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IMPACT ASSESSMENT REPORT

Accompanying the document

Proposal for a Regulation

of the European Parliament and of the Council on measures to reduce the cost of deploying gigabit electronic communications networks and repealing Directive 2014/61/EU (Gigabit Infrastructure Act)

{COM(2023) 94 final} - {SEC(2023) 96 final} - {SWD(2023) 47 final}

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Glossary

Term or acronym	Meaning or definition
ADSL/VDSL	Asymmetric Digital Subscriber Line / Very high-bit-rate Digital Subscriber Line
ARPU	Average Revenue per User
BCRD	Broadband Cost Reduction Directive
BEREC	Board of European Regulators for Electronic Communications
CAM	Connected and Automated Mobility
CAPEX	Capital Expenditure
CO2e	Carbon dioxide equivalent
CEF	Connected Europe Facility
DESI	Digital Economy and Society Index
DOCSIS	Data Over Cable Service Interface Specification
DSB	Dispute Settlement Body
ECN	Electronic Communications Networks
EECC	European Electronic Communications Code
eMBB	enhanced Mobile Broadband
FTTH/B	Fibre To the Home/Building
FTTC	Fibre to the Cabinet
FWA	Fixed Wireless Access
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GPON	Gigabit passive optical network
HVT	High-Value Target
ICT	Information and communications technology

IoT	Internet of Things
ISSG	Inter-service Steering Group
KPI	Key Performance Indicator
LCA	Life Cycle Assessment
LTE	Long Term Evolution (*a mobile technology*)
NBP	National Broadband Plans
NGA	Next Generation Access
NRA	National Regulatory Authority
NUTS	Nomenclature of Territorial Units for Statistics
P2P	Point to Point
P2MP	Point to Multipoint
REFIT	Regulatory Fitness and Performance Programme
SAWAP	Small-area wireless access point
SIP	Single Information Point
SMP	Significant Market Power
WACC	Weighted Average Cost of Capital
VHCN	Very High Capacity Network
5G	Next generation (5th) of wireless/mobile technologies

1. INTRODUCTION: POLITICAL AND LEGAL CONTEXT

The present Impact Assessment accompanies the legislative proposal for a revised legal instrument following the review of the Broadband Cost Reduction Directive ('BCRD' or 'the Directive')[1] adopted on 15 May 2014. The revision was announced in the 2020 Communication on 'Shaping Europe's Digital Future'[2], which mentions that for digital infrastructure and networks alone, the EU has an investment gap of EUR 65 billion per year[3].

This is a REFIT[4] initiative. The current Directive does not include a review clause, but a review at this time is justified by the partial effectiveness and efficiency of the current Directive to achieve its original objectives, the market and technological changes occurred since 2014 and the increased need for very high capacity fixed and mobile connectivity from businesses and citizens and the need to ensure that by 2030 the Union achieves Gigabit coverage to all EU households and 5G in all populated areas on time and with the minimum possible cost for private and public actors. Given the necessary procedures of adoption and transposition as well as transition measures, and the time required to plan and execute investments, a review at a later stage would not be able to contribute to the 2030 connectivity targets.

The roll-out of high-speed fixed and mobile electronic communications networks across the Union requires substantial investments. The BCRD aimed to facilitate and incentivise the rollout of these networks by lowering the costs of deployment with a set of minimum harmonised requirements relating to civil works coordination and access to physical infrastructure, in order to exploit synergies across sectors and re-use existing physical infrastructure. *Ceteris paribus* this should make broadband roll-out more effective and reduce the social and environmental costs linked to them, such as pollution and nuisances.

Indeed, a major part of those costs can be attributed to inefficiencies in the roll-out process related to the use of existing passive infrastructure (such as ducts, conduits, manholes, cabinets, poles, masts, antenna installations, towers and other supporting constructions), bottlenecks related to coordination of civil works, burdensome administrative permit granting procedures, and bottlenecks concerning in-building deployment of physical infrastructure. These inefficiencies lead to higher costs for deployments, in particular in rural areas, but not only.

The BCRD builds on measures already deployed by (only) some Member States across the Union to contribute to the establishment of a digital single market. To do so, it provides for rights and obligations on network operators (meaning providers of public electronic communications networks ('electronic communications operators' or 'ECN operators') and undertakings providing a physical infrastructure for gas, electricity, heating and water (except for drinking water) production, transport or distribution services or for transport services). It lays down rights for ECN operators to access existing physical infrastructure irrespective of its location under fair and reasonable terms,

[1] 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 (BCRD), OJ L 155, 23.5.2014, p. 1–14.
[2]https://ec.europa.eu/info/sites/default/files/communication-shaping-europes-digital-future-feb2020_en_4.pdf.
[3]. There is a considerable consensus among market analysts, putting the figure on the investments needed for the European Gigabit Society interim targets (by 2025) in the range of EUR 345 to 360 billion for the EU-27, with about 1/3 of this figure potentially coming from already expected private funding, and therefore leaving an investment gap of about EUR 250 billion. See: Ferrandis-et-al.pdf (econstor.eu)" (See Staff Working Document accompanying the Path to the Digital Decade (SWD (2021) 247 final, 15.9.2021), p. 25). The investment need to reach the 2030 Digital Decade targets will be significantly higher.
[4] https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/12463-High-speed-broadband-in-the-EU-review-of-rules_en

without prejudice to the rights of the owner of the land or of the building in which the infrastructure is located.

The BCRD should have been implemented by January 2016. The 2018 Commission's report on the implementation of the BCRD revealed a late and inconsistent implementation across the EU and persisting inefficiencies, hindering the potential impact of cost reduction measures to foster a more efficient and faster deployment of electronic communications networks across the EU. As shown in the evaluation report (Annex 7), at present the Directive's objectives have only partially been achieved.

The review aims to address persistent obstacles to the deployment of fixed and mobile electronic communications networks, notably VHC networks, in particular by reducing deployment costs and time. Stakeholders, Member States, and experts consistently acknowledge that these problems persist despite the implementation of the BCRD and the other instruments within the electronic communications framework that contribute to facilitate network deployments as well as the more recent Connectivity Toolbox consisting of Member States best practices in the area of cost reduction (see section 1.2). The cost of civil works to deploy the physical infrastructure to host electronic communications networks constitutes a significant portion (which could be up to 80%[5]) of the overall cost of deploying high-speed broadband infrastructure.

While within the same scope overall, the review will ensure the alignment with new EU connectivity ambitions, focusing on incentivising gigabit speeds, and facilitating timely and less costly very high capacity networks ('VHCN') deployment, including fibre and 5G, with significant attention to EU environmental targets.

1.1. Political context

As the BCRD, the proposed review only addresses one – albeit extremely important – factor in VHCN roll-out, i.e. the **cost of building networks**. Hence, it can *contribute* to accelerating the deployment, but not in itself guarantee the achievement of the 2030 Gigabit connectivity targets, even in the best of cases.

On an aggregate level VHCN deployment depends first of all on **a number of exogenous factors**, such as the **pre-existing legacy infrastructures** which can partially substitute VHC networks. For example, in some Member States existing cable networks were upgraded with DOCSIS 3.0 and 3.1 to reach NGA bandwidths; in other Member States there were no such cable networks in place. Equally, there are considerable **differences in costs for rolling out networks depending on the geographic characteristics of the areas** (mountains, islands, remote areas) and the different population density levels that lead to different cost and levels of profitability, the **competitive market situation**, the **demand by consumers and business** (influenced by e.g. digital skills levels of the population) and the take-up of services (which for example is much higher in northern Member States) or, finally, **housing settlement patterns** (single-family housing vs. apartment blocks). Moreover, heritage preservation legislation in historic cities or other restrictive local urbanistic rules can make deployment very onerous even in areas which in theory are well-suited for very profitable roll-out, such as urban areas[6]. As a result, network roll-out should not be expected to be identical across Member States, even if all Member States pursued identical policies.

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[5] ICF, WIK & EcoAct study, section 2.1

[6] See Decision JV Inuit (TIM/Vodafone), March 2020; http://eur-lex.europa.eu/homepage.html?locale=en, Case M.9674,

In addition, VHCN deployment is affected by **national policies** that follow the EU pro-competitive regulatory framework for electronic communications but are shaped to local, regional and national future connectivity needs. **Subsidies through Member States' national broadband plans** ('NBPs') aim to make broadband coverage available across a country/region by focusing on areas where VHCN deployments are otherwise deemed not to be economically viable; solutions proposed for NBP projects have predominantly focused on fibre solutions. In the future, Member States will also pursue policies in the framework of the proposal for a Digital Decade policy programme[7] once it enters into force that will stimulate demand, for example by improving citizens' digital skills and offering eGovernment solutions.

Against this background of different starting situations and similar but not identical policies, the key factors for electronic communications networks operators are the **expected return on investment of** VHCN, which is basically the difference between expected revenues and deployment cost, and the possibility to **raise the necessary financing,** which depends *inter alia* on the type and size of the project. Thus, a **reduction in deployment costs will** inevitably make investments more likely to be profitable and hence, in a competitive environment, i**ncrease VHCN deployment prospects**. **This effect holds independently of all the other factors mentioned above**. One should also note that for both profitability and the raising of finance, **long-term regulatory certainty** is of paramount importance, as changes in the legal rules can have an immediate effect of costs, revenues and cash flow.

However, the Evaluation report (see Annex 8) has shown that the BCRD has not been fully effective in reducing costs of broadband networks deployments and thereby contributing to full network coverage in all Member States. It is true that a**ll measures currently included in the BCRD have proven important and relevant to reduce the cost of deployment of electronic communications networks**, including regarding access and coordination with other utilities and transport networks.

Nevertheless, the minimum harmonisation nature of the Directive, with many voluntary provisions as well as considerable scope for exclusions or exemptions, has led to its **non-homogeneous implementation**. On the one hand, some Member States implemented the Directive in a minimum fashion[8]. On the other hand, some Member States went beyond the provisions of the Directive[9].

Some provisions have been more intensively applied than others (e.g. provisions on transparency of existing infrastructure and access to it are more used than provisions on coordination of civil works) and outcomes are variable. One of the lessons learnt from the evaluation of the

[7] COM(2021) 574. The proposal is accompanied by a Staff Working Document SWD(2021) 247, which explains the rationale behind the choice of the targets.

[8] For example, the Single Information Points (SIPs) on civil works co-ordination contain for the most part only the minimum information and typically do not require operators to notify planned works proactively. Moreover, about half of the Member States have introduced exemptions for civil works of insignificant value or for critical national infrastructure. Furthermore, in most Member States the transposition of access to in-building infrastructure provisions of the Directive has not gone beyond the minimum requirements of the Directive.

[9] Section 3.2 of the Evaluation report shows that in about one fifth of Member States the SIP contains more contextual information like maps and in about one third of Member States the SIPs also provide information on planned civil works that network operators proactively made available. These include Member States where civil works co-ordination is in more widespread use. Some Member States adopted pricing methodologies for access to physical infrastructure (in legislation or guidelines), obligations of reference offers and access to assets owned by non-network operators (e.g. municipalities) or access to non-network elements (e.g. public buildings, street furniture). Some Member States also established rules for cost sharing or procedures for civil works coordination. About half of Member States have extended obligations to meet requests for co-ordination of civil works to privately financed network operators (in such cases the exemptions are also applied to both publicly and privately financed civil works).

implementation of the current Directive is that more clarity or guidance on some provisions of the Directive as well as enhanced, fully digitized information platforms/SIPs, including for permit granting, could significantly reduce the administrative burden associated with network rollout. This shows considerable scope to refocus and improve the Directive. Similarly, the Fit for Future Platform notes that there is still room for improvement in some Member States[10].

At the same time, demand for bandwidth from households and businesses is increasing rapidly across the EU[11]. Modelling of expected bandwidth requirements in the near future (i.e. to 2025) by the Commission's external consultants, ICF, WIK & EcoAct study (the 'ICF, WIK & EcoAct study' or the 'support study') , suggests that a significant proportion of end-users will require downstream bandwidths of at least 1Gbit/s and upstream bandwidths of 600Mbit/s or more in the home[12]. In practice, supporting bandwidths of this level upgradable for future needs is likely to require the widespread deployment of Fibre to the Home (FTTH) technology[13], or 5G Fixed Wireless Access (FWA) in areas where FTTH is not economically viable.

An FTTH connection consists of optical fibre all the way to the consumer plug in the wall. A FWA technology consists of fibre until a relay station close to the customer premises and a wireless connection from there to the customer.

In addition, **demand by consumers and business** for fast and ubiquitous connectivity has unexpectedly but considerably increased by the drastic confinement measures taken during the acute phase of the COVID pandemic. They forced an unprecedented number of people to resort to their home internet access for work, education and leisure. Digital technologies and robust infrastructure are now imperative for accessing everything from health services to culture, in big cities as well as in rural areas. This resulted in a sharp increase of network traffic, driven primarily by video-related services. According to ETNO, up to 50% increase in voice traffic, up to 40% increase in mobile data traffic, and up to 70% in fixed data traffic were observed. According to OECD[14], in the wake of the COVID-19 pandemic bandwidth consumption increased by up to 60%, as a result of practices such as home working.

In response to these developments, the 'Communication on a 2030 Digital Compass: the European way for the Digital Decade'[15] and the Decision on the 2030 Policy Programme 'Path to the Digital

[10] Fit for Future Platform Opinion 2022/SBGR1/01 of 5 December 2022
[11] Annual increases in bandwidth consumption of 22% in Western Europe and 26% in Central and Eastern Europe were reported by Cisco even prior to the COVID pandemic (See https://www.ieee802.org/3/ad_hoc/bwa2/public/calls/19_0624/nowell_bwa_01_190624.pdf). Moreover, since the Broadband Cost Reduction Directive's adoption in 2014, there have been a number of technological, market and regulatory developments (e.g. broadband services with higher speeds, the start of roll-out of the fifth mobile generation – the so-called 5G, a higher number of interconnected devices in the 'Internet of Things').
[12] These levels of bandwidth demand may even be an under-estimate in view of the step-change in 'tele-working' practices that were triggered by the COVID-19 pandemic (https://ec.europa.eu/jrc/sites/jrcsh/files/jrc120945_policy_brief_-_covid_and_telework_final.pdf). These practices are estimated to have contributed to an increase of 30-60% in fixed broadband traffic during lockdown periods, some of which may outlive the pandemic (See https://www.nokia.com/blog/redoing-the-math-the-impact-of-covid-19-on-broadband-networks/).
[13] Docsis 3.1 is capable of Gigabit download speeds, but is associated with asymmetric bandwidths, which is less suited to cloud-based and home working applications. Further upgrades towards Docsis 4.0 and support for symmetric bandwidths will require significant additional deployment of fibre.
[14] https://www.oecd.org/coronavirus/policy-responses/keeping-the-internet-up-and-running-in-times-of-crisis-4017c4c9
[15] COM(2021) 118.

Decade'[16] established new EU connectivity goals: by 2030 all European households should be covered by a Gigabit network, with all populated areas covered by 5G. The ambition is that "nobody should be left behind", and the population living and the businesses operating in rural should have the same opportunities as their counterparts in urban areas. It also reflects the above-mentioned new needs resulting from the COVID pandemic and the increased reliance of society and businesses on advanced digital secured connectivity.

The Council Conclusions on Shaping Europe's Digital Future of 9 June 2020 stress that the COVID pandemic has demonstrated the need for fast and ubiquitous connectivity. This situation calls on Member States, in close cooperation with the Commission, to develop a set of best practices to reduce the costs of network deployment and facilitate the roll-out of very high capacity infrastructures, including fibre and 5G[17]. Last but not least, the climate targets of the European Green Deal, enshrined into Europe's first Climate Law by the Council and Parliament in June 2021[18], require the highest possible resource efficiency.

1.2. Legal context

The Broadband Cost Reduction Directive is part of the regulatory framework for electronic communications. It lays down some minimum rights and obligations applicable to the use of existing infrastructure (and related provision of relevant information), the speeding up of permit granting procedures, and pre-equipment and access to in-building physical infrastructure for new and majorly renovated buildings.

Contrary to other instruments supporting the achievement of EU fixed and mobile broadband targets (i.e. the European Electronic Communications Code – EECC or the Code[19]) which mainly, save in specific cases[20], provide for the possibility to impose obligations on electronic communications operators with a dominant position - significant market power (SMP[21]) - in a given electronic communication market, the BCRD imposes obligations of access, transparency and civil works coordination on any undertaking operating an electronic communications network or providing physical infrastructure in the provision, distribution or transport of gas, water and sewerage and transport, irrespectively of whether they hold SMP. Moreover, whereas other instruments provide for the possibility to impose obligations for any element of an electronic communications networks, including passive elements (e.g. ducts, masts, poles, antennas, cables) and active elements (e.g. base stations, routers, switches), the BCRD only covers passive *physical* infrastructure (ducts, masts and poles but not antennas or cables). Moreover, whilst Article 57 of the EECC aims to ease conditions for the deployment of 'Small Area Wireless Access Points' (SAWAPs or small cells)[22] that are active elements of a wireless / mobile network, it does not cover the deployment of other types of cells that can be crucial to the deployment of 5G networks.

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[16] Decision (EU) 2022/2481 of the European Parliament and of the Council of 14 December 2022 establishing the Digital Decade Policy Programme 2030, OJ L 323, 19.12.2022.
[17] Council Conclusions on Shaping Europe's Digital Future, 9 June 2020, 8711/20. This call resulted in the adoption of a Commission Recommendation on a Connectivity Toolbox (see more in legal context).
[18] https://data.consilium.europa.eu/doc/document/PE-27-2021-INIT/en/pdf
[19] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L1972
[20] See for example Article 61(3) EECC.
[21] In addition, the Commission Recommendation on Relevant Markets susceptible to *ex ante* regulation (https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32020H2245), the Recommendation of 20 September 2010 on regulated access to Next Generation Access Networks (NGA) and Recommendation of 11 September 2013 on consistent non-discrimination obligations and costing methodologies complement the SMP framework.
[22] Definition (23) of the EECC

Provisions relating to the assignment of spectrum for 5G[23] and the new digital decade 5G targets require from Member States the timely availability of specific harmonized 5G pioneer bands, namely the 700 MHz, the 3.6 GHz and the 26 GHz bands, for the development of 5G networks. This entails the rollout of the necessary wireless / mobile infrastructure, in particular the deployment of Small-area wireless access points (SAWAPs or small cells), and therefore requires the facilitation of their installations. The BCRD is complementary to these provisions in the sense that it concerns the physical infrastructure needed, *inter alia*, for the backhaul connection of the base stations (including small cells) to the core network via fibre, which will ensure the necessary high capacity for the provision of 5G services and will contribute significantly, by reducing their wireless connections to the core network, to the reduction of exposure of the general public to electromagnetic fields (EMF)[24].

In September 2020, the framework was complemented by a Recommendation on a Connectivity Toolbox[25] aimed at reducing the cost of deployment of Very High Capacity Networks (VHCN)[26] and ensuring timely access to 5G radio spectrum. The subsequent 'Connectivity Toolbox'[27] agreed by Member States in March 2021 includes 22 best practices related to network cost reduction[28]. The best practices cover some of the areas currently included in the BCRD, notably those regarding permits, access to physical infrastructure and transparency related measures and dispute resolution, which were considered the most critical in the short term. However, there are other areas, such as coordination of civil works (except for transparency aspects) and in-building physical infrastructure, which are not covered by the Connectivity Toolbox, thereby leading to limitations in terms of its overall potential. Moreover, the 'Connectivity Toolbox' is not a binding legal instrument, and its implementation is left to Member States' initiative.

Between April and November 2021, Member States submitted their roadmaps providing plans to implement the Connectivity Toolbox. Overall, there was wide variety of roadmaps both in terms of content and format and some were lacking sufficient details, which have made it difficult to grasp the reality of such plans. Despite some good examples, **in most cases the roadmaps only**

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[23] Article 54 of EECC.

[24] The Council of the European Union adopted in 1999, pursuant to Article 168 of the TFEU, Recommendation 1999/519/EC on the EMF limits to be applied by the Member States for protecting public health, which entails limitations for the emitted power of radio base stations. Those limits set out in the annex of the Recommendation follow a precautionary approach in line with the International Commission of Non-Ionising Radio Protection (ICNIRP) guidelines of 1998. The ICNIRP guidelines have been slightly modified in March 2020 in order to take into account the latest 5G technology evolution. As a result, the Commission mandated in June 2021 the Scientific Committee on Health, Environmental and Emerging Risks (SCHEER) to provide an opinion on the need for a technical revision of the annexes to the Council Recommendation for the frequency range 100 kHz to 300 GHz. This opinion will be delivered in 2022.

[25] The Recommendation responds to a call for swift adoption and implementation of measures to accelerate the deployment of very high capacity networks and encourages Member States to adopt best practices concerning processes for permit applications and rights of way, and to expand measures to enhance transparency regarding existing and planned network infrastructure and enable the re-use of existing physical infrastructure to cover all physical infrastructure capable of hosting VHCN that is controlled by public bodies. https://digital-strategy.ec.europa.eu/en/library/commission-recommendation-common-union-toolbox-reducing-cost-deploying-very-high-capacity-networks.

[26] VHCN refers to fully optical networks up to the distribution point at the serving location (for example, the basement of a multi dwelling building) or networks capable of delivering similar network performance, see article 2(1) EECC.

[27] https://digital-strategy.ec.europa.eu/en/news/connectivity-toolbox-member-states-agree-best-practices- boost-timely-deployment-5g-and-fibre

[28] The Connectivity Toolbox also includes best practice 39 on informing the general public about the compliance of radio base stations installation with the applicable EMF standards.

proposed to implement a limited number of best practices[29]. By June 2022, the Commission has received 22 reports (from 21 Member States and Norway) on the implementation of the Connectivity Toolbox. The Connectivity Toolbox has triggered non-homogeneous action in some Member States and as regards specific areas (e.g. guidelines on dispute settlement mechanisms or legal requirements for appropriate permit fees), while a relatively high number of measures are still ongoing (e.g. introducing permit exemptions and fast track permit granting procedures, or ensuring the availability of information in SIP) and certain best practices have rarely been implemented (e.g. tacit approval or fast track procedures for rights of way, ensuring access to publicly controlled physical infrastructure or establishing a coordinator/promoter body in relation to the latter access requests).

While in general, the Connectivity Toolbox has collected a good set of best practices which could possibly improve to some extent the effectiveness of some provisions of the current Directive, the final overall impact would depends on the willingness of Member States to keep focus on finalising implementation of the numerous on-going practices, given that this is in essence a voluntary exercise.

Moreover, the recent Commission proposal for a Union Secure Connectivity Programme[30] aims to facilitate broadband access by satellite to areas that lie beyond the reach of other fixed and mobile electronic communications network infrastructure. That's possible because satellite communications provide limited capacity but ubiquitous coverage, which is complementary to terrestrial networks (ground-based in a form of cable links such as fibre broadband or wireless). The system will also provide connectivity over geographical areas of strategic interest, for instance Africa and the Arctic, as part of the EU Global Gateway strategy. It can also ensure minimum connectivity in emergency situations such as in Ukraine during the war. Nevertheless, satellite is not considered to be a substitute for fixed broadband technologies from a performance perspective[31], and its main purpose is to ensure resilience and provide ubiquitous high-speed broadband capacity for governmental users including in otherwise 'dead zones' rather than the Gigabit speeds required in the post-COVID digital era.

Finally, it should be noted that there are funding initiatives to support high speed (and Gigabit-capable) broadband in rural and other less well served areas, including the digital part of the Connected Europe Facility (CEF and CEF Digital)[32], post-COVID recovery funds[33], and national State Aid initiatives[34]. The recently revised Guidelines on State aid for broadband networks[35], also contribute to accelerate and extend broadband deployment by clarifying when public support is in line with competition rules.

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[29] The Toolbox best practices were taken into account in the design of the policy options to minimise risks of inconsistencies.

[30] https://ec.europa.eu/commission/presscorner/detail/en/ip_22_921

[31] According to the WIK (2020) study on Future product and service markets susceptible to ex ante regulation, or in the explanatory memorandum accompanying the EC (2020) Recommendation on Relevant Markets, satellite does not feature as a substitute to fibre or cable technologies.

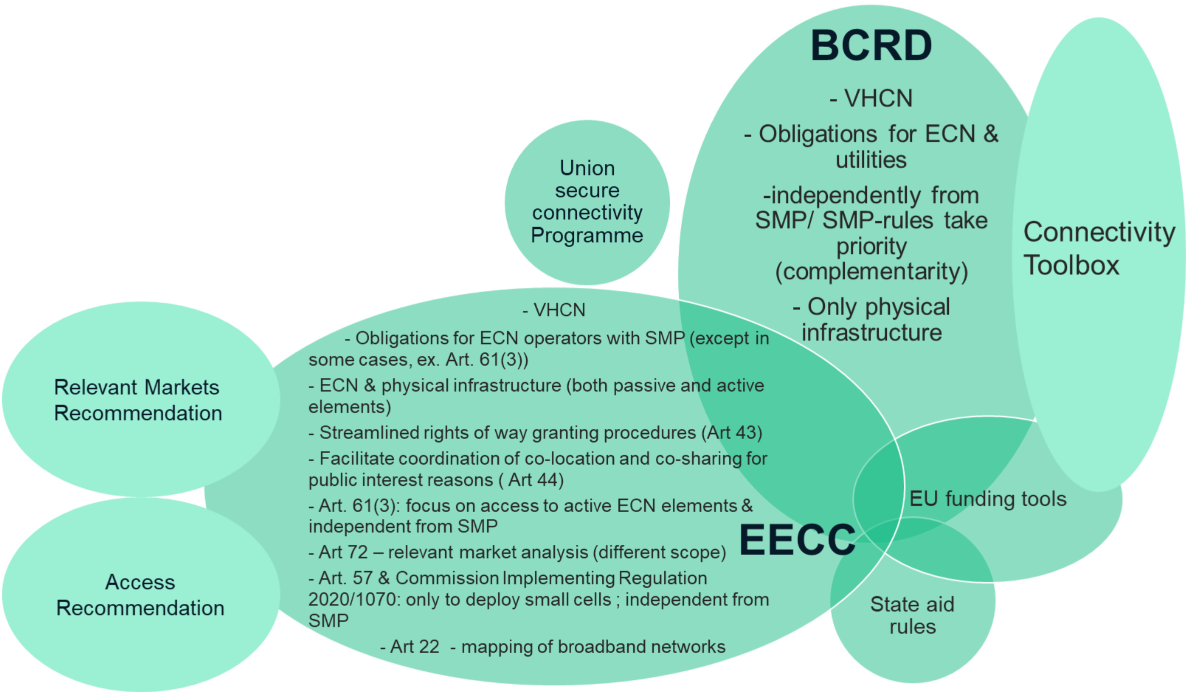
[32] https://hadea.ec.europa.eu/programmes/connecting-europe-facility_en.

