italy, and Luxembourg. No NRA stated that an environmental impact study is required. There are some BEREC members[19] which do not explicitly mention environmental aspects in their national legislation transposing Article 44, while other BEREC members have

[14] These are Austria, Belgium, Croatia, Czechia, Cyprus, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Luxembourg, Malta, Poland, Portugal, Romania, Serbia, Slovenia, Spain and The Netherlands.
[15] Ireland, France, Denmark.
[16] Denmark, Malta, Poland, Portugal, Spain, The Netherlands.
[17] For instance, AGCOM.
[18] The NRAs in whose countries environmental aspects are relevant are ACM, AGCOM, AKOS, ANCOM, BIPT, BNetzA, ComReg, CTU, EETT, HAKOM, MCA, NMHH, OCECPR, RATEL, RTR, DADG and UKE.
[19] E.g. France, Latvia, Lithuania.

narrower scopes regarding types of infrastructure. Belgium, for example, has implemented the criterion on protecting the environment just on the antenna sites. In Czechia, the environmental aspects are only relevant for infrastructure sharing, when the building of a new site is impossible, e.g. because of restrictions due to a natural reservation or water protection areas.

Respondents from only two countries[20] stated that they have imposed co-location and sharing of network elements and associated facilities based on Article 44, as can be seen in the graph below. In Croatia, co-location and sharing of physical infrastructure is imposed on the operators if appropriate technical access conditions exist (e.g. availability of free space, suitability of the technical solution). The manner and conditions of access, co-location and joint use are prescribed in more detail in an ordinance. Objectives listed in Art 44 of the EECC, including environmental protection, public health, public security, meeting town- and country planning were mentioned as general goals. In Spain, the decisions have been adopted by the Minister of Digital Transformation and therefore, the NRA could not provide any further information about the decisions.

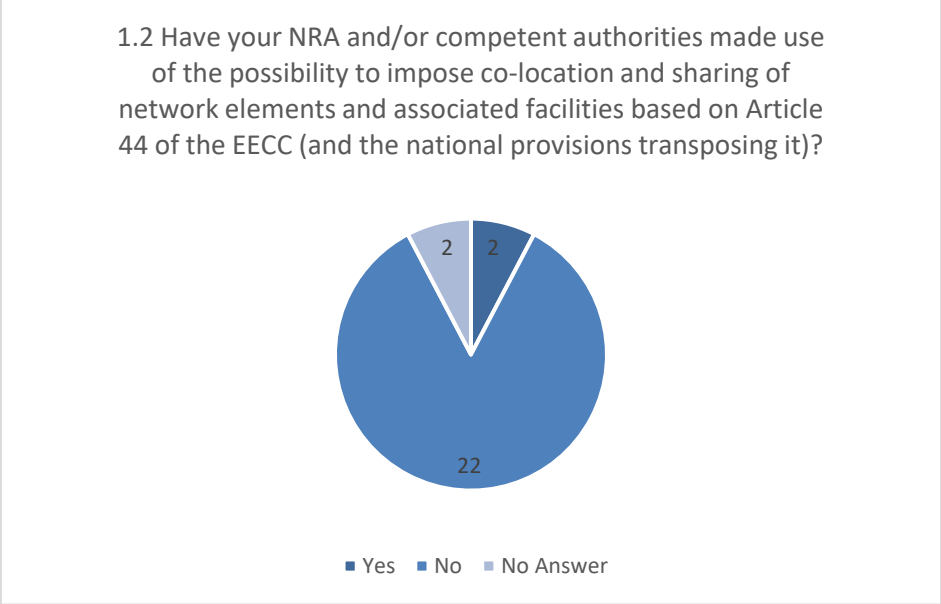


Figure 1

So far, only few decisions have been based on Article 44. Only one NRA[21] provided information on the rationale for imposing co-location and sharing of network elements and associated facilities. This NRA stated that the main goal was to promote the use of existing network elements and associated facilities, in order to enable deployment of new networks, to

[20] Croatia, Spain.
[21] HAKOM.

reduce costs and to protect the environment, public health, public security or to meet town- and country planning objectives - although no special evaluations were made regarding the protection of the environment. Chapter 4 contains further information on the potential advantages and difficulties concerning environmental aspects in infrastructure sharing.

3.2. Implementation of other provisions for imposing infrastructure/network sharing (e.g. Article 61)

Having considered the implementation of Article 44 among NRAs with regards to the aspect of environmental sustainability, this report goes on to consider the implementation of other provisions of both the EECC and BCRD aimed at promoting access to infrastructure,[22] which are focused on access to infrastructure and coordination of civil work. This report seeks to consider the possibility for NRAs or other competent authorities (OCAs) to impose obligations in relation to passive or active infrastructure sharing in the frame of spectrum licenses awarding. These provisions do not specifically mention the objective of the protection of the environment, but NRAs were asked in the survey to indicate if they have been implemented in such a way to enhance efficiency and environmental sustainability.

Regarding access to infrastructure, it should be noted that complementary information concerning access obligations imposed on SMP operators can be found in the BEREC Report on the regulation of physical infrastructure access.[23]

3.2.1 Access to infrastructure

Article 61(3) of the EECC empowers NRAs to mandate the sharing of network elements (wiring and cables) and associated facilities inside buildings or up to the first concentration or distribution point as determined by the national regulatory authority, where that point is located outside the building, such as ducts, conduits, masts, and street cabinets, "*where it is justified on the grounds that replication of such network elements would be economically inefficient or physically impracticable*."

As regards Article 61(4) of the EECC, under specific conditions, when it is directly necessary for local provisioning of services which rely on the use of radio spectrum, competent authorities can impose obligations to share passive infrastructure or to conclude localized roaming agreements "*provided that no viable and similar alternative means of access to end-users is made available to any undertaking on fair and reasonable terms and conditions*".

The BCRD, which is now replaced by the GIA sets obligations on access to existing physical infrastructure and on coordination of civil works.

[22] P. 1–14, see especially Article 3 on Access to existing physical infrastructure and Article 5 on Coordination of civil works.
[23] BoR (25)77

When asked whether NRA/OCA implemented the national provisions corresponding to Article 61 of the EECC and the relevant provisions of the BRCD (related to access to infrastructure in such a way that environmental considerations are encompassed), 23 out of 26 NRAs have responded in the negative. (see graph in Figure 2 below). Only three NRAs responded in the affirmative regarding the implementation of these provisions.[24] Despite this low result for such implementation, some NRAs who responded in the negative have indicated that there is some inclusion of environmental considerations within the wording of national provisions transposing Article 61 of the EECC and/or the BRCD.[25]

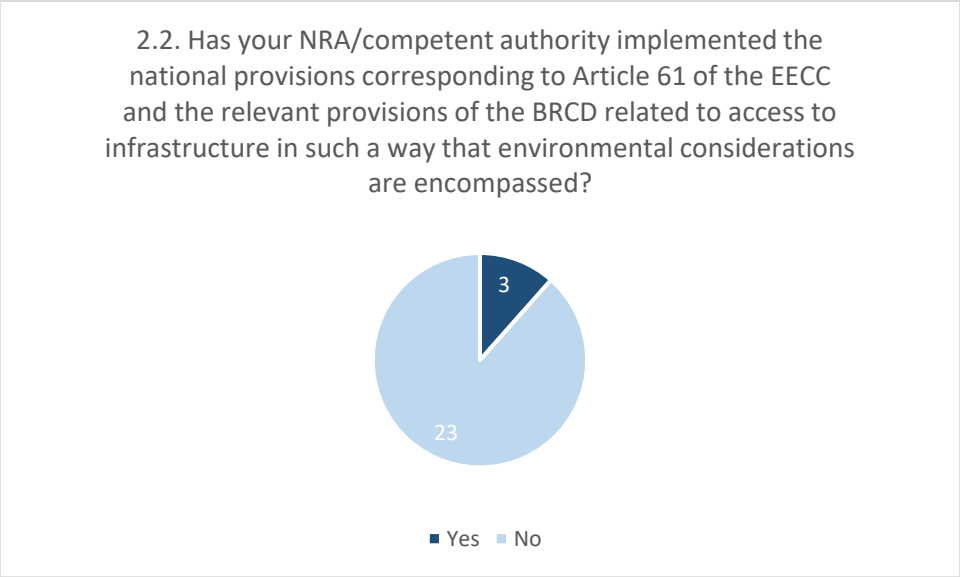


Figure 2

The following question referred to the same provisions in Article 61 of the EECC and the related provisions BCRD, but this time asked if any decision has been motivated, even partially, by the objective of environmental protection. 23 NRAs responded in the negative to this question, 2 NRAs responded in the affirmative[26] and one NRA did not provide any response positively as illustrated in Figure 3 below.

[24] NKOM, BNetzA, AGCOM.
[25] ANACOM, PTS.
[26] BNetzA, AGCOM.

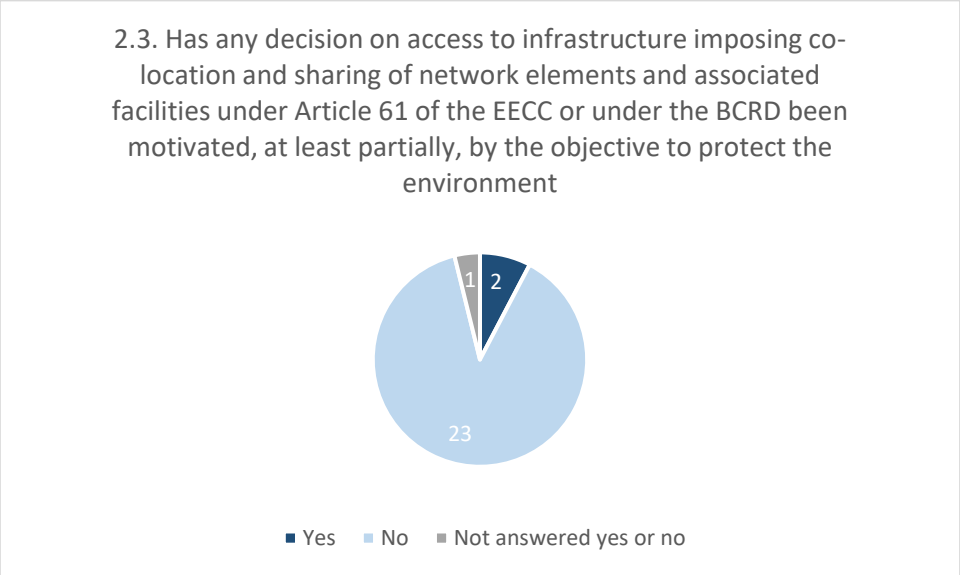


Figure 3

In most of the BEREC members, there was no reference made to the protection of the environment with regards to the national provisions in transposing Article 61 of the EECC and the provisions of the BCRD.

Nonetheless, Latvian NRA SPRK stated that environmental aspects, even if they do not directly apply to the electronic communications industry, may be defined in other specific environmental regulations. ANCOM has also noted that in Romania, environmental protection issues are regulated by other national authorities. Furthermore, two NRAs specified that although there was no reference to the environment in the provisions transposing Article 61 of the EECC and the BCRD, infrastructure sharing could lower the environmental cost of deploying electronic communication networks,[27] or stated that any use of the BCRD provisions for infrastructure sharing has a positive impact on environment since it avoids duplication of infrastructure.[28] Furthermore, in France, Arcep has been working on infrastructure sharing since 2009, particularly in the context of access to fibre networks. These efforts were aimed at defining clear rules for the deployment and mutualisation of fibre infrastructure, notably in less densely populated areas. ARCEP's approach has been consistent with the European regulatory framework. Since then, all FttH networks are shared and although the set of decisions and recommendations taken by the NRA[29] do not mention the protection of the environment directly, they mention network deployment efficiency. The provisions transposing Article 61(3) of the EECC refer also to general Arcep's regulatory objectives which include among other objectives "a high level of protection of the environment", when stating that Arcep can specify the terms and conditions for access by internet service providers to FttH networks. As regards the implementation of the national provisions in such a way that environmental

[27] HAKOM.
[28] Arcep
[29] Arcep

considerations are encompassed, Arcep considers it beneficial to pursue environmental objectives in the implementation of the GIA regulation and in the review of the EECC.

In several countries environmental considerations are taken into account in some manner with regards to electronic communications regulation. In Portugal, the NRA is allowed to impose co-location and sharing of infrastructure for environmental reasons on the basis of a national Decree-Law 123/2009 derived from the earlier Article 12(2) of Directive 2002/21/CE (Framework Directive), dated back to before the BCRD. In Greece, the provisions transposing the BCRD mention that the Dispute Resolution Body takes into account, among other criteria, the protection of the environment when resolving a dispute regarding access to existing physical infrastructure. However, as no dispute resolution requests have been submitted, the environmental protection provision remains unspecified. In Germany, sustainability is not explicitly mentioned in the transposition of Article 61(3) and (4). Nevertheless, reduction of emissions is mentioned in the explanatory memorandum, and in its decisions based on the provisions transposing the BCRD, the ruling chamber considered both the explanatory memorandum and additional arguments related to emissions. BNetzA underlines that the aims of cost reduction and economic sustainability lead in the same direction and that environmental sustainability is used as an additional argument.

More specifically, as regards the implementation of the BCRD provisions on coordination of civil work, several NRAs outline that coordination of civil work is mainly done to lower the costs and to minimize the disturbance of local residents[30] or that the measures for the expansion of broadband networks make it cheaper.[31] In Cyprus, coordination of civil work can include environmental requirements, as the NRA[32] may impose one or more environmental, spatial and urban planning requirements. In Poland, a number of provisions regulating civil work coordination focus on sustainability-related effects.[33] In Finland, explicit references to sustainability-related effects or objectives are not mentioned in the national provisions, however, environmental considerations are mentioned as one example in the recitals of the proposal for legislation. Other NRAs outline that coordination of civil works helps the environment[34] and that it has a positive impact on environment since it avoids duplication of works.[35] In Malta, the Competent Infrastructure Regulator (CIR), Transport Malta (TM), in line with Article 44(1) of the EECC and local law, may impose co-location, or network sharing elements, to protect the environment and public health, amongst other reasons, or to meet

[30] BIPT
[31] PTS
[32] OCECPR
[33] The Act on supporting the development of telecommunications services and networks comprises a number of provisions regulating civil work coordination focused on sustainability-related effects, e.g. that (i) network operator is obliged to make accessible for telecommunication entrepreneur the information on scheduled or conducting civil works, (ii) network operator is obliged to consider the request of telecommunication entrepreneur in terms of coordination of construction works, (iii) local public administration bodies are authorised to settle dispute between network operator and telecommunication entrepreneur in terms of coordination of construction works by issuing administrative decision.
[34] HAKOM
[35] Arcep

town and country planning objectives. In Malta, spectrum licences awards allow for the possibility of infrastructure and network sharing.