[33]https://ec.europa.eu/info/business-economy-euro/recovery-coronavirus/recovery-and-resilience-facility_en#example-of-component-of-reforms-and-investments.

[34] Report on Implementation of Broadband State Aid https://op.europa.eu/en/publication-detail/-/publication/d6b8368d-f3dd-11ea-991b-01aa75ed71a1/language-en.

[35]. Communication from the Commission "Guidelines on State aid for broadband networks", COM(2022) 9343, https://competition-policy.ec.europa.eu/document/download/124c08a6-1dfd-452e-ad1e-3b9fa8c6ce18_en?filename=2022_broadband_guidelines.zip

Figure 1: Interactions between legal instruments



The public consultation confirmed the relevance of BCRD's objectives to facilitate and incentivise the roll-out of electronic communications networks; however the improvements achieved are not considered to mirror expectations, mainly due to the heterogeneity of BCRD implementation across Member States. The Body of European Regulators (BEREC) is of the view that the impact of the BCRD was limited to those Member States with no prior similar framework. Only limited effectiveness is recognized by the ECN operators as regards reinforced coordination of civil works, which is considered burdensome and leading to delays in projects' deployment. The lowest progress is registered in reduction of time and cost of permit granting. The views of ECN operators and of public authorities converge as regards the need for reconciliation and ensuring coherence between the BCRD and the EECC.

2. PROBLEM DEFINITION

2.1. What are the problems?

The Evaluation Report shows that the current Directive has only been partially effective in achieving its objective and that a number of improvements would be required to make it suitable to support EU's new connectivity needs and ambitions. That's because the flexibility allowed to the Member States not to implement certain measures or to apply exemptions resulted in an inconsistent implementation across the EU. Additional reasons why the Directive was not fully effective in tackling the problems mentioned are imputable to a lack of clarity of certain formulations in the Directive (i.e. 'fair and reasonable' conditions of access or 'alternative means') which led to complex, costly and inconsistent implementation. Also, significant problems remain in particular with regard to permit granting, which is critical for timely VHCN deployment. Finally, some network or non-network physical infrastructure that would have facilitated deployments were not included in the scope of the Directive.

In addition, new problems stemming from the evolving market, technologies and stakeholders needs have emerged. First, the ambition in terms of network performance has increased from 30Mbps to at least 100 Mbps and even further to 1 Gigabit by 2030. Therefore, significant gaps remain between the EU's connectivity goals of complete VHCN coverage by 2030 and the actual network coverage. Total VHCN coverage in the EU increased between 2013 and 2020 from 16% to 59% of households, but less than half of households (42%)[36] benefit from a futureproof[37] FTTH connection. While good progress has been made in Member States such as Latvia, Spain, Portugal and Sweden, coverage of FTTH remains below 15% in certain Member States such as Germany, Greece and Belgium[38]. The problem is even more evident in rural areas, for which FTTH coverage on average across the EU is only 28%, with some Member States (notably Bulgaria, Belgium and Greece) having rural FTTH coverage close to zero[39].

Second, the latest generation of wireless (including mobile technology), 5G, has matured and is now set to take on a large role in economic life. Yet, despite the emergence of providers of wireless physical infrastructure such as « tower companies » that account for over 35% of the wireless physical infrastructure in Europe[40], 5G coverage is still limited in most cases (5G coverage in Europe by mid-2020 amounted to only 14% of populated areas in 14 Member States[41]), and operators' focus has thus far been on providing 5G for enhanced mobile broadband (eMBB) in lower frequency bands including the newly auctioned 700MHz band, which mainly involves the upgrade of existing sites and associated backhaul (e.g. to dark fibre – potentially in conjunction with FTTH deployment), typically by upgrading existing sites[42].

Therefore, in the context of new EU connectivity targets and objectives and the regulatory, market and technological developments as well as the findings of the evaluation, the main problems tackled by this initiative are (i) the high deployment costs for VHCN (in practice, mostly FTTH and mid-band 5G), and (ii) persisting slow deployment of electronic communications networks.

Figure 2: Problem Tree

[36] Digital agenda scoreboard.

[37] As noted in a number of studies, FTTH infrastructure is the technology which is most suitable to being upgraded to meet future bandwidth demands. DOCSIS and FWA technologies face limitations in bandwidth and/or symmetry, and would require significant additional deployment of fibre backhaul to improve the quality characteristics over time. See for example WIK (2020) https://op.europa.eu/en/publication-detail/-/publication/7309fa31-b758-11ea-bb7a-01aa75ed71a1/language-en/format-PDF/source-245670272 .

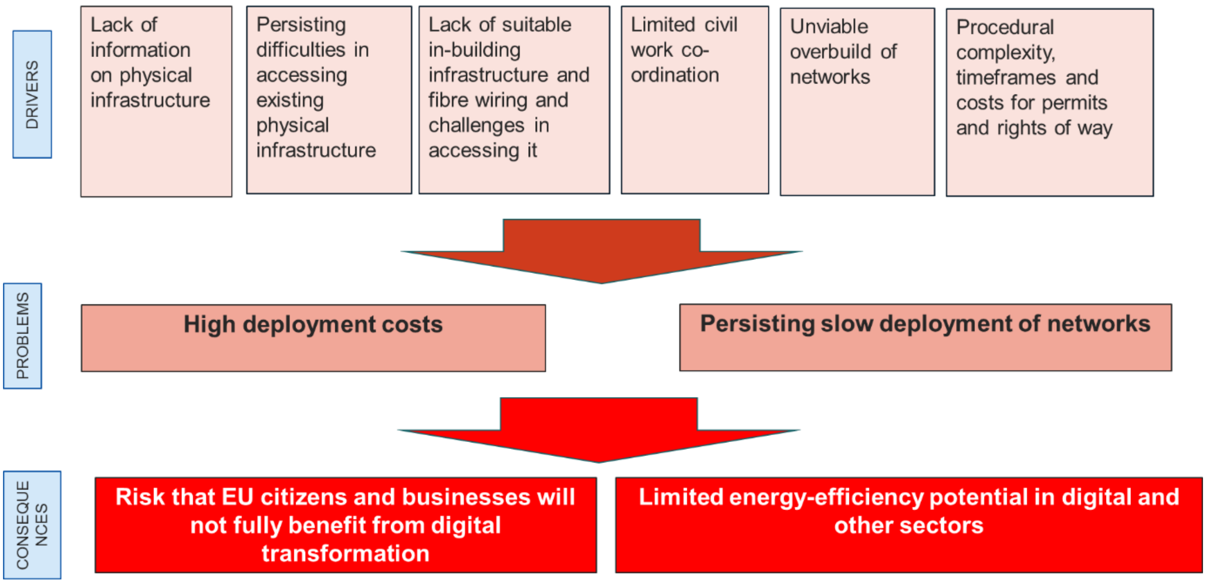
[38] According to DESI 2021, in mid-2020, Malta was leading with 100% of VHCN coverage, while Greece was at 10%.

[39] See support study, chapter 4.1.1.

[40] The European Wireless Infrastructure Association, which regroups 9 independent wireless infrastructure companies operating in 16 Member States, claims a portfolio of more than 80,000 assets in Europe.

[41] Source: DESI 2021 https://digital-strategy.ec.europa.eu/en/policies/desi and https://5gobservatory.eu/market-developments/private-investments/.

[42] See support study, chapter 3.2. Deployments involving picocells, metrocells, and microcells (low-power base stations) for outdoor coverage may need to be installed in locations such as shopping malls, hospitals, office buildings and hotels, or on lamp posts and other street furniture, poles or on the side of buildings. In order to meet these forecast deployments, mobile network operators in the EU will need to source hundreds of thousands of new sites, and deploy fibre backhaul to support the expanded network.



Source: European Commission

High deployment costs

High deployment costs for VHCN, including FTTH and mid-band 5G, undermine deployment incentives and viability of new deployments. A key factor in the deployment of physical infrastructure suitable to host broadband, and more specifically VHCN networks is represented by the high costs required to plan, design and rollout a network, including the costs to build civil engineering infrastructure, e.g. ducts, masts etc., and in particular the costs to excavate the ground to build ducts suitable to host an electronic communication network. That applies to ECN networks in general, but the problem is more acute for fibre (last mile) and 5G (densification) which are the technologies expected to help meeting the connectivity targets at this stage of technological development.

Total costs are estimated at EUR 145bln[43] to reach 90% households with FTTH from today's level, which is the baseline scenario assumed by the support study (see section 5.1). This amount includes EUR 3.8bln of public subsidies[44]. Based on current figures regarding costs of labour, equipment and materials, civil works represent around 70% of the total capital expenditure (capex) required in deploying FTTH in a greenfield scenario[45].

Experience from the BCRD evaluation shows that measures that facilitating access to existing physical infrastructure and related information provisions (transparency) allow ECN operators to

[43] For comparison, total telecom investment in Europe stood at EUR 51.7bn in 2019 (https://etno.eu/news/8-news/694-state-of-digi-2021-pr.html).

[44] Core assumptions are that under the status quo, 5% of new deployment will share existing ducts and 15% will share existing poles, and 3% of new deployment will take advantage of civil works co-ordination. Based on model business case for an operator which does not have ubiquitous physical infrastructure of its own.

[45] ICF, WIK and EcoAct, Review of the Broadband Cost Reduction Directive, 2021 (the support study). Estimates from the study conducted in support of the Impact Assessment associated with the 2013 proposal for a Regulation on measures to reduce the cost of deploying high-speed electronic communications networks (https://www.eerstekamer.nl/eu/europeesvoorstel/swd_2013_73/part_3_impact_assessment_on/document/f=/vj8upf8oq8te.pdf) alongside previous research by WIK suggest that it could account for up to 80% of the total costs incurred (Jay, S.; Neumann, K-H.; Plückebaum, T.; Comparing FTTH access networks based on P2P and PMP fibre topologies, Conference on Telecommunications, Media and Internet Tecno-Economics (CTTE) 2011, Berlin, 16. - 18. May 2011).

reduce by 10-30% the cost of deployment for fixed networks and by more than 30% the cost of deployment of wireless, including mobile, networks. Obligations to coordinate civil works which are publicly fully or partially financed, and related information measures (transparency) allow network operators to reduce up to 30% the costs of deployment and share risks when deploying networks including new physical infrastructure. This figure can go up to 50% savings in case of civil works coordination with other utilities.

In-building infrastructure also represents a substantial proportion of the costs of deploying FTTH, accounting for 10-15% of the cost per household. Assuming that 10% of buildings will have suitable in-building infrastructure for the deployment of FTTH, EUR 11.5bn can thus be estimated for new in-building infrastructure. To reach the remaining households, often in less densely populated areas, a further EUR 20bln (including EUR 7bln in subsidies) may also be needed[46]. Any reduction in the investments needed would enable network operators to use more financial resources to invest in additional VHCN coverage or performance enhancement.

The problem of high costs to deploy is particularly serious with respect to fixed networks in rural areas, because access lines are long and, as rural areas are less populated, fewer customers provide operators with less opportunity to recover their investment/deployment costs. Those areas are therefore less profitable. For example, the support study shows that while the cost of deploying FTTH to a household in a dense urban area is less than EUR 1,000 on average across the EU, the average cost increases to nearly EUR 2,000 when serving customers in rural areas. Costs of around EUR 200 per household can also be incurred to deploy in-building infrastructure to be able to connect end-users (e.g. to deploy ducts and fibre from the basement of the building to the apartment)[47].

In the absence of significant subsidies[48] (or higher prices for rural customers), many rural areas would remain unserved with VHCN, and customers in those areas would be cut off from digital access to employment, healthcare and educational benefits that are available in other areas. There is already a gap between urban and rural areas: EU rural VHCN coverage went from 4% to 28% between 2013 and 2020, less than half total coverage (59%).

High costs are also a significant challenge hampering the deployment of the new 5G networks, which currently make extensive use of mid-band frequencies (below 6 GHz). Deploying mobile networks using these mid-band frequencies such as 3.6 GHz pioneer 5G band will require the deployment of hundreds of thousands of small cells, including SAWAPs but not only[49], many of which will require fibre backhaul as well as potential costs relating to site leasing and permits[50].

Persisting slow deployment of networks

In order to start deploying a wireless/mobile network, network operators need to obtain permits and access to sites (rights of way). However, the procedures to obtain such permits and rights of way have been reported to be long and complex (e.g. the average duration was 12 months in Czech Republic and almost 8 months in Germany compared to the mandatory deadline of 4 months).

[46] Analysys Mason, Costs and benefits of 5G geographical coverage in Europe
[47] Estimates from ECN operators for the cost of in-building infrastructure range from EUR 100- EUR 450 depending on differences in labour cost and the type of housing.
[48] Ref. to Commission state aid guidelines on broadband deployments
[49] See for example forecasts for small cell deployment in Europe and globally provided by the Small Cell Forum "Small cells market forecast July 2021" https://scf.io/en/documents/050_-_Small_cells_market_forecast_July_2021.php.
[50] That is particularly true for small cells that do not fall within the definition of SAWAP for the purposes of Art 57 EECC.

Complex and lengthy procedures do not only increase costs for network operators, but also increase the risk of not timely reaching the digital targets on full Gigabit and 5G coverage due to slow deployment. Delays in obtaining permits and rights of way can add one to two years to the timing for the deployment of wireless VHCN in particular as well as (in some cases) costs associated with the process of obtaining permits and other permissions that can amount to 10-20% in the case of base stations.

The difficulty in obtaining permits is seen as a factor which can slow down deployment considerably. A majority of stakeholders pointed towards the lack of coordination between the various authorities competent for granting permits, the multiplicity of permits needed for ECN deployment, the lack of electronic means/procedures for permit applications and the non-respect of the deadline to grant all ECN deployment related permits, including those for rights of way.

In addition, the persistent diversity of rules pertaining to access terms and conditions, permit granting, level and availability of information required to request access or civil works coordination, within and across Member States is so great that it slows down the network rollout at European level as investment plans need to be adapted to local rules and works have to be subcontracted separately, in function of the solution chosen for each area. The fact that local presence needs to be ensured in every municipality throughout very long periods (starting before rollout plans are defined through to the completion of the projects) puts resource constraints on companies willing to roll out across regions and countries. The lack of transparency on permits rules and procedures, including those of rights of way, also prevents proper planning across borders (e.g. in cross-border cities/municipalities; borders areas in general). ECN operators estimate that the teams to handle permit applications for fixed and mobile infrastructure from multiple authorities cost EUR 75m annually across the EU[51].

Additional delays in network deployments have also resulted from long and costly disputes among operators to obtain access to existing physical infrastructure. BCRD attempts to address this problem, but certain BCRD provisions (‘fair and reasonable’ terms and conditions) suffer from a lack of clarity. As a result, several Member States have clarified access terms and conditions through disputes or guidelines, which are however very different across Member States despite addressing the same problem.

2.2. What are the problem drivers?

<u>Driver 1</u>: Absent, incomplete or outdated information on the existing physical infrastructure.

The lack of transparency on suitable available infrastructure has a significant impact on the cost and time of deployment since it reduces the effectiveness of the actual access to physical infrastructure. While transparency on physical infrastructure has significantly improved since the application of the Directive, the extent to which such information is complete and up to date has been a significant challenge. Moreover, information about the exact location of physical infrastructure (geo-referencing) as well as about public non-network infrastructure or facilities is available via a Single Information Point (SIP) in only a limited number of Member States[52] (as this is not an obligation under the current BCRD), which would appears to be a significant shortcoming for future deployment of mobile networks in particular.

[51] See support study, section 1.7.

[52] Information regarding public non-network physical infrastructure or facilities is reflected or expected to be reflected in SIPs in Czechia, Finland, Latvia and Germany, but was not reported as available (or no information was given) in other Member States.

Many stakeholders[53] are concerned about the quality and completeness of information on existing physical infrastructure owned by network operators. The information available about the location of the physical infrastructure often is outdated and/or potentially inaccurate (or insufficiently specific), and incomplete, if not provided by all relevant parties (network operators and public authorities).

Many stakeholders[68] are concerned about the quality and completeness of information on existing physical infrastructure owned by network operators. BEREC is of the opinion that the gathering of information on physical infrastructure is hindered by the way the process is currently foreseen in the BCRD, i.e. on a request basis and mostly optional via the SIP. The Fit for Future Platform underlines the risk that stakeholders involved in the rollout of broadband could inadvertently damage critical infrastructure[54].

Driver 2: **Persisting difficulties in accessing existing physical infrastructure** (by reference to current definition in the Directive but also **including non-network infrastructure owned or controlled by public bodies, such as public buildings or street furniture**) to deploy new networks.

The Evaluation report shows that Member States have implemented the BCRD with varying speeds of implementation (most were late) and with a different degree of implementation. **Where there is no ubiquitous SMP-based access** due to the lack of ducting (e.g. Germany), where there exist a patchwork of different operators in different areas (e.g. Lithuania, Hungary, Slovakia and Poland) or where SMP obligations on the wholesale local access markets have been withdrawn (e.g. Romania, Bulgaria), **the access to physical infrastructure under the Directive has been effective**. On the other hand, in Member States **where SMP-based access is effective** (e.g. France and Portugal) or where there is widespread availability of dark fibre (e.g. Sweden), **the access** to physical infrastructure for the purposes of deploying high speed broadband under the Directive **remains limited**. As a result, the shared use of existing physical infrastructure between ECN operators varies between Member States, depending, among others, on the availability and quality of the existing physical infrastructure. The shared use of ducts pursuant to the BCRD covers from up to 1% of the total length of the reach of the incumbent network in Germany and Finland, 2.3% in Hungary, 4% in Estonia to up to 20% (Poland and Italy), while BCRD-based pole access is more used than BCRD-based access to ducts,

Nearly three quarters of disputes referred to Dispute Settlement Bodies (DSBs) under the BCRD concern access to existing physical infrastructure, with most concerning denial of access or terms and conditions for access[55]. The limited data available[56] on the take-up of BCRD-based physical infrastructure access seems to indicate that there are significant differences in the take-up of

[53] See support study, Commission public consultation (Annex 2), and Evaluation SWD (Annex 7).
[54] Fit for Future Platform Opinion 2022/SBGR1/01 of 5 December 2022
[55] Six out of seven ECN operator representatives responding to the survey as part of the support study considered that either the price for physical infrastructure access, the terms and conditions, or both were unreasonable, while respondents to the Commission's public consultation highlighted that the principle of 'fair and reasonable terms and conditions' for accessing physical infrastructure had not been effectively applied.
[56] National authorities were requested to provide data on the usage of BCRD-based physical infrastructure access, but only six of them provided information. The remaining data was estimated on the basis of information provided by ECN operators. Take-up of BCRD-based physical infrastructure access in many of the Member States, which did not provide data, appears to be low based on feedback from ECN operators.

physical infrastructure access in different Member States, which may have been influenced *inter alia*[57] by differences in the conditions for physical infrastructure access[58].

Based on estimates by the support study, costs involved in running Dispute Settlement Bodies are estimated at EUR 5m per annum for the EU 27. Costs to establish a SIP range from EUR 150,000 to EUR 2.5m (depending on scope / complexity) with an average of EUR 0.5m in annual maintenance costs per Member State. Costs for network operators (to negotiate access and provide information) are estimated at approximately EUR 68m per annum EU-wide (but some of these costs may have pre-dated the BCRD or may have arisen in its absence).

Access to physical infrastructure based on obligations imposed by national regulatory authorities (NRAs) on operators designated with SMP is not always a realistic alternative to BCRD-based access[59]. There are some Member States where SMP-based access to physical infrastructure is not available on a widespread basis. That may be because no ECN operator has been designated as having SMP in a relevant market linked to broadband deployment[60], or because the SMP operator does not have full coverage or its network is partially deployed within ducts and partially directly buried in the ground[61]. In addition, there are circumstances where SMP-based access may not be available (due to lack of space) or where access to utility physical infrastructure may be more suitable or more cost effective.

Access to non-network physical infrastructure such as public buildings or street furniture is not covered by the BCRD, yet can be a significant cost factor. For example, for deploying the small cells required for the new 5G networks (including but not restricted to SAWAPs) costs are estimated around 40% higher than if non-network physical infrastructure were subject to equivalent obligations[62].

Most alternative ECN operators and their associations, including those owned by local authorities, consider the current access obligations as appropriate. A significant number of stakeholders disagree with the suggestion that the ‘fair and reasonable’ principle for access to physical infrastructure has been applied effectively. On the other hand, a number of public authorities are of the view that the principle has been applied effectively and efficiently.

Irrespective of their market position, many ECN operators have requested the extension of such obligations to non-network physical infrastructure held by public bodies. Mobile operators claimed they lack information about the location of other (non-network) facilities (such as public buildings and street furniture) which might be suitable to deploy mobile infrastructure.

[57] Factors influencing take-up include the availability of effective physical infrastructure access from the incumbent based on SMP regulation, or the absence of physical infrastructure (ex. where electronic communications networks were buried on the ground).

[58] For example, it is notable that there is high re-use of utility poles in France and Portugal based on long-established offers from energy network operators (pre-dating the BCRD), while Italy has benefited from extensive re-use of duct and pole infrastructure based on prices, which were reduced by the AGCOM acting as DSB. Charges for pole access in Poland are reported by the NRA to be around 10 times higher per metre and month than in Italy and Portugal.

[59] WIK (2020) study concerning the review of the Recommendation on Relevant Markets susceptible to ex ante regulation https://www.wik.org/en/veranstaltungen/weitere-seiten/relevant-markets. Based on an assessment of ‘dominance’ by one or more operators in a given area whereas access to physical infrastructure under the BCRD is mandated on a symmetric basis as a general cost-reducing measure.

[60] For example, Romania and Bulgaria.

[61] For example in Germany and the Netherlands.

[62] Support study, page 105.

<u>Driver 3:</u> Lack of suitable in-building infrastructure and fibre wiring and challenges in timely accessing it. The access to in-building infrastructure improved following the implementation of the Directive. In-building infrastructure represents a challenge for the timely deployment of VHCN for the majority of ECN operators. They report that in some Member States there is no adequate in-building infrastructure available to host new fibre networks, or where it has been installed, that there are many cases where the cabling does not meet their needs from a technological perspective (e.g. only coax, twisted copper pair), or does not reflect the required topology (Gigabit passive optical network (GPON) or point to multi-point v point to point (P2P) fibre). Lack of suitable physical infrastructure means that ECN operators incur significant costs in deploying new in-building infrastructure, sometimes including in-building ducts and cable trays. Moreover, terms and conditions, including unreasonable prices of access, the diverse ownership of in-building infrastructure and a lack of compliance by building owners with obligations to allow access to ECN operators for the purpose of installing in-building infrastructure remain key concerns for ECN operators. They estimate the cost of deploying new in-building infrastructure including dark fibre in buildings at between EUR 100 and EUR 450 per dwelling.

In situations where in-building infrastructure for the deployment of VHCN infrastructure exists, locating and negotiating access can take considerable time and require significant human resources for both ECN operators and for the owners of those infrastructures, notably in cases where there are multiple owners of that infrastructure (e.g. different local and regional authorities, regional utilities, or landlords). The challenge increases when building regulations and electronic communications legislation are handled at different levels of a Member State's administration[63]. In some Member States, these problems resulted in a large number of disputes between ECN operators and building owners[64]. ECN operators note that the building and construction sector may not be fully aware of the rules stemming from the BCRD, while competent authorities may not be fully active in their enforcement.

Stakeholders consider that the in-building infrastructure can be an important bottleneck for the deployment of new networks and its importance is likely to increase in the future. Some ECN operators deplore that alternative installation methods for deploying fibre are not considered by some local authorities and that private buildings' owners would often block changing in-building infrastructures because of cost reasons. In BEREC's experience, problems have been found when in-building infrastructures are built in such a way that they do not technically allow third party access.

<u>Driver 4:</u> Limited civil work coordination.

The lack of information about planned civil works is also challenging the efficient ECN rollout, as this limits the opportunities for timely and efficient coordination and might even trigger interruption of planning or works in cases where projects address the same areas simultaneously. Yet, as pointed out by the Fit for Future Platform, the co-use of existing infrastructure for broadband, water and gas could also limit the negative impact of deployment of broadband

[63] For example in Austria regional rules apply for the building and construction sector whereas the telecommunication law applies nationwide.

[64] A particularly large number of dispute have been reported in Poland concerning in-building infrastructure are referenced in the BEREC report on the Implementation of the BCRD https://berec.europa.eu/eng/document_register/subject_matter/berec/reports/7534-berec-report-on-the-implementation-of-the-broadband-cost-reduction-directive

networks on the environment[65]. Still, ECN operators report that delays associated with co-ordination and complex procedures are the most problematic aspects of civil works co-ordination[66]. They also observe that the procedures for civil works co-ordination are cumbersome or vary from one authority to the other, or that there are challenges in agreeing on cost sharing.

As regards the availability of information on planned civil works, low progress is reported following the Directive. ECN operators complain that they do not receive any notification of planned civil works, including for road works, sufficiently in advance to enable them to consider it in their forward planning. Most ECN operators report limited use of this possibility. Civil works co-ordination has only been extensively used in few Member States (such as Belgium, Slovenia, and to a more limited extent Sweden and Finland) that have defined procedures, provided guidelines on cost sharing and facilitated interaction between network operators[67]. Requirements for *proactive* notification of planned civil works to the SIP are in place only in a few cases, such as Belgium and Lithuania, and in many cases information about planned civil works is available only on request or with a delay. Delays associated with co-ordination are problematic[68], since procedures for civil works co-ordination are cumbersome, vary from one authority to the other, or raise challenges in agreeing on cost sharing: disputes concerning coordination of civil works represent about 9% of all disputes between 2015 and 2020. Moreover, given the limited time offered to join planned civil works, the dispute resolution process may not be sufficiently agile to timely address such issues.

A vast majority of stakeholders agree coordination of civil works may bring benefits for the joint deployment of networks. ECN operators indicate three main beneficial outcomes: cost reduction, more sustainable network deployment and low burden on citizens, but express caution as synergies with non-electronic communications are limited. Public authorities express a more optimistic view and recall the need for improving administrative coordination to foster deployment of networks. BEREC is of the view that coordination of civil works has a high potential for cost savings, but that this potential is often not realised, including due to lack of information on relevant opportunities and the difficulty to synchronise plans.

<u>Driver 5</u>: Unviable overbuild of ECN networks. In some cases, requiring ECN operators deploying very high capacity networks to provide access to their physical infrastructure to competitors or to coordinate civil works could undermine the business case for the roll-out. This is the case in particular in the rural and most remote areas where deployment of several infrastructures might not be financially viable. In practice, unviable overbuild concerns situations where a –usually non-incumbent or alternative- network operator plans to invest in rolling out a network in a rural area (low population/low revenue perspective/lower chances to recover the investment) and in the same area a – usually incumbent - operator requests coordination of civil works to upgrade its typically existing high-speed electronic communications network into very high capacity network. While this situation would generate more infrastructure-based competition (i.e. the same ducts would host parallel fibre networks) in less profitable areas, by generating an extra capacity which could result in the inability to recover the investment made, it also risks dis-incentivising the investment from the alternative operator in the first place. This issue is of high concern for some

[65] Fit for Future Platform Opinion 2022/SBGR1/01 of 5 December 2022
[66] See Annex – synopsis of interviews conducted for the support study.
[67] Information about the number of deployments involving civil works co-ordination was provided by only 4 national administrations.
[68] See Annex – synopsis of interviews conducted for the support study.

network operators in Germany[69], and it is likely that the problem will increase and extend to other Member States as operators move more and more to deploy in rural areas.

These repercussions on the investment incentives of first movers in those areas can occur even if State Aid could be granted for the rollout and even if the wholesale network access prices or the cost apportioning of civil works are adjusted to take into account the impact on the business case, as provided in Article 3 and 5 of the BCRD. For example, operators could abstain from investing in new deployments fearing that their business case is undermined[70]. Thus, unviable overbuild can result in less rather than more deployment. It is therefore of outmost importance to strike the right balance between facilitating shared access to infrastructure and coordination of civil works via regulation and preserving operators' incentives to invest in rolling out new networks.

Driver 6: Procedural complexity, timeframes and costs for permits and rights of way. Obtaining access, permits or rights of way may be problematic for deploying operators, due to the challenges below:

- the need to obtain several permits and rights of way, especially when they are delivered by different authorities (or the lack of a single point of entry)[71], associated with the lack of coordination;
- the lengthy and diverse procedures, also due to the lack of electronic processes (manual systems and processes for permit granting are associated with longer processing times and potentially higher costs for the authorities concerned[72]);
- the non-respect of the deadlines to conclude the procedure; and
- the lack of explicit rules, including on compensation, if requirements for permit-granting procedures are not met, in particular deadlines and refusal conditions.

While the permit granting procedure has improved, very few public authorities provided information about the actual timeframes taken to process permit applications[73], and data comes mostly from the operators interviewed[74]. Yet, according to the support study, the maximum and average time taken to receive a decision for a permit application for fixed deployments exceeded the 4-month limit currently imposed in the context of the BCRD in a number of cases, (the average time was 12 months in Czech Republic and almost 8 months in Germany; the maximum time

[69] Please refer to Box 3-5 WIK evaluation report, pages 71-73. A number of cases have been brought to the German Dispute Settlement Body where an applicant wanted to co-deploy with a network financed via state aid. In order to avoid inefficient duplication of infrastructure in funded projects where wholesale access must be granted, the German legislation provides for: "Applications may be unreasonable in particularly if co-deployment would lead to duplication of a planned publicly funded fibre optic network providing non-discriminatory open network access".

[70] In the study (WIK et al (2020), The Role of State Aid for the rapid deployment of broadband in the EU), WIK confirmed through modelling that the provision of access to physical infrastructure could affect the profitability of VHCN deployment in very rural areas, if there was significant uptake of this form of access or if ECN operators were required to dimension ducts to facilitate access to physical infrastructure.

[71] GSMA quoted from its members that more than 50% of MNOs have experienced timeframes of 1-2 years or more than 2 years for permit approval, suggesting that the 4 months requirement in the BCRD has not been met, at least for certain cases associated with the deployment of mobile infrastructure. The time required to deploy infrastructure on rooftop sites was even greater than that for macrocells, with average timeframes of 15 months across its operations.

[72] For example, the Gigabitbüro in Germany reports that following the implementation of digital systems by a region in Northern Germany, the time taken for building permits was reduced by 30%. According to Digital Denmark Digitalization saves 296 million euro per year, Ministries in Denmark have reduced case processing time by 30% and transparency in Ministries and organizations increased 96%.

[73] Information was provided only by national administrations in Hungary, Cyprus, Greece and Lithuania. It was not possible to verify this information with reference to feedback from ECN operators in all cases.

[74] It took up to 6-8 months to receive a permit for fixed network deployment in certain Member States, i.e. Portugal, Spain and Italy (see Evaluation report, Annex 7).

reported was 8 months in Spain and 6 months in Portugal). 50% of mobile network operators have experienced timeframes more than a year for permit approval[75]. In the same line, the Evaluation report shows that timelines for permit applications have not been enforced in all Member States. At the same time, most Member States use some measures to facilitate the timely granting of permits, either through compensation for damages, permit exemptions or - in some Member States - through tacit approval if a decision has not been made within the deadline (although these are often specific to certain type of permits (e.g. fixed or wireless) only). Still, **permit granting practices and fees still vary widely**.

Table 1: Time required to deploy a site

Time Duration for Site Deployment		
Member State	**Time for Administrative Approvals**	**Time for Site Deployment**
Albania	12 - 24+ months	12 - 24+ months
Austria	6 - 12 months	12 - 24+ months
Belgium	6 - 12 months	12 - 24+ months
Bulgaria	12 - 24+ months	12 - 24+ months
Croatia	3 - 6 months	6 - 12 months
Czech Republic	6 -12 months	12 - 24+ months
Denmark	6 -12 months	12 - 24+ months
Estonia	<3 months	6 - 12 months
Finland	6 -12 months	12 - 24+ months
France	3 - 6 months	12 - 24+ months
Germany	6 -12 months	12 - 24+ months
Greece	12 - 24+ months	12 - 24+ months
Hungary	3 - 6 months	12 - 24+ months
Ireland	6 -12 months	12 - 24+ months
Italy	6 -12 months	12 - 24+ months
Latvia	3 - 6 months	6 - 12 months
Lithuania	6 -12 months	N/A
Netherlands	N/A	N/A
Portugal	6 -12 months	12 - 24+ months
Romania	6 -12 months	6 -12 months
Slovakia	3 - 6 months	6 - 12 months
Spain	6 - 12 months	12 - 24+ months
Switzerland	12 - 24+ months	12 - 24+ months

Source: Mobile Network Deployment Policy and Implementation of the Broadband Cost Reduction Directive in Europe, GSMA Report, March 2021

Several ECN operator representatives responding to the support study survey or at the BCRD consultant workshop in June 2021[76] highlighted concerns over their ability to access public facilities in the context of deploying mobile infrastructure. High costs to obtain rights of way for mobile sites (of between EUR 12,000 and 23,000) have also been reported in some Member States[77], and operators noted that there was a lack of national policies and/or mechanisms to

[75] support study, section 4.1.4. There are significant variations in the actual timeframes for permits between countries and even between permits for wireless and fixed network deployment. Timeframes of up to 6-8 months to receive a permit for fixed network deployment are reported in certain countries (i.e. Portugal, Spain and Italy), but also delays of up to a maximum of 24 months for wireless infrastructure. However, measures to enforce the overall four months deadlines seem to be missing in some Member States.

[76] See Annex 2 of the support study.

[77] Mobile operators reported high costs in particular in Hungary, Italy, and Romania. Information was not available for all Member States.

provide for dispute resolution in many cases[78]. Furthermore, those already high costs risk further increasing due to potential speculative practices by land owners.

In many cases, procedures for the deployment of wireless infrastructure necessary for the new 5G networks became longer and more complex than those for fixed infrastructure. The cost of site leasing could present a major challenge for mobile operators, if site leasing costs for small cells are not significantly reduced compared to current costs charged for larger cell sites. Costs for the latter can amount to 15% of the operating costs associated with 4G and basic 5G access networks[79] in Europe.

2.3. Who is impacted and how?

ECN operators are directly impacted by all the problem drivers. The resulting higher costs and longer duration of network deployment could limit the scale of investments that ECN operators can make and/or affect their profitability. Larger ECN operators, including those with nationwide and multi-national footprints, are particularly affected by the large number of authorities involved in obtaining permits for ECN deployment and access to sites for installing mobile infrastructure. Meanwhile, smaller ECN operators without their own legacy ducts and poles (including operators that could be characterised as SMEs) are hampered by a lack of effective options to access physical infrastructure and the opportunity to coordinate civil works, which may undermine their ability to compete for State Aid or to deploy alternative FTTH networks in competition to, or in place of deployment by incumbent operators. When they do deploy their own physical infrastructure, smaller ECN operators deploying VHCN also fear that requirements to let other operators access their physical infrastructure or co-ordinate civil works will lead to unviable duplication of VHCN and undermine their business case. Delays or limitations in the deployment of fixed and mobile VHCN have a knock-on effect on other elements of the value chain including impacts on revenues for equipment manufacturers and the manufacturers of fibre cables.

Energy and transport companies as well as other network operators[80] face a lack of clarity regarding the application of the BCRD and have concerns that the terms under which they are required to provide access or to co-ordinate civil works may not allow them to recoup their costs or may not take into account security or health risks associated with their core business. The existing system under the BCRD based on individual dispute resolution creates uncertainty for these players and is associated with high administrative costs.

Consumers, in particular those in rural areas, face limitations on access to Gigabit broadband, which restrict their ability to make use of advanced digital applications. This could limit their ability to benefit from remote healthcare and education or to engage in home working. Consumers also face disruption when operators dig the streets in parallel instead of co-ordinating their deployment, as well as further disruption and increased costs when ECN operators are forced to deploy FTTH wiring inside buildings which were not pre-equipped with this infrastructure.

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[78] Interviews conducted in the context of the support study.

[79] See Analysys Mason 2019 White Paper "What are the key considerations for 5G sites" https://www.analysysmason.com/research/content/perspectives/5g-key-considerations-rma18/. Annual site rental costs for 5G macrocells are quoted at EUR5650 per annum Oughton et al. 2019, https://www.researchgate.net/publication/330190823_Assessing_the_capacity_coverage_and_cost_of_5G_infrastructure_strategies_Analysis_of_The_Netherlands Oughton et al. 2018 https://ideas.repec.org/a/eee/telpol/v42y2018i8p636-652.html

[80] This includes water and sewerage companies, whose infrastructure tends to be less commonly requested by ECN Operators than those of energy and transport organisations.

Lack of access to, or high prices for Gigabit connectivity is also a significant challenge for **businesses, and in particular SMEs and smaller public facilities** (such as doctor's surgeries, libraries) because it limits their ability to benefit from productivity gains associated with faster broadband and advanced digital applications. Thus, delays in achieving full VHCN coverage could affect EU's wider digital development and capacity for industrial leadership and public sector transformation, which are key pillars of the EU's Digital Decade goals[81]. SMEs are likely to be disproportionately impacted as they may rely on mass-market Gigabit broadband solutions, whereas larger businesses may be able to afford bespoke connectivity solutions including leased lines to support their bandwidth needs[82].

Municipalities and/or **other competent authorities** have to deal with multiple separate requests for access to public physical infrastructure or civil works coordination when they act as a network operator as well as with requests for permits and rights of way from ECN operators, increasing administrative workload. For them, manual systems and processes for permit granting are associated with longer processing times and potentially higher costs. They also have to factor in the uncertainty in case of disputes which hampers forward planning and efficient resource allocation.

Finally, slower transition to modern FTTH and 5G networks results in relatively increased GHG emissions from electronic communications networks themselves, since existing electronic communications networks, such as FTTC/G.fast or cable DOCSIS 3.1 are less energy efficient in transmitting data traffic. Deployment models such as network sharing and co-ordination of civil works also serve to reduce GHG emissions associated with network deployment. Moreover, slow deployment of fixed and mobile VHCN limits the potential for other sectors to use digitisation as a means to achieve energy savings, undermining the achievement of the European Green Deal targets, especially in rural and remote sites in sectors such as agriculture, energy generation, and transport.

A majority of stakeholders pointed out factors that negatively impact roll-out: the lack of coordination between the various authorities competent for granting permits, the multiplicity of permits needed for ECN deployment, the lack of electronic means/procedures for permit applications and the non-respect of the deadline to grant all ECN deployment related permits, including those for rights of way. An association of municipalities has cited challenges implementing EU rules setting exemptions for permits for certain categories of small cells (the SAWAPs).

2.4. How likely is the problem to persist?

The outcome of the evaluation suggests that measures taken under the current Directive are unlikely to lead to significant improvements in most aspects related to the two identified problem areas explained above.

As explained in detail in section 5.1, instruments such as Article 57 of the EECC or the Connectivity Toolbox are unlikely to solve all the problems identified across the EU, and in particular the challenges to locate and access sites for wireless/mobile deployment or the lack of suitable in-building infrastructure and fibre and the limited coordination of civil works. Article 57 of the EECC, when transposed and implemented, will still be limited to the deployment of small

[81] https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/europes-digital-decade-digital-targets-2030_en.
[82] Further analysis of the impacts on SMEs acting as consumers and as ECN operators, is contained Annex 3.

cells that meet certain criteria while leaving out other network elements which need to be installed for 5G. Similarly, a review of existing measures by Member States as well as commitments made in the Connectivity Toolbox roadmaps and measures implemented so far show that in many cases there are no concrete action taken in relation to the agreed best practices for reducing the cost of deploying fixed and mobile broadband. Moreover, the scope of the Toolbox does not include all areas covered by the BCRD (excluding for instance access to in-building wiring, civil work coordination, except for transparency measures).

Lengthy and complex processes result in excessively high administrative costs. For example, ECN operators employ large teams to handle permit applications for fixed and wireless / mobile infrastructure from multiple authorities at an estimated cost of more than EUR 75m annually across the EU[83]. These estimates do not reflect the cost to local authorities and other competent authorities of processing permit applications for ECN deployment, which could be at least of the same magnitude, and likely higher, given the large number of local and regional authorities active across the EU.

Complex processes and the lack of clarity about terms to access public facilities are also expected to impact wireless / mobile deployment, and particularly for the deployment of 5G in mid-bands (below 6 GHz)[84], as well as 5G development in millimetre wave bands (26 GHz and above), because the use of higher frequencies will require extension in backhaul networks and the deployment of new sites. Projections suggest that under current conditions, deployment of 5G in mid-bands, in particular in the 3.6 GHz pioneer band, is likely to be restricted to major cities and highways, and that it may reach only around 30% of the population at the end of 2025.

Moreover, the cost of negotiating access to multiple small cell sites (including those needed to install SAWAPs) owned by different public bodies is significant and time consuming for ECN operators and public authorities. Overall, the support study estimates that if resources needed for access requests by the largest fixed mobile converged operators increase by one third to address increased access requirements for mobile sites and rights of way linked to 5G densification and FTTH expansion, additional costs would amount to around EUR 24m across the EU[85].

Delays in the availability of advanced 5G services are also expected. Investments in outdoor small cells (including but not limited to SAWAPs), a necessary infrastructure, to support more advanced applications such as Connected and Automated Mobility (**CAM**) are not yet prioritised by most mobile network operators according to interviews by study consultants, and a 2021 study by Analysys Mason[86] suggests that comprehensive deployment of 'full 5G' (beyond dense urban areas) and support for associated use cases is likely to begin only in 2025, and that by 2030. Coverage of massive MIMO[87] will reach only between 30-60% of the population and 10% in terms of geographic area on a purely commercial basis. This would leave many significant roads, transport links and agricultural areas unserved, as well as certain healthcare facilities and municipal buildings.

[83] Support study: Estimate based on an average of 55 FTE per MS at level ISCO 2. Estimated resources derived from interviews with ECN operators conducted in the context of the study.
[84] 5G coverage based on low frequencies ("basic" 5G- below 6 GHz) is expected to be largely complete by the end of 2026
[85] Based on feedback from ECN operators provided in the context of the questionnaire and interviews for support study.
[86] Costs and benefits of 5G geographical coverage in Europe.
[87] MIMO (multiple-input multiple-output is a wireless access technology to deliver the needs of 5G and beyond.

3. WHY SHOULD THE EU ACT?

3.1. Legal basis

The new instrument will amend the BCRD which was adopted under Article 114 of the Treaty on the Functioning of the European Union (TFEU).

Despite improvements since the regulation of electronic communications started the establishment of a single telecoms market in the Union, electronic communications markets remain national (see merger control decisions), with different supply and demand conditions, different spectrum licences awarded on a national basis, and different (albeit harmonised) regulatory regimes. Telecom operators must adapt their strategies to national constraints and differences even when they form part of larger multinational groups. This fragmentation of the EU market alongside national borders prevents the EU from reaping the full potential of an EU-wide telecoms market. While there are around 50 mobile, and more than 100 fixed operators in the EU, the four main European mobile operators (i.e. Deutsche Telekom, Vodafone, Orange and Telia) hold over 60% of the mobile market. At the national level where competition occurs, the level of concentration is high with 16 Member States having three mobile network operators, 9 Member States having four and 2 Member States having five. In certain Member States, the number of distinct mobile telecoms network infrastructures is even lower than the number of operators due to existing network sharing arrangements (e.g. in Denmark or Italy). Nonetheless, **ECN operators are not able to realise scale effects because differences in national rules keep telecom markets mainly national**. Even for the big four operators, scale effects are limited because they operate in national markets and do not seem to fully harmonise their offerings and operational systems.

Yet, digital infrastructures, comprising among others fibre cables supporting fixed electronic communications, and antennas required to provide mobile communications, including in remote areas, have **a strong downstream effect on cross-border trade and services provision**, since many services can only be provided where an adequately performant network is in place all across the EU. Hence, they are essential to ensure the proper establishment and functioning of a market for digital products and services within the EU, e.g. fixed and wireless/mobile communications, data services, and the digital transformation of manufacturing, health, construction, agriculture and mobility ecosystems.

For example, deployment of mid-band 5G is needed to support 5G applications (e.g. Internet of Things - IoT) that are intrinsically multi-national or facilitate cross-border connections, such as **Connected Automotive Mobility; such vehicles could not travel in areas where VHCN is lacking**. More generally, full connectivity everywhere is required for moving applications if they are to take advantage of the single market. Similarly, many "data-hungry" **advanced industrial and technical applications**, including in particular artificial intelligence (AI) applications, the European Quantum Communication Infrastructure (EuroQCI) Initiative[88] and high-performance

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[88] The EuroQCI will include a terrestrial segment relying on fibre communications networks linking strategic sites at national and cross-border level, and a space segment based on satellites. It will link national quantum communication networks across the EU and provide global coverage, https://digital-strategy.ec.europa.eu/en/policies/european-quantum-communication-infrastructure-euroqci

computing, for example used for smart farming or environmental surveillance, **rely on ubiquitous coverage** (including in remote areas). Moreover, the applications that are playing an increasingly important economic role due to the COVID pandemic, such as videoconferencing, also rely overwhelmingly on VHCN. The European Data Strategy adopted in February 2020 foresees that the global data volume will reach 175 zettabytes and the data processing model will change to 80% smart connected objects and 20% centralised computing facilities by 2025. The successful and efficient rollout of highly secured and state-of-the-art fibre and 5G network are therefore indispensable for future digital services and the industrial data wave.

Hence, ubiquitous VHCN coverage is crucial to ensure that these services can be provided seamlessly **cross-border**. When roll-out costs are higher than necessary, which will *ceteris paribus* reduce deployment of VHCN, provision of many of these services will become impossible in a number of areas, negatively impacting the function of the internal market.

Therefore, in view of the objective of improving the conditions for the establishment and functioning of the internal market, Article 114 of the TFEU remains the appropriate legal basis.

3.2. Subsidiarity: Necessity of EU action

Experience acquired with the implementation of the BCRD has demonstrated that the common objective to provide the EU with full high speed broadband coverage could not be achieved by Member States alone within a reasonable time and with the highest possible savings of private and public investment. The measures that Member States have adopted so far to incentivise network deployments and in particular to reduce the cost and time of deployment differ greatly, sometimes even from region to region and from municipality to municipality. This patchwork of rules and practices at national and sub-national levels, facilitated by the fact that a Directive allows for more flexible transpositions, hinders the further development and growth of European companies – e.g. electronic communication companies, equipment manufacturers, or civil engineering companies – by significantly increasing the administrative overhead costs of VHCN deployment. Fragmented approaches across Member States to solve the same problems increase complexity and costs especially for multi-national operators, which have made half of investment in electronic communications across the EU[89]. Given that the current legal instrument is a Directive, it has not been possible to limit effectively the variety of fees charged to operators. For smaller companies this fragmentation constitutes an obstacle in their efforts to reach economies of scale at EU level in the face of increasingly global competition.

While the recently adopted European Electronic Communications Code is harmonising different aspects related to the authorisation regime, SMP regulation and consumer protection, it does not address **obstacles** specifically linked with network deployment such as local permits rules, bottlenecks to access existing non-SMP physical infrastructure or to coordinate civil works. In the absence of additional policy action at European level, it is likely that the patchwork of rules at national and sub-national levels resulting from the implementation of the BCRD will persist or accentuate and, as such, will increase the fragmentation of the internal market. At the same time,

[89] According to the ETNO State of Digital Communications Report 2020, total European telecom capex amounted to EUR48.6bln in 2018. More than half of this investment derives from companies that operate in more than 1 Member State. According to Statista, Orange’s Capex reached EUR 7.13bln in 2020, while Vodafone’s European capex amounted to EUR 6.14bln and Telefonica invested EUR 2.9bln in Spain and Germany, Deutsche Telekom reported capex of EUR 6.4bln in Europe. CK Hutchison Group Telecom reported EUR 2.2bln in European capex in 2020.

the problems encountered to accelerate VHCN deployment (see section 2.1) are common to most if not all Member States. The causes of the problems (see section 2.2) are also similar across the Member States, and reducing costs and streamlining administrative procedures as key tools to address these problems are equally valid in all Member States. Thus, **the absence of a harmonised set of rules such as would be provided by a Regulation makes market entry from other Member States unnecessarily difficult**, as operators need to invest a second and third time in regulatory compliance. Yet entering in almost each national market is a core part of the competitive strategies of multinational market players, to the benefit of the internal market.

VHCN deployment that is slower, less widespread and more expensive than necessary would in particular jeopardise a swift exploitation of the possibilities afforded by 5G, which will be one of the most critical building blocks of our digital economy and society in the next decade. The launch of commercial 5G services will require substantial investments into the densification of wireless/mobile networks, small cells and other types of wireless infrastructure as well as backhaul connections to the core network via VHCN in order to achieve the distinct 5G capabilities, such as area traffic capacity, connection density or user experienced data rates.

One should note that in particular the deployment of fixed VHCN backhaul connections will, by reducing wireless connections to the core network, contribute significantly to the reduction of exposure of the general public to electromagnetic fields (EMF)[90]. To date, twenty Members States apply the Council Recommendation levels/limits, while seven impose stricter limits than those of the Recommendation, but use them as a reference level. The fragmentation of nationally applicable limits risks public trust in the Council Recommendation 1999 and thus in the development of 5G networks, despite the fact that the consistent application of EMF limits is in line with Article 45 (2) (h) and 58 of the Code. However, this cannot directly be tackled by EU action, since the legal competence to regulate the emission power of mobile stations, and therefore the exposure of the public to EMF, is primarily in the hands of the Member States Reducing the exposure can however make this fragmentation less relevant.

5G will support new types of applications connecting devices and objects, including Connected and Automated Mobility, the Internet of Things (IoT), but also ad hoc tailor- made connectivity solutions for a number of vertical industrial sectors (automotive, healthcare, transport, utilities, manufacturing, logistics, energy distribution, agriculture, education, tourism, media and entertainment), where today's networks provide only inferior "one size fits all" solutions. Although many of these transformations have already started on the basis of existing networks, it is anticipated that they will reach their full potential only with the deployment of 5G. As a result, 5G success in Europe is expected to generate highly qualified jobs in the ICT sector and the adjoining ecosystems estimated at up to two million jobs in the EU[91].