The EECC allows NRAs/OCAs to impose infrastructure and network sharing obligations when setting out conditions to individual rights for use of the radio spectrum (Article 47(2) of the EECC) or when BEREC members grant, amend or renew rights of use for radio spectrum (Article 52(2)(a)).

Enquiring about whether NRAs/OCAs in each country have imposed obligations in relation to passive or active infrastructure sharing in the frame of spectrum licenses awarding (notably based on provisions of Article 47 of the EECC), seven NRAs[36] responded in the affirmative, 16 responded in the negative, and three NRAs did not provide a response (see graph in Figure 4 below).

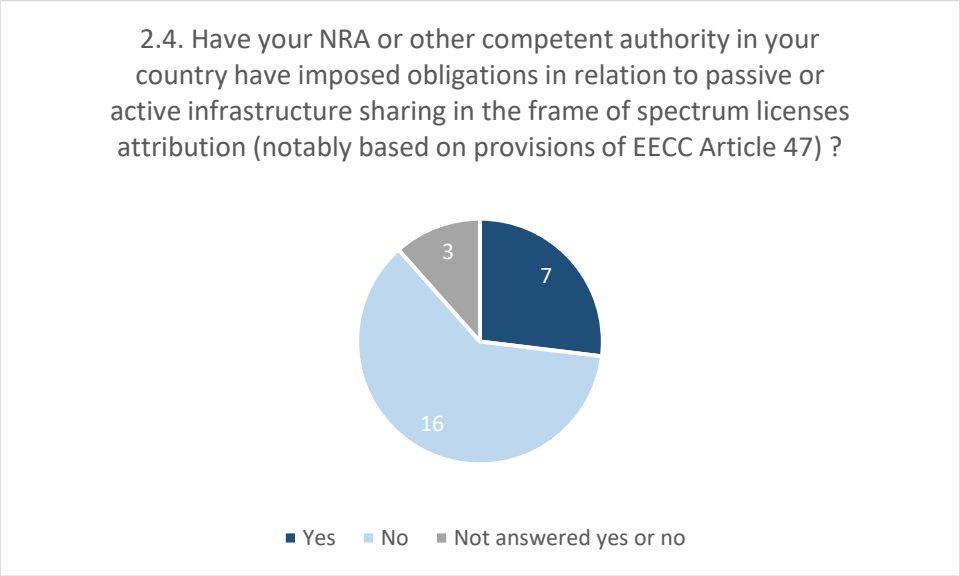


Figure 4

Nevertheless, in the countries where infrastructure sharing obligations have been imposed in the frame of spectrum licenses, the survey results showed that no decision has been motived by the objective to protect the environment. In Croatia, infrastructure sharing obligations are aimed at providing a better coverage. In France, network sharing obligations have been imposed in the frame of spectrum licenses awarding in order to ensure:

- The development of investment, innovation and competitiveness in the electronic communications sector;
- The exercise of effective and fair competition between network operators and providers of electronic communications services for the benefit of users;

[36] BIPT, HAKOM, Arcep, EETT, MCA, AKOS, CNMC.

- The land-use planning.

The current provisions of the EECC limit the possibility for countries to impose infrastructure obligations as they have to be either announced in the spectrum licenses or to be specifically localised, which leads to a small number of countries having made use of it. A broader empowerment of NRAs to decide on imposing passive and active infrastructure sharing, out of the scope of spectrum licenses, could enhance infrastructure sharing and environmental sustainability.

The survey results revealed that the transposition of EECC articles related to access to infrastructure and network sharing and of the BCRD often do not include any reference to environmental protection. However, there were a few cases where general provisions have been integrated and specific requirements for environmental impact assessments or sustainability guidelines were included, despite having no explicit mandate to integrate these environmental considerations. This indicates a diverse approach to integrating environmental sustainability into electronic communications infrastructure planning and regulation across the EU. Nevertheless, regulatory provisions related to access to physical infrastructure and network sharing are considered to have a positive impact on environmental sustainability. Pursuing the inclusion of environmental considerations in the provisions on infrastructure sharing in the implementation of the new GIA regulation which replaces the BCRD and in the revision of the EECC would thus be a positive development, promoting considerations on environmental sustainability.

3.3. Environmental considerations in the assessment of mobile network sharing agreements between operators

Infrastructure sharing may derive from commercial agreements between mobile network operators which, on a voluntary basis, decide to share passive and, in some cases, active infrastructure. Most NRAs gather information on infrastructure sharing agreements only under specific circumstances (in cases of disputes) and in most countries, there is no formal legal/regulatory requirement for operators to notify NRAs about infrastructure sharing.

Where specific guidance/rules with respect to infrastructure sharing are provided,[37] five NRAs[38] have indicated that the protection of the environment is a criterion on the basis of which the operators' network sharing agreements are analysed. Hence, in France, Arcep adopted in 2016 network sharing guidelines[39] to provide predictability to MNOs regarding Arcep's assessment of mobile network sharing agreements. Generally, these guidelines recognise that mobile network sharing agreements can contribute to the protection of the

[37] According to BEREC Report on infrastructure sharing, BoR (18) 116, half of the countries provide guidance with respect to infrastructure sharing, guidelines being provided either by NRAs, competition authorities or government ministries.

[38] RTR, OCECPR, Arcep, EETT and AGCOM.

[39] https://www.arcep.fr/uploads/tx_gspublication/2016-05-25-partage-reseaux-mobiles-lignes-directrices.pdf

environment and in particular of natural and landscape heritage, by allowing the common use of infrastructures between several operators, which limits the need for the installation of new infrastructures, such as towers. It can also be noted that guidelines for infrastructure sharing,[40] adopted by BIPT in 2012, list the environmental benefits among the main arguments in favour of RAN sharing. It is also considered that infrastructure sharing can contribute towards broader environmental goals and mitigate citizens' concerns over electromagnetic field (EMF) radiation from base stations. Passive and active sharing can mitigate the visual impact of mobile networks on the landscape by reducing the total number of masts and towers. Sharing power supplies reduces energy consumption, which helps supporting government and corporate policies on reducing carbon emissions. In Greece, the national law provides that co-location may be imposed "with a view to protecting the environment", with specific provisions established for the co-location of antenna systems.

As regards the definition of an analytical framework related to environmental considerations, the OCECPR, the NRA of Cyprus, indicates that according to the secondary legislation concerning colocation, operators have an obligation to negotiate colocation agreements including inter alia, reasons related to the need to protect the environment. RTR considers that competition law is relevant within the analytical framework and refers to chapter 9 of the EC Horizontal Guidelines[41], which covers horizontal agreements that pursue a sustainability objective. Nevertheless, although it is generally admitted that network sharing agreements and more generally infrastructure and network sharing can benefit to environmental sustainability, the primary objective of network sharing agreements is not environmental sustainability, but rather to reduce deployment costs while improving service offering.

On the question of if the impact on the protection of the environment has already been considered in the assessment of infrastructure/network sharing agreements between operators, the majority of NRAs indicate that environmental considerations haven't been taken into account when assessing network sharing agreements.[42] Four NRAs note that the protection of the environment is not the main concern in the assessment of infrastructure/network sharing agreements between operators but rather the competition.[43] RTR states that in principle, the impact on the protection of the environment has been considered but was not explicitly mentioned and not decisive in one of its decision.[44] SPRK indicates that as a primary objective, the impact on competition is assessed, but the impact on the environment is discussed as well. In Denmark, where sharing agreements of private companies are analysed in case of a complaint about the failure to conclude a sharing agreement or about the conclusion of agreement on terms that are not fair and reasonable,

[40] https://www.bipt.be/file/cc73d96153bbd5448a56f19d925d05b1379c7f21/e46162a74b310463820f3cfcde4fc5e79a251887/3666_en_02_tech_infra_sharing_eng_final.pdf

[41] European Commission, Communication, Guidelines on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal co-operation agreements (2023/C 259/01)

[42] See Annex for an overview of mobile network active sharing agreements and their assessment by NRAs or competition authorities.

[43] RTR, DADG, ComReg, SPRK.

[44] https://www.rtr.at/TKP/aktuelles/entscheidungen/entscheidungen/c_1_23.de.html (non-confidential version, only in German).

the environment is not the main consideration when issuing a decision. The Irish NRA ComReg notes it cannot have a firm view on spectrum rights sharing (pooling) and network sharing other than it would look more favourably on agreements that wouldn't unduly restrict competition and would deliver demonstrable benefits shared with end-users. MCA from Malta notes that although there are existing sharing agreements for duct access, they were primarily established on the principles of income and reciprocity amongst the operators.

3.4. Quantitative data shared by BEREC members

Quantitative data on infrastructure sharing can be an important element to evaluate the scale of environmental benefits of different types of network deployments (e.g. passive infrastructure sharing, active sharing of network elements). Hence, for the purpose of this report, BEREC's survey asked NRAs the existing quantitative data at national level on passive and active sharing of infrastructure or network elements, as of 31st December 2023, for both mobile and fixed networks. The data requested in the BEREC's survey was further split into the following three categories of locations: '*Densely populated areas*', '*Medium density areas*', and '*Thinly populated areas*'.

For mobile networks, ten NRAs[45] provided data regarding site sharing. A subgroup of these ten NRAs provided the 'total' numbers, without providing this data on a more granular level (e.g. classify areas as densely, medium density and thinly populated or differentiating for the total number of masts, poles and towers).

BEREC notes only few NRAs provided data with this subcategorization (*'Densely populated areas', 'Medium density areas', 'thinly populated areas'*). BEREC underlines that due to the geographic size of the region, certain NRAs may not differentiate between so-called 'medium' versus 'thinly populated' areas in the data where telecommunication infrastructure are located.

BEREC acknowledges that not every NRA collects this data, therefore the information in the graphs provided reflects the data regarding shared infrastructure sites provided by the aforementioned ten NRAs.

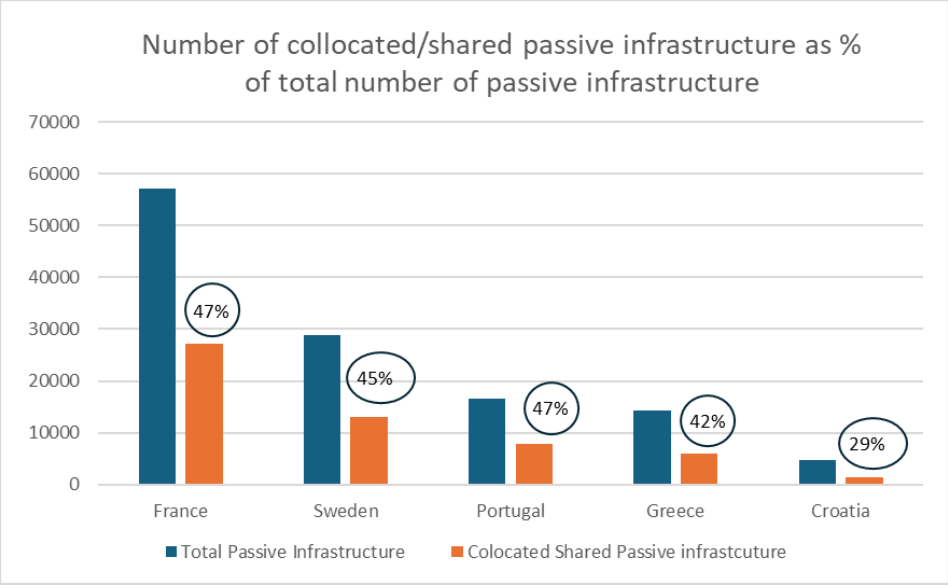
NRAs have also been asked to provide data with a distinction between collocated/shared passive infrastructure[46] and passive and active shared sites[47] on a collocated/shared passive infrastructure.[48] From the data provided and displayed in figures 5 and 6, it can be observed that collocated/shared passive infrastructure represent 47.3% of the total number of sites with passive infrastructures in France, 43.6% in Sweden, 42% in Greece, 39% in Austria, 29.1% in Croatia. Active site sharing represents 65% in Portugal, 60.7% in France (mostly in thinly populated areas) and 98% in Greece. Two NRAs[49] also mentioned respectively active

[45] Arcep, ANACOM, BIPT, CNMC, EETT, HAKOM, MCA, OCECPR, PTS, RTR.
[46] Infrastructure on which mobile equipment is installed (tower, mast, rooftop, etc.).
[47] MNOs radio transmission points.
[48] The methodology used to collect the data may have differed between NRAs.
[49] BIPT and CNMC.

infrastructure sharing agreements between operators, which will have an impact on the rates of active infrastructure sharing.

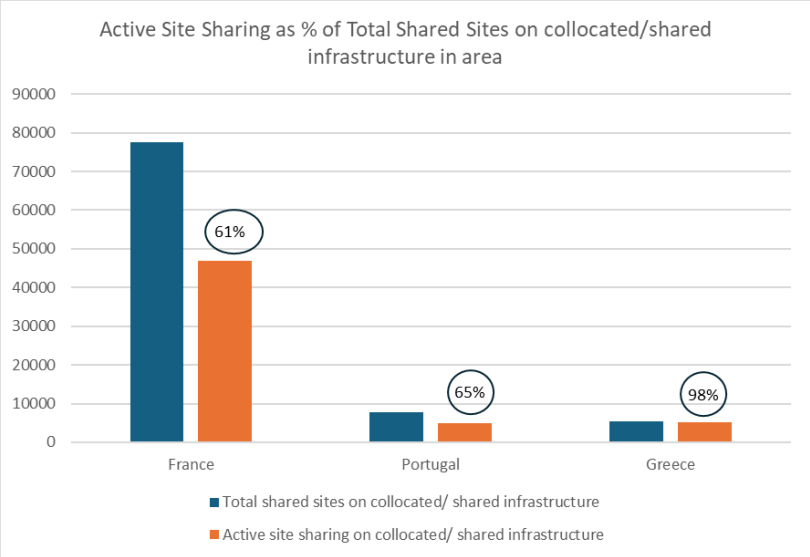
It should be noted that following two figures depict data provided by NRAs to the BEREC survey for this report and may not include all operator data in that country.