3.3. Subsidiarity: Added value of EU action

Fragmented availability of information and fragmented access to physical infrastructure as well as the lack of digital information platforms/tools and of digital permit granting systems (at least on a

[90] The Council of the European Union adopted in 1999, pursuant to Article 168 of the TFEU, Recommendation 1999/519/EC on the EMF limits to be applied by the Member States for protecting public health, which entails limitations for the emitted power of radio base stations. Those limits set out in the annex of the Recommendation follow a precautionary approach in line with the International Commission of Non-Ionising Radio Protection (ICNIRP) guidelines of 1998.

[91] https://op.europa.eu/en/publication-detail/-/publication/2baf523f-edcc-11e6-ad7c-01aa75ed71a1/language-en (page 7)

national level) give rise to significant unnecessary administrative costs for the industry and to longer deployment processes, and thus hamper entry and expansion by electronic communication providers. High deployment costs are particularly pronounced for non-incumbent fixed and mobile operators which do not have their own legacy physical infrastructure, and thus a failure to ensure effective access to physical infrastructure or support civil works co-ordination can tilt the playing field in favour of existing (often nationally based) large players at the expense of potential challengers, in particular cross-border entrants, thus affecting the good functioning of the internal market. The immediate benefit of EU action would be that the EU would have a clear and predictable framework supporting network deployment.

Measures at EU level would allow more efficient planning and investment deployment processes (and thus economies of scale) for ECN operators. For example, network operators active in several Member States would be able to negotiate access to physical infrastructure, and to obtain permits including rights of way, more easily and at less cost, as well as to deploy fibre in-buildings more efficiently. Moreover, such economies of scale and associated savings would go beyond the electronic communications sector and would spread to other industries as well (e.g. equipment manufacturers could have an EU market for technical solutions enabling cross-utility cooperation; construction companies could benefits from cross-border works).

As a result, EU action would also facilitate specific cross-border projects promoted by the EU. The Connecting Europe Facility makes available EUR 2.07 bn[92] for the development of projects of common interest relating to the deployment of and access to safe and secure very high capacity networks, including an indicative list of 5G corridors[93], ensuring that major terrestrial transport paths have uninterrupted 5G coverage. The deployment of these projects of common interest encompass: finalising commercial and technical plans, applying for permits and rights of way, performing civil works and installing equipment and, finally, connecting customers. The first three phases will significantly benefit from EU action improving the BCRD. It will allow network operators involved in projects of common interest better planning and implementation of the concerned multi-country digital connectivity infrastructures. All Member States would be affected by inefficient deployment.

As estimated in the ICF, WIK & EcoAct study, with a better enforcement of more adapted rules of the Directive, the EU could save EUR 2bn of public resources and EUR 10bn of private investment in the deployment of FTTH networks[94] (cost of non-action). EU inaction would also acquiesce to slow deployment of full fixed and 5G networks, and allow excessive bureaucracy to cause cost to ECN operators and public administrations, which may exceed EUR 40m per year, mostly for additional staff handling access and permit requests. On the other hand, if uncoordinated action were taken at national level, at most a 3 months reduction on average in the timeframes to deploy mobile infrastructure could be achieved to across the EU[95]. Finally, EU inaction would risk

[92] EUR 2.07bln of the CEF2 budget has been allocated to digital infrastructures https://digital-strategy.ec.europa.eu/en/activities/funding-digital. Other EU funding includes the European Structural Investment Fund (ESIF), Digital European Programme (DEP), European Investment Bank (EIB) funding and the Recovery and Resilience Facility (RRF)

[93] These are: the core network “Atlantic”, “Baltic – Adriatic”, “Mediterranean”, “North Sea – Baltic”, “North Sea – Mediterranean”, “Orient/East-Med”, “Rhine – Alpine”, “Rhine – Danube” and “Scandinavian – Mediterranean” corridors.

[94] These represent the opportunity costs of the status quo vs preferred option when deploying FTTH to 90% of households.

[95] See assumptions for BCRD Impact Assessment (ICF, WIK & EcoAct). They estimate that the average time to deploy new FTTH infrastructure could be reduced by around 3 months as a result of measures requiring Member States to define the deployments that could benefit from permit exemptions, and clarifying the timeframes for permit granting

depriving certain regions in the EU of the full benefits of digitalisation, which means furthering the digital divide and inequalities between EU citizens.

Finally, the major building renovation wave by 2030 triggered by the Green Deal objectives also represents a huge opportunity for high performant in-building infrastructure, including fibre readiness. According to the Commission Communication,[96] 35 million building units should be renovated by 2030 to become more energy efficient. Moreover, the increased rate and depth of building renovation will have to be maintained also post-2030 in order to reach EU-wide climate neutrality by 2050. The cost of equipping new and majorly renovated buildings with highly performant in-building infrastructure, including fibre ready infrastructure, is marginal comparing with the overall renovation cost. Therefore, EU action regarding in-building infrastructure and the related standards should ensure that all Member States use this opportunity to make significant progress in this direction at the same time and with the same speed.

Stakeholders considered that the (albeit minimum) harmonisation brought by the BCRD was effective compared with national measures, in particular in providing regulatory stability and legal certainty. To a more limited extent stakeholders, in particular national administrations and NRAs, considered the BCRD to increase economies of scale for companies with operations in multiple Member States, and to facilitate doing business across the EU.

A large group of operators and most business associations recall the need for further harmonization and regulation at EU level, especially regarding administrative procedures such as permit granting to overcome market fragmentation, whereas a smaller number of ECN operators indicate the need for allowing Member States leeway to implement and enforce EU legislation.

Meanwhile, a vast majority of public authorities is more reluctant than operators regarding measures at EU level. Advanced local authorities do not want to change their successful systems, while less advanced ones others fear not only additional costs but also have issues with the distribution of competencies between central and local authorities.

4. OBJECTIVES: WHAT IS TO BE ACHIEVED?

4.1. General objective

The main aim to which the revision of the BCRD should ultimately contribute is the fulfilment of the 2030 Gigabit connectivity targets set by the Commission and supported by the Council. To do so, the objective of the revised legal instrument resulting from the review of the BRCD is to increase coverage and facilitate the deployment of fixed and mobile very high capacity networks in the EU, thereby contributing to a better functioning of the internal market.

and simultaneous processing of rights of way. The consequence might be that 90% FTTH coverage could be achieved within 57 months from January 2026 rather than 60, as projected in the baseline. They also estimate that digitisation of the permit application process coupled with mandatory use of tacit approval and the introduction of minimum exemptions from permit granting at EU level the timeframe to achieve a 90% coverage of FTTH from a baseline level of 65% in 2025 could be reduced by around 6 months, thereby achieving this target within 54 months (by mid-2030 rather than end 2030). The timescales to deploy mobile infrastructure, which tends to be even more susceptible to delays as a result of obstacles in the permit granting process could be even further shortened, to around, reducing the time taken to deploy full 5G based on 3.6 GHz to 75% of households (from a baseline of 30% in 2025) to 52 months.

[96] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions “A Renovation Wave for Europe - greening our buildings, creating jobs, improving lives” COM/2020/662

The EU's new ambition for 2030 on a digital transformation of the economy and society, which is human-centric and respectful of the sustainability, means that every citizen and business in the EU should be put in the position to benefit from the opportunities offered by digitalisation, no matter where they are located, in urban or in rural areas. This requires VHCN-level connectivity, since capacity and performance needs of businesses cannot adequately be satisfied by less capable networks. Moreover, rural areas should not be excluded from the digital transformation, as, for instance, many citizens may decide to work remotely or need remote health services in those areas. Similarly, in order to support territorial cohesion businesses located in rural areas should be able to benefit from VHCN deployment underpinning high quality level digital solutions, like for ex. smart factories or smart farming. It should be underlined that since this Directive is part of a broader framework (see section 1), the revision of the BCRD, while increasing coverage and facilitating deployment is not able to achieve the VHCN connectivity targets and objectives on its own.

4.2. Specific objectives

This initiative's specific objectives[97] are to

1. Reduce costs of VHCN deployment by optimising the deployment and re-use of physical infrastructure

   Network operators seeking to re-use existing physical infrastructure in order to deploy VHCN should be able to find easily all the relevant information about such physical infrastructure by consulting a platform where that information should have been provided in electronic form by private operators and public authorities. Network operators deploying new VHCN should also be able to count on obtaining access to existing and suitable physical infrastructure (including non-network facilities and in-building infrastructure) at fair and reasonable conditions, while safeguards should be in place to prevent unviable overbuild. Publicly funded civil works should be coordinated whenever there is an interest by an ECN operator.

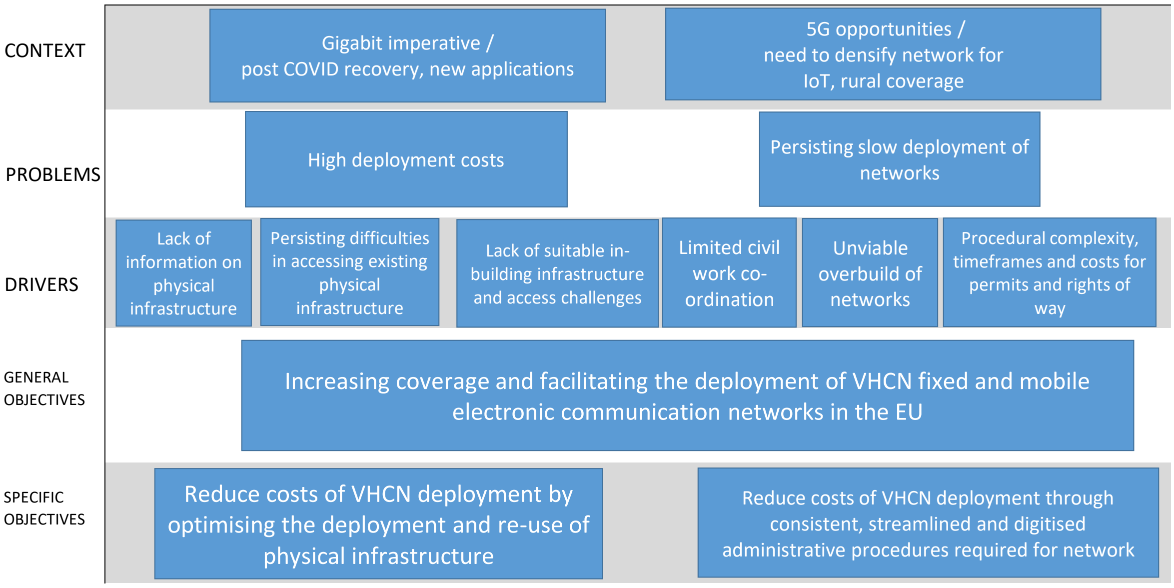
2. Reduce costs of VHCN deployment through consistent, streamlined and digitised administrative procedures required for network deployment across the EU

   Procedures, permit granting and rights of way required for VHCN deployment should be organised in such a way as to minimise bureaucracy and delays, including through approximation of rules, where appropriate.

These objectives are also consistent with the European Green Deal, as fibre and 5G networks are expected to increase energy savings in other sectors as well in the operation of electronic communications, thereby contributing to reductions in greenhouse gas emissions by 2030. Moreover, by further promoting the re-use of existing physical infrastructure and the coordination of civil works, the revised legal instrument promotes a more environmental friendly deployment of ECN. The specific objectives are also consistent with the Charter of Fundamental Rights, and in particular with Article 16 (Freedom to conduct a business), Article 17 (Right to property), and Article 37 (Environmental protection).

Figure 3: Intervention logic

[97] The Impact Assessment prepared for the BCRD proposal adopted in 2013 contained as specific objectives elements such as access to existing physical infrastructure, coordination of civil works, etc. While these measures remain central, this IA SWD presents general and specific objectives which are defined at high level, for which the measures referred before (as well as others foreseen under the new initiative) constitute an important factor.



Source: European Commission based on support study

5. WHAT ARE THE AVAILABLE POLICY OPTIONS?

Four policy options have been examined. They generally reflect a progression from less to more ambitious changes and from lower to higher EU-level harmonisation.

The project team, supported by the external consultant, elaborated a number of measures which were considered apt to support the objectives of reducing costs of network deployments and optimise administrative procedures. Given that the bundling of individual measures in the options is inherently subjective and combinations of measures in the different areas are multiple, the project team identified the following criteria that could inform its choice of bundling, notably:

- (i) the number of changes and the areas affected by such changes,
- (ii) the extent of obligations imposed on public authorities or network operators, and
- (iii) the level of harmonisation overall.

The choice of individual measures to feed into specific policy options (and the several policy options) also took account of stakeholders' consultations and proportionality considerations. These were notably presented during the validation workshop organised by the consultant which took place in January 2022. The resulting options and logic are the following **(see more detailed description of the four policy options and their content in Annex 4**):

5.1. What is the baseline from which options are assessed?

The baseline would consist in the continuation of the implementation of the current Directive, together with the rest of the EU regulatory framework for electronic communications (notably the Code), and the (voluntary) Connectivity Toolbox .

Article 57 of the Code and the related Commission Implementing Regulation[98] are expected to somewhat reduce the administrative burden as well as the cost of deploying small-area wireless access points (SAWAPs) by establishing exclusions at EU level from permits for those small cells which meet certain criteria and require public authorities to provide access to certain non-network facilities including street furniture and public transport facilities[99], which are suitable to host SAWAP on fair and reasonable terms. However, the negotiation process for accessing public sites is likely to be complicated, often involving a range of local and regional actors, and there is likely to be limited information about the location and suitability of relevant infrastructure for SAWAPs[100].

Moreover, the timely deployment of 5G will require network elements other than SAWAPs, i.e. larger in terms of volume and emission power, which will also require access to different assets or physical infrastructure than those covered by Article 57 of the Code. There are very few Member States that have extended the principle of access beyond SAWAPs, as set out in Article 57(4) EECC and/or provided information about the location of facilities (including public buildings) with support for the conclusion of access agreements via a coordinating body, and it is too early to assess the impact.

The Connectivity Toolbox contains a recommendation that access should be facilitated to public infrastructure for facilities which go beyond the narrow definition of SAWAPs. However, having regard to the Member States' Connectivity Toolbox Roadmaps, there are few concrete plans and actions taken by national administrations to take active measures that would go beyond the requirements of Article 57 EECC.

On the other hand, the implementation of the Connectivity Toolbox (together with measures introduced beforehand) should help for instance increase the use of civil works co-ordination due to the pro-active notification of planned works[101], while the introduction of exemptions for certain categories of works is expected to streamline permit application processes[102]. However, current experience shows that permit exemptions are limited to specific cases and the approaches taken vary widely[103], which could perpetuate a fragmented approach.

Table 2: Permit exemptions foreseen by Member States

Case	MS
Associated network elements (boxes, conduits…)	1
Masts/cabinets/antennas/cables satisfying certain criteria	11
Minor works	2 regarding rights of way, 1 under conditions
Technical innovation/Technical adaptation on existing masts/supports	2
Infrastructure contained in framework agreements	2
Cable deployment on electricity poles	3

[98] https://eur-lex.europa.eu/eli/reg_impl/2020/1070/oj.
[99] The Directive specifically refers to light poles, street signs, traffic lights, billboards, bus and tramway stops and metro stations.
[100] The connectivity roadmaps in general do not provide much information on initiatives taken in this area.
[101] Pro-active notification of planned civil works is currently practiced in 8 Member States, and partially implemented in another 5. In addition, concrete plans have been announced in 7 more. Discussions or plans without a concrete deadline have been reported in 3 Member States.
[102] Permit exemptions already exist in 15 Member States with plans in 5 more.
[103] For example, some Member States such as Romania, have granted exemptions in relation to repair and upgrades, while others such as Lithuania and the Slovak Republic have exempted wide (but differing) categories of works from the need for a permit. Meanwhile in some cases exemptions are limited or not present.

Certain categories of infrastructure (optical fibre, cables under certain conditions)	4
Deployments on already existing physical infrastructure	3
Building permit exemption for the majority of electronic communication networks	1

Source: Summary Report of Best Practices of the Special Group for developing a common Union Toolbox for connectivity

Moreover, an assessment of the Connectivity Toolbox roadmaps shows that there are no concrete plans to introduce digital platforms for permit granting[104] or require simultaneous processing of permits and rights of way and permit applications with alignment of the deadline in several Member States[105], and a significant number of Member States have no plans to provide guidelines on the interpretation of wholesale pricing principles for access to physical infrastructure or cost allocation in the context of civil works co-ordination[106]. But even taking these few cases into account, guidelines on wholesale charges for access to physical infrastructure at national level could also increase complexity and divergence in the application of the principles set out in the EU legislation.

Furthermore, the Connectivity Recommendation and the related Toolbox do not contain any provision relating to in-building infrastructure, even though this element constitutes a substantial portion of the cost of deploying VHCN (estimated at 10-15%) and ECN operators consider that challenges persist in many Member States. Only a limited number of Member States[107] have introduced standards and certification measures to address this bottleneck at national level, and where they exist, the degree of enforcement varies, and obligations apply only to the buildings which are newly built or renovated. For these reasons, the support study assumes that under the *status quo* only 10% of buildings still to be reached by FTTH across the EU will have high-speed broadband ready in-building infrastructure pre-installed[108], and that ECN operators accessing additional buildings may in some cases still need to invest in in-building fibre and potentially elements of in-building infrastructure to connect customers to FTTH.

The review of the BCRD is conducted in parallel with the work on a new Commission Recommendation on VHCN, which will provide guidance to NRAs on remedies to be imposed on operators with SMP, with a view to foster efficient investment in VHCN, while promoting competition in retail services. In particular, the new recommendation could provide guidance on the obligations that should be imposed on these operators with regard to access to their physical infrastructure assets and the price control obligations imposed in relation to the access to these assets. However, the recommendation would address only networks owned or operated by SMP operators, and its provisions would not be binding on the NRAs.

[104] Austria, Spain, France, Luxembourg, Malta, Portugal or Sweden have no concrete plans indicated in their roadmaps.

[105] Bulgaria, Estonia, Hungary, Ireland, Luxembourg, Latvia, Malta, Netherlands or Poland have no concrete plans indicated in their roadmaps.

[106] Guidelines on wholesale charges for access to physical infrastructure are not planned or are only under discussion in ten Member States. Nine Member States have engaged in providing guidelines on cost apportionment in the context of planned civil works.

[107] According to the Evaluation study, standards exist in 11 Member States but not in 7 others. Information (information not available for the other Member States) and not all standards include in-building fibre (e.g. Lithuania's standard covers only in-building infrastructure).

[108] Feedback from ECN operators suggests that the proportions vary widely from one country to another with high levels of availability in countries such as Spain and Portugal, which have long-standing rules on in-building infrastructure and very low or negligible levels in some other countries.

In this baseline scenario ICF, WIK & EcoAct's projections show that, on average, duct access will be used for 5% and pole access for 15% of new fixed and mobile VHCN deployment by 2030. In addition, around 3% of new deployments could be based on co-ordination of civil works[109]. These projections would still imply that a substantial proportion of newly constructed VHCN infrastructure will be deployed based on greenfield deployment, resulting in unnecessary costs and excess GHG emissions associated with construction, or can only realistically be deployed by operators which have their own physical infrastructure, which could limit the prospects for competition for public funds (thereby raising costs) or restrict infrastructure competition[110]. Moreover, ECN operators would still need to expand existing teams handling permit applications and access to sites for the deployment of VHCN infrastructure (including access to buildings, as well as network infrastructure) to support deployments of FTTH and mid-band 5G by around 20% on average. Local authorities may also need to devote additional resources to handle these requests.

Taking into account the above as well as the Member States national broadband plans[111] adopted in connection with the EU Gigabit society targets for 2025[112] together with the allocation of additional state aid[113] and EU funds, ICF, WIK & EcoAct expect that under the *status quo*, VHCN coverage in the EU will reach around 65% by 2025 and 90% by 2030[114] (current total VHCN coverage is 59%). While these forecasts could be optimistic in view of the uncertainty regarding the actual use of State aid and EU funding, they are consistent with projections made by Analysys Mason[115], although below those made by IDATE for the FTTH Council Europe. From 2025 onwards, ICF, WIK & EcoAct assume that cable networks will be gradually transitioned towards FTTH and thus eventually incorporated within the FTTH figures.

Similarly, based on available literature[116] and experience with the deployment of previous generations of mobile technology[117], ICF, WIK & EcoAct predict that 5G population coverage based on low frequencies such as 700MHz ('basic' 5G) as a proportion of the population will be

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[109] Civil works co-ordination is used extensively for ECN networks in only a few countries such as Belgium, Slovenia and some municipalities in Sweden (support study surveys and questionnaires). ECN operators generally favour re-use of existing physical infrastructure where available over civil works co-ordination.

[110] Either through duplication of networks in areas where this is economically viable, or through competition "for the market" in areas where only 1 VHCN is viable.

[111] https://digital-strategy.ec.europa.eu/en/policies/broadband-eu-countries.

[112] Commission Communication "*Connectivity for a Competitive Digital Single Market - Towards a European Gigabit Society*" of 14 September 2016, COM (2016) 587 final, https://eur-lex.europa.eu/legal-content/en/TXT/?uri=CELEX%3A52016DC0587.

[113] 2020 WIK found in a 2020 study for the EC (DG Competition) that Member States (including the UK) had committed a total of EUR 11.5bln of aid for the construction of broadband networks, and this had leveraged a further EUR 6bln in private or other complementary public investments. This funding was linked to the deployment of 18m lines on completion of the projects, but only 13m were based on Gigabit-capable FTTH/B technology, which if all targeted at rural areas would result in Gigabit-capable coverage in rural areas reaching only 54% of rural households.

[114] The support study considers that while 8 Member States have already achieved fibre coverage levels of more than 70%, the current low EU average FTTH penetration levels (of around 42%) are influenced by a number of Member States which have limited FTTH penetration today, but where incumbents and other investors have plans to increase this penetration within the coming years. For example, Deutsche Telekom plans to reach 10m homes with FTTP by 2024, and analysts predict that it will serve 60% of households by 2030, complementing coverage by other players in the German market, which would be likely to extend coverage further. Open Fiber has stated its intention to serve 19.5m households by 2024 (74% of the total households in Italy). Credit Suisse also expects incumbents in Ireland, Italy, Belgium and the Netherlands and to expand their fibre coverage to more than 40% of households by 2024, while the French incumbent is expected to achieve FTTH coverage of more than 90% within this timeframe.

[115]Analysys Mason (2020) Full fibre access as strategic infrastructure: strengthening public policy for Europe.

[116]https://www.analysysmason.com/consulting-redirect/reports/filling-europes-5g-coverage-gaps/.

[117] Deployment of a given mobile solution typically takes between 3-5 years.

largely complete by the end of 2026. However, geographic coverage will continue to lag behind[118]. Moreover, deployment of mid-band 5G, which will support higher bandwidths and low latency IoT applications, is likely to be restricted to major cities and highways, reaching 30% of the population at the end of 2025 and extending to only 75% by 2030[119]. Some streamlining of resources would occur but 5G adoption in Europe (excluding IoT and Fixed Wireless Access (FWA)) would significantly lag behind that of the US and Japan by 2025[120] and EU's FTTH coverage would be below that of China and Japan.

The recent Commission initiative on a Union Secure Connectivity Programme complements the BCRD while having a different objective. The latter aims to facilitate broadband access by satellite to areas that lie beyond the reach of other fixed and mobile electronic communications network infrastructure. However, satellite is not considered to be a substitute for fixed broadband technologies from a performance perspective[121], and its main purpose is to ensure resilience and provide ubiquitous high-speed broadband capacity for governmental users including in otherwise 'dead zones' rather than the Gigabit speeds required in the post-COVID digital era. It should also be noted that under that initiative, the EU would have the right to prioritise the provision of governmental services over commercial services. The Secure Connectivity initiative is part of the EU's attempts to improve its strategic autonomy, i.e. being less reliant on non-EU actors, especially regarding technology. It should also be noted that satellite and 5G for wireless/mobile connectivity, including Fixed Wireless Access (FWA), are different technologies. Both 5G FWA and satellite will be used though to provide connectivity in rural areas, islands and outermost regions. Speeds they can provide are also different.

5.2. Description of the policy options

The table below presents the different measures included in each policy option.

Except for option 1 (minimalistic changes), the policy options do not differ as to the legal form to be chosen for the revised legal instrument which should take the form of a **revised Regulation** covering all substance areas. A Regulation will overcome the current shortcomings resulting from the extent of the optional provisions of the BCRD (which led to a very patchy and minimalistic implementation). A Regulation would ensure uniform implementation, while not requiring Member States to transpose its provisions, thereby inherently opening up the possibility that the new provisions could produce their positive impact on deployments cost reduction in a shorter time period, thus providing more timely support to the achievement of the Digital Decade connectivity targets. Moreover, a Regulation would also reduce the risk of national over-regulation beyond the

[118] For instance, Ericsson forecasts that by 2026, 68% of mobile subscriptions in Western Europe will be based on 5G, but 5G subscriptions in Central and Eastern Europe are expected to reach only 35% https://www.ericsson.com/4adc87/assets/local/mobility-report/documents/2020/november-2020-ericsson-mobility-report.pdf.

[119] Analysys Mason.

[120] GSMA (2019), The 5G Guide.

[121] Developments on satellite hybrid solutions are taking place (with a global emphasis as well as Europe). In this context, the evolving convergence of terrestrial and satellite systems as well as terrestrial networks (broadcasting and mobile) transforms co-existence paradigms into opportunities for collaborative spectrum sharing. However, further analysis is required of the potential satellite use cases that hybrid solutions potentially enable in the European context, given the high penetration of terrestrial solutions. It should be noted that the revised legal instrument deals with the development of fixed and wireless infrastructure that covers all types of infrastructure and does not cover spectrum management.

EU requirements ("gold-plating") which increases the regulatory burden to EU businesses. A Regulation would therefore achieve the greatest impact in terms of the advancement of Gigabit networks deployment.

Table 3: Policy options in a nutshell

Option 1 – Update, clarify and align (minimalistic approach)	**Option 2 – Extend and strengthen, exclude VHCN from obligations**	**Option 3 (preferred) – Extend and strengthen with partial harmonisation**	**Option 4 – Extend and strengthen with full application to private assets and full harmonisation**
Minimal "facelift", mainly to align with EECC (VHCN scope instead of high-speed networks), mandate some currently voluntary measures (transparency, permit granting) and clarify certain provisions	Option 1 + the following: Exemptions for VHCN networks in order to address investment incentive problems (e.g. overbuild) Extension of access obligations to include publicly controlled (non-network) physical infrastructure (with exceptions for proportionality) Strengthening obligations on permit granting (interim deadlines, exemptions, etc.)	Option 2 (without VHCN exemption) + the following: Addressing investment incentive problems via detailed EU rules and EU level guidance (for access to physical infrastructure and coordinated civil works), rather than broad exemptions Improved transparency: information sent by all network operators (with exceptions for proportionality), georeferenced information, all planned civil works, fully digitised SIPs Major strengthening of obligations on permit granting procedures (e.g. tacit approval, 'one-stop-shop' fully digitised platform, EU definition of permit exemptions, fees limited to admin costs, consistency of permit granting procedures at national level) Mandate in-building fibre wiring and standardisation / certifications, of in-building physical infrastructure (national level) and guidance on access to in-building (EU level)	Option 3 + the following: Extension of obligations to all private network operators and other private agents holding non-network assets (for access to physical infrastructure, civil works coordination, transparency) Single consolidated digital platform for physical infrastructure, planned civil works and optionally permits Mandate in-building fibre wiring, standardisation of in-building physical infrastructure (EU level) and guidance on access to in-building (EU level)

Policy option 1 - *brings only few changes, does not extend much obligations (only in 2 areas: permits and transparency) and brings no further EU harmonisation.* It is very minimalistic with some corrections and updates and no major changes in the obligations, except for a few. Policy option 1 relies on the consideration that a slightly revised Directive, coupled with the continued implementation of the Connectivity Toolbox best practices and the rest of the electronic communications framework, could be a balanced minimalistic way to improve the effectiveness of the most critical areas of the BCRD. First, mandating the provision of information held by public bodies in electronic format via SIP would address the problem of lack of or incomplete information about existing physical infrastructure. Second, mandating permit applications by electronic means and compensation for damages incurred due to delays in permit granting procedures would address the problem of reducing time and costs needed to obtain permits.

Among ECNs, a substantial majority support the submission of permit applications by electronic means. A large majority of other operators as well as of public authorities equally agrees that a key measure is the submission of permit applications by electronic means.

In addition, the Directive would also align it with the European Electronic Communications Code and its objectives, in particular the deployment of VHCN, which makes it technologically neutral and future-proven.[122] Finally, Option 1 would clarify some existing provisions with the view to align different interpretations of the same provisions across Member States (such as permits, publicly financed projects subject to civil works coordination) and clarify that assets subject to EECC or state aid obligations are excluded from parallel BCRD access obligations. Given its minimalistic changes, this option is expected to produce a limited impact thereby strengthening the single market only to a limited extent.

Policy option 2 - *brings more changes and new obligations (although mainly to public bodies while exempting VHCN operators from some) but not much new harmonisation as it still leaves Member States margin to define several elements*. Concretely, this option (but also options 3 and 4) increases the obligations on public authorities notably as regards access to their non-network public physical infrastructure because it is critical for VHCN deployment, notably of 5G mobile networks. Instead it exempts VHCN assets and projects from access to physical infrastructure obligations and civil work coordination to reduce the burden on VHCN operators and remove all together the risks of unviable overbuild[123] (however in so doing it risks emptying most of the regulation of its value). Option 2 leaves margin to Member States to define still many elements (such as the exceptions for sensitive public buildings or assets which could be defined by Member States themselves, and a coordinating body which, where appointed by Member States - in some they already exist - could facilitate the access requests and the processing of the request by public authorities).

This option is expected to improve measures on access to existing physical infrastructure, transparency, civil work coordination and reduce administrative burden by facilitating permit granting. It is therefore likely to strengthen the single market, by for instance facilitating market entry from different Member States or facilitating deployment of 5G networks which can support cross-border services and applications.

Irrespective of their market position, many ECN operators have requested the extension of access and transparency obligations to non-network physical infrastructure held by public bodies, as well as clearer and simpler rules on permits.

Policy option 3 *overall increases the changes (which affect all areas of the BCRD) and introduces new obligations which are both on public bodies and network operators and the level of EU harmonisation*. Option 3 would largely maintain the measures included in Option 2 (including the enlargement of the scope of the obligation to grant access to non-network publicly owned physical infrastructure and the few permit measures) but instead of providing for an exemption for VHCN infrastructure, it would define clearer rules in the Regulation on key aspects of access to physical infrastructure and civil works coordination (such as ‘fair and reasonable’ access conditions, alternative means of access or cost apportioning for coordinated civil works) as well as on grounds for refusal of access to physical infrastructure or coordination of civil works. Such rules would be

[122] This alignment to VHCN scope incentivizing VHCN deployments and matching the current/future connectivity needs would mean that ECN operators deploying low performance networks would not be able to benefit from the measures foreseen under the new initiative (same situation as for deployments below 30Mbps under the current Directive). This impact is expected to be limited as most ECN operators do not deploy anymore or rarely low performant networks and those who do could possibly benefit for example from other forms of regulated access (derived from SMP or state aid).

[123] A more nuanced exemption consisting in limiting the exemption to some geographical areas was discarded. Experience with the implementation of Article 22 of EECC on mapping and the related BEREC guidelines has shown the challenges for clearly defining specific areas and hence to formulate clear related exemptions and implement them..

accompanied by guidance at EU level to ensure a consistent application and a harmonized approach to similar problems. Thus, the problem of unviable overbuild would be tackled through EU rules and guidelines, allowing to limit the refusals to provide access or coordinate civil works to more specific circumstances and on a case-by-case basis compared to Option 2. This option would also establish consistent rules and processes on permit granting at national level supported by a 'one-stop-shop' based on a single national digital platform/tool, tacit approvals of permit requests/rights of ways where possible, and limit permit fees to the level of administrative cost. Deployments subject to exemption from permit granting would be specified at EU-level. This option would hence overall address the problems of high complexity, timeframes and costs to obtain permits and rights of way in a more harmonised manner.

ECNs and their business associations, public authorities and operators of physical infrastructure intended to host ECN largely support integrating permit granting and setting a single entry point (one-stop shop). However, public authorities (notably local authorities which are competent for permit granting in most of the Member States) which already use digital platforms for permit granting (sometimes not limited to ECN) or for making available information on physical infrastructure and civil works have concerns if they would not be able to keep their current digital systems/tools while those who would have to build one from scratch have concerns as regards the administrative burden, cost and time associated with setting-up a 'one-stop-shop'.

To improve transparency conditions and access to information, this option would expand information requirements on existing physical infrastructure (i.e. which shall be geo-referenced and provided directly by all network operators (public and private), with some exceptions to ensure proportionality) as well as on planned civil works (proactive notification of all planned civil works) and require both sets of information to be available in respective digital platforms, and if possible interconnected.

The majority of stakeholders, including BEREC, consider that the availability of constantly updated information via the SIP on planned civil works and on physical infrastructure is relevant to network deployment, including information on georeferenced location. According to most of stakeholders, a unique information repository to be populated by network operators and public bodies would be the best mechanism for ensuring the most appropriate and efficient access to relevant information regarding existing physical infrastructure and planned civil works. In BEREC's view, an obligation for all network operators to proactively make available via the SIP the relevant information on planned civil works would increase coordination and respectively decrease investment costs.

In order to address problems of lack of or access to suitable in-building infrastructure and to ensure every EU household has access to Gigabit connectivity, this option would mandate fibre-ready in-building infrastructure and fibre in-building in every new (or majorly renovated) household as well as standardisation of in-building physical infrastructure at national level and guidance on access to in-building infrastructure at EU level (together and consistent with that of access to physical infrastructure). As this option is expected to significantly improve measures on access to existing physical infrastructure, transparency, civil work coordination and reduce administrative burden by facilitating permit granting, it would also strengthen the single market, by for instance facilitating market entry from different Member States or ensuring 5G networks are developed to support cross-border services and applications.

BEREC's view is that in-building physical infrastructure should not only be accessible but also should be built so that access is possible, making newly constructed buildings 'broadband ready'.

ECN operators see the provision of suitable in-building infrastructure and the access to it as an absolute necessity for residential fibre roll-out and call for enhancing the current provisions on in-building infrastructure, including raising the ambition from high-speed to VHCN/fibre. They also propose an obligation for building owners to deploy and give access to in-building fibre wiring. However, some public authorities deplore the lack of obligation for co-owners to invest in in-building infrastructure. Most stakeholders see technical standards and guidelines as key for the provision of suitable in-building infrastructure and to reduce the number of disputes.

Policy option 4 - *is the most far reaching in terms of number of changes, it further extends obligations to private network operators owing physical infrastructure and to private agents owing assets which are not part of a network (e.g. commercial buildings) and harmonises all elements at EU level*. Option 4 would entail maximum EU-level harmonisation, because it would include all the measures in policy option 3, but it would extend new obligations for network operators, public authorities and even other private operators. Specifically, it would extend access and transparency obligations to certain private assets (e.g. commercial buildings) and obligations of civil works coordination also to projects which are not publicly funded. This option would mandate the establishment of a combined single digital platform for existing physical infrastructure, planned civil works and, optionally, permit granting procedures. Finally, this option would mandate standardisation of in-building physical infrastructure at EU level (compared to standardisation at national level in policy option 3). Because of the number and reach of the changes it would bring, this is likely to be the option that would strengthen the single market the most.

5.3. Options discarded at an early stage

The repeal of the existing Directive would imply removing current EU-level obligations and relying entirely on soft law measures such as the Connectivity Toolbox to guide Member States in limiting costs and administrative burdens at national level. The option was considered (broadly on qualitative terms) but discarded upfront as the identified problems would be expected to increase, given the lack of some minimum harmonised rules, for example in areas such as establishing deadlines for permit granting procedures or promoting coordination of civil works. Also having in mind that broadly all categories of stakeholders have confirmed the relevance of BCRD and its objectives and pointed to areas of improvements, the repeal option should be discarded.

6. WHAT ARE THE IMPACTS OF THE POLICY OPTIONS?

In order to proceed with the assessment of the economic, societal and environmental impacts of the four policy options, we have mainly relied on the results provided by a cost model and theory-based modelling exercise developed as part of the support study by ICF, WIK & EcoAct, which is briefly described below (see Annexes 5 and 7 for the full description of the methodology and underlying assumptions).

The model used in the support study is a **detailed bottom-up cost model**, covering the use of FTTH and 5G Fixed Wireless Access in the access network and used to calculate the cost savings and potential expansion in VHCN deployment. The **main parameters** are the cost of deployment per km in different scenarios (e.g. under asphalt, aerial), the cost of network elements to be deployed (ducts, poles, fibre cables etc) and the Weighted Average Cost of Capital (WACC) which are derived from cost data used in regulatory cost models prepared by one of the contractors for the German electronic communications regulatory authority.

The type of model used, **the underlying assumptions** and rationale for those assumptions are described in Annex 5 and in more detail in Annex 4 of the support study. The assumptions used for the modelling were based in part on inputs from stakeholders via surveys and interviews (as well as on benchmarks) carried out as part of the support study. The assumptions made concerning the impact of the different options on outcomes concerning infrastructure re-use and other factors are shown in Tables 1 and 15 (in Annex 5). The different elements of each option are listed alongside assumptions regarding the directional effects (showed using + and -). These are then used to adjust the model inputs for factors such as the proportion of shared ducts and poles, and civil works coordination, the wholesale charge for access to physical infrastructure, etc.

The assumptions made concerning the impact of the different policy options on outcomes concerning infrastructure re-use and other factors used for the modelling were partly based on **inputs from stakeholders via surveys, interviews and workshops** (as well as on benchmarks), as part of the support report. These assumptions were presented to the stakeholders during a workshop organised by the contractors of the support study on 27 January 2022 where the contractors presented the methodology and main conclusions of the support study and stakeholders had the possibility to comment.

It should be noted that according to the consultants, the **modelling approach is very mature** because it has been used and continuously updated in various projects (prior to being applied to the impact assessment of this initiative). In doing so, the model has received peer quality reviews from the consultant group, as well as reviews by different project partners/customers, national regulatory authorities and governments. In general, the use of a regulatory cost model as a basis for the exercise makes the calculation more robust than other types of more simplistic modelling.

The expected direct policy effects of the different policy options on accessing existing infrastructure and civil works co-ordination as well as their effects on the timing of VHCN deployment (step 1) were fed into a specially adapted cost and viability model developed by contractors. This in turn provided estimates of the impact of the policy options on the cost of FTTH and 5G deployment, and the potential additional coverage that could be achieved if cost savings were reinvested in VHCN deployment (step 2). These scenarios were translated into effects on broadband speed and bandwidth consumption (step 3), which enabled an assessment of the economic and environmental impact of the policy options on GDP and GHG emissions, based on correlations between these factors established in academic literature (step 4). The societal impact is instead described in qualitative terms.

6.1. Economic impact

The cost model calculates the total capex requirements and viability of deployment in given areas on the basis of assumptions made regarding the degree of infrastructure sharing and civil works co-ordination that might result from the different policy options. Assumptions concerning the effects of different options on the degree of infrastructure sharing and civil works co-ordination (step 1) have been developed on the basis of data gathered from dispute settlement bodies and ECN operators alongside interviews conducted for the support study and relevant literature revised by the contractors.[124] The following table summarises the main estimates for step 1:

[124] Including the fact that the model in the support study assessed the deployment business case for an operator which does not have ubiquitous physical infrastructure of its own.

Table 4: Estimates of the increases of the different options on infrastructure sharing, co-deployment, and the timeframes for deployment (step 1)

	Baseline	Option 1	Option 2	Option 3	Option 4
Shared use of ducts (% new VHCN deployment in existing PI)	5%	6%	6%	8%	8%
Shared use of poles (% new VHCN deployment in existing PI)	15%	17%	17%	20%	20%
% new deployment based on civil works co-ordination	3%	3%	3%	5%	7%
Wholesale price for access to existing physical infrastructure (wholesale price per metre for duct access EUR)	0.05	0.05	0.05	0.04	0.04
Wholesale price for access to existing physical infrastructure (wholesale price per metre for pole access EUR)	0.04	0.04	0.04	0.03	0.03
Total sites needed to provide universal low frequency 5G coverage	5275	5275	5275	5275	5275
Cost of deploying macrocells (cumulative present value of costs EUR)	110, 000	110000	99000	94000	92000
Cost of deploying small cells (average cost per installation EUR)	34	34000	29000	24000	23000
Cost of in-building infrastructure per premise (greenfield) EUR	200	200	200	200	200
% premises for which there is a reduction in cost for in-house infrastructure	10%	12%	12%	17%	15%
% cost reduction compared with newly built infrastructure	30%	35%	35%	75%	75%
Wholesale market share attainable in less dense areas (where duplication is not viable)	70%	70%	75%	75%	75%
Average time taken to achieve 90% FTTH coverage from a baseline of 65% (months)	60	60	57	54	56
Average time taken to deploy full 5G to achieve 75% population coverage (via 3.6 GHz) from a baseline of 30% coverage (months)	60	59	54	52	54

Source: support study

On the basis of detailed modelling using an adapted bottom-up cost model for the deployment of VHCN, the support study estimated the following impact in terms of km of new network built by 2030 depending on the degree of infrastructure sharing and co-ordination of civil works achieved with the different options. The efficiencies achieved could reduce the cost of deployment and reduce the required subsidies[125]. The next step has assessed what would be the VHCN coverage increase in case the savings are all reinvested in additional FTTH coverage beyond the base case in which case FTTH coverage is assumed to reach 90% by 2030 (scenario A) or in case they are all

[125] The business case for investment and required subsidies have been calculated for policy option 3 on the assumption that the operator deploying infrastructure has an average penetration of 75% by 2030. This may be realistic on the basis that many of the areas that are still to be served with FTTH in the EU may only be viable for 1 (or at most 2) infrastructure-based providers. Progress is expected to have been made towards switch-off of legacy networks by 2030. If take-up is lower than 75% of homes passed, then the required subsidies would be higher than projected.

reinvested in deploying 5G FWA in unserved areas (scenario B) rather than deploying FTTH or maintaining FTTC in those areas. The increase in the deployment of mid-band 5G has also been estimated. Both scenarios are relevant, and ECN operators and Member States (via subsidy programmes) might choose either option or a combination depending on the specific characteristics of the rural areas to be served and the bandwidth needs of the populations / industry in those areas. These scenarios are useful in terms of allowing a quantitative comparison of the options, even if there would be many factors affecting the actual decision about the use-reinvestments of the cost savings achieved[126].

The following table summarises the main results after step 2, which already show that options 2 and 3 are the ones which are contributing the most to the objectives of the imitative (namely Gigabit coverage for all households in the EU and 5G in all populated areas):

Table 5: Outcomes of the model (step 2)

	Outcomes of the model (step 2)			
	Shared infrastructure / co-deployment (km)	Cost / subsidy savings (bln EUR)	VHCN coverage by 2030 (FTTH / 5G FWA)	Coverage of mid-band 5G
Baseline	249,662	-	90% / 90%	75%
Option 1	292,702	4.8 / 0.4	91.6% / 97%	75%
Option 2	297,407	1.6 / 1.6	93.5% / 98.5%	76.5%
Option 3	468,344	14.5 / 2.4	96.5% / 99.1%	77%
Option 4	528,498	17.5 / 2.6	96.8% / 99.2%	77%

Source: support study

Then the model assesses the impact in terms of broadband speed and bandwidth consumption, to finally obtain the outcome in terms of GDP, jobs and GHG emissions. Table 7 included at the end of this section provides for the overall conclusions of this analysis. As a result, policy options 3 and 4 are likely to have the most significant positive impacts for economic and societal development as well as in limiting GHG emissions from the electronic communications sector during a period where bandwidth consumption is expected to expand rapidly.

There is widespread literature on the topic of economic impact of improved broadband quality in terms of GDP growth and job creation. Literature suggest that the increased availability of VHCN that could be supported through the revision of the BCRD is likely to create positive spill-over effects as digitisation is used to improve energy efficiency in other highly polluting sectors such as buildings and transport. In addition, a key driver of economic benefits from 5G is expected to come from knock-on effects in other sectors resulting from 5G applications (including IoT), such as in healthcare, manufacturing, transport, energy or agriculture. However, these effects could not be quantitatively assessed.

[126] The scenario of reinvesting all savings in 5G FWA for the last 10% is what seems to be happening in countries such as Sweden and Estonia which have decided to rely on wireless infrastructure in the most rural areas rather than more costly fibre. The US may also go down this route. This approach would enable full (near 100%) coverage of Gigabit capabilities thereby limiting the urban rural digital divide, but the speed and service quality in rural areas would be less than that in areas benefiting from FTTH (and thus some quality divide would persist). The alternative scenario of reinvestment in FTTH provides an alternative approach focused on quality, but shows that complete coverage would not be reached in this case. Member States may decide to choose scenarios lying between these 2 extremes, in which case the outcomes (in terms of coverage, speed, GDP impact) would also lie between the results shown.

Drawing on the literature, the support study assessed the economic impact based on a theory-based model estimating how expected increases in fixed and mobile speeds resulting from the different policy options for the revision of the BCRD might impact GDP. The modelling approach draws on the elasticities estimated respectively by the 2SLS model in Bohlin Rohman Kongaut (2017) for FTTH and Edquist *et al.* (2018)[127] for the impact of 5G on the basis of the impact that resulted from 4G) .[128] The main results of the theory-based modelling exercise developed in the support study are provided in this section (see Annex 5 for more details).

As regards the impact of 5G (2023-2030) and fixed VHCN (2023-2030) on GDP, the following table displays the overall increment to GDP resulting from increased fixed VHCN and 5G deployment compared with the baseline and distinguishing scenarios A and B for fixed network reinvestment.

Table 6: Incremental impact options on GDP up to 2030 (billion EUR) from 5G and fixed VHCN

Scenario	Option 1	Option 2	Option 3	Option 4
5G + fixed VHCN (A)	21	56	105	109
5G + fixed VHCN (B)	16	26	39	39

Source: support study

As shown above, scenario A (savings are reinvested in additional FTTH coverage beyond the base case) appears to have a greater GDP impact than scenario B (savings are reinvested in deploying 5G FWA in unserved areas) across all policy options, suggesting that the impact of the increases in VHCN coverage that could be achieved by focusing on 5G FWA rather than FTTH in rural areas are counteracted by the reduced speeds that would be achieved by serving rural customers with FWA instead of FTTH.[129]

However, policy-makers might consider that equity gains might exceed economic gains in the second scenario. More generally, there is an ongoing debate in the literature over the equity-efficiency trade-off considering that investing in rural areas would address the digital divide but at the expense of not pursuing efficiency gains. The theory of efficient markets indicates that resources should be allocated where the return on investment is maximized[130]. In contrast, investing in rural areas would improve digital equity by reducing digital disparities. However, the final results on GDP impact of both scenarios are uncertain given the number of factors intervening.

[127] Edquist H., Goodridge P., Haskel J., Li X., Lindquist E., "How important are mobile broadband networks for the global economic development?", Stockholm, Sweden, 2018, page 18. Available at: https://www.sciencedirect.com/science/article/pii/S0167624517301695?casa_token=1bgDcPUBOz0AAAAA:l6bubQB3Xe9pmMyebwnRrc9jGZzW6L8dnejxrkfQ3EFQy0iqBiGxEyCSgfTr5UDJZG9M_ryOu_8.

[128] As regards the estimations of impact of 5G (mobile) on GDP, the authors (Edquist *et al.* (2018)[128]) found that a 1% increase in coverage results in 0.02% GDP growth per capita. The authors made use of data for 4G technology from the OECD countries panel. Given the limited availability of quantitative studies on 5G due to the novelty of such technology, this study seems the most appropriate proxy at the moment. However, it should be noted that relying on these results, presupposes that the positive GDP effects of speed increases associated with 4G will continue to apply as speeds increase further with increasing take-up of 5G. In reality, the annual change of GDP growth decreases in time as the projections assume a positive but decreasing growth rate.

[129] The speed gap between FTTH and FWA offers is very significant in most cases. If speeds made available via FWA increase by more than expected, the gap between the two scenarios could be less.

[130] Pereira J.P.R., 2016. Broadband Access and Digital Divide. In: Rocha Á., Correia A., Adeli H., Reis L., Mendonça Teixeira M. (eds) New Advances in Information Systems and Technologies. Advances in Intelligent Systems and Computing, vol 445. Springer, Cham. https://doi.org/10.1007/978-3-319-31307-8_38

Moreover, the modelling has also estimated that the additional bandwidths and reach of the FTTH networks could contribute to the creation of around 154,000 jobs under policy option 1, 338,000 jobs under policy option 2, 627,000 jobs under policy option 3 and 656,000 under policy option 4. The estimations regarding the impact of increased VHCN deployment on **jobs** are considered less robust than those on GDP because there is less peer reviewed literature available and the results of research which has been conducted vary, potentially because studies focus on specific countries such as Sweden and the US, and may not be representative.[131] For this reason, the estimates regarding impact on jobs should be given less emphasis and treated as rough estimates (or alternatively shown through directional symbols such as '+', '++' etc.). It should be noted that the rough estimates given should be underestimates, because they do not take into account potential effects on job creation from 5G applications. There are (commercial) studies listed in the report about the potential effect of 5G on job creation, but such estimates are very speculative because they look at the possible effects of new applications that have not yet been rolled out to any significant degree in Europe or elsewhere, and there is limited data available on which to conduct empirical research.[132]

Although difficult to quantify, it is expected that there will be a spillover effect on different sectors of the economy from 5G and IoT. For example, new IoT applications in fields ranging from CAM, smart cities to smart factories, smart agriculture and smart grids, can positively impact productivity in those sectors and bring competitive advantages for business while also creating jobs. Such effects could have a multiplier effect with different rounds of impacts as discussed in the literature[133].

6.2. Societal impact

The examples of societal benefits from Gigabit broadband are numerous and include home care applications, greater educational opportunities, support for teleworking and improved entertainment options, as well as boosting consumer welfare. In a recent study in the UK assessing the impact of superfast broadband on wellbeing, Simetrica-Jacobs found that having access to superfast broadband was associated with an increase in wellbeing worth around £225 (equivalent to around EUR260) per household per year.[134] Although in this study, superfast broadband was defined as having a download speed of only 24Mbit/s, other research confirms that services which require higher bandwidths could provide equal (or even greater) contributions to consumer welfare and play an important role in reducing inequalities.Inadequate broadband connectivity is likely to be particularly accentuated in rural areas, because the cost of deployment is significantly higher. The effects of inadequate connectivity (amongst other factors) may have been amongst the drivers of

[131] For example, an OECD report which examined the effect of fibre networks in 290 municipalities in Sweden for the period 2010 – 2012 further found that on average 10% higher FTTP/FTTB penetration is correlated with a 1.1% higher employment rate, when controlling for other significant factors such as urbanisation level, population evolution, income, education level and business creation. Using a two-way fixed effects regression model on a panel of 3,142 U.S. counties for the period 2001 – 2013, Lapointe (2015) shows that a 10% increase in the percentage of households with access to fibre (FTTP/B) network is associated with a 0.13% increase in total employment and a 0.1% increase in the number of firms at the county-level.

[132] Tech4i2 (2019) estimates for Switzerland that 5G-enabled output will be supporting 137,000 jobs (1.5% of the population) in 2030.643 Omdia (2019) forecasts a slightly more conservative net positive impact by 5G on employment of 0.6% of the population across five countries analysed by 2030.