Figure 5: Number of collocated/shared passive infrastructure for mobile network (on which several MNOs sites are hosted) as % of total number of passive infrastructure (tower, rooftop, mast, etc.) hosting MNOs' sites*



***Note: For data in France, Arcep considers in this calculation the number of "supports", which refers to a physical location — an infrastructure that accommodates mobile equipment (such as a pylon, rooftop, high point, etc.).
The information presented in this figure reflects the data provided by the NRAs.

Figure 6: Number of active shared sites (MNOs radio transmission points) on a collocated/ shared active infrastructure as percentage of total shared sites in area for mobile networks**



**Note: For Greece, EETT data does not include antenna structures/installations with low electromagnetic outputs.
The information presented in this figure reflects the data provided by the NRAs.

For fixed networks, it is not possible to provide a breakdown of percentages of infrastructure sharing in a similar manner as provided for mobile networks in the section above. From the survey results, BEREC notes that NRAs collect data using various units of measurements; for example, for fibre sharing, some NRAs use the metrics of either number or percentages of total premises passed, whereas other NRAs use kilometres. BEREC notes that NRAs did not provide any data on the number of co-location sites. Six NRAs (NMHH, MCA, OCECPR, ARCEP, PTS and HAKOM) provided data on passive and active infrastructure sharing (physical infrastructure sharing (ducts, poles), fibre access and active sharing). Certain NRAs disclosed in the survey that they do not collect any data regarding infrastructure sharing for fixed networks.

Table 1 below illustrates the heterogeneity of data collected and shared by NRAs. For example, one NRA (NMHH) provided information regarding total lengths of ducts and poles in kilometres, whereas other NRAs (e.g., HAKOM) provides the total kilometres for ducts, and then the total numbers for poles. Another NRA (MCA) did not provide any number of kilometres or units, but rather provided the of 'Passive infrastructure sharing' as a percentage of the total number of shared/collocated sites or lines in the country.

Table 1: Number of shared/collocated sites or lines by types of sharing for fixed networks

		Number of shared/collocated sites or lines		
		Total	**Passive infrastructure sharing**	**Active infrastructure sharing**
TOTAL	**NMHH**	29,919 km	29,919 km (ducts, poles, dark fibre)	-
	MCA		Between 5% to 7%	-
PIA Sharing	**NMHH**	23,583 km	23,583 km (ducts and poles)	-
	ARCEP	Only for SMP – 600k kilometres of ducts and 13 million of poles (supporting copper)	Almost all these physical infrastructures are or will be reused by operators during fibre rollouts	-
	HAKOM	-	19861km (ducts), 3334 poles	49606 copper
Fibre Sharing	**NMHH**	6,336 km	6,336 km (dark fibre)	-
	ARCEP	38 million premises passed	95% already passively shared (with a potential of 100%).	-
	PTS	Approximately 35000 leased dark fibre connections between node to residential building.[50]	-	-
	HAKOM		31928 dark fibre	17173 fibre

Despite the lack of homogeneity in the available data for both fixed and mobile networks regarding infrastructure sharing, BEREC was able to draw some key findings:

- The majority of NRAs did not provide quantitative data regarding infrastructure sharing for fixed or mobile networks. Additionally, the lack of comparable data across BEREC member NRAs made it difficult to compare the relative environmental benefits derived from infrastructure sharing/co-location. However, it can be concluded from the data collected, that the physical infrastructure (ducts, poles, towers etc.) is being shared among operators across Europe, which infers that environmental benefits are being observed in these regions from this sharing.
- Six NRAs (Arcep, ANACOM, BIPT, EETT, HAKOM, OCECPR) could provide data regarding sharing of active infrastructure for both fixed (Arcep, HAKOM) and mobile (Arcep, ANACOM, BIPT, EETT, OCECPR). This included data on antennas, entire base stations or even elements of the core network, despite increasing trends in

[50] Note by PTS: Number shows dark fibre connections between node to residential building leased as of 31 December 2023. This indicates that parts of the networks owned by one company, is being shared with another company. However, it does not mean that the lines are actually shared in the sense that both operators use the for connecting end users.

sharing this type of infrastructure. Some countries expressed difficulties in assessing shared sites. Despite data on shared masts not being widely collected by NRAs, in general masts have the potential for sharing.

- For the countries that provided data on fixed networks, it can be concluded that many existing ducts and poles used for the deployment of fixed networks are currently or will be reused by operators through sharing agreements. Active wholesale products can also benefit the environment as other operators can use this access to provide high-speed services to customers, using existing lines (fibre or copper), without the need to rollout their own networks. However, it should be highlighted that the share of active parts of the networks have significative implications on infrastructure-based competition. Infrastructure sharing, or even sharing elements of the network, can provide environmental benefits; however, other regulatory issues, for example implications on competition dynamics or the deployment of fibre networks, need to be taken into account.
- The standardised collection of data on network sharing is important for comparability and for any future study to evaluate the impact of network sharing on sustainability. NRAs could consider benefits of cooperation for environmental sustainability in their regulatory decision making when weighing all relevant aspects.

3.5. Strategic and prospective inputs

3.5.1. Incentives put in place in order to promote infrastructure sharing

In general, infrastructure sharing brings cost savings for telecom operators, as they could capitalize on shared resources by reducing CAPEX costs. Most NRAs consider that there are no or only limited additional regulatory incentives put in place in their country to promote infrastructure sharing.[51] Nevertheless, infrastructure sharing is promoted in some countries by the regulatory framework like in Spain or in France, where passive mobile infrastructure sharing is encouraged throughout the country, with some provisions targeting specific areas (e.g. mountain areas or rural areas with low housing and population density). Similar provisions on passive infrastructure sharing are in place in Austria.[52] Arcep noted that significant network sharing rates derive from obligations to share active installations or only passive mobile infrastructures depending on the case that have been imposed on operators within the framework of rights for the use of radio frequencies. Otherwise, on a commercial basis, network sharing agreements are generally concluded between two MNOs. In Czechia, as part of the Recovery Plan for Europe, the Ministry of Trade and Industry has opened a

[51] Question submitted to the NRAs: “Are there incentives put in place in order to promote infrastructure sharing?”. 14 NRAs replied “no” (ACM, ANCOM, ANACOM, BIPT, BNetzA ComReg, EETT, IRL, MCA, NMHH, PTS, RATEL, RRT, RTR) , 8 NRAs “yes” (OCECPR, CTU, DADG, Arcep, SPKR, NKOM, AKOS, CNMC), 3 NRAs didn’t answer.

[52] According to Art. 64 Austrian Telecommunications Act 2021, passive sharing for mobile networks is mandatory.

tender for enhancing 5G coverage in railway corridors. The conditions of the tender specifically request that all MNOs must have access to passive or active sharing of the infrastructure built with the support of this scheme. But the reasoning for this sharing was rather economic and logistical. Some NRAs[53] quoted measures which derive from the implementation of the provisions of the BCRD on access to infrastructure and transparency concerning planned civil works. They have been implemented in some cases in a wider sense, like in Denmark, where the definition of "network operator" has been broadened to encompass undertakings such as municipalities constructing and offering access to ducts. These access obligations have been in force since 1999, prior to the BCRD, and also applies to owners of private buildings, structures and infrastructure exceeding a specified height. Two NRAs[54] mentioned regulatory obligations to grant co-location in cost-oriented prices.

3.5.2. Specific work or assessment on environmental sustainability and infrastructure / network sharing or deployment

Environmental benefits of infrastructure / network sharing have been cited in various papers from BEREC, think tanks, industry organizations and NRAs.[55] In Greece, as regards environmental sustainability, according to Article 20 of the Climate law, telecom operators (fixed/mobile) should report calculate and report their GHG emissions using specific standards, beginning in 2022, to a competent authority and GHG emissions are calculated using specific standards.[56]

It can be concluded from NRA responses to the survey that there is a lack of specific focus or assessment (quantitative studies, regulatory evaluations, etc.) on environmental sustainability. Existing infrastructure or network sharing can serve as a basis to assess the positive impact of such practices on sustainability, particularly in terms of reducing carbon footprint and electricity consumption.

In some countries, mobile operators, which have created a joint venture for active infrastructure sharing of the mobile sites (without spectrum), have claimed that this has a positive impact on environmental sustainability as it will enable a reduction of energy consumption of more than 20% and lower the number of sites by 40%.[57]

---

[53] DADG, SPRK.
[54] OCECPR, NKOM.
[55] BEREC 2018 Report on Infrastructure sharing (BoR (18) 116), BEREC 2019 Common position on mobile infrastructure sharing (BoR (19) 110), CERRE 2020 Report "Implementing co-investment and network sharing", May 2020, GSMA 2023 5G Co-construction and sharing Guide and MCA's discussion paper The contribution of the Communications Sector and the MCA's potential role towards achieving Malta's sustainability goals, published in October 2023, which makes multiple references to infrastructure sharing and co-location of network elements as potential contributors to limit the GHG emissions of the ICT sector and where NRAs are considered to have typical remit.
[56] More specifically, the ISO14064-1:2018 standard (scope 1 and 2) or a combination of the 2006 IPCC Guidelines and GHG protocol/
[57] Active mobile infrastructure sharing (without spectrum) between Proximus and Orange through the joint venture MWingz in Belgium: https://www.proximus.com/green/net-zero-and-true-circularity.html

3.5.3. Environmental sustainability benefits stemming from infrastructure sharing

As compared to a non-shared deployment, the responding NRAs mentioned a variety of benefits stemming from infrastructure sharing. Besides economic advantages, the NRAs named, e.g. reduction of costs,[58] enabling deployment[59] and operational synergies.[60] Also, infrastructure sharing and avoiding duplicated deployment reduce the social and environmental costs in the rollout of mobile and fixed networks.[61]

The NRAs identified a whole list of positive environmental impacts of infrastructure sharing:

- Reduction of the number of units of equipment used;[62]
- Resource efficiency, reduction of (natural) resources and material consumption;[63]
- Reduction of the need for civil works[64] and reduction of the volumes of generated waste;[65]
- Reduction of energy consumption[66] as it improves efficiency[67] and helps coping with rising energy costs and consumption;
- Reduction of emissions and the carbon footprint,[68] avoiding the resource intensive process of constructing new facilities;[69]
- Protection of the environment[70] – especially reduction of visual pollution[71] and other environmental impacts (on local natural habitat and biodiversity,[72] water and resource depletion[73]);
- Saving space in rural areas that need to be cleared in order to establish a safe protected area for a transmission tower;[74]
- Reduction of the impact on the urban environment in terms of reduction in road works,[75] pollution, noise and traffic congestion (for fixed infrastructure sharing);[76]
- Potential circularity of the infrastructure without any additional soil artificialization.[77]

[58] BNetzA, CNMC, HAKOM, MCA, PTS.
[59] HAKOM
[60] BNetzA
[61] DADG
[62] ANACOM, Arcep, BIPT.
[63] AKOS (citing excavation as an example), CTU, MCA, NMHH, OCECPR, DADG, SPRK.
[64] OCECPR
[65] BIPT, MCA.
[66] Arcep, BIPT, ILR, NMHH, OCECPR.
[67] Mentioned by BIPT.
[68] ANACOM, ANCOM, OCECPR.
[69] ANCOM.
[70] HAKOM
[71] BIPT
[72] ANACOM, CTU
[73] ANACOM
[74] CTU
[75] NMHH, MCA
[76] MCA, DADG
[77] ILR

In regards to NRAs' views on the contribution of different infrastructure and/or network elements to the environment, it appears that the benefits vary according to the sharing types (passive, active, roaming).

Some NRAs state that no measurements or standardized indicators are available to either assess the level of impact or rank it according to contribution to the environment.[78] Hence, it would not be possible to quantify potential environmental benefits of infrastructure sharing based on the available data.[79] Nevertheless, Arcep considers that mobile passive sharing will have mainly positive impacts on the reduction of the use of support goods[80] and BIPT specified that passive infrastructure only focusses on non-electric infrastructure. Thus, active mobile infrastructure sharing will have additional impacts on reduction of equipment and energy consumption. Most NRAs consider that sharing of the mobile RAN network would be of the utmost benefit to the environment since they are the most energy demanding.[81] Indeed, reducing the number of base stations and radio signal transmitters can lead to a reduction in energy consumption and radio emissions. Consequently, optimizing the energy-efficient operation of active network elements can bring significant contributions to environmental sustainability. Also, the longer an active network element is shared, the greater the environmental benefits, thanks to savings in both materials and energy. [82] According to PTS, sharing of fixed links for backhauling would be on second place of interest.

As regards to fixed networks specifically, construction works are considered to have the largest negative impact on the environment when it comes to their lifecycle, with sharing of towers, ducts and poles contributing most to the environment benefits.[83] Therefore, better coordination of those activities and sharing of infrastructure would be beneficial for the environment. Divergent opinions have been expressed about access network and core network.[84] One NRA[85] noted that in general, energy consumption is greater in wireless networks and have the potential for increased sustainability through sharing, but aspects such as competition, security, etc. are important to be included in the assessments.

3.5.4. Plans to enhance the integration of environmental considerations

According to the survey, some NRAs are currently focusing on active mobile infrastructure sharing. In France, in addition to the measures already in force, extending mobile network active sharing obligations between all or some of the MNOs in specific areas are under study. This is because active mobile network sharing in rural areas particularly could contribute,

[78] ANACOM, OCECPR.
[79] BNetzA
[80] According to ITU-T L.1450 Recommendation:
"*Support goods encompass equipment installed on site or at facilities for the grid and non-grid power supply of networks, as well as equipment installed on site or at facilities for cooling purposes*".
[81] Arcep, BIPT, EETT, PTS, RATEL SPRK.
[82] Mentioned by CTU.
[83] According to HAKOM.
[84] CNMC and NMHH.
[85] NKOM.

under certain conditions, to reducing the environmental footprint, while improving coverage and quality of services.

More generally, in Malta, MCA intends to enhance the integration of environmental considerations when determining the potential imposition of network or infrastructure sharing obligations during the allocation of the right for the use of radio spectrum.