[133] Prieger, J.E., 2020. An economic analysis of 5G wireless deployment: impact on the US and local economies. Fahn, M. and Yan, S., 2021, April. Analysis of the Impact of 5G Development on the Macroeconomy. In 2021 6th International Conference on Social Sciences and Economic Development (ICSSED 2021) (pp. 255-259). Atlantis Press.

[134] See Annex C 'Subjective wellbeing analysis of the Superfast Broadband programme', which sits as part of a wider report 'Evaluation of the Economic Impact and Public Value of the Superfast Broadband Programme' (2018).

rural unemployment and depopulation. Various studies suggest that improved broadband connectivity in rural areas could help to reverse the trend of depopulation of rural areas and ensure more equitable distribution of economic benefits. There is a wide range of literature that suggests that rural communities that would otherwise suffer from depopulation and unemployment benefit disproportionately from the deployment of Gigabit infrastructure, as it supports rural job creation and offers the potential for remote households to benefit from remotely delivered services including education and healthcare. According to the latest World Social Report published by the UN in May 2021, improved Internet access and connectivity will provide better jobs and higher standards of living for the roughly 3.4 billion people living in rural areas.[135]

Faster broadband can also support more efficient delivery of healthcare in rural areas (as well as elsewhere). A study assessing developments in Sweden[136] found significant savings in using digital FTTH-based homecare especially in rural areas. It concluded that even with limited adoption, these solutions could contribute to annual net cost reductions of $0.6m in a rural municipality with 8,000 residents by 2020. In another study, examining the effects of ultrafast broadband deployed in the rural country of Cornwall in the UK, Garner et al. (2019)[137] found, that eHealth readiness improved over 18 months from 4.36 out of 10 to 4.59 out of 10. The authors concluded that one of the reasons for improved readiness for the adoption of eHealth services was the rollout of ultra-fast broadband, which increased both peoples personal ability to use eHealth and their methods of access.

One important function of Gigabit broadband, which has received increased attention following the COVID-19 pandemic, is the ability to support remote working. Teleworking may be associated with many benefits for employees, such as increased job satisfaction, organizational commitment, and job performance and lower work stress and exhaustion.[138] A quantitative model estimation by SQW (2013)[139] of the projected social impacts of faster broadband speeds (although not FTTH per se) shows that the increase in teleworking driven by faster broadband would save about 60 million hours of leisure time per annum in the UK by 2024. In addition, by avoiding commuting costs, the additional teleworking enabled by faster broadband would lead to total household savings rising to £270 million p.a. by 2024, and would result in lower pollution. Furthermore, SQW projected that increased productivity from teleworking could reach £1.8 billion by 2024. However, Samek Lodovici et al. (2021) note on a societal level that teleworking may contribute to the emergence of new employment and social inequalities, between those who can telework and those who cannot, because they are employed in non–teleworkable sectors/occupations[140] or have no access to a

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135 United Nations (2021), World Social Report 2021, https://www.un.org/development/desa/dspd/wp-content/uploads/sites/22/2021/05/World-Social-Report-2021_web_FINAL.pdf

136 Forzati, M. and C. Mattson (2014), FTTH-enabled digital home care – A study of economic gains, Department for Networking and Transmission, Acreo AB.

137 Abbott-Garner P, Richardson J, Jones R.B. (2019), The Impact of Superfast Broadband, Tailored Booklets for Households, and Discussions With General Practitioners on Personal Electronic Health Readiness: Cluster Factorial Quasi-Randomized Control Trial. In Journal of Medical Internet Research, Vol 21, No 3 (2019): March. https://www.jmir.org/2019/3/e11386/

138 Article published in *Psychological Science in the Public Interest* Allen, T.; Golden, T.; Shockley, K. (2015), How Effective Is Telecommuting? Assessing the Status of Our Scientific Findings. In Psychological Science in the Public Interest 2015, Vol. 16(2) 40–68. Golden, T; Gajendran, R. (2019), Unpacking the Role of a Telecommuter's Job in Their Performance: Examining Job Complexity, Problem Solving, Interdependence, and Social Support; *Journal of Business and Psychology* volume 34, pages55–69 (2019).

139 SQW (2013), UK Broadband Impact Study

140 Sostero et al. (2020) estimate that the share of teleworkable occupations ranges between 35% and 41% in two thirds of EU countries. ILO (2020) estimates are around 30% of workers in western Europe and 18% in eastern Europe are in tele-workable occupations, with the main difference stemming mainly from differences in Internet availability, as well as the sectoral composition of the economy.

broadband connection.[141] Thus, the absence of a suitable connection to support teleworking (and the failure to digitize in sectors which could take advantage of remote working opportunities) could have detrimental effects on equality and societal cohesion.

The COVID-19 pandemic has also highlighted the importance of ultrafast connectivity for education,[142] confirming the need not only to ensure high performance connectivity for students but also for schools and higher education institutions themselves.[143] A recent report from the Broadband Commission as well as a White Paper by Hyperoptic[144] illustrate, on the basis of various case studies, the overall benefits education and school connectivity can bring to society.[145]

Moreover, many of the existing studies focus on the effects of FTTH or higher speed fixed broadband infrastructure, because applications for these technologies are already well-developed, but it should be noted that, due to its additional capacity as well as quality characteristics 5G could support the development and use of new types of innovative content, applications and services which contribute to societal welfare including improvements in transport (both private and public) and smart city applications.[146]

As regards the implications for the initiative, the societal impact of the different policy options for the revision of the BCRD is intrinsically linked to their capability to accelerate and expand fixed and mobile VHCN deployment. As policy options 3 and 4 have been shown to have the greatest potential in this area (see previous section), we can also conclude that these policy options would provide the greatest contribution to wider societal benefits including reductions in the urban-rural digital divide, and improved access to digital healthcare and remote education or teleworking solutions. Policy option 2 would provide only moderate benefits and policy option 1 only limited benefits, linked to their expected effect in terms of VHCN deployment. Importantly, pursuing policy options 3 or 4 would also provide monetary savings for governments engaged in subsidizing broadband deployment of around EUR 2.4bln, which could potentially be used either to invest in more rural coverage (through FWA or FTTH) or to directly invest in public services.

In addition, policy options 3 and 4 would contribute to the increased re-use of existing infrastructure and co-ordination of civil works, which would limit roadworks and construction,

141 Samek Lodovici et al. (2021), "The impact of teleworking and digital work on workers and society". Study requested by the EMPL committee, p. 15 (https://www.europarl.europa.eu/RegData/etudes/STUD/2021/662904/IPOL_STU(2021)662904_EN.pdf)

142 According to a United Nations Policy Brief of mid-April 2020, 94% of learners worldwide were affected by the pandemic in 200 countries United Nations Policy Brief: Education during COVID-19 and beyond, https://www.un.org/sites/un2.un.org/files/sg_policy_brief_covid-19_and_education_august_2020.pdf

143 Connectivity gaps for such institutions have been highlighted even prior to the COVID pandemic – see eg Ecorys, WIK et al (2020) Supporting the Implementation of CEF2 Digital https://op.europa.eu/en/publication-detail/-/publication/8947e9db-4eda-11ea-aece-01aa75ed71a1/language-en

144 Hyperoptic(2020),Understanding the Social Impact of hyperfast broadband, https://hyperoptic.com/wp-content/uploads/2020/05/sclvlpage.pdf. Prepared by Hyperoptic with HACT (Housing Associations' Charitable Trust) & Simetrica-Jacobs

145 Broadband Commission (2020), The Digital Transformation of Education: Connecting schools, Empowering Learners, https://www.broadbandcommission.org/wp-content/uploads/2021/02/WGSchoolConnectivity_report2020.pdf

146 See discussion in WIK (2019) Analysis of the Danish Telecommunication Market in 2030 https://www.wik.org/fileadmin/Studien/2020/Analysis_of_the_Danish_TK_Market_in_2030.pdf and WIK (2018) The role of wholesale only models in future networks and applications https://stokab.se/download/18.796da515175469f3e544f/1603888583380/The%20role%20of%20wholesale%20only%20models%20in%20future%20networks%20and%20applications%20(2018)%20WIK-Consult.pdf

which can itself be a source of social cost to nearby residents.[147] In fact, according to the cost and viability model of the support study, policy options 3 and 4 would more than double re-use of existing infrastructure and civil works co-ordination, reducing the amount of new (greenfield) deployed networks from 530,000km under the baseline scenario to around 250,000km.

In conclusion, policy options 3 and 4 would give rise to the largest societal benefits, both directly by avoiding around 280,000 km of new civil works and indirectly – by supporting the expansion of fixed and mobile VHCN to reduce the urban rural digital divide or by releasing around EUR2.4bln funds that would otherwise have been used for broadband subsidies for other potential social or economic purposes.

6.3. Environmental impact

Digital connectivity infrastructure is essential for achieving the twin digital and green transition, which are main priorities for the Commission. In 2019, the European Commission adopted a Communication on the European Green Deal, which sets out a target for the EU to achieve climate neutrality by 2050. The Commission has also proposed an interim target to reduce greenhouse gas (GHG) emissions by at least 55% by 2030 compared with 1990[148]. Digital technologies will play a key role in the transition to a green economy, as they are important enablers of energy efficiency in other sectors[149].

In this section, the modelling is considering the potential effects of revisions to the BCRD on emissions associated with both the deployment and operation of VHCN, which are considered in the modelling exercise (see Annexes 5 and 6 for more information)[150]. The assessment of the environmental impact in terms of greenhouse gas emissions of three distinct factors is provided below: **fixed network operation**, **fixed network deployment** (most significant impact) and wireless, including **mobile, network operation**[151].

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[147] See for example Celik, Budayan (2016) How the residents are affected from construction operations conducted in residential areas

[148] In June 2021, the Council and Parliament adopted legislation that enshrines these objectives into Europe's first Climate Law (https://data.consilium.europa.eu/doc/document/PE-27-2021-INIT/en/pdf).

[149] As an illustration, a paper submitted to the World Economic Forum estimated in 2019 that CO2 emissions could be reduced by 15% globally because of digitisation (Ekholm, B, Rockström, J. (2019), "Digital technology can cut global emissions by 15%. Here's how.").

[150] Other type of impacts are minor in comparison (with the exception of materials used in equipment and in particular end-user equipment, which is outside the scope of BCRD), cannot be readily quantified, and there is limited available literature (see BEREC study on the "Environmental Impact of electronic communications"). As regards the assessment of other non/less-quantifiable environmental impacts, such as e-waste, degradation of the landscape or impact on the bio-systems, it should be noted that the modelling focuses on both the potential effects of revisions to the BCRD on emissions associated with the deployment and operation of VHCN as well as the wider potential for VHCN to support reduction of GHG emissions in other sectors. However, the Impact Assessment report does not consider other types of environmental impacts beyond GHG emissions (including potential positive indirect environmental impacts) as, with the exception of material used for equipment, other impacts are of less relevance, cannot be readily quantified and there is limited available literature. There is material environmental impact associated with the production of equipment. However, the largest impact from equipment production is associated with end-user equipment (in particular from larger devices), which is strictly speaking outside the scope of this initiative. Literature concerning environmental impacts across the lifecycle of electronic communications networks is documented in the recent study from the Body of European Regulators for Electronic Communications (BEREC) on the "Environmental Impact of electronic communications". On other positive indirect environmental impacts attributable to broader network coverage, the positive impacts mostly come from knock-on effects from improvements in energy efficiency in other sectors including buildings, transport and energy.

[151] The environmental impact of mobile network deployment was not assessed due to lack of literature on impacts specific to masts, and the risk of incurring in double-counting as mobile networks rely to certain extent on common (backhaul) fixed networks.

The modelling developed in the support study has assessed total electricity consumption of the access network based on number of total subscribers over time across the different policy options. This implicitly accounts for the increase in data consumption that is expected across all policy options and in particular policy options 3 and 4. Electricity consumption estimates were based on Oberman (2020), Godlovitch et al. (2020) and JRC's Code of Conduct on Energy Consumption of Broadband Equipment (EC JRC, 2020). Assessing the GHG emissions from the electricity, the support study considers the electricity grid mix emissions based on Buck, et al., (2019).

The **results for fixed broadband operation** are summarized in the table below, which shows that in the baseline scenario, aggregate emissions across the 2020-2030 period is 23.98 million tonnes CO2e. All policy options lead to reductions in emissions with a maximum reduction of 240,300 tonnes CO2e in policy option 3. Comparatively, however, this is only a 1% reduction compared to the status quo. The main driver of reduction in emissions is the shift in subscribers from the less energy efficient technologies (ADSL, FTTC/VDSL and cable) towards the more energy-efficient FTTH. The results of the modelling exercise show that policy options involving higher increases in FTTH deployment (namely options 3 and 4) result in lower overall emissions, as the efficiency gains compensate for the effect of data consumption increases. The results are presented in the following table.

Table 7: Emissions from operation of fixed broadband networks 2023-2030

	Baseline	Option 1	Option 2	Option 3	Option 4
Aggregate t CO_2e	23,983,665	23,898,511	23,801,256	23,743,365	23,764,980
Difference vs baseline		-85,154	-182,409	-240,300	-218,685
Relative difference		-0.36%	-0.76%	-1.00%	-0.91%

Source: support study

The deployment of electronic communications networks also results in GHG emissions (and other environmental impacts) although likely a lower proportion of the total impact of ECN on GHG emissions than network operation.[152] Accessing existing physical infrastructure (as an alternative to deployment of new physical infrastructure) therefore provides an opportunity not only to reduce costs but also to avoid a large amount of the environmental impact that otherwise would have been associated with creation and deployment of new infrastructure.

The **results for fixed broadband deployment** are summarized in the following table which shows that in the baseline aggregate emissions for deployment across the 2020-2030 period is 13.7 million tonnes CO_2e. All policy options lead to increases in emissions up to 1.1 million tonnes for policy options 3 and 4. This represents over 8% increase compared to the baseline.

Table 8: Emissions from deployment of fixed broadband networks 2020-2030

	Baseline	Option 1	Option 2	Option 3	Option 4
Aggregate t CO_2e	13,708,197	13,853,193	14,283,662	14,889,433	14,830,603
Difference vs baseline		144,996	575,465	1,181,236	1,122,406

[152] Nokia - People & Planet Report 2019 suggests that deployment accounts for around 10% of the emissions associated with ECN compared with around 90% linked to network operation

Relative difference		1.06%	4.20%	8.62%	8.19%
Emissions intensity t CO2e/km	4.67	4.64	4.63	4.46	4.42

Source: Support study

The results across all policy options are driven by additional new deployment needed to achieve higher FTTH coverage, e.g. 7% increase in new ducts for policy option 3. So despite all options having a higher proportion (and absolute length) of deployment in existing ducts and poles, this is outweighed by the simultaneous need for new ducts and poles linked to increased coverage.

While in the case of fixed/mobile network operations the difference of emissions compared to the baseline is positive (i.e. a reduction of emissions); in the case of fixed network deployment, it is on the contrary negative (an increase of emissions, which for policy options of 3 and 4 represents 8% increase compared to the baseline – see table 5). This is due to the expected additional km of VHCN networks (see results of step 2 of the model), with policy options 3 and 4 leading to the highest additional deployment of networks, as well as to the highest environmental impact related to fixed network deployment. The assessment shows that all policy options are leading towards a higher proportion of network deployment based on existing ducts and poles. However, it is to be noted that this positive result is outweighed by the simultaneous need for new ducts and poles linked to the increased coverage which also results (to various extent) under the different policy options (e.g. as a result of the application of the envisaged measures, the VHCN networks coverage is expected to increase and therefore requires deployment of new ducts and poles in addition to the use of the measures under the initiative and therefore there is an associated environmental impact related to fixed network deployment).

In order to be able to identify the benefits brought by this initiative, the model does a further step and calculates what would have been the emissions derived from fixed network deployment for all the policy options, in case the deployment had been done in the same proportions of new and existing ducts/poles and civil works coordination as in the baseline (e.g. not taking into account the measures envisaged in the policy options). The results are summarised in table 6 below, which shows the benefits brought in terms of avoided emissions by the envisaged measures under the different policy options for the same amount of fixed network deployment. This exercise leads to avoided emissions of up to 0.86 million tonnes CO2e in policy option 4 and 0.70 million tonnes CO2e in policy option 3, while the amount is less for policy options 1 (0.11 million tonnes of CO2e) and 2 (0.13 million tonnes of CO2e).[153]

These results put into value that, despite the net increase on GHG emissions derived from the fixed network deployment, the foreseen measures contribute to lowering the emissions. It also confirms that accessing existing physical infrastructure (as an alternative to deployment of new physical infrastructure – greenfield approach) and coordinating civil works provide an opportunity not only to reduce costs but also to avoid a large amount of the environmental impact that otherwise would have been associated with the creation and deployment of new infrastructure in case such additional infrastructure is deployed in the absence of new measures under the BCRD.

[153] These figures come from the fourth row of Table 6 where they are expressed in tones instead of million tonnes of CO2e.

Table 9: Emissions from deployment of fixed broadband networks 2020-2030 with proportion of deployment technique as Status Quo

	Baseline	Option 1	Option 2	Option 3	Option 4
Aggregate t CO_2e	13,708,197	13,965,453	14,419,146	15,589,390	15,688,087
Difference vs baseline		257,256	710,949	1,881,193	1,979,890
Relative difference		1.88%	5.19%	13.72%	14.44%
Avoided emissions (t CO_2e)		112,260	135,484	699,957	857,484

Source: Support study

Upgrading mobile networks presents an opportunity in the ability to increase bitrates and connectivity, but equally presents challenges as total energy consumption may increase as legacy systems remain in place (Sabelle, et al., 2016). Even if traffic moves away from legacy mobile networks, 2G and 3G, in favour of 5G their energy consumption would remain. As suggested by JRC's Code of Conduct on Energy Consumption of Broadband Equipment (EC JRC, 2020) nearly 70% of the power busy-hour-load-state consumption is used in the low-load state. Switching off these systems could therefore lead to an overall reduction in energy consumption. This is confirmed in an article by McKinsey where they identify a number of tools to help reduce energy consumption. Here they identify shut down of legacy systems (2G) could lead to energy savings of 3% (Lee, et al., 2020).

The modelling has assessed total energy consumption of the access network and the results are summarized in the following table on **emissions from mobile broadband network operation**[154]. This shows that in the baseline (policy option 0), aggregate emissions across the 2023-2030 period is 4.01 million tonnes CO_2e. All policy options lead to reductions in emissions with a maximum reduction of 1,121 tonnes CO_2e in policy options 3 and 4. Comparatively, however, these are insignificant reductions of less than 0.1% compared to the baseline. The main driver of reduced emissions is the increased energy efficiency of 5G. However, increased energy efficiency is counterbalanced by expectations of significant increases in data consumption linked to the deployment of 5G networks (and in particular mid-band 5G).

Table 10: Emissions from operation of mobile broadband networks 2023-2030

	Baseline	Option 1	Option 2	Option 3	Option 4
Aggregate t CO_2e	4,015,672	4,015,268	4,015,587	4,014,551	4,014,551
Difference		-403	-85	-1,121	-1,121
Relative difference		-0.01%	0.00%	-0.03%	-0.03%

Source: Support study

[154] See footnote 148 above.

6.4. Conclusions

On the basis of what is presented in the previous sections, the following table provides an overview of the macroeconomic, societal and environmental impacts that are expected to result from the different policy options and which are analysed and compared in detail in section 7. Only scenario A (savings are reinvested in additional FTTH coverage beyond the base case) is depicted here, as it appears to have a greater GDP impact.

Table 11: Summary of macro-economic, societal and environmental impact

	Economic Impact		Societal Impact	Environmental Impact ($t\ CO_2e$)	
	GDP increased linked to reinvestment of savings (FTTH/mid-band 5G)	Jobs[155] (resulting from additional FTTH)	Reduced inequality	Net environmental impact	Fixed deployment (avoided emissions)[156]
Option 1	EUR 21bln (EUR17bln/EUR4bln)	0.0008% / 154,000	(+)	59,439	-112,260
Option 2	EUR56bln (EUR41bln/EUR15bln)	0.0018% / 338,000	+	392,971	-135,484
Option 3	EUR105bln (EUR76bln/EUR29bln)	0.0033% / 627,000	++	939,815	-699,957
Option 4	EUR109bln (EUR80bln/EUR29bln)	0.0034% / 656,000	++	902,600	-857,484

Source: support study

The symbol '(+)' indicates positive but limited benefits, '+' moderate benefits and '++' high benefits.

Finally, in relation to the so-called "**do not harm principle**", no significant negative impact on the environment has been identified. No significant harm is expected to be done to the climate and environmental objectives of the European Green Deal by the application of the envisaged measures under the policy options considered for this initiative. On the contrary, the underlying goal of the revised measures (to encourage sharing of physical infrastructure and coordinated network deployment which should boost the deployment of FTTH and full 5G, as well as the digitalisation of access to relevant information and permit granting procedures) is consistent with improved energy efficiency as well as limiting nuisance and other negative environmental effects associated with civil works. The Impact Assessment also notes that digital connectivity infrastructure would

155 Based on data on EU employment as of Q1 2021 Eurostat and assuming that 0.5% increase in FTTH coverage is linked to a 0.5% increase in employment, an average between results from Mölleryd, B. (2015), Development of High-speed Networks and the Role of Municipal Networks, OECD Science, Technology and Industry Policy Papers, No. 26, OECD Publishing, Paris and Lapointe, P. (2015), Does speed matter? The employment impacts of increasing access to fiber Internet, Georgetown University.

156 These figures indicate the avoided deployment-related emissions compared with a situation where the same (additional) deployment of FTTH occurs as is assumed for the options concerned but the degree of sharing of existing infrastructure and co-deployment remains the same as in the status quo.

help other sectors to become 'greener' and therefore is essential for achieving the twin digital and green transition, which are main priorities for the Commission.

7. HOW DO THE OPTIONS COMPARE?

7.1. Comparison based on economic, societal and environmental impact

As regards the **economic impact**, if the cost savings from increased infrastructure re-use and streamlined processes are reinvested in FTTH, we anticipate an increase to GDP of EUR76-EUR80bln in the period up to 2030 if policy option 3 or 4 are implemented while these figures drop to EUR17bln and EUR41bln if policy options 1 and 2 are implemented. In addition, measures which accelerate the deployment of mid-band 5G are expected to contribute around EUR29bln to economic growth under policy options 3 and 4, policy options 1 and 2 providing relatively for EUR4bln and EUR15bln. The additional bandwidths and reach of the fibre network under those policy options could contribute to the creation of around 627,000-656,000 jobs[157] EU-wide, policy options 1 and 2 providing relatively for 154,000 and 338,000. In addition, a further significant boost to economic growth could result from the boost to digitisation of other industries (including energy, transport, manufacturing, etc.) that will be facilitated by 5G IoT under these policy options, but the precise impacts are difficult to quantify.

As regards the **societal impact**, by enabling a wider section of society to benefit from Gigabit broadband, policy options 3 and 4 are also likely to have positive societal impacts, in particular by reducing the urban-rural digital divide; while policy option 2 is expected to provide certain positive impact and policy option 1 more limited positive effect. As the COVID pandemic has shown, advanced connectivity is overall particularly important as an essential enabler for teleworking, remote education or health. In addition, reductions in civil works that could be enabled through greater re-use of existing infrastructure should reduce disruption and noise pollution from civil works, which can be viewed as a social cost.

As regards the **environmental impact**, the reviewed BCRD, which will further support the re-use of existing facilities or the co-ordination of civil works and update its scope to support VHCN deployment, should also have positive effects on greenhouse gas emissions, by fostering the deployment of technologies (FTTH and 5G) which are more energy efficient during the operational phase. We estimate[158] that the reductions in greenfield deployments that may result from policy options 3 and 4 could avoid 0.7 and 0.8 million tonnes in GHG emissions respectively and 0.1 million tonnes both for policy options 1 and 2 in the period to 2030 compared with a situation where FTTH is deployed to the same extent, but based on the current more limited reliance on infrastructure sharing.

The migration to more energy efficient FTTH and 5G technologies should also help to limit the increases in GHG emissions that would otherwise arise as a result on increasing demands for bandwidth. If coupled with the phase-out of legacy technologies over the next 10 years, we

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157 Assuming that a 10% increase in FTTH coverage is linked to 0.5% increase in employment, based on an average between the findings of Mölleryd, B. (2015), Development of High-speed Networks and the Role of Municipal Networks, OECD Science, Technology and Industry Policy Papers, No. 26, OECD Publishing, Paris and Lapointe, P. (2015), Does speed matter? The employment impacts of increasing access to fiber Internet, Georgetown University, which finds that a 10% increase in FTTH is linked to an increase in employment of 0.13%..

158 Emissions resulting from the deployment of the fixed broadband network are based on new ducts distances considering use of existing poles and ducts as well as coordinated civil works. The support study has used the results of Ecobilan (2008) and Solivan (2015) to provide an estimate for the emissions for the different deployment alternatives.

anticipate that the increased FTTH coverage resulting from policy options 3 and 4 should lead to reductions of around 1% in GHG emissions compared with the status quo in the period up to 2030 and around 0.03% savings in emissions from the operation of mobile networks; the respective figures for policy option 1 being 0.36% and 0.01% and for policy option 2 0.76% and 0%. Importantly, if policy options 3 or 4 are pursued, emissions are not expected to increase compared with the status quo, despite projections[159] that bandwidth consumption would increase 9-fold in fixed networks and 19-fold for mobile by 2030. We did not take into account knock-on effects that could arise from improved energy efficiency due to the accelerated deployment of 5G and its use in sectors such as transport, agriculture and energy. Literature suggests that these could significantly outweigh any direct impacts on GHG emissions coming from electronic communications networks themselves.[160]

To conclude from the assessment done so far on the basis of the modelling, policy options 3 and 4 are likely to have the most significant positive impacts for economic and societal development as well as in limiting GHG emissions from the electronic communications sector during a period where bandwidth consumption is expected to expand rapidly. Instead, when taking into account the more granular assessment on the basis of specific criteria of effectiveness, efficiency, coherence, feasibility and EU added value provided in the next section, policy option 3 appears as the preferred option.