Certain NRAs are conducting studies on environmental sustainability. In Austria, RTR commissioned a study on the environmental impacts of fibre networks in comparison to "legacy networks. The consultants showed that FTTH is the most energy-efficient technology with the lowest CO_2 emissions among the examined access network technologies and underlined the positive effects in energy and CO_2 savings of a rapid rollout and migration to FTTH[86]. In Greece, EETT has commissioned a study regarding sustainability of ECN in the Greek market (October 2024). Although EETT does not have a mandate over environmental issues, this study will be used as a basis to define further steps. In Spain, CNMC is currently analysing the possibility of including specific environmental aspects in its decisions. In Hungary, NMHH has plans to assess environmental effects for granting the rights for the use of radio spectrum, to introduce financial incentives (e.g. lower supervisory fees when environmental requirements are met), to broaden mandatory elements of reference for access to infrastructure (e.g. expected environmental effects), to add environmental aspects to spectrum granting procedure and to make detailed environmental assessment of network sharing. In France, Arcep has been collecting data from the four main telecom operators to monitor their environmental footprint since 2020. Following a new decision approved in February 2025, Arcep is expanding its data collection to fixed network equipment suppliers, focusing on metrics such as the volume of fibre cables sold in France and associated GHG emissions. Nkom has conducted a study of the footprint of digital infrastructure in Norway in 2024. The study will be the basis for further work to reduce emissions[87]

In some BEREC members, environmental considerations have already led to specific measures when awarding rights for the use of radio spectrum, but not specifically related to infrastructure sharing. In Austria, in the latest spectrum award and for the first time, the regulatory authority is allowing these awarded frequencies to be switched off between 00:00 and 05:00 in connection with supply requirements, provided there is no reduction in performance compared to daytime operation. In Norway, the new Electronic Communications

[86]The study can be accessed here: https://www.rtr.at/TKP/aktuelles/publikationen/publikationen/oekologische-effekte-des-glasfaserausbaus.de.html (in German only).

[87] The study in Norwegian only: https://nkom.no/hoeringer/rapport-digital-infrastruktur/_/attachment/download/00ec2ab4-d056-46e7-8a23-a9b94da758f2:e416b69a4c4fde2a9bb6fdbb7bcd78327d87b0db/Fotavtrykket%20til%20norsk%20digital%20infrastruktur_2024.pdf

Act contains provisions that give the authority the legal basis to set climate relevant conditions related to the right for the use of radio spectrum.

3.5.5. Challenges to integrate environmental considerations in the decision-making process

NRAs identified many challenges to integrate environmental considerations in the decision-making process. In their responses, the NRAs mentioned several types of challenges.

a) Issues of mandate

Several NRAs mentioned they observe a **lack of explicit mandate** to integrate environmental considerations in the decision-making process for infrastructure sharing[88] and **lack of legal basis** for imposing concrete obligations.[89]

Only in Cyprus,[90] France,[91] Serbia and Spain,[92]did the NRAs have specific mandate to ensure the compliance with environmental objectives in the electronic communications sector. The Danish Agency for Digital Government Supply and Infrastructure (DADG) is not explicitly entrusted with ensuring compliance with environmental objectives in the electronic communications sector. However, environmental considerations are valid in the administration of the area in Denmark. In most countries (Austria, Croatia, Czechia, Greece, Italy, Romania, Slovenia), it is the Ministry who is responsible for ensuring the protection of the environment and achieving environmental sustainability.[93] In other countries (Belgium,[94] Finland, Germany, Malta, Norway, Sweden, Luxembourg[95]), one dedicated agency/authority or multiple regional and local authorities are responsible for ensuring the protection of the environment and achieving environmental sustainability**.** In some countries, the responsibility can be shared

[88] ACM, CTU, RATEL.
[89] HAKOM, EETT, RTR.
[90] OCECPR's strategic planning includes matters of environmental sustainability and its legislation which has transposed the EECC includes relevant general provisions for environmental protection, it is currently under review to be modified.
[91] Arcep operates mainly through data collection. Since 2020, Arcep has implemented an annual publication to describe the environmental impact of digital: the annual survey “Achieving digital sustainability”. Initially collecting environmental data from the four main telecommunications operators, Arcep’s data collection powers were extended by law in December 2021 to include data from other digital players such as data centre operators and terminal manufacturers.
[92] The General Telecommunications Act 11/2022, of June 28th do not set up the protection of the environment as a specific objective of the law, but, in a few cases, not in general, environmental aspects must be taken into account in order to comply with this law. The General Telecommunications Act entrusts different authorities, mainly the Minister of Digital Transformation, the CNMC and others.
[93] In three cases, the Ministry is supported by an agency or separate organisations the Czech Nature Conservation Agency of the Czech Republic Agency for Protection of the Environment (CNC AOPK), the Portuguese Agency for the Environment (APA) and the Slovenian Inspectorate for Natural Resources and Spatial Planning.
[94] The responsibility for environmental aspects rests with the regional governments, meaning that each region has its own environmental Agency.
[95] In Luxembourg, the "*Administration de l’ Environnement*" is responsible for ensuring the protection of the environment and achieving environment sustainability. Antennas’ installations are subject to authorisation delivered by that Administration.

between the ministry in charge of environmental matters and the national environmental agency (e.g. Portugal).

Hence, these two aspects of environmental considerations and infrastructure access, are in many cases managed by different national authorities. In some cases, the agenda for environmental impact is assigned to the ministry and agency protecting the environment with no means established how to share the agenda at national level, nor how to engage other public or private stakeholders , which may be more competent with regards to environmental considerations.[96] In Ireland, Article 44 of the EECC has been transposed in such a way that the opinion of the relevant authority (in most cases, it is the local authorities, whose remit includes granting licenses and planning permission which should include environmental considerations) must be considered.

Due to the lack of explicit mandate to integrate environmental considerations in the decision-making process for infrastructure sharing and the lack of legal basis for imposing concrete obligations, certain NRAs reported consequently **missing resources, knowledge, skills and expertise** on environmental sustainability to effectively integrate environmental aspects into decision-making processes.[97]

b) Issues of practical application

The NRAs acknowledged that there is a strong need for **flexibility and focus on overarching sustainability principles** to create future-proof decision-making. Measuring, examining and assessing the direct and especially indirect environmental impact of ECN/ECS is a very complex task for regulators, especially due to the lack of data and the need for a clearer and more harmonised mandate at EU level to collect such environmental data. BEREC and its member NRAs have been working to develop expertise on sustainability indicators, leading to a dedicated report[98] and the establishment of a list of indicators for data collection on the environmental footprint of ECN/ECS. Advancements in precise measurements of the environmental footprint of ECN/ECS could enable regulators to assess the negative environmental impact averted through infrastructure sharing, in order to **weigh up environmental issues alongside other regulatory objectives,** such as quality of service, network deployment and rollout according to the technology advancements.[99]

Also, depending on the extent and quality of any analyses and assessments in that regard, the integration of environmental considerations in the decision-making may result in **potential delays in regulatory decisions**.[100]

[96] ANCOM, CTU, DADG.
[97] AKOS, CTU, HAKOM.
[98] BoR (23) 166
[99] ANACOM, OCECPR.
[100] DADG

It is **difficult to quantify environmental sustainability.** Environmental factors are very complex and it is necessary to have unbiased, comprehensive, reliable, standardized and up-to-date data on the environmental benefits and a methodology defining an analytical framework to consider environmental benefits when imposing infrastructure/network sharing obligations or assessing network sharing agreements between operators. Imposing infrastructure/network sharing obligations or assessing network sharing agreements between operators requires making a balance between different regulatory objectives. In order to integrate environmental considerations in the balance, a thorough impact assessments should be done.[101]

One NRA also mentioned that application of further measures, more reporting and collecting the environmental data from telecom operators, in order to measure the negative impact of the environment in their countries and to publish statistical information are facing negative perceptions from the sector.[102]

c) Interaction with other regulatory objectives

The conflicting objectives are not only related to connectivity. Trade-offs between environmental sustainability and other goals have to be assessed. The partially counteracting regulatory goals must be balanced in an objective way.[103]

To mention some of them, **cost considerations** and balancing eco-friendly requirements with higher costs is among the most discussed.[104] MCA mentioned that the benefits of infrastructure sharing in Malta are less significant compared to larger countries, where economies of scale make sharing more economically viable. Integrating environmental considerations in decision-making is thus hindered by cost and competition concerns. Initiatives with long-term cost recovery and those posing non-competitiveness are less likely to be adopted.

The infrastructure sharing could also have a **potentially negative impact on competition**, especially as regards sharing of spectrum and/or mobile RAN networks.[105] Hence, as mentioned by SPRK, the competition assessment (including assessment of impact on environment) needs to be carried out in case of active infrastructure sharing only (MORAN/MOCN). It can also be outlined that considering environmental aspects when assessing decisions that affect competition should rely on commonly shared standards and a level playing field to avoid distortions among market players.[106]

[101] AKOS, Arcep. BIPT, BNetzA, NKOM, OCECPR, RRT, TYT.
[102] CNMC.
[103] AKOS, BNetzA, Arcep.
[104] NMHH, OCECPR.
[105] EETT, PTS
[106] BIPT

3.5.6. Complementary actions to amplify positive effects of infrastructure and network sharing on environmental sustainability of ECN/ECSs

A majority of the respondents agree that complementary actions are needed. Some NRAs acknowledged[107] that all the complementary actions mentioned in the questionnaire (such as assessment, share of practices among NRAs, guidelines and definitions of standards), could increase the positive impact of infrastructure sharing in terms of environmental sustainability and such development would lead to harmonisation of practices- making the overall situation clearer and more transparent.

Sharing of experiences and best practices among NRAs on infrastructure and network sharing related to environmental sustainability is important for most NRAs,[108] especially since the legal mandate is unclear and/or the situation is different in various countries.[109] If some NRAs have implemented a specific methodology to assess the impact of infrastructure and network sharing on environmental sustainability, Arcep is of the opinion that it would be helpful to the other NRAs to have a consistent approach in the impact assessment in order to objectify positive effects of infrastructure and network sharing on environmental sustainability. According to MCA, in general, successful infrastructure sharing cases can inspire others to follow suit.

To facilitate implementation and comparison across countries, and to have a reference framework for both NRAs and industry, many NRAs are in strong support of **developing guidelines,** applicable at the EU level and adopted by BEREC along with the Commission. In addition to developing guidelines, there is also support for **defining standards** for sustainable infrastructure and network sharing, providing sufficient flexibility to take into account national specificities.[110] According to ANACOM, these are essential not only for assessing environmental impacts but also for determining the net impacts, considering the positive effects of infrastructure sharing. According to some NRAs,[111] further guidelines and best practices would be helpful in order to ensure a harmonized and common approach in Europe, especially if environmental sustainability is added as a regulatory goal. Guidelines on voluntary environmental impact assessment could provide quantitative figures of environmental impact of the deployment and operation of the popular ECN/ECSs, e.g., fixed (fibre), wireless (5G, Wi-Fi), satellite.[112]

RTR refers to its **specific national procedure on ex-ante assessment of active sharing agreements** (Article 85 Austrian Telecommunications Act) that includes an assessment based on competition law and the applicable European and national guidelines on **competition law and sustainability**. It also refers to the existing Common position of BEREC

[107] CTU, EETT.
[108] ACM, AGCOM, ANACOM, ANCOM, HAKOM, ILR, MCA, NKOM, NMHH, RATEL, DADG, Arcep.
[109] As reminded by Traficom.
[110] AGCOM, AKOS, ANACOM, ANCOM, BIPT, CNMC, ILR, MCA, NKOM, DADG, SPRK.
[111] BNetzA, OCECPR, DADG
[112] RTR

on mobile infrastructure sharing and on the other hand the existing rules on sharing in the EECC transposed into national law.

Certain NRAs also support **further studies** on the impact of network sharing on environmental sustainability, which are anyway needed to integrate environmental considerations in the decision-making process.[113] All stakeholders should be involved in the process in order to provide relevant data, including MNOs and TowerCos which are also important actors in network sharing. Three NRAs[114] proposed new aspects of thematic work for BEREC: i) collaboration among stakeholders, including regulatory bodies, industry, academic and research institutions, and non-governmental organizations, is very much needed, to develop comprehensive solutions and strategies for sustainable sharing and ii) in BEREC directly, the work could have the form of a specific workflow on this topic to enhance the collective knowledge and experience.

3.5.7. Levers for supporting the promotion of more sustainable deployment of ECN/ECS – including through further infrastructure sharing

The survey asked NRAs about the levers they consider suitable to support the environmental sustainability of the ECN/ECS further deployment. Several NRAs[115] mentioned proposals, which could be included within the frame of the revision procedure of the EECC.[116]

As infrastructure / network sharing is largely considered among NRAs as a positive contributor to the environmental sustainability, there is a suggestion that NRAs/OCAs would be allowed, in compliance with EU law, to **impose mobile network sharing obligations in specific areas** (e.g. rural, historical, cultural, environmentally sensitive areas) outside of spectrum rights licenses. As regards fixed networks, it has been suggested to give attention in terms of sustainable development to the copper switch-off and building of optical networks in rural areas (co-funded by EU), which could be included in existing acts or new measures for better coverage in remote rural areas with energy-efficient mobile networks, possibly extending optical networks to base stations.[117]

NRAs could be better empowered to take decisions on infrastructure sharing if the **environmental protection was included as an objective** in the mechanisms already existing in the regulation on infrastructure sharing (either for provisions such as Article 44 of the EECC, or the GIA).[118]

Another lever proposed in the survey is to **assess environmental impact** when taking decisions granted that it does not constitute an overburden for decision-makers and

[113] AGCOM, Arcep, ILR, NKOM
[114] AKOS, Arcep, OCECPR.
[115] ACM, AKOS, Arcep, BIPT, CNMC, ComReg, EETT, MCA, OCECPR, RATEL, RRT.
[116] OCECPR, ComReg, RRT, RATEL.
[117] AKOS.
[118] Arcep, OCECPR

stakeholders[119] and/or **take into account environmental issues in the dispute proceedings about infrastructure sharing.**[120] In that respect, specific and clear regulatory mandate regarding environmental sustainability would ensure a harmonized and universal application of such measures in the deployment of ECN/ECS[121] and would support NRAs in the promotion of more sustainable deployment.[122] Furthermore, it must be clear how to approach environmental protection/environmental sustainability issues under the review of the EECC to ensure harmonised approach.[123]

The review of the EECC, and potentially the expected "Digital Network Act" proposal could be a possibility to include **additional competences for NRAs towards e.g. NetCos and TowerCos,** including environmental sustainability as an objective.[124] In addition, non-regulatory levers that could be supported were mentioned, such as industry workshops/consultations on sustainability issues, studies on carbon footprint and environmental impact of ECNs and ECSs, or end-user awareness programmes.[125]

3.5.8. Influence of current trends on network/infrastructure sharing practices and impact on environmental sustainability

The current trends in network architecture are likely to impact the practices in terms of network and infrastructure sharing. These trends could have various implications for sustainability considerations: efficient resource utilization, enhanced infrastructure sharing opportunities and promotion of innovation and collaboration.[126]

From an environmental sustainability perspective, as operators share the same physical infrastructure (data centres), they can achieve reduced impact with significant carbon footprint reduction and impact on water consumption.[127] They will allow for more flexible and efficient resource allocation, reducing the need for physical infrastructure, lower energy consumption and overall reduced environmental impact.[128] New technologies and network architectures are expected to be designed with sustainability improvements in mind.[129] Coupling technological advancements with a focus on environmental sustainability and associated appropriate actions will be important.[130] Establishing a standardized definition for measuring sustainability across its various aspects remains crucial.[131] For instance, Open-RAN architecture raises

[119] BIPT which suggests that in that respect, the NRA could be assigned as the authority that defines the proper indicators and controls the statements of the providers.
[120] CNMC.
[121] OCECPR
[122] EETT.
[123] ComReg, RATEL, RRT, OCECPR.
[124] OCECPR.
[125] ANCOM.
[126] SPRK.
[127] Arcep.
[128] BIPT.
[129] ANACOM.
[130] AKOS.
[131] ANACOM.

concerns about the potential energy inefficiency of commercial-off-the-shelf (COTS) hardware, despite its versatility.[132] Further studies could be considered on the impact of these new technologies on infrastructure sharing and environmental sustainability.

More specifically, as regards the infrastructure sharing opportunities, **virtualization** enables to host several software-enabled equipment (called "virtualized network functions (VNFs)") into the same hardware (this is an example of consolidation and sharing of network elements within the same network operator). Similarly, virtualization supports network sharing among operators by enabling VNFs from different operators to run onto the same hardware. Virtualization of the RAN would be a possible way of network sharing provided that supporting interfaces and underlying infrastructure are open or standardized so that operators can use and manage independently their own RAN software on a common cloud infrastructure. It will depend on how all the equipment is orchestrated. Under existing sharing agreements, one operator is typically responsible for all the component parts of a shared site, with both operators using the same RAN vendor or software release, and life cycle management.[133]

Selecting from the other technologies available, the **C-RAN** enables the aggregation of BBUs of different radio sites and collocate them within a single pool.[134] **Edge computing** implies the co-location of computer servers which will be installed as close as possible to the users and traffic sinks/sources.[135] With the advent of **MEC and Stand-Alone transitions**, this flexibility will extend deeper into the access network, reaching closer to end users[136]. Certain NRAs noted possible effects of satellite developments on infrastructures scheme (e.g. terrestrial equipment, cloudification), with eventual consequences on sharing practices and on sustainability.[137]

4. Views of stakeholders (e.g. industry associations)

A technical workshop was held with several organisations, including Connect Europe, ECTA and EWIA[138] which responded to a call by BEREC to collect and reflect the views of stakeholders on infrastructure sharing and environmental sustainability. BEREC asked the stakeholders a set of questions related to i) the current regulatory framework; ii) commercially driven incentives in terms of infrastructure sharing; iii) existing study/assessment on infrastructure sharing possible environmental impact and iv) prospective inputs on the future of infrastructure sharing. This section reflects solely the views of stakeholders who participated in the technical workshop. BEREC does not endorse the views summarised in this Chapter 4, nor supports the different studies mentioned by respective organisations. Furthermore,

[132] ANACOM.
[133] Arcep.
[134] Arcep.
[135] Arcep, see also BEREC Report on Cloud and Edge Computing Services,
[136] MCA.
[137] BIPT, MCA, NKOM.
[138] MVNO Europe and the Shift project were also consulted but were not able to provide inputs before the date of publication of the draft version of this report.

Chapter 4 presents the perspectives shared during the workshop, while other contributions received during the public consultation, such as the interaction with network resilience objectives, have been considered in BEREC's report on the outcome of the public consultation.

4.1. Infrastructure sharing impact on environmental sustainability

The stakeholders agree on the general benefits of network sharing for environmental sustainability, which go beyond reducing costs for operators:

- Reduction of carbon emissions, land use, waste production and energy consumption by avoiding overbuilding and duplication of infrastructure;
- Energy efficiency, with network sharing optimising the energy consumption of networks.

These benefits are documented by EWIA in a study conducted on its behalf by EY Parthenon[139] on how the TowerCos business model, based on passive infrastructure sharing, can help reduce the sector's carbon footprint. That study concludes that, based on the expected growth rate of sites in the next ten years and on the fact that independent TowerCos enable greater levels of infrastructure sharing, a reduction of the number sites, compared to a scenario led by MNO deployments, will result in less concrete and steel materials being used, leading to a net carbon emission saving. In addition, shared cooling facilities and an innovative energy savings feature, coupled with the use of renewable sources would help annual energy savings up to 15%. According to this study, thanks to a reduced number of towers, a reduction in maintenance visits is expected, reducing both the number of kilometres travelled by maintenance teams, as well as the size of the fleet needed. This will be translated in an overall reduction of pollution deriving from CO_2 emissions of maintenance vehicles.

Other stakeholders indicated that they had no in-depth study on the subject.[140] Nevertheless, Connect Europe outlined there are environmental benefits to network sharing with lower emissions, land usage and less waste. Infrastructure sharing prevents overlaps in infrastructure and potential 'overbuilding', which duplicates energy consumption and results in a relatively larger carbon footprint.

For ECTA, in a general sense, infrastructure sharing has the potential for positive environmental impact both in terms of reducing embodied emissions of hardware and operational impacts from energy and cooling. There exist different challenges for fixed and mobile networks and there are also concerns that apply specifically to consumer and

[139] EY, The sustainability contribution of the European independent TowerCos sector, a report for the European Wireless Infrastructure Association, March 2023.

[140] ECTA cited the study by Pantelis Koutroumpis (University of Oxford), Pau Castells (GSMA), Kalvin Bahia (GSMA), "*To share or not to share? The impact of mobile network sharing (or consumers and operators)*", 2023. This study does not focus on the impact of network sharing on environmental sustainability but rather on the impact on markets and consumers.

wholesale or enterprise business deployments. Similar to Connect Europe, ECTA acknowledged the higher network densification required by 5G technology which is likely to increase the energy consumption unless coupled with environmentally sustainable solution. When it comes to the technical implementation of the sustainability objectives by the NRAs, and in order for NRA's or other bodies to better integrate environmental concerns, ECTA suggested to conduct net impact analyses on use cases for infrastructure sharing and refers to general methodologies developed by the ITU[141] and the European Green Deal Coalition.[142]

4.2. Existing practices and commercially driven infrastructure sharing

According to Connect Europe, voluntary network sharing agreements have become widespread in Europe. Connect Europe claims to have seen the benefits of infrastructure sharing extending beyond just cost reduction and quality improvements, but also to enable wider and faster roll-outs, where operators join efforts to deploy new technologies in both fixed and mobile. Both fixed and mobile network roll-out can be facilitated by allowing flexibility for market players that decide to enter into voluntary commercial wholesale agreements, network sharing and co-investment agreements.

ECTA expects that mobile network sharing agreements and deals with tower companies. which entail mast sharing, may become even more attractive options for operators with respect to 5G networks and common environmental goals. The competitive environment in European telecoms over the past 20 years must also be preserved. ECTA believes that the paper “To share or not to share? The impact of mobile network sharing for consumers and operators”[143] is a good description of the different trade-offs, synergies and sensitivities that could derive from mobile network sharing.

EWIA highlighted the major role of TowerCos for passive wireless infrastructure sharing and underlined that the independent TowerCo model leads to an efficient sharing with positive impact on competition and economics (economics savings, better coverage and accelerated time to market including for new innovative service providers).

[141] Recommendation L.1480: Enabling the Net Zero transition: Assessing how the use of information and communication technology solutions impact greenhouse gas emissions of other sectors
[142] https://www.greendigitalcoalition.eu/overview-of-egdc-methodologies/
[143] Koutroumpis, P. et al, 2023, “To share or not to share? The impact of mobile network sharing for consumers and operators”, https://www.sciencedirect.com/science/article/pii/S016762452300046X#br0010

4.3. The role of policies and regulation to support infrastructure sharing and environmental impact of networks according to stakeholders

Connect Europe members have found that infrastructure sharing agreements can be very difficult and bureaucratic and depends on a number of factors, including the size of the networks concerned. Connect Europe believes that voluntary and commercially viable network sharing agreements should be supported by removing hurdles that currently exist in practice for operators and a more flexible framework, for example one which includes the presumption of legality for active RAN sharing. They cited their response to the Commission's draft Horizontal Guidelines, where the organisation stressed in the absence of consistent rules for legitimate sharing, it can be difficult for parties to identify the boundaries of such agreements.

ECTA noted that the majority of current mobile infrastructure sharing agreements in Europe are the result of commercial negotiation rather than regulatory intervention and deduced that this is a clear indication of how those sharing agreements are driven by the operators' own initiative rather than an external push by the authorities. ECTA believes the current legislation[144] and guidance[145] are appropriate to avoid the risk of restriction of competition and that its effective implementation and preservation remains key for the correct balance of the market dynamics in terms of achieving multiple objectives of competition, network infrastructure investments, innovation, environmental sustainability and consumer welfare. Nevertheless, ECTA highlighted the regulatory approach adopted by France under the Mobile New Deal as a successful example of network sharing imposed by regulation ensuring a balance between the objectives of competition and territorial coverage. This position was shared by EWIA.

To attract and retain investment, including from outside Europe, EWIA believes it is important that EU policy makers and NRAs are able to ensure long-term stability of rules that will foster additional investment in the future. In this regard, it welcomes the recently adopted GIA regulation and supports any tool that can foster infrastructure sharing and its positive role on environmental sustainability of networks.

[144] In particular, the provisions of the EECC were mentioned (Articles 44, 47, 61, 73).

[145] The European Commission's guidelines on horizontal restrictions, revised in 2023, which include a section dedicated to telecommunications infrastructure sharing agreements. ECTA argued that the EC considers that active sharing agreements do not restrict competition by their object and sets criteria to be considered. It argues that certain factors are important to take into account in the analysis of the restrictive effects of competition of the agreements, such as the opening of the agreement to a third operator and the existence of local regulations that restrict competition (e.g. low levels of electromagnetic field emissions in certain countries that reduce deployment spaces, permits).

4.4. Stakeholders' prospective work relevant for the future of infrastructure sharing in the context of network cloudification and virtualisation

In 2023, Connect Europe commissioned a report by Deloitte[146] which emphasised the future importance and impact on the telecom sector of open networks (OpenRAN, APIs) and virtualisation of network functions, including edge cloud. In particular, and in light of future 5G SA and 6G network technologies, Connect Europe highlighted that the virtualisation of mobile networks makes the differentiation between passive and active sharing, including spectrum sharing to some extent, less relevant, with the main differentiators in terms of quality and performance being software-based. Connect Europe considers that spectrum sharing would be better approach to address the needs of verticals rather than reserving spectrum in auctions which can create scarcity and fragmentation of spectrum. This is important in terms of environmental sustainability, as increasing spectrum per site is more energy efficient than increasing the number of sites, especially considering the dense deployment of base stations needed for 5G. According to Connect Europe, overly strict limitations on mobile active sharing could prevent spectrum management to play a positive role in the fight against climate change. When considering infrastructure sharing decisions, environmental concerns need to be given proper attention.

Unlike Connect Europe, ECTA sees no role for the virtualized access solutions (i.e., APIs) to the network and thus no affiliated issues in terms of infrastructure sharing. ECTA emphasizes that effective wholesale (passive and active) access to electronic communications infrastructures is and will remain a fundamental pillar, even in a world characterized by the advent of cloudification and virtualization. ECTA believes that any option that would restrict wholesale access to infrastructure for operators with significant market power by replacing it with access to application programming interfaces would constitute a brake on the development of innovative technologies. For ECTA, an example of innovative technology for infrastructure sharing contributing to environmental sustainability could be the IPCEI (Important Projects of Common Economic Interest) CIS (Cloud Infrastructure and Services) projects. One ECTA member, Eurofiber, is part of the consortium working on Modular & Integrated Sustainable Datacentre, which aims to deploy a decentralized network of data centres, resulting in multiple smaller data centres which would be used for computing (i.e. energy intensive activities) that could be placed either close to where green energy is produced or where heat generation could be utilized.

From EWIA's perspective, innovations can be ways for TowerCos to extend their sharing model to new areas: Distributed Antenna Systems (DAS) and Small Cells are opportunities for TowerCos to offer active networks of neutral hosts, Edge Infrastructure and Cloud RAN

[146] 'Future connectivity: new study finds radical change is coming and highlights investment challenge', Deloitte for ETNO (now Connect Europe), 2023

are emerging concepts in mobile network architecture that offer potential for pooling, and Artificial Intelligence, enhanced imaging and computing technologies are already enabling the rise of “Digital TowerCos” by exploiting the powerful use cases of digital twins.

5. Conclusions and future work

BEREC emphasizes the importance of ensuring network deployment and promoting connectivity for all European citizens. It is also crucial to ensure that the environmental impact of this deployments and of the electronic communications sector is minimized. In this regard, infrastructure sharing, whether passive or active, can be an instrument to reduce the environmental footprint of deployments and increase energy efficiency.

It should be noted that infrastructure sharing, especially where active components of the networks are concerned, can raise significant issues in terms of competition, investment incentives, and service quality, which depend on the context (e.g. the population density and the derived demand for data services in of the area in question). Coherently with the EU regulatory framework, these aspects are already considered by regulators and BEREC reminds readers that this document focuses on the links between environmental sustainability and infrastructure sharing. This report also makes reference to other bodies of work on the subject of infrastructure sharing, concerning issues beyond the environmental impact of such sharing practices.

Infrastructure sharing can bring about various benefits such as cost reduction, improved energy efficiency, consumer choice, greater public acceptance of infrastructures, as well as the minimisation of environmental impact of telecom infrastructures. While there is a lack of quantitative data and studies on the negative environmental impacts averted through infrastructure sharing, regulators and stakeholders agree on the various environmental gains, including carbon avoidance, that such sharing can enable. It should be emphasised that the benefits of infrastructure sharing have to be weighed against potential technical, legal and regulatory issues in terms of quality of service, competition and investment.

Table 2: Summary potential environmental benefits associated with infrastructure sharing

Environmental Benefit	Lifecycle phase	Description	Expected Impact
Reduction in Duplicative Infrastructure	Manufacturing and deployment	By sharing infrastructure, fewer physical structures like towers and ducts need to be built, reducing the overall environmental impact.	Reduction in the number of new towers, ducts, and other physical structures.