7.2. Comparison of policy options per criteria

In line with the Better Regulation Guidelines, we have carried out a detailed analysis of the elements which compose each policy option, allowing for a comparison. The support study has quantified to the extent possible and rated the potential impacts of the baseline scenario and the four policy options considered.

The main factors considered for the assessment of the four policy options, which are described in section 5.2) are summarised below.

Effectiveness

Baseline: While the existing BCRD in combination with the Connectivity Toolbox and Article 57 EECC would enable certain improvements in reducing costs in broadband deployment, the application of these measures is unlikely on its own to deliver the cost reductions and easing of the administrative burden that is required to timely meet the EU connectivity targets. Identified inefficiencies of the current Directive will therefore persist and fragmented application is likely to remain. Permit granting processes may improve somewhat, but outcomes will remain patchy. Use of infrastructure sharing and coordinated civil works would improve to a certain extent but most VHCN deployment would be greenfield. As shown in table 2, we expect that under the status quo, there will be 250,000km of deployment by 2030 based on BCRD measures and VHCN coverage in the EU will reach around 65% by 2025 and 90% by 2030, due to national broadband plans adopted in connection with the EU Gigabit society targets and forthcoming adaptations to the Toolbox

[159] Projections in bandwidth consumption have been estimated on the basis of reports concerning the link between broadband speeds and bandwidth consumption and the average bandwidth consumption for different types of technology.

[160] For example GeSi (2015) - GeSI Mobile Carbon Impact argues that applications based on mobile communications can support a reduction in emissions which is approximately five times greater than the carbon emissions from mobile networks themselves. A similar finding is reported in IEA (2017) - Digitalization and Energy, which examines the impact of digitalization on energy demand in transport, buildings and industry. The report also illustrates how digitalization has increased productivity in oil, gas, coal, and power supply.

Roadmaps together with the allocation of significant amounts of State Aid and EU funds. As regards the deployment of mid-band 5G (based on 3.6 GHz band), it is expected that 75% of the population would be covered by 2030.

Policy option 1: The amendments foreseen will have limited positive effects and their impact on fixed (and especially mobile) VHCN deployment is likely to be limited as shown in table 2. Policy option 1 would increase network deployment by 290,000 km based on the use of cost-saving measures including re-use of existing infrastructure and civil works co-ordination. This policy option could lead to cost reductions in FTTH deployment of around EUR5bln and create the potential for a reduction in subsidies by around EUR0.43bln. If the costs saved are reinvested in additional FTTH deployment, the model indicates that FTTH coverage could be extended to reach 91.6%. If saved costs are invested instead in deploying the lower cost solution 5G FWA, VHCN coverage levels of 99% could be achieved. Coverage of mid-band 5G is expected to reach 75% under this option, thereby achieving limited additional coverage compared with the baseline.

As regards reducing costs through more consistent, streamlined and digitised administrative procedures required for network deployment, only a limited effect is expected derived from (only) mandating that permit applications are submitted by electronic means. At the same time, such a measure would be in line with the principle of digital by default and therefore constitute an improvement compared to the baseline.

Policy option 2: By addressing the problem of unviable overbuild through VHCN exemption, this option would improve the business case for VHCN deployment in less dense areas (thereby substantially contributing to reducing requirements for subsidies). However, it also risks limiting the potential for infrastructure competition in more urban areas, which could limit quality and choice for consumers overall. A more targeted exemption (e.g. in white areas as defined for state aid or by way of Art.22 geographical surveys) would not be easy to implement as experience has shown that definition of these areas is difficult and constantly evolving and will rely on alternatives mappings under state aid or article 22 being timely available and up to date. This policy option would contribute to reduce the costs and administrative burden of deploying VHCN, in particular for mobile deployment thanks to the extension of obligations to access existing physical infrastructure to cover also *non-network* infrastructure owned by public bodies for the purposes of VHCN deployment. According to operators favouring transparency on non-network assets, it was considered that this measure would have a moderate to significant impact on their ability to make use of non-network PIA. As regards consistent, streamlined and digitised administrative procedures, this policy option would broadly bring the same limited effects as policy option 1. Improvements regarding permit granting procedures would also likely be effective to some extent in reducing the timeframes to obtain permits, but would not address the problems associated with the variety of different authorities, rules and procedures.

Policy option 2 would increase network deployment to around 300,000 km based on the use of cost-saving measures including re-use of existing infrastructure and civil works co-ordination. It could lead to certain decline in infrastructure competition due to measures which would limit unviable overbuild. However, this carries a benefit in terms of additional subscribers and moreover the improved business case for the 'first mover' ECN operator due to the higher market shares in the deployment area coupled with cost-saving measures under this option (cost reductions of EUR1.6bln)could reduce the need for subsidies by around EUR1.6bln compared with the status quo. If the costs saved are reinvested in additional FTTH deployment, the model indicates that FTTH coverage could be extended to reach 93.5%. If saved costs are invested instead in deploying the lower cost solution 5G FWA, VHCN coverage levels of 98% could be achieved. This policy option is likely to contribute to the acceleration in the deployment of mid-band 5G, potentially contributing to additional coverage of 2% compared with the status quo, due to provisions on access to non-network infrastructure and associated information. Coverage of mid-band 5G is expected to reach 76.5% under Option 2.

Policy option 3: This policy option will be the most effective in reducing costs for fixed and mobile VHCN deployment as well as the related administrative burdens. In addition to supporting the deployment of small cells (not limited to SAWAPs) and other wireless infrastructure through the expansion of obligations to access existing physical infrastructure to non-network elements, the development of EU-level guidance is likely to address key challenges regarding access to physical infrastructure and civil works co-ordination, including pricing, thereby further incentivising them while preserving the business case for VHCN deployment (providing for a case by case approach to addressing the issue of unviable overbuild). This policy option contains a number of measures which would make the provisions of the revised legal instrument more effective, such as the reinforcement of information obligations including the setting of digitised platforms, and the introduction of standards at national level and mandating FTTH in-building wiring in new and majorly renovated buildings.

As regards consistent, streamlined and digitised administrative procedures, a higher impact is expected from this policy option due to the fact that SIPs should be fully digitised (and interconnected where possible) and a digital permit platform should also be established ('digital by default' principle). Moreover, this policy option also introduces measures such as the EU-level defined exemptions for permits and the setting and use of advanced digital platforms for permit granting, the streamlining of procedures and authorities involved, and tacit approval which are expected to be instrumental to improve enforcement against permits timeframes, thereby significantly streamlining permit granting procedures overall.

Policy option 3 would increase network deployment to around 470,000 km, based on the use of cost-saving measures including re-use of existing infrastructure and civil works co-ordination. Moreover, the increased take-up of cost-saving measures such as re-use of existing infrastructure and co-ordination of civil works would counter-act the cost increasing effects of connecting more households, resulting in a reduction in the total cost of achieving a 90% coverage rate for FTTH of around EUR15bln and a reduction in required subsidies of EUR2.4bln compared with the status quo. If the costs saved are reinvested in additional FTTH deployment, the model indicates that FTTH coverage could be extended to reach 96.5%. If saved costs are invested instead in deploying the lower cost solution 5G FWA, VHCN coverage levels of 99% could be achieved. This policy option could enable an increase in coverage of mid-band 5G to around 77% of the population by 2030 compared with 75% in the status quo.

Policy option 4: This policy option provides the potential for a high degree of cost savings in VHCN deployment for ECN operators. However, by widening the scope of obligations on private network operators and applying a maximum degree of harmonisation, it risks applying obligations in certain cases where they may not be necessary to achieve positive outcomes, and creating delays in cases where there are existing well-functioning national processes, standards or separate platforms that would need to be transformed to meet new EU-level requirements. These shortcomings may mean that policy option 4 may at best fail to improve on the cost and time saving which can be achieved under policy option 3, while at worst it could introduce delays in the adaptation of permit granting systems and the implementation of in-building standards which undermine the achievement of positive outcomes. As regards streamlining and digitising administrative procedures, a slightly higher impact than policy option 3 is expected due to the fact that SIPs for existing physical infrastructure and civil works should be consolidated with the digital permit platform ('digital by default' principle).

Policy option 4 would increase network deployment to nearly 530,000 km based on more than double use of cost-saving measures including re-use of existing infrastructure and civil works co-ordination. This option could add further cost savings (EUR17.5bln) and reductions in subsidies (EUR2.6bln) although the extent of these savings is not significantly greater than those that can be achieved under policy option 3. If the costs saved are reinvested in additional FTTH deployment, the model indicates that FTTH coverage could be extended to reach 96.8%. If saved costs are invested instead in deploying the lower cost solution 5G FWA, VHCN coverage levels of 99% could be achieved. This policy option could enable an increase in coverage of mid-band 5G to around 77% of the population by 2030.

Efficiency[161]

Baseline: The total recurring administrative costs associated with processing permits, processing physical infrastructure access requests and civil works co-ordination (with or without dispute resolution) and for providing information – are approximately EUR275m per annum, and could rise to around EUR315m in connection with the deployment of a significant number of small cells, which could increase both access-related administrative costs and costs relating to permits (for those deployments not falling within the SAWAPs permit exemption). The higher proportion of these recurrent costs are by far supported by ECN operators (EUR 201.3m), followed by other network operators (EUR 50.3m), local authorities (EUR 50.9m), authorities managing SIPs and dispute resolution processes (EUR 9.36m) and construction companies (EUR 2m).

The costs directly linked with the implementation of the BCRD are costs associated with DSB and SIP management. Other costs would likely have been incurred at higher levels in the absence of the BCRD, if operators sought access to physical infrastructure or civil works co-ordination in the absence of any support from BCRD rules, or ECN operators may have avoided making requests for access or civil works co-ordination, leading to significantly higher construction costs. These cost estimations provide a rough benchmark against which we compare administrative costs associated with proposed changes to the BCRD.

Policy option 1: It is associated with very limited (direct) costs but also limited benefits in terms of reduced deployment costs and improved administrative processes for VHCN, given the limited changes foreseen. Provisions such as a mandatory SIP and electronic processing of permits are in line with eGovernment initiatives and will give rise to wider benefits to public authorities, which save on administrative costs in the medium term. Yet this option would give rise to cost-savings in VHCN deployment which could amount to as much as EUR5bln EU-wide.

Policy option 2: The benefits of this policy option are on balance likely to outweigh the costs, because the expenses associated with implementing some of the foreseen changes will contribute to longer term cost savings and support the digitisation of public services. Specifically, this policy

[161] The benefits in relation to the BCRD relate to cost savings in VHCN deployment as well as streamlined administrative processes. Thus, administrative efficiency is both a measure of effectiveness and efficiency in relation to the Impact Assessment for the BCRD. However, in the assessment of efficiency, alongside cost savings for ECN operators deploying VHCN, we also take into account cost impacts (positive or negative) on stakeholders which are not the direct beneficiaries of the measures proposed.

option could give rise to cost savings of around EUR2bln compared with the status quo in achieving FTTH deployment to reach 90% of households, and substantially reduce the required subsidies (by EUR1.5bln) in part because exclusion of VHCN-hosting assets from obligations could improve the business case for VHCN deployment in the most remote areas including those in receipt of public funding.

Policy option 3: This policy option brings significant benefits in reducing costs for VHCN deployment alongside its potential to reduce administrative complexity and associated costs at least in the medium term. As a result, the benefits of this policy option appear to significantly outweigh the costs, which in the short term are roughly estimated at around EUR70m for all stakeholders[162], with public authorities supporting the highest proportion (approx. EUR 35-40m one-off for local authorities in relation mainly to permit granting procedures and digitised permit platforms[163], and EUR 10-15m one-off and EUR 6-7m recurrent for DSB/SIPs).[164] It is expected that ECN operators might incur around EUR 15m of set-up costs in connection with their input into permit granting systems and SIPs (alongside associated changes to internal processes and data gathering methods) as well as their participation in the development of standards for in-building infrastructure and EU-level guidance. Other non-ECN network operators may also have set-up costs of around EUR 5-7m relating to new requirements in a few countries to submit information directly to the SIP and their input into the development of guidance on access to physical infrastructure and civil works co-ordination. Moreover, representatives of construction companies may incur costs of around EUR 1-2m providing input to the development of standards for in-building infrastructure including fibre, in those countries where such standards are not yet in place.

The various measures in the area of permit granting which are meant to streamlined these procedures are expected to provide for EUR 15m per annum cost savings in terms of administrative simplification for ECN operators. Moreover, building companies would benefit from standards on in-building infrastructure and wiring which should guarantee a more efficient FTTH pre-equipment of new and majorly renovated buildings (no estimate). This policy option also foresees the establishment of certain guidance/standards at national (in-building infrastructure) and EU (access to in-building infrastructure, some criteria for access to existing physical infrastructure and civil works coordination) level, which should facilitate the implementation of relevant provisions as well as the resolution of potential disputes resulting in cost savings for ECN operators of EUR 24 m per annum.[165]

Policy option 4: It involves a number of provisions that would increase administrative costs in particular for privately financed network operators and policy-makers at EU level. The new provisions on permit granting and in-building wiring and infrastructure could provide important benefits in theory to ECN operators, and in particular operators operating cross-border that would

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[162] These are broadly one-off costs, except for the authorities that manages dispute resolution mechanisms and SIPs which entail recurrent costs of EUR6-7m/year for maintenance and enforcement.

[163] However, it is likely that a portion of this cost would be borne by national administrations (potentially with support from EU funding for digitisation programmes). It should also be noted that a large part of the costs that may be incurred by local authorities, SIP management authorities and DSBs are likely to be passed to ECN operators in the context of fees for permit applications, dispute resolution and access to the SIP platform.

[164] Certain local authorities express concerns over the implementation costs and question the need for measures regarding permit granting as well as questioning the appropriateness of handling such measures within the context of legislation concerning ECN. However, these measures are consistent with wider goals to promote eGovernment, and should lead to reduced administrative burdens for local authorities in the medium term.

[165] Details on how the different stakeholders' groups (including SMEs) would be affected by this policy option are included in Annex 3.

benefit from fully harmonised conditions. However, these benefits are likely to be achievable only following a lengthy period of implementation including process re-engineering and the revision of existing standards. Thus, benefits in terms of accelerated deployment would be unlikely to be realised in the medium term and the transformation would involve significant cost. There could be some benefits to expanding access obligations to private non-network facilities and extending transparency and notification obligations to privately financed operators because they would increase the potential access and civil works coordination opportunities. However, the incremental advantages are likely to be limited in view of the preference by ECN operators to obtain access to public non-network facilities and to use solutions other than civil works co-ordination where available (such as access to network and public non-network assets under BCRD or SMP access to physical infrastructure), while the additional cost is high (the total cost of preparing the EU level provisions on in-building infrastructure might amount to around EUR 5.2m over the length of the process[166]). In conclusion, the costs associated with policy option 4 are likely to exceed the benefits, this option being associated with significantly high implementation costs.

Coherence: The main elements to consider as regards coherence are (i) the alignment with other initiatives and legal instruments at EU level (external coherence), in particular the EECC, the Digital Compass Communication and the proposal for a Digital Decade Policy Programme[167], and (ii) the alignment within the grounds to reject requests for access to existing physical infrastructure and for coordination of civil works (internal coherence).

Maintaining the current BCRD without amendment would not be coherent with the EU's more ambitious Gigabit objectives (external coherence) and also risks perpetuating a potential (internal) incoherence (or lack of clarity) within the revised legal instrument concerning the potential grounds to reject requests respectively for access to physical infrastructure and civil works co-ordination. All policy options would ensure the coherence of the revised legal instrument with the renewed connectivity ambition of the EECC and the more recent Digital Decade Communication and policy programme, while policy options 2, 3 and 4 would also address the potential incoherence within the current Directive regarding the grounds to reject requests for access to physical infrastructure and for civil works co-ordination by way of VHCN exemption (policy option 2) or by defining specific circumstances for rejection (policy options 3 and 4). Policy options 2, 3 and 4, would further reinforce the coherent application of the EECC and BCRD in the treatment of access to non-network facilities and the processing of rights of way, while policy options 3 and 4 would also ensure coherence in the application of access obligations to physical infrastructure under SMP and BCRD provisions, and the handling of in-building wiring and associated obligations for access to wiring and physical infrastructure in buildings.

EU added value: Policy option 1 would maintain a significant degree of flexibility for Member States in the application of rules to reduce the cost of deploying broadband infrastructure, but

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[166] Moreover once defined, these new EU-level standards for in-building infrastructure would need to be implemented at national level, which would likely require intensive resourcing from bodies responsible for monitoring construction as well as construction companies themselves. There is a risk in particular that Member States which currently have well-functioning systems which are effective in ensuring adequate in-building physical infrastructure (but which might not conform precisely to the EU standard) would need to re-engineer their processes and manuals unnecessarily. The precise costs of doing so are difficult to quantify but could be significant, noting that there are already well-functioning standards for in-building infrastructure and/or wiring in a number of countries.

[167] Other measures have also been assessed for external coherence but have not raised any particular issue, e.g. the Connectivity Toolbox and associated Connectivity Recommendation, the Commission Recommendations concerning relevant markets susceptible to ex ante regulation, and the approaches to be taken to access regulation in cases where ECN operators are found to have SMP (currently subject to review).

would add limited value compared with the status quo, which has proven ineffective in particular in tackling the complexities and regional fragmentation involved in obtaining permits and access rights for networks deployments. Policy option 2 achieves some added value but would not fully tackle the problem of fragmented systems and rules (for ex. regarding terms and conditions for access to physical infrastructure and civil works coordination or permits which will continue to be defined at national or regional level). Policy option 3 achieves the highest degree of added value compared with Member States acting alone in particular because it secures harmonisation in areas which are vital for the rapid deployment of fixed and mobile VHCN EU-wide (including access to sites for 5G deployment, the removal of barriers created by fragmentation in the permit granting process and the deployment of FTTH in-building) while maintaining flexibility for Member States in areas which are best addressed at national level, including in particular for the definition of standards for in-building infrastructure or the decision of whether or not to extend certain obligations to privately financed operators. And policy option 4 although in theory seems to provide for high EU added value, it may raise difficulties as it would involve decisions being made at EU-level (in particular regarding EU standards for in-building infrastructure, and extension of certain obligations to private network operators), undermining Member State's ability to take timely action which reflects the situation on the ground.

Legal/political feasibility

Baseline: As a continuation policy option, it is highly feasible. Member States and their public administrations are expected to support this policy option, relying on the continuation of the implementation of the Directive, which provides for minimum harmonisation, and the voluntary improvements under the Connectivity Toolbox. On the contrary, ECN operators are calling to strengthen and use to the maximum the potential of the Directive at a time where they are facing pressure to increase VHCN investment. Overall, political feasibility at EU level is doubtful as the EU has committed to reach ambitious Digital Decade connectivity targets by 2030 and the costs of deploying the underlying physical infrastructure remains very high.

Policy option 1: This policy option based on minimum revisions is likely to be supported by Member States and public administrations, except possibly some local authorities (for example, those not advanced on electronic procedures for permit granting) as some of the currently voluntary provisions on permit granting procedures are turned mandatory. ECN operators are expected to consider it too thin on the basis of the problems reported as regards VHCN deployment. If this policy option is pursued, we cannot expect a significant contribution of this initiative for reducing the costs of VHCN deployments and therefore reaching the 2030 Digital Decade connectivity targets.

Policy option 2: Some ECN operators are expected to support this policy option, as some of them (and their associations) have suggested the possibility to limit the scope of the revised legal instrument's obligations to only other (non-telco) network operators (although some incumbents are at the same time advocating for the relief of SMP obligations in favour of the more horizontal BCRD provisions), but they are likely to consider that it falls short on some aspects related to transparency, permit granting or in-building. Non-telco network operators (utilities, transport) would not favour it as the new regime would rely mainly on their physical infrastructure/civil works, and the addition of non-network public assets. National authorities in charge of implementing the new provisions could raise questions as to how to delineate the newly defined scope based on what would be considered (or not) VHCN deployment, this could raise some feasibility issues. Public authorities may complain of the burden to implement the new access/transparency measures for non-network public assets suitable for VHCN deployment (though there is already a precedent in Art. 57 EECC) and of a shift of obligations mainly on public authorities/operators rather than on private ones. The optional measure of establishing a coordinating body for access requests to public physical infrastructure may to a certain extent alleviate this concern.

Policy option 3: This policy option provides for a more balanced approach of obligations on public authorities and private network operators and tackles the most important bottlenecks identified, so we expect that this will be much supported by ECN operators. Public authorities would most probably consider this policy option going beyond what is necessary or proportional (e.g. in terms of EU harmonisation) and too costly and burdensome and will instead favour status quo or policy option 1. They would possibly complain about the access/transparency obligations on public assets, which is however critical for improving the effectiveness of provisions on access to physical infrastructure and coordination of civil works. Guidance on different elements related to access and civil works coordination would most probably be welcomed by all parties (operators and public administrations) as they would contribute to fewer disputes overall and swifter access and coordination (although public authorities and BEREC/NRAs are of the view that Member States are best placed to develop such guidance). The full set of measures proposed in the area of permit granting is expected to be resisted by local authorities –although their competence to deliver permits would remain untouched- while very much supported by telecoms operators as addressing the major deployment bottleneck. In the context of the Connectivity Toolbox, a couple of Member States have reported that tacit approval could raise constitutional concerns in their countries, for which exceptions could be considered. Finally, it might be possible to finance the implementation of some of the proposed measures (such as the one on digitised platforms) through post COVID EU recovery funds. Overall, considering some concrete elements introduced to ensure proportionality (for example as regards categories of public building/assets subject to access obligations, transparency measures and tacit approval), this policy option is considered as highly feasible both in legal and political terms.

Policy option 4: The extension of obligations for access to private non-network physical infrastructure should be done in careful compliance with property law and, in this regard, policy option 4 could be considered as going beyond what is needed to address the identified problems, in particular as most ECN operators were calling for being able to access non-network public assets (in addition to existing network elements) but seemed comfortable with relying on commercial negotiations for other types of assets. The extension of the civil works coordination to all privately and publicly funded projects would be opposed by network operators, which could argue the measure could unnecessarily delay their planned deployments. The consolidation of the SIPs on physical infrastructure, planned civil works, and possibly also permit granting into a single consolidated national digital platform could theoretically be useful for a more efficient implementation of the measure under the new instrument (and welcomed by telecoms operators), but it could also entail significant costs for administrations and difficulties for a timely implementation; it could meet some resistance as it may be necessary to change existing digital platforms. It might be possible though to finance the implementation of some of the proposed measures (such as the one on digitised platforms) through post COVID EU recovery funds. Finally, the EU standards for in-building infrastructure could face difficulties/delays in definition and implementation as building practices might widely differ from one Member States to the other, might not provide results in the short term. This policy option is therefore likely to be opposed both by private entities (holding private non-network assets) and public authorities, which would be politically difficult to support as possibly perceived too far reaching in terms of new obligations and EU harmonisation.

The quantitative/qualitative analysis presented in more detail above is summarised in the following table showing the main conclusions in terms of impacts per criteria:

Table 12: Comparison of policy options – overview

	Effectiveness		Efficiency		Coherence		EU added value	Feasibility	
	Reduced deployment cost/burden	Consistent, streamlined and digitised administrative procedures	Administrative cost (short / long run)	Benefits in relation to cost	Internal	External		Legal	Political
Option 1	+	+	--- / --	+	-	+	+	+++	-
Option 2	+	++	--- / -	++	+	++	++	++	+
Option 3	++	+++	---- / ++	+++	+	+++	+++	++	+++
Option 4	+++	+++	----- / +	++	+	+++	++	+	++

Source: European Commission based on support study

The symbols '+'/'-' indicate limited positive/negative impact compared to the baseline, symbols '++'/'--' indicate moderate positive/negative impact and symbols '+++'/'---' indicate high positive/negative impact.

8. PREFERRED OPTION

8.1. Outcome of comparison of policy options

Based on the assessment provided in section 7, the outcome of the comparison of the policy options points to policy option 3 as the preferred option and results as follows:

As described in section 7.1, when looking at the **socioeconomic and environmental impact**, policy options 3 and 4 are likely to have the most significant positive impacts for economic and societal development as well as in limiting GHG emissions from the electronic communications sector. In particular, policy option 3 is expected to bring EUR109bln of increase of GDP up to 2030 linked to the reinvestment of cost savings, is likely to have positive societal impacts in particular by reducing the urban-rural digital divide and could avoid 0.7 million tonnes in GHG emissions in the period to 2030 compared with a situation where FTTH is deployed to the same extent but based on the current more limited reliance on infrastructure sharing and should lead to reductions of around 1% in GHG emissions compared with the status quo in the period up to 2030 and around 0.03% savings in emissions from the operation of mobile networks.

Regarding **effectiveness**, except for option 4[168], policy option 3 provides for the greatest impact in terms of new networks deployed by 2030 re-using physical infrastructure and coordinating civil works (470,000 km[169] instead of 250,000 km under baseline, 290,000 km under policy option 1 or 300,000 km under policy option 2) as well as in reducing the cost of FTTH deployment to 90% of households (by EUR 14.5bln instead of EUR 4.8bln under policy option 1 and 1.6bln under policy option 2) and reduced the required public subsidies (by EUR 2.4bln instead of EUR 0.43bln under policy option 1 or EUR 1.6 under policy option 2). If these savings are reinvested in further VHCN deployment, they could contribute to 96.5% coverage of FTTH or 99.1% coverage if 5G FWA rather than FTTH is used to serve the final 10% of households beyond the 90% that are assumed served by FTTH under the status quo (compared with respectively 91.6% (FTTH scenario) and 97% (FWA scenario) under policy option 1, 93.5% (FTTTH scenario) and 98.5% (5G FWA scenario) under policy option 2 and the slightly better results of 96.8% (FTTH scenario) and 99.2% (5G FWA scenario) under policy option 4). We also estimate that policy option 3 could accelerate the deployment of mid-band 5G, by simplifying the process of deploying small cells (including but not limited to SAWAPs as defined in the EECC and associated Implementing Regulation),[170] as well as enabling an increase in coverage of mid-band 5G to around 77% of the population by 2030 (same under policy option 4) compared with 75% in the status quo and policy option 1 (with 76.5% under policy option 2).

Concerning **efficiency**, policy option 3 involves significant certain short term costs (EUR70m), in particular linked to the establishment of consistent permit granting procedures and the establishment of digital platforms for the processing of permits for ECN deployment. However, once these procedures and platforms are established, policy option 3 is expected to lead to longer term administrative cost savings not only for ECN operators, but also for public authorities including municipalities as indicated in Section 8.2. In addition to providing legal certainty and fostering take-up of cost saving measures by ECN operators, measures under policy option 3 such as the provision of clearer rules in the legislation potentially alongside EU-level guidance on conditions for access to physical infrastructure and to in-building infrastructure, as well as on cost allocation for civil works co-ordination and for grounds for refusal are also expected to reduce the administrative burden on DSBs and authorities co-ordinating the provision of access to non-network public facilities. In addition to providing medium-term administrative cost savings, policy option 3 could also act as a catalyst for digitisation of local Government processes and the adoption

[168] Option 4 scores better in terms of new networks deployed using access to existing physical infrastructure or civil works coordination (530.000 km), reduced cost of FTTH deployment (EUR 17,5bln) and reduced public subsidies (EUR 2,6bln). However, it is overall more costly, it could take longer to implement (see efficiency) and less proportionate to the objectives.

[169] The main drivers of these increases are expected to be improved terms and conditions and legal certainty resulting from greater legal precision potentially coupled with EU-level guidance concerning the terms and conditions for access to physical infrastructure and civil works co-ordination as well as improved information including georeferencing and pro-active information about planned civil works.

[170] Key elements contributing to these outcomes under Option 3 are the extension of access to physical infrastructure obligations non-network public infrastructure, the introduction of obligations to provide information about public non-network facilities on the SIP (where proportionate), the option to assign a co-ordinating body for negotiations for access to non-network public facilities and strong measures to create common digitised procedures and shorten the lengthy timeframes associated with obtaining permits, rights of way and other permissions needed for the deployment of VHCN infrastructure. The relatively limited incremental impact on full 5G coverage can be explained by the fact that certain benefits, in particular relating to improved conditions for access and permits for small cells which meet the definition of SAWAPs would be realised under the status quo, as a result of the implementation of Article 57 EECC and the associated SAWAPs Implementing Regulation.

of smart city initiatives, which offer the prospect of delivering wider economic and societal benefits.[171]

Although policy option 4 could achieve slightly higher cost savings or increase the potential for VHCN compared with policy option 3 in the long run, these benefits are likely to be outweighed by persisting additional administrative and other costs, that would apply to owners of private non-network facilities (including tower companies and commercial building operators) and to private network operators all considered together, which would be affected respectively by the extension of obligations for access to non-network facilities to cover all property owners; and by the extension of civil works co-ordination obligations to cover privately financed deployments. Policy option 4, which foresees the establishment of standards for in-building infrastructure at EU-level, could delay the implementation compared with a national approach and require the revision of existing effective national standards in some countries. Policy options 1 and 2 would require less up-front investment by European, national and local authorities than policy options 3 and 4, because these options do not require the development of standards for in-building wiring nor consistent procedures and digital platforms for permit granting or for SIPs at a national level, but equally, they would not significantly reduce the existing high and persistent administrative burden that ECN operators currently face when planning to deploy VHCN, and could have unintended effects on VHCN investment.

All policy options would ensure that the BCRD is made **coherent** with wider objectives for Gigabit connectivity and avoid potential overlaps between BCRD obligations on access to physical infrastructure and those based on SMP or State Aid, so in this respect Option 3 is not specific. Instead, policy option 1 would not fully address a problem of internal coherence in the BCRD whereby the business case for VHCN deployments will continue to be taken into account for obligations to access physical infrastructure but not for civil works co-ordination, while other policy options would do. All policy options but option 1 would increase coherence between the BCRD and EECC by elaborating on the Art 57 EECC provisions concerning access to public non-network facilities as well as the provisions in the EECC on rights of way. By including provisions requiring the standardisation of in-building infrastructure including a requirement for the installation of in-building fibre, policy options 3 and 4 would additionally complement existing provisions in the EECC which set out conditions under which access to in-building wiring may be mandated (Article 61 EECC) and thus offer the greatest prospect of coherence between the BCRD and other legal instruments.

Overall, policy option 3 is likely to provide the greatest degree of **added value at EU level**, while preserving flexibility for Member States on aspects which are best decided locally, such as the development of standards for in-building infrastructure for use by construction firms, or the decision on whether to extend civil works co-ordination obligations to private network operators. Instead, Policy option 1 would provide limited added value beyond the current BCRD, which has been found in the context of the evaluation of the BCRD to be only partially effective in addressing administrative burdens and costs which are hampering VHCN deployment. Policy option 2 would address some concerns, notably regarding access to non-network public facilities, as well as offering some improvements to timeframes for permits and rights of way. However, its added value at EU level would be limited in view of the fact that it does not tackle the fragmentation in

[171] See for example https://www.sciencedirect.com/science/article/abs/pii/S0264275115001274

regulatory decision-making[172] and permit-granting procedures and the lack of suitable in-building infrastructure and wiring, which have been identified by ECN operators as core barriers to the deployment of VHCN.[173] Conversely, policy option 4 would extend the EU's remit into areas which are likely to be more efficiently handled at a national level including standards for in-building infrastructure, and would also harmonise regulation at a maximal level (extending obligations for access to non-network infrastructure and civil works co-ordination to private network operators) which may not be proportionate in all circumstances.

Policy option 3 provides also for the higher ranking in terms of **legal and political feasibility**. This policy option addresses all the different relevant areas with a comprehensive set of measures in all of them. It also considers some limitations in order to ensure proportionality (see for example, the possible limitation to the transparency obligations on network operators and public authorities, on tacit approval for permits to take account of constitutional issues, or the establishment of a body coordinating access request to non-network physical infrastructure). The various elements of this policy option offer a credible solution to the identified problems and persistent bottlenecks and in terms of reducing costs for VHCN deployment in view of the EU 2030 Digital Decade connectivity targets. Overall, this policy option presents a focused policy intervention with an intensity proportional to its objectives. Moreover, it is designed in a way that is future-proofed as for example it does not refer to specific technologies (besides the in-building infrastructure and wiring measures).

To conclude, policy option 3 would provide the optimal combination for effectively reducing costs in deployment of VHCN networks by deployment and re-use of physical infrastructure and through more consistent, streamlined and digitised administrative procedures required for network deployment. It best balances short term implementation costs with medium term benefits, and limits unnecessary regulatory burdens, by ensuring that Member States can take decisions based on national circumstances in areas where this would be most efficient. Therefore, policy option 3 constitutes the preferred option for the revision of the BCRD.

8.2. REFIT (simplification and improved efficiency)

Several measures under policy option 3 are relevant in terms of administrative simplification and improved efficiency, in particular the various measures in the area of permit granting (e.g. tacit approval, 'one-stop-shop, EU definition of permit exemptions, fees covering admin costs, consistency of permit granting procedures at national level, interim deadlines for considering a completed application) which are meant to streamlined these procedures (EUR15m per annum). Moreover, building companies would benefit from standards on in-building infrastructure and wiring which should guarantee a more efficient FTTH pre-equipment of new and majorly renovated buildings (no estimate).

On the other hand, policy option 3 is adding some new obligations/rules mainly for public authorities (the previously referred measures for permit granting, access to publicly controlled non-network physical infrastructure and related transparency obligations), as well as for network operators (transparency obligations). However, having fully digitised SIPs should also contribute to simplify the compliance with the transparency obligations by all relevant stakeholders (public

[172] Notably the differences in the application of principles around fair and reasonable terms and conditions, and cost allocation for civil works co-ordination

[173] Estimates from ECN operators suggest that the cost to install VHCN-ready in-building infrastructure in the absence of suitable in-building ducts and other facilities could vary between EUR100- -EUR450 depending on the cost of labour and type of housing. This is a significant sum in relation to the cost of deploying FTTH to a household.

authorities and network operators). The preferred policy option also foresees the establishment of certain guidelines/standards at national (in-building infrastructure) and EU (access to in-building infrastructure, some criteria for access to existing physical infrastructure and civil works coordination) level, which should facilitate the implementation of relevant provisions as well as the resolution of potential disputes (EUR 24 m per annum).

The most significant quantifiable cost savings associated with the preferred option 3 are shown in the following table, quantitative estimates could not be established for all the various elements of the preferred option as available data was variable or there was no supporting data available. For example, it is expected that local authorities could save time and achieve significant cost savings as a result of the proposed reform and digitisation of permit granting applications as well as the (optional) proposals to co-ordinate access to public facilities for ECN operators. However, the degree of cost savings is difficult to estimate for this stakeholder group, in view of the large number of bodies and variations in current practices. In addition, it should be noted that while they are expected to be directionally accurate, all quantifications should be considered as estimates,[174] and may under or over-estimate the actual savings that result from the measure. [175] Nevertheless, as argued by the Fit for Future Platform, opting for more sustainable forward-looking technologies can also prevent costs that would occur at a later stage when dismantling outdated infrastructure[176].

Table 13: Potential cost savings associated with the preferred option

REFIT Cost Savings – Preferred Option(s)		
Description	**Amount**	**Comments**
Cost savings related to the deployment of VHCN		
Reduced cost to deploy FTTH to 90% households	EUR 15bln reduced investment, EUR 2.4bln reduced subsidy	This is the aggregate cost saving for network deployment resulting from improved prospects for access to physical infrastructure and civil works co-ordination (supported by transparency measures) as well as reduced costs for in-building infrastructure and wiring. This includes cost savings to ECN operators of around EUR 1.3bln due to pre-installation of in-building fibre. However, construction companies could incur costs of around EUR 675m to deploy such fibre.
Administrative cost savings		
Reduced cost for ECN operators to negotiate access to physical infrastructure/ reduction in disputes	EUR 24m per annum	The preferred option is expected to mitigate administrative cost increases on ECN operators (and public authorities and DSBs) that would otherwise occur in the context of locating sites and negotiating access to physical infrastructure, including for sites for mid-band 5G. Clearer rules at EU level are expected to reduce the need for dispute resolution in relation to access to physical infrastructure and

[174] In particular estimates may prove not to be exact because they are based on extrapolations drawing on responses from a subset of network operators, which volunteered to provide information, but may not be fully representative of all network operators across Europe. The assumptions used are detailed in the support study.

[175] There are a number of other areas where simplification is introduced but there are no estimates, such as the increased utilisation of the physical infrastructure of non-telco network operators and expanded civil works co-ordination, benefits of in-building standards for construction companies, as well as several areas for public authorities (digitisation of permit-granting processes, permit exemptions and tacit approval, strengthened information requirements for civil works co-ordination, guidelines on access to physical infrastructure, extension to non-network facilities). On the latter, the (optional) introduction of a coordination body for access requests to public assets could reduce costs by approx. EUR14m.

[176] Fit for Future Platform Opinion 2022/SBGR1/01 of 5 December 2022

		civil works co-ordination.
Reduced cost to process civil works permit applications	EUR 15m per annum	This represents expected cost savings to ECN operators. Cost savings are also likely to be realised by local authorities.

Source: support study

8.3. Application of the 'one in, one out' approach

The administrative costs for businesses relevant for the OIOO calculations relate to the new transparency obligations (providing information about existing physical infrastructure and pro-active notification of planned civil works, both georeferenced). They could not at this stage be adequately estimated. The administrative costs related to these obligations are expected to be limited as only few Member States do not have those requirements already in place or some of them plan to implement them in the near future. Moreover, the costs for businesses related to the need to create or adapt interfaces and train personnel to interact with any new digital permit granting systems and digitised information platforms (Single Information Points) were calculated with other non-administrative costs and cannot be isolated.

The expected benefits for businesses due to the administrative savings which could be estimated amount approx. to EUR 40m per annum. The administrative cost savings result from the streamlining of access negotiations and reductions in related disputes (approx. EUR 24m per annum) and from the streamlined permit application processes (approx. EUR 15m per annum). These benefits can possibly be extended to other sectors (beyond electronic communications) in case the permit platforms are implemented and used also by these sectors, as is the case already in several Member States.

There are a number of other areas where cost savings are expected but there are no estimates, such as benefits for ECN operators resulting from the increased utilisation of the physical infrastructure of non-telco network operators (which could be accrued by approx. EUR 14m as a result of the (optional) introduction of a coordination body for access requests to public assets) and from expanded civil works co-ordination as well as benefits for construction companies resulting from in-building standards.

Given the limitations faced in the quantification exercise of costs and benefits derived from the preferred policy option, we cannot make a definite quantified conclusion as regards the overall balance of administrative costs and benefits pursuant to the OIOO. However, given the nature of the instruments and the fact that most costs are one-off while most benefits are recurrent (EUR 40m per annum), we can expect a positive overall balance.

9. HOW WILL ACTUAL IMPACTS BE MONITORED AND EVALUATED?

Monitoring of the impact of the revised BCRD is one of the important factors to ensure the success of this initiative in contributing to the achievement of the 2030 Digital Decade connectivity targets. This has proved challenging under the current Directive, in particular as it did not set out specific reporting obligations nor define monitoring KPIs and therefore several potentially adequate indicators are not currently collected by national authorities.

In the following table, we relate the problems identified in the context of this Impact Assessment to the goal which the revised BCRD seeks to address and for which specific indicators are to be agreed.

Table 14: Problems to goals of the revised instrument

Problem	Goal
Challenges to access existing network physical infrastructure	Increased re-use of existing network physical infrastructure
Challenges to access public physical infrastructure	Increased use of public physical infrastructure for VHCN deployment
Unnecessary duplication of civil works	Increased civil works co-ordination
Lack of or incomplete information about existing physical infrastructure (including network and non-network infrastructure suitable for the deployment of VHCN), planned works	Coherent, up-to-date and precise information about the location of existing and planned network infrastructure as well as information concerning the location of public facilities suitable for the deployment of ECN
High complexity, timeframes and cost to obtain permits / rights of way	Simpler, and less burdensome (shorter and less costly) permit granting procedures
Lack of suitable (or access to suitable) in-building infrastructure and wiring	Increased number of FTTH-ready homes

Source: support study

Annex 6 includes a table listing potential indicators which could help monitoring the different areas of the future initiative, building on indicators included in the original 2013 BCRD Impact Assessment, and also reflecting indicators identified in the 2018 WIK/ VVA study[177] on the Implementation and Monitoring of the Directive. The discussions already initiated with Member States in the Communications Committee (COCOM) for monitoring the implementation of BCRD through KPIs may be continued in order to agree the most appropriate, useful and feasible set of indicators as well as the practical details of the implementation of the monitoring system (templates, periodicity, authorities concerned, etc.). In doing so, available indicators in existing reports (DESI, Digital Decade, etc.) should be considered, as well as the associated reporting costs for new KPIs[178].

To further improve the on-going COCOM process, the new instrument could mandate Member States, in close cooperation with the Commission within COCOM, to define an appropriate set of indicators to monitor the revised legal instrument and ensure the respective data gathering.

[177] https://op.europa.eu/en/publication-detail/-/publication/7823c241-7a7d-11e8-ac6a-01aa75ed71a1/language-en. https://op.europa.eu/en/publication-detail/-/publication/7823c241-7a7d-11e8-ac6a-01aa75ed71a1/language-en.

[178] According to the support study, the incremental cost to ECN operators of gathering KPIs should not be significant, in view of the fact that NRAs already for the most part gather data on the use of access to physical infrastructure based on SMP and other wholesale indicators in the context of market reviews. The timing of such data gathering exercises could be aligned. In cases where it is clearly indicated by ECN operators that they are reliant on certain key providers of access or co-ordination under the BCRD, such as a major utility, information could be collected from this source rather than from multiple ECN operators, in order to reduce the administrative cost of data gathering.

ANNEX 1: PROCEDURAL INFORMATION

1. LEAD DG, DECIDE PLANNING/CWP REFERENCES

The review of the Broadband Cost Reduction Directive is one of the actions announced in the Commission's Communication 'Shaping Europe's Digital Future' as part of the initiatives which would contribute to achieving the aim that 'technology works for people' and was part of the Commission's Work Programme 2020.

This proposal was prepared under the lead of the Directorate-General Communication Networks, Content and Technology (CNECT), in particular Directorate B 'Connectivity', Unit B1 – Electronic Communications Policy. The process of the review was started in March 2020 and the DECIDE reference is PLAN/2020/7443. The evaluation and impact assessment for the Broadband Cost Reduction Directive's review are carried-out in a 'back-to-back' process.

2. ORGANISATION AND TIMING

In accordance with the Better Regulation Guidelines, an Inter-service steering group (ISSG) was set up with representatives from various Directorates General and services of the Commission to assist DG Communication Networks, Content and Technology in the preparation of the Impact Assessment and legal proposal.[179] The ISSG is composed of representatives of Commission Directorate-Generals for Competition; Economic and Financial Affairs; Energy; Environment; Climate action; Internal Market, Industry, Entrepreneurship and SMEs; Legal Service; Mobility and Transport; Regional and Urban Policy; Secretariat-General.

The ISSG steered and monitored the progress of the exercise, ensuring the necessary quality, independence and usefulness of the evaluation. These services with a policy interest in the review of the Broadband Cost Reduction Directive have been associated in the development of this analysis and have provided support through the main steps of the process.

The ISSG met (online) for the first on 29 April 2020, where it provided support for the preparation of the consultation of the Roadmap/Inception impact assessment and the draft Consultation strategy. Shortly after the ISSG was consulted on the draft terms of reference for the support study. In July 2020, the ISSG was consulted on the draft questionnaire for the wide public consultation covering both backward and forward-looking aspects and its members were informed of the outcome of this exercise (factual summary report). ISSG members were invited to participate and were informed of the outcome of the different consultation activities which were run during the first semester of 2020 (Commission and study workshops). On 2 December 2021, the ISSG met (online) and discuss the draft evaluation SWD and accompanying support study and comments were received by 9 December 2021. On 4 February 2022, the ISSG met to discuss the draft Impact Assessment SWD (and accompanying support study) and the final evaluation SWD, and comments received orally and in written have been duly considered for the finalisation of this Impact Assessment.

[179] Ares(2020)1969081

3. CONSULTATION OF THE RSB

The upstream meeting of the Regulatory Scrutiny Board (RSB) of 18 November for impact assessment report gave the RSB members the opportunity to make suggestions also on the evaluation report (e.g. lessons learnt). This report has duly addressed the various remarks made, as appropriate. It is worth noting that this is without prejudice of any further RSB comments in the scrutiny of 16 March 2022.

The RSB reviewed the Impact Assessment report on 16 March 2022 and gave a positive opinion. Based on the Board's recommendations for improvement[180], the Impact Assessment has been revised as follows:

Comments of the RSB	*How and where comments have been addressed*
(B) Summary of findings	
(B1) The report does not clearly set out the incremental value of the revised legal instrument . It does not explain the different determinants affecting the roll-out of very high capacity networks, including national and EU rules and other initiatives. It does not bring out clearly enough the single market aspects of both the problems and the options, including stakeholders' views.	Section 1.1 has been improved to provide more clarity about the incremental value of the revised legal instrument and the determinants affecting the roll-out of very high capacity networks. Section 3 and 5.2 have been improved to clarify the single market aspects of the problems, and options respectively.
(B2) The report does not sufficiently explain the importance of the 5G standard and building the very high capacity cross-border infrastructure and sharing it for its successful deployment.	The importance of 5G and of building the required infrastructure for 5G deployment has been better explained throughout the document. In particular, section 3 expands on the importance of 5G to support cross-border applications, in various industry sectors as well as on the importance of fixed VHCN infrastructure to support the deployment of 5G.
(B3) The report is not sufficiently clear on the methodological assumptions and parameters underpinning the econometric models used for the analysis of economic and environmental impacts. It does not clearly argue the net positive	Section 6 and Annex 5 have been improved to provide more clarity about the econometric models used, including the assumptions, robustness, extrapolation, etc. Section 6.3 presents more clearly the net environmental impact.

180 The RSB opinion is published in the EUR-Lex website

environmental impact.	
(C) What to improve	
(C1) The report should be clear and more explicit about the incremental nature and value of the proposal to help render the analysis more proportionate. It should explain better the different determinants affecting the deployment of very high capacity networks, also with reference to fibre optic investments for 5G connectivity, the different initial situations of the Member States and national and local regulations in place.	Please refer to points B1, B2 and B3 above. In addition, in improving section 1.1 on the incremental value of the revised legal instrument and the determinants affecting the roll-out of very high capacity networks, reference was made to fibre optic investments for 5G connectivity, also adding explanations on the different initial situations across Member States.
(C2) The report should strengthen the single market dimension of the analysis, explaining the rationale for building EU-wide, cross-border connectivity and expanding the arguments relating to market entry and the scale effects restrained by the current differences in national rules. It should also take into account the evolution of multinational market players and their competitive strategies in Europe (i.e. entering in almost each national market). As public authorities in the Member States seem more reluctant on deepened harmonisation measures, the report should explain their positions and the rationale behind them.	Section 3 has been improved to clarify the single market dimension of the analysis. The rationale for building cross-border connectivity as well as arguments relating to market entry and the scale effects, also relating to market players' strategies to enter national markets are clarified in sections 3.1 and 3.2. Moreover, section 3.3 expands on the position of public authorities.
(C3) The report should explain the central importance of 5G as the new generation technology standard for broadband mobile networks, and explain why, in this context, the roll-out of optical fibre and infrastructure sharing is vital for the successful deployment of 5G technology and how this will impact on different stakeholders beyond the electronic communications sector.	Section 3 has been improved to better explain the importance of 5G, also to support applications in other industry sectors than the electronic communications sector. Specifically, other factors generating fragmentation in this respect (i.e. national differences in electromagnetic emissions) that are not tackled by this initiative, are explained in sections 3.2 and the 3.3.

The report should also mention other factors generating fragmentation in this respect (i.e. national differences in electromagnetic emissions) that are not tackled by this initiative, but which may nonetheless affect expected harmonisation outcomes.	
(C4) The report should provide more detail on aspects pertaining to competition in relation to existing physical infrastructure within the electronic communication sector as well as with other network operators. It should also better discuss the trade-offs between the needs for infrastructure sharing and the risk of excess capacity (overbuild).	Section 2.2 has been improved to better explain aspects relating to competition in relation to existing physical infrastructure and the trade-offs between the needs for infrastructure sharing and the risk of excess capacity.
(C5) With regard to the econometric modelling, the report should explain to what extent the specific measures proposed could be disentangled from other factors that may affect deployment decisions. It should expand the presentation of the underlying assumptions in terms of their origin and robustness, including the extrapolation methodology, to allow for easier and more credible assessment of the performance of policy options. The analysis of environmental impacts should better explain and disaggregate the parameters used in the model, to allow for better understanding of the effects and to present, with more clarity and convincing arguments, the net positive impacts on the CO2 and other Green House Gas emissions.	The econometric modelling is built on assumptions explained in detail in the report and the annexes, including the limitations as regards disaggregation of results. Section 6 and Annex 5 have been improved to provide more clarity about the modelling including origin of the assumptions, robustness, extrapolation, etc. Section 6.3 provides further information on the analysis of the environmental impact and presents more clearly the net impacts.
(C6) The report should explain the envisaged legal delivery instrument for the revised legal instrument when discussing	Additions in chapter 5.2, indicate that the preferred instrument would be a regulation.

subsidiarity and proportionality aspects.	

4. EVIDENCE, SOURCES AND QUALITY

The variety of views which have been collected through the extensive consultation activities contributed to the objectivity and independence of the evaluation, and allowed to cross-check data. Various sources have been used for evidence gathering, in particular:

- **implementation reports**: implementation, monitoring and screening exercises run by DG CONNECT regularly; annual reports issued by DG CONNECT covering market and regulatory developments in electronic communications such as the Digital Economy and Society Index (DESI).
- 2018 Commission report on the implementation of the Broadband Cost Reduction Directive.
- **dedicated support study**: *Support for the evaluation of current measures at European and national level to reduce the cost of deployment of electronic communications networks and for the preparation of an impact assessment to accompany an EU initiative to review Directive 2014/61/EU*[181] *(VIGIE 2020/0647),* The objective of the study is to support the evaluation of the Directive by assessing the effect of measures adopted under this Directive (including voluntary measures and measures going beyond scope of the Directive), taking into account the effect of other measures related to the reduction of the cost of high-speed broadband deployment adopted at national level. The study also supports the preparation of an impact assessment to accompany a possible Commission initiative for the review of the Directive by contributing to the problem definition and assessing the impact of a number of policy options and refining them as necessary. To this end, the support study conducted targeted consultations consisting of surveys, interviews, case studies and workshops. The study also took into consideration the results of the open public consultation and, eventually, the roadmaps developed by Member States for the implementation of the Common Union Toolbox of best practices to foster connectivity that Member States submitted between April and November 2021.
- **literature review**: several reports[182] and studies[183] related to the Broadband Cost Reduction Directive were reviewed and an extensive literature review was carried out.
- **Opinion of the Fit for Future Platform**[184] on "*How to favour interconnectivity between the digital and the green transition, including through simplification?"* This opinion emphasized the importance of better access to data through improved co-use and governance of existing physical infrastructure for broadband roll out.

[181] VIGIE 2020-0647
[182] 2020 Summary Report of Best Practices - Outcome of phase 1 of the work of the Special Group