Energy Efficiency Improvements	Operation	Shared infrastructure (especially when active components equipment is shared) allows for more efficient energy use by reducing redundant equipment and optimizing resource allocation.	Lower energy consumption per network, particularly in data centres and cellular networks.
Resource Conservation	Manufacturing	Fewer materials such as metals, plastics, and other resources are needed for new infrastructure, conserving natural resources.	Reduced extraction and processing of raw materials, contributing to less environmental degradation.
Reduction of CO2 Emissions	Operation and deployment	Fewer new deployments and optimised energy usage lead to lower emissions of CO2 and other greenhouse gases.	Potential reduction of thousands of tons of CO_2 annually, especially in densely networked areas.
Decreased Land and Resource Use	Deployment	Less land is needed for new installations, minimizing environmental disturbance and reducing the exploitation of natural resources.	Lowered environmental footprint in sensitive ecosystems, less deforestation or land clearing.
Reduction of E-waste	Decommissioning	Infrastructure sharing reduces the need for replacement and disposal of electronic devices and components, helping to lower electronic waste.	Minimized accumulation of outdated and discarded electronic components.

It is worth noting that infrastructure sharing is an established feature in electronic communications markets included through commercially driven agreements that are established without regulatory intervention. As covered in BEREC's Common position on

infrastructure sharing,[147] the current regulatory framework enables competent authorities, – in limited and respectively specific situations, to restrict or to impose infrastructure sharing. Various provisions allow for the restriction and imposition of passive or active infrastructure sharing obligations at the European level with the aim to contribute to achieving the objectives of the European regulatory framework on electronic communications. For fixed networks, infrastructure sharing is part of access regulation implemented by the European regulatory framework. The coordination of civil work is also a public policy and regulatory principle established in European law by the BCRD, which is currently being replaced by the GIA. In mobile networks, in addition to the general provisions allowing the imposition of infrastructure sharing obligations in the exercise of rights of way, spectrum allocation procedures can include network-sharing obligations. It appears that the current European framework does not foresee the ability to formulate infrastructure sharing obligation for mobile networks, outside of spectrum allocation.

As evidenced by the BEREC survey for this report, the implementation of infrastructure sharing regulatory provisions are quite fragmented across Europe: for instance seven NRAs impose infrastructure sharing obligations, each based on different provisions such as Article 47, 61 of the EECC, or the relevant provisions of the BCRD. According to this report, the majority of BEREC members claim that no additional incentives are put in place in their country to promote infrastructure sharing. Furthermore, a very small number of NRAs currently integrate environmental considerations into their decisions regarding infrastructure sharing. It appears that the lack of a clear mandate on environmental sustainability is one of the main obstacles to such integration, as well as the lack of expertise and specific standards/guidelines on the assessment of environmental aspects.

Hence, to facilitate the inclusion of environmental considerations in regulation, including regarding infrastructure sharing, adding an environmental sustainability objective to the regulatory mandate of NRAs, as mentioned by the EC in its White Paper and already supported by BEREC,[148] would be a favourable development. While regulatory tools already exist to encourage infrastructure sharing, the possibility to expand the capacity of NRAs to impose or incentivise infrastructure sharing to the benefit of the minimisation of ECN/ECS's environmental footprint could be examined during the next review of the EECC. Furthermore, additional guidance at EU level could support NRAs and competent authorities willing to include sustainability aspects while assessing decisions related to electronic communications and infrastructure sharing. Such guidance could complement existing guidelines on horizontal sustainability agreements[149] and would have to be elaborated upon in close cooperation with NRAs, competent authorities and stakeholders.

[147] BoR (19) 110, BEREC Common position on infrastructure sharing (2019)
[148] BoR (24) 100, BEREC's input to the EC public consultation on the White Paper "How to master Europe's digital infrastructure needs? (2024)
[149] European Commission's Horizontal Guidelines (2023) - Chapter 9 on Sustainability Agreements: https://competition-policy.ec.europa.eu/document/fd641c1e-7415-4e60-ac21-7ab3e72045d2_en

It is also noted that only ten NRAs collect or did have access to data on infrastructure sharing, and none have conducted environmental impact assessments of sharing practices so far. In this regard, BEREC deems it relevant to foster the sharing of data by the operators and encourage relevant stakeholders (market players, researchers, public bodies, etc.) to conduct quantitative studies to improve our collective understanding on the links between infrastructure sharing and environmental protection. The availability of active RAN Sharing data and environmental data, supported by a clearer and harmonised mandate at EU level for NRAs to collect environmental data from telecom players , could also contribute to developing NRAs' expertise on the subject and facilitate the inclusion of this information in their decisions.

To foster the sharing of best practices on the topic, it would be relevant for BEREC to include an environmental component in any subsequent work on infrastructure sharing, in alignment with the objectives set in its 2021-2025 Strategy. Moreover, in the context of the work conducted by the EC to establish a Code of Conduct for the environmental impact of ECN/ECS, infrastructure sharing, particularly passive sharing, could be considered among the best practices included in this Code of Conduct. Finally, looking to the future of networks, network cloudification and virtualisation trends could also present an opportunity to promote resource optimization through network sharing when it is relevant and compatible with applicable legal obligations. These trends and challenges could be topics for future BEREC workstreams.

Finally, BEREC will continue to explore how regulators and the current framework can support the twinning of digital and environmental transitions.

Annex: Overview of mobile network active sharing agreements and their individual assessment by NRAs or competition authorities

Country	MNOs involved	Individual assessments of active sharing agreements by NRAs or competition authorities	Have environmental considerations been taken into account when assessing the agreements?	Additional comments
Austria	**T-Mobile Austria (Magenta) and Hutchison Drei Austria**	H3A and TMA notified a cooperation on active network components on 3 April 2023. It consists of a MOCN type regional roaming of H3A into TMA's network in mainly rural areas and a MOCN active sharing with spectrum pooling in remote areas. According to the assessment of the NRA, the cooperation results in an appreciable restriction of competition within the meaning of Art 101 Para. 1 TFEU; at the same time, taking into account the conditions (commitments), it is ensured that the exemption criteria of Art 101 Para. 3 TFEU are cumulatively fulfilled.	The parties argued that the cooperation would decrease energy consumption. However, sustainability issues were not decisive for approving the active sharing agreement.	
		The regulatory objectives within the meaning of Art. 1 Para. 3 Nos. 4 and 5 TKG 2021 are also met, as cooperation is permitted and at the same time it is ensured that competition is (still) guaranteed (No. 4 leg cit). In addition, the circumstances of end users and, in particular, consumers in the various geographical areas are taken into account to the extent that the additional coverage resulting from the cooperation is intended to have an impact in more rural areas. In addition, MVNOs and their end customers also benefit from the ‘gains’ of the co-operation.		

Belgium	**Proximus and Orange (Mwingz)**	Following a complaint by the third mobile operator (Telenet), an investigation was started by the Belgian Competition Authority in 2019 (BMA-2022-P/K-45-AUD). The complaint concerned the impact of the auction agreement on competition in the retail and wholesale markets for mobile telecommunications services. The BIPT collaborated with the competition authority during its investigation. No competitive concerns were found.	No.	
Bulgaria	**No active sharing agreement**	Not applicable		
Croatia	**Telemach Hrvatska and Hrvatski Telekom**	Assessment not carried out.	Not applicable. Environmental considerations are not within the competence of HAKOM.	Commercially driven national roaming agreement for 2G and 4G covering limited area of national territory.
Cyprus	**Epic and Primetel**	In Cyprus DEC 335/2013 stated that the designated SMP MNO by the Commissioner, was assigned the obligation of access with the form of national roaming. The SMP MNO was obliged to negotiate, within reasonable time, an agreement with any authorized and registered MNO with regards to national roaming. Several obligations were imposed regarding quality, availability, pricing, coverage in order to facilitate the sharing agreement. In 2019 with the deregulation of the relevant market (market 15), DEC 219/2019 amended the existing decision with regards to the obligated party being any MNO operating nationally as opposed to the SMP MNO.	According to the Regulatory Decision concerning co-location, the obligated organizations have the obligation to negotiate and satisfy reasonable requests for the co-location and shared use of physical infrastructure and/or auxiliary infrastructure and facilities of the public electronic communications network upon relevant request. In addition to this obligation, the obligated organizations have an obligation to negotiate agreements for the shared	

			use of physical infrastructure and/or auxiliary infrastructure for reasons related to the need to protect the environment.	
Czech Republic	**T-Mobile and CETIN/O2**	CTU assessed ex-post the infrastructure sharing agreement between T-Mobile and CETIN and published an informal opinion in May 2015. CTU has no competence to enforce competition law. The assessed network sharing agreement concerns the Czech Republic with the exception of Prague and Brno. Differently to most other sharing agreements, the agreement is between the two largest MNOs. The smallest MNO, Vodafone, operates an independent active access network. The assessment states that, in the short term, CTU expects no negative impact on the retail level of competition. However, in the long term the effects on innovation and deployment of new technologies need to be monitored. Since infrastructure costs are only a minor component of total costs of operators, CTU did not see a risk that cost communalities restrict retail competition. Furthermore, CTU did not see a risk that the remaining competitor was pushed out of the market due to significant cost disadvantage. Based on the information CTU was given, CTU did not see a risk of tacit collusion. CTU did not see a risk on the wholesale market and the related investment in coverage. Furthermore, spectrum license could require increased coverage. To sum up, competitive concerns were focused on the long-term effects on innovation and deployment of new technologies.	No.	

		The European Commission was in charge of an assessment based on competition law. The European Commission accepted the commitments offered by the parties that addressed the Commission's competition concerns over their network sharing agreement: to modernise the mobile network, to set and review the financial conditions for unilateral network deployments, to implement measures aimed to limit information exchange between the parties. After the 5G-frequencies auction CTU organised in 2021, T-Mobile and CETIN extended their infrastructure sharing agreement also on the 5G network.		
Denmark	**Telenor and Telia**	The Danish Competition Council (DCC) investigated the cooperation between Telenor and Telia ("TT-Netværket") in 2012. DCC found six different anticompetitive concerns with respect to Art. 101(1) TFEU. Five remedies were identified to address those concerns. A requirement to accommodate wholesale customers on customary and market conditions to address the risk of collusion on the wholesale market was imposed. An internal tariff structure reflecting underlying cost shall be used to avoid the conversion of fixed into variable costs. The parties may solely buy spectrum together in order to avoid the accumulation of excessive frequency resources. The parties must offer antenna sites to others that are to be dismantled due to the network consolidation. Requirements on the organization of the joint venture shall address and remove the risk of excess information exchange between the parties. For the sixth anticompetitive concern – reduction of competition on significant parameters such as coverage and the development and spread of new technology – the parties provided sufficient proof that the criteria for individual exemption in TFEU Article 101(3) were met.		

		Besides the TT-Netvaerket, the Danish mobile market consists of two largely independent competitors: TDC and Hi3G Denmark. In 2015, Telenor and Telia proposed to merge, but withdrew their application when the European Commission required conditions that the merging parties did not accept.		
	Hi3G and TDC	In areas where Hi3G does not have coverage itself, Hi3G has a national roaming agreement with TDC to use their network. However, this is not an actual network sharing agreement.		
Estonia	**No active sharing agreement**	Not applicable		
Finland	**DNA and Telia Finland**	DNA Oyj and Telia Finland Oyj have had a joint venture since 2014 (Suomen Yhteisverkko Oy) which initially was regional to Northern and Eastern Finland covering c. 50% of Finnish land area and c. 13.5% of Finnish population. When the joint venture was established, the Finnish competition authority expressed competitive concerns with respect to a potential harmonisation of mobile networks and thus a restriction on national network competition. Furthermore, operators might tacitly collude to the detriment of consumers. The importance of incentives to invest in new technology and high quality networks was stressed. As remedies to these concerns, the Finnish competition authority accepted commitments from the parties with a commitment to provide MVNO access to the national network of the involved parties. Furthermore, the parties gave commitments to rent out masts and sites to competitors. In addition, based on the commitments, information exchange between the parties is restricted,		

		and the parties maintain the ability to bring their preferred network features or additional capacity to the joint network. In January 29 2021, the companies published press releases in which they announced expansion of the operational area of Suomen Yhteisverkko to cover 62.5% of Finnish land area and c. 28.5% of Finnish population. The companies have provided the Finnish Competition Authority with new commitment suggestions which were in public consultation at the end of 2024 (https://www.kkv.fi/ajankohtaista/uutiset/kuuleminen-dnan-ja-telian-yhteisverkon-laajentamisesta/).		
France	**All operators**	From 2002, the historic “white zone” coverage program, i.e. where no operator offers coverage, and its successors required the 3 then the 4 MNOs to ensure coverage (initially in 2G only) of the areas concerned, via roaming, passive sharing, active sharing (depending on the different programs). In 2018, the Mobile New Deal provides for the obligation for operators to participate in the “Targeted Coverage System”. This obligation has been imposed in the operators’ spectrum licenses. Operators are required: - at least to share the passive infrastructure elements in each area for which they must ensure coverage within the framework of the targeted coverage system and which is common with another operator, and - in cases where the four operators are appointed for the same area in which the services are not provided at a level of good coverage, to implement active sharing with frequency sharing making it possible to provide very high-speed services in the area. In order to implement these active sharing obligations, the four MNOs have signed a network sharing agreement which has been approved by Arcep.	No.	In 2015, mobile network sharing agreements have been submitted to a specific legal framework. When Arcep finds that this is necessary for the achievement of the regulatory objectives, which include among others the protection of the environment, or for compliance with the commitments made under radio frequencies licenses by operators which are parties to a network sharing agreement, it may ask operators, after the opinion of the Competition Authority, to modify the network

				sharing agreements already concluded by specifying their geographical scope, their duration or the conditions for their extinction. In order to provide predictability to MNOs regarding Arcep's assessment of mobile network sharing agreements in the light of the objectives assigned to the sectoral regulatory policy, Arcep adopted network sharing guidelines in 2016. These guidelines provide a grid for analyzing network sharing agreements between operators. The evaluation of network sharing agreements proceeds from an assessment of their favorable and unfavorable effects with regard to the regulatory objectives on the basis of a case-by-case assessment. Without prejudice to the case-

				by-case assessment, the Authority distinguishes the regulatory objectives on which, a priori, a mobile network sharing agreement has a favorable effect and those on which, a priori, a mobile network sharing agreement has an unfavorable effect. Hence, mobile network sharing agreement can contribute to the protection of the environment and in particular of natural and landscape heritage, by allowing the common use of infrastructures between several operators, which limits the need for the installation of new infrastructures, such as towers.
	Free Mobile and Orange	One of the two main network sharing agreements in France is the national roaming agreement between Free Mobile (4th mobile operator and last entrant) and Orange. It is a 2G/3G roaming agreement allowing Free Mobile's customers on Orange's network. Designed to	No.	

		allow the entrance to the market of a new mobile operator, by providing access to an existing infrastructure, national roaming could have undermined investment incentive for the hosted operator if lasted excessively. Following the adoption of national specific provisions in French law, Arcep adopted beginning of 2016 guidelines on mobile network sharing (that provides an analysis grid of what could be acceptable or not in terms of network sharing, with regard to its regulation objectives, including digital territory planning, infrastructure-based competition, etc.), and then invited the operators to modify, if necessary, the existing sharing agreements to comply with its guidelines. As a result, Free Mobile and Orange agreed, in June 2016, on a roaming extinction trend, based on a progressive speed throttling for Free Mobile's roaming customers from January 2017 to end of 2020. After analysis, Arcep considered that these evolutions were in line with its guidelines and there was no need to use its new power to ask for modification of the roaming agreements granted by the adoption of national specific provisions in French law. An amendment to the roaming agreement was sent to Arcep in February 2020: it extended the roaming termination period by two years, until December 31, 2022. Another amendment was signed in 2022 extending the agreement for three years, until December 31, 2025. After a thorough examination of these amendments, the Authority concluded that it did not appear necessary to ask Free Mobile and Orange to modify their contract. For each amendment, the authority considered that, in view of the market situation, the investment dynamics of Free Mobile in its own network and the characteristics of roaming, the execution of this		

		contract, as amended by the amendments, was not likely to hinder the achievement of the regulatory objectives provided for in Article L. 32-1 of the French postal and electronic communications code, relating in particular to the exercise of effective and fair competition between operators for the benefit of users and the development of investment, innovation and competitiveness in the electronic communications sector.		
	SFR and Bouygues Telecom	In addition to the roaming agreement between Free Mobile and Orange (described above), another important sharing agreement in France is the active sharing between Bouygues Telecom and SFR. It involves active sharing of their networks (in 2G/3G/4G) on 85% of the territory and 4G roaming of SFR's customers on part of Bouygues Telecom's network. On 15th June 2016, following the adoption by Arcep of its guidelines, Bouygues Telecom and SFR transmitted to Arcep an amendment to their 2G/3G/4G network sharing, including the extinction of the 4G roaming of SFR on Bouygues Telecom network by the end of 2018. In addition, the operators precisely documented the incremental deployment expected, induced by the sharing agreement, in comparison with a situation where the operators deploy standalone networks, leading to an increased 2G/3G coverage and accelerated 4G coverage. Finally, the operators committed to provide, on a semi-annual base, detailed information about the development of the program with regard to forecasts. After analysis, Arcep considered that these evolutions were in line with its guidelines. An amendment in 2019 established the rules for the design, selection and deployment of new shared 2G/3G/4G sites in the geographical area of this	No.	

		agreement, in particular with a view to implementing their regulatory obligations arising from the “New Deal Mobile”. The network sharing arrangements initially provided for in the sharing agreement were applicable to these new sites and they remained unchanged for existing sites included in the scope of the agreement. In 2023, Arcep received three new amendments to the sharing agreement, under the terms of which it is provided in particular: - that network sharing, without frequency sharing, initially implemented for 2G, 3G and 4G technologies, is extended to 5G technology. The technical, operational and financial terms relating to the 5G operation of the shared network are specified; - that a further densification of the shared network is planned, with an increase in the number of new sites. The geographical scope remains constant. After analysis, Arcep concluded that it does not appear necessary to ask Bouygues Telecom and SFR to modify their contract. Arcep considered that the execution of this contract, as amended by the amendments, is not likely to hinder the achievement of the regulatory objectives provided for in Article L. 32-1 of the French postal and electronic communications code, relating in particular to the exercise of effective and fair competition for the benefit of users, the development of investment, innovation and competitiveness in the electronic communications sector, as well as the development and interest of the territories. In particular, the addition of 5G technology and the reassessment of the deployment objectives of new sites on the shared network contribute to meeting the quality of service needs linked to the evolution of mobile services and the coverage needs of new generation networks.		

	Digicel and Free Caraïbe	Digicel and Free Caraïbe signed a mobile network sharing contract in the Antilles and Guyana in February 2020, which was notified to Arcep. Through their joint company Madiacom, owner and operator of the common mobile radio network, the two operators plan the gradual implementation, envisaged over two years, of network pooling (RAN-sharing) across all territories, with temporary cross-sharing of their low frequencies (800 MHz and 900 MHz), as well as, in the meantime, the temporary reception of Free Caraïbe on Digicel's frequencies. Arcep published a press release in June 2020 to inform market players of the existence of the contract and called on them to provide any comments they may have. Following this call, Arcep received comments from Dauphin Telecom, Orange Caraïbe and Outremer Telecom, which were published. In December 2020, Digicel and Free Caraïbe notified Arcep of an amendment to their network sharing agreement. This amendment specified that the transitional phase of hosting Free Caraïbe on Digicel frequencies, which will end gradually by territory with the implementation of the RAN-Sharing solution, will end within a maximum of two years from the launch of this phase. However, the amendment provided that in the event of technical difficulties in the implementation of RAN-sharing, the parties may extend this period by a maximum of one additional year by means of an amendment to the contract. The amendment also specified the geographical scope of the cross-sharing of low frequencies and strengthened the parties' investment projects in French Guiana. Arcep informed the sector of this in a press release.	No.	

		After analysis, Arcep concluded that it does not appear necessary to ask Digicel and Free Caraïbe to modify their contract as amended by the amendment of December 16, 2020. Arcep considered that the execution of this contract, as amended, was not likely to hinder the achievement of the regulatory objectives provided for in Article L. 32-1 of the French postal and electronic communications code, in particular with regard to: - the transitional nature of the phase of hosting Free Caraïbe on Digicel frequencies, the planned trajectory of gradual extinction of this hosting by territory with the implementation of the RAN-sharing structural solution, the setting of a maximum deadline to complete this transition, and the criteria governing a possible extension of this phase by amendment; - the size and population of the territories concerned by network sharing (RAN-sharing), which do not require distinguishing between rural areas and dense areas in the implementation of RAN-sharing; - the Parties' low frequency portfolios and those of competing operators to date in the territories concerned by the temporary sharing of 800 MHz and 900 MHz frequencies, limited under the contract to the RAN-sharing implementation phase. Furthermore, Digicel and Free Caraïbe presented by letter to Arcep the ambition of their partnership in terms of improving the coverage and quality of mobile service in the territories for the benefit of users and committed to sending Arcep annual progress reports. Arcep is closely monitoring the gradual extinction by territory of the reception of Free Caraïbe on Digicel frequencies, as well as the progression of the benefits provided to users, in		

		particular in terms of coverage, by the shared network between Digicel and Free Caraïbe. Finally, Arcep will examine, if necessary, any possible amendment to this agreement, in light of the regulatory objectives.		
	Orange and Zeop Mobile	Zeop Mobile and Orange signed a roaming agreement in Reunion Island in 2017 as part of the launch of Zeop Mobile on the Reunion Island mobile market. This sharing agreement initially organized Zeop Mobile's roaming on Orange's 2G, 3G and 4G networks in Reunion Island for a period of three years, starting on April 1, 2019. Orange and Zeop Mobile then signed an amendment in July 2021 extending Zeop Mobile's roaming on Orange's 2G/3G/4G network (for voice, SMS, data services) in Reunion Island for three years (April 2022-March 2025) on the Orange network under the same technical conditions as the initial contract. After a call for comments from the sector and a thorough examination, Arcep concluded that it did not appear necessary to ask Zeop Mobile and Orange to modify the amendment extending their roaming contract until March 2025. It considered that the extension of voice, SMS and high-speed data roaming until March 2025 was not likely to hinder the achievement of the regulatory objectives set out in Article L. 32-1 of the French postal and electronic communications code, relating in particular to the exercise of effective and fair competition between operators for the benefit of users and the development of investment in the electronic communications sector, in particular with regard to: - Zeop Mobile's investment dynamics in its own network and the ongoing investment to offer voice and SMS services to its customers through its own 4G network;	No.	

		- the continued decline in proportion of Zeop Mobile's roaming data traffic since 2017 and the decline in voice, SMS and data traffic volumes provided for by the amendment over the three-year extension; - the market situation, in particular the level of coverage in the territory of the 4G networks of operators competing with Zeop Mobile, the provision by these operators of voice and SMS services through their historical 2G/3G networks or the current low penetration rate of voice and SMS compatible terminals on 4G on the Reunion market. Beyond March 2025, the amendment provides for the possibility for Zeop Mobile to request two successive one-year extensions of roaming for voice and SMS services and "possibly the remaining low-speed data linked to voice usage". These two possible successive extensions must each be the subject of an amendment. Arcep will examine, where appropriate, these amendments which will be notified to it in light of the regulatory objectives. The Authority will remain attentive to the continuation of Zeop Mobile's investments in the deployment of its own network.		
Germany	**Telefónica and 1&1 (expiring in 3Q 2024)**	In 2014 Telefónica merged with E-Plus (KPN). The merger was approved by EU COM (case number M.7018) with several remedies in 2014. Among other commitments, Telefónica committed to offer national roaming on its network to a new entrant. In 2019 1&1 acquired spectrum in the 5G auction. As part of the award proceedings, all affected license holders (Deutsche Telekom, Telefonica and Vodafone) were obliged to engage into negotiations on national roaming on request of 1&1. In 2021 Telefónica and 1&1 agreed on national roaming for 2G and 4G. In 2024 1&1 changed	No	
	Vodafone and 1&1 (from 3Q 2024)			

		its national roaming partner from Telefónica to Vodafone. This contract change was based on commercial negotiations between the companies (for 2G, 4G and 5G). In 2025 BNetzA secured the national roaming as part of the extension of usage rights in the 800 MHz, 1800 MHz and 2600 MHz bands. All affected license holders (Deutsche Telekom, Telefónica and Vodafone) are obliged engage into negotiations on national roaming on request of 1&1. As long a national roaming agreement consists with one of the existing MNOs, the obligation is fulfilled.		
	Telekom, Vodafone and Telefónica	In February 2020 Vodafone and Deutsche Telekom announced a plan to cooperate in areas where only one of the two partners offers LTE. It was a market-based approach to improve coverage in rural areas and along traffic routes. BNetzA and the German Federal Cartel Office did not agree to such bilateral cooperation because it could be discriminatory against competitors. After further negotiations between the operators the so called gray spot sharing agreement was opened to all competitors. In 2021 three bilateral agreements were reached between the nationwide network operators Deutsche Telekom, Telefónica and Vodafone. In these agreements, the operators mutually grant each other access to a similar number of several hundred base stations via MOCN. It was explicitly stated that 1&1 could also enter into such cooperation if it had its own network and suitable base stations.	No	
Greece	**Vodafone and Nova (ex Wind Hellas)**	In Greece, EETT examined, in 2013 (as the relevant competition authority of the market), the agreement of the 2 Greek mobile operators, namely VODAFONE and NOVA (ex. WIND), in order to create a subsidiary, called “VICTUS SA” (to deploy on 2G and 3G technology). Since then, the authority has examined 2 amendments	Please check information provided.	

		of this agreement upgrading it in 4G and 5G technology and issued 3 decisions in total, permitting the implementation of the agreement. The assessment of EETT, concluded that the agreement (and its amendments) did not infringe Art. 1 of Law 3959/11 and/or Art. 101 TFEU, as: It did not include anti-competitive clauses (restrictions for the 2 parties), the autonomy/independency of the 2 competitors (powers on independent exclusive sites, deployment in different technologies and different parts of the frequencies) was safeguarded, the parties had separate provision of retail services at the market, there was no core and no spectrum sharing, the parties had different deployment plans and also the agreement produced benefits (significant cost savings, better/quicker network deployment and coverage, quicker services in remote areas of Greece, **less environmental harm** and social benefits)		
Hungary	**Magyar Telekom and** **Yettel Hungary (previously Telenor)**	Magyar Telekom and Telenor Magyarország notified NMHH about an agreement to mutually and partially share spectrum with each other in the 800 MHz band for LTE nationally with exception of the capital Budapest in 2015. NMHH approved the lease as a secondary trading. NMHH stated that the agreement enabled both operators to offer a larger capacity and better technologies characteristics. Furthermore, NMHH examined whether the individual obligations that are linked to the individual licenses are fulfilled. Since NMHH has no competence to examine the competition law aspects of the lease agreement, NMHH sent its decision to the Hungarian Competition Authority for information purposes after the decision was made. In February 2015, the Hungarian Competition authority initiated proceedings with respect to that agreement. In January 2018, the Hungarian	No.	

		Competition authority held unannounced inspections at both parties of the cooperation in order to examine whether there was collusion during the tender in 2014. The Hungarian Competition Authority has terminated the competition procedure on 8.12.2023.		
Ireland	**Not applicable**	Not applicable		
Italy	**Wind Tre and Iliad**	In 2016 the Italian mobile market has been interested by the Wind/H3G Merger case M.7758 as approved by the Commission decision of September 1st, 2016. As far as it concerns RAN sharing option and 3G/4G MOCN services among the new merged entity (Wind Tre) and the new MNO Iliad, these are included in the MNO Final Commitment, as approved by the Commission. As for the trading of the rights of use of frequencies involved in the merger, AGCOM adopted the Decision n. 430/16/CONS concerning its opinion to the Ministry.		
	Wind Tre and Fastweb	In June 2019, Fastweb and Wind Tre announced an agreement leveraging on the operators' respective assets aimed at the roll-out of a nationwide shared 5G network supporting next-generation mobile services. The shared 5G network will include Wind Tre and Fastweb macro and small cells, connected through dark fiber from Fastweb, to be deployed nationwide, with a targeted coverage of 90% of the population by 2026. Wind Tre will manage the 5G network, while both operators will remain independent in the commercial and operational use of the shared infrastructure. As part of the agreement, Wind Tre will provide Fastweb with roaming services on Wind Tre’s existing network (4G and legacy technologies), thus allowing Fastweb to extend its mobile coverage to national level, while Fastweb will provide Wind Tre		

		wholesale access to Fastweb's FTTH and FTTC network. The agreement has an initial duration of ten years and was approved by the competent authorities (Ministry/AGCOM). In 2024, this agreement was extended in terms of shared frequencies only in the Province of Bolzano, always with the authorization of the competent authorities.		
	TIM and Vodafone	In July 2019, TIM and Vodafone signed agreements for the expansion of their existing passive sharing agreement and for an active mobile network sharing partnership to jointly roll-out 5G infrastructure (including the active sharing of their existing 4G networks to facilitate 5G active sharing), allowing more efficient deployment of the new technology over a wider geographic area and at a lower cost. TIM and Vodafone will combine their respective passive networks within the tower operator INWIT, creating the Italy's biggest tower company and the second largest in Europe, with more than 22,000 towers. The proposed acquisition of joint control over INWIT by Telecom Italia and Vodafone was approved by the European Commission, under the EU Merger Regulation, conditionally on compliance with a commitments package offered by the two operators.		
	Wind Tre and Iliad to form the joint venture Zefiro Net	In 2022 Iliad and Wind Tre created Zefiro Net S.r.l., a joint venture (JV) with 50% share capital, established to share and manage together their mobile networks (RAN Sharing Agreement) in less populated areas of Italy (the so-called JV Area). Zefiro Net has the responsibility for the technical management - on behalf of the two partners - of the RAN, the physical infrastructure that allows the provision of mobile radio services in MOCN (Multi Operator core Network) mode, acting as MVNE (Mobile Virtual Network Enabler), in the JV Area). The two operators agreed to work synergistically to accelerate		

		the diffusion of mobile networks, including 5G networks, with significant benefits in terms of the availability of ultra-broadband services for the inhabitants of the areas in which the JV operates. Wind Tre and Iliad share most of their frequency bands by means of the JV. The agreement was approved by the competent authorities (Ministry/AGCOM). As for AGCOM, the decision n. 284/22/CONS considered the opinion of the Competition Authority on competition issues, according to the Code. In 2024, this agreement was extended in terms of shared frequencies only in the Province of Bolzano, always with the authorization of the competent authorities.		
Latvia	**Tele2, BITE Latvija and UNISTARS**	In 2020 a joint venture company Centuria was created with intention to share RAN and all spectrum between Tele2 and BITE Latvija (second and third mobile operators in Latvia) as well as UNISTARS (small operator within BITE group that has rights to use 3.5 GHz). In March 2021 SPRK adopted the final decision to allow RAN sharing and part of spectrum sharing (not all). However, both sides afterwards took a decision to suspend the project and Centuria ceased to exist in May 2022.	Yes, overall environmental considerations (data provided by operators) were assessed, i.e., benefits vs weaker competition	
	BITE Latvija and UNISTARS	MOCN sharing between BITE Latvija and UNISTARS. Even though both operators are within the same group, the national legislation did not allow to use the spectrum that is assigned to another operator without any competition assessment and decision taken. That is the reason why the assessment and decision was necessary (the final decision was adopted by SPRK in February 2023). Right now, the intention is to merge them and transfer the rights of use of 3.5GHz to BITE Latvija, which means that the decision to share RAN and spectrum (3.5 GHz	Yes, overall environmental considerations (data provided by operators) were assessed	

		and 1.8 GHz) will cease to exist as soon as SPRK adopts a new decision after ongoing national consultation.		
Lithuania	**No active sharing agreement**	Not applicable		
Luxembourg	**No active sharing agreement**	Not applicable		
Malta	**GO p.l.c and Melita Ltd .**	Considering the small geographic area of Malta, there are no major co-location sharing agreements in place between the major fixed network operators. All fixed network operators, however, do have commercial colocation reference offers in place. Duct infrastructure sharing agreements are in place between the fixed network operators. The percentage of shared duct access is only in the region of between 5 and 7% of all duct infrastructure, which are primarily established on the principles of income and reciprocity amongst operators.		
Netherlands	**No active sharing agreement**	Not applicable		
North Macedonia	**No active sharing agreement**	Not applicable		

Norway	**Telenor and Lyse**	Telenor has been designated as having Significant Market Power in the national wholesale mobile access market (former M15). One of the obligations imposed on Telenor is to provide national roaming access as a competition remedy. The third mobile network operator, Lyse Tele, has entered into a national roaming agreement with Telenor based on this obligation.		According to the Norwegian electronic communications act, Nkom may require a provider of an electronic communications network or associated facility, who is entitled to expropriate, to grant another provider without such a right access to co-location or shared use of network elements and associated facilities in order to protect the environment. Further, it is stated that the Ministry may issue regulations on co-location for providers.
Poland	**Orange Polska and T-Mobile Polska**	By the decision of the Polish NCA taken on 16 March 2011, Polska Telefonia Cyfrowa (currently T-Mobile Polska) and Polska Telefonia Komórkowa – Centertel (currently Orange Polska) obtained consent to establish a joint venture company responsible for managing the radio access networks of both operators (RAN sharing agreement). After conducting the antitrust proceedings, the NCA found that the concentration will not lead to a significant restriction of competition. The NCA did not justified its decision as it took into account entirely the parties' request, did not resolve the parties' conflicting interests, was also not issued on appeal.	Not to our knowledge	

Portugal	**NOS and Vodafone**	In October 2020, NOS and Vodafone signed a nationwide agreement for the active radio access network (RAN) sharing of mobile infrastructure, excluding spectrum, mainly in regions of low population density. https://www.vodafone.pt/en/press-releases/2020/10/vodafone-portugal-and-nos-sign-a-historic-agreement-for-sharing-infrastructure-and-mobile-network-development.html		
Romania	**Vodafone Romania, Orange Romania DIGI Romania, Telekom Romania Mobile Communications**	In the context of its current evaluation regarding the takeover of Telekom Romania Mobile Communications S.A. by Vodafone Romania S.A. and of some of the company's assets by DIGI Romania S.A., the Competition Council is looking into all forms of network sharing, passive and active. (NB - there is significant degree of passive infrastructure sharing between MNOs in Romania).	No	In addition: 1. Orange and Vodafone deployed a shared pilot network based on open RAN in a rural area of Romania, near Bucharest, with the first 4G calls over the shared network taking place in October 2023. In May 2024, the shared pilot network was extended to cover a greater number of rural areas and include 2G virtualised RAN (vRAN) technology. 2. It would be worth looking into the impact of spectrum sharing and pooling on environmental sustainability. These tools are mandated by the EECC for other

				reasons, but may exhibit positive effects on sustainability. ANCOM Decision nr 687/2023 permits spectrum sharing and pooling, subject to prior approval.
Slovakia	**Orange Slovensko and Swan (4ka).**	In July 2023, SWAN (4ka) and Orange Slovensko concluded an agreement on the provision of national roaming.	Not applicable. Environmental considerations are not within the competence of RU.	
	Slovak Telekom and O2 Slovakia	In August 2023, O2 Slovakia and Slovak Telekom concluded an agreement on sharing mobile network technology. They are currently continuing the network sharing project and gradually adding more localities.	Not applicable. Environmental considerations are not within the competence of RU.	
Spain	**Yoigo and Telefonica**	In 2013, Yoigo and Telefonica agreed on a reciprocal national roaming. Yoigo provided Telefonica with national roaming services for 4G, whereas Yoigo received national roaming services in order to increase its coverage. The relevant background for Yoigo is that it only had spectrum in 1800 MHz bands and above and had problems in providing coverage nationally. The relevant background for Telefonica is that the reciprocal		

		sharing agreement enabled Telefonica to delay its own 4G rollout. In July 2015, CNMC declared so provisions of these agreements null and void and fined Telefonica €6 million and Yoigo €300,000. Especially the rollout delay of Telefonica and by compensation offering national roaming to Yoigo was found to be restrictive of competition. No efficiencies that would justify such a restriction were found. Yoigo plans to migrate its reliance on roaming from Telefonica's network into Orange's network from 2019. Nevertheless, despite this particular case where some risks were identified and addressed, the overall impact of infrastructure sharing agreements in Spain has been positive.		
	Telefónica and Digi	In 2024, Telefónica and Digi agreed on a long-term national roaming and RAN sharing agreement. Digi, an MVNO transitioning to an MNO, will utilize Telefónica's network to maintain coverage while deploying its own network using the 60 MHz spectrum acquired from MásOrange, with the agreement enhancing Digi's cost efficiency and coverage. The relevant background for Digi is its rapid growth as a low-cost operator and its need for a stable transition period to become an MNO.		
	Vodafone and Orange	In 2012, Vodafone and Orange agreed on a reciprocal national roaming and RAN sharing deal, covering 2G, 3G, and 4G services to improve network coverage and reduce deployment costs, generally targeting populations with fewer than 175,000 inhabitants. The agreement is expected to be extended to support 5G rollout, potentially covering more populations in the future.		

	Mas Movil and Orange	In 2024, MásMóvil and Orange, as part of their merger into MásOrange, agreed on a network integration plan to consolidate their operations. The fusion was approved by the European Commission in February 2024, which required ceding 60 MHz of spectrum to Digi and allowed MásOrange to unify more than 6.5 million FTTH lines and 25 million mobile lines, as reported by the CNMC's 2023 annual data.		
Sweden	**Telia and Tele2**	Telia and Tele2 are phasing out cooperation.	Environmental consideration was not taken into account.	Telia and Tele2 have the collaboration SUNAB with spectrum in 900 MHz and 2100 MHz around 3G technology. They will end the cooperation and are phasing out as we speak (their license expire in 2025-12-31).
	Telenor and Hi3G	Telenor and Hi3G are phasing out cooperation.	Environmental consideration was not taken into account.	Then we have 3GIS with Telenor and Three, they are having 3G-cooperation in the company 3GIS. They are also phasing out cooperation, but are just saying that their license expire in 2025-12-31.
	Telenor and Tele2	PTS approved the transfer of 900 MHz and 2600 MHz from Tele2 and Telenor to N4M. A complaint was filed with respect to the deepened cooperation between Tele2 and Telenor restricting competition within the meaning of Article 101 TFEU and its national equivalent. The main argument was that a high concentration of spectrum would give Telenor and Tele2 the possibility to offer more	Environmental consideration was not taken into account.	Net4Mobility is jointly owned by Telenor and Tele2. They share network and spectrum. The two mobile operators Telenor and Tele2 has responsibility

		advanced services (higher speed), and therefore a competitive advantage over other mobile operators. The Swedish Competition Authority did not undertake any action following the analysis of the complaint.		of two large areas each where they are responsible for operating the network. There are also some jointly owned spectrum and networks regarding 3G that will expire in 2025-12-31. Telia and Tele2 have the collaboration SUNAB with spectrum in 900 MHz and 2100 MHz around 3G technology. They will end the cooperation and are phasing out as we speak. Then we have 3GIS with Telenor and Three, they are having 3G-cooperation in the company 3GIS. They are also phasing out cooperation I think but are just saying that their license expire in 2025-12-31. Maybe that is not of equal interest as the

				cooperation in Net4Mobility which is still strong and ongoing.
Montenegro	**No active sharing agreement**	Only passive site sharing in place, based on commercial agreements among the MNOs. 65% of antenna masts and 31% of buildings are shared between at least 2 MNOs. Ducts sharing is imposed by regulator to the ex-incumbent and approximately 10% of total duct lengths are shared based on conditions set in colocation reference offer.		

Glossary

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

Passive sharing: a common use by two or more operators of passive elements of their respective networks. Passive elements are those which are not able to process or convert telecommunication signals in any way and which are not integrated parts of the system dedicated specifically to the conveyance of signals. Passive elements are sometimes referred to as 'unpowered components' as these elements usually do not require a power supply. This is however not always the case. For instance, air conditioning for cooling equipment might be considered a passive element, but usually requires an external power supply. Passive sharing can encompass the sharing of passive backhaul elements. Co-location is a form of passive sharing where the operators share the same location (such as compound, base station sites, rooftops, etc.) for the construction of the base stations. It could be limited to a common access to the location. It could also include the use of common masts and other mounting/supporting constructions or cabinets including related installations (such as air conditioning, power supply etc.).

Site sharing: a form of co-location where two or more operators agree to deploy their masts or other supporting constructions in the same location. Typically, each operator provides own mast, backhaul, cabinets and active equipment. Mast sharing is a form of co-location where two or more operators agree to use the same mast or other supporting construction. Generally, each operator provides own backhaul, cabinets and active equipment.

Active sharing: a common use by two or more operators of active elements in the radio access network of their respective networks, such as antennas and radio network controllers (RNC). Active elements are those which are able to generate, process, amplify and control signals. National roaming is a form of active sharing. Examples of active elements are very diverse and include many different types of electronic equipment (hardware and software) capable of various functions (transmitters, receivers, amplifiers, decoders etc.). While antennas have been traditionally classified as passive elements, technology advance has led to a paradigm shift to active antenna systems (AAS), which are considered a key enabler for 5G networks. Such antennas (or antenna arrays) can also be considered as active when equipped with radio frequency units such as amplifiers and signal processing elements. Furthermore, 5G, including virtualization technology, may enable new forms of network sharing, in particular for building common network slices tailored to specific services.

RAN sharing: a form of active sharing where two or more operators agree to use the same access network equipment, including base station active equipment and possibly the antenna. Each operator uses its own core network. This type of active sharing itself can typically be split into two types, depending on whether operators share the same spectrum or not:

- Multi-Operator Radio Access Network (MORAN) sharing is a form of RAN sharing where only equipment is shared (i.e. not spectrum). The end-users of each operator access the services of their respective MNO with the frequencies of their respective MNO.

- Multi Operator Core Network (MOCN) sharing is a form of RAN sharing where all elements of the radio access network, including spectrum, are shared. The end-users of each operator can access the services of their respective MNO through all the frequencies that are shared in the access network. The frequencies can be provided by one or several operators that are part of the sharing. When the frequencies of several operators are used, it is called MOCN with frequency (or spectrum) pooling.

National/local roaming: a form of active sharing where one operator uses the mobile service of another operator within the same country for the purpose of providing services to its end users.

Core Network sharing: a form of sharing where operators agree to share elements of their core network, either on a standalone basis or in addition to sharing elements of their access network(s). Core network sharing can be limited to data transmission ring which connects the core network components and can extend to components themselves (such as switching centre with HLR, billing platforms and value-added services (VAS))

Backhaul sharing: a form of sharing where one or more operators share backhaul elements. It is a form of passive sharing when the shared elements are passive, for example ducts and poles. It is a form of active sharing when it is the common use of network components for data transmission.

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

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

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

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

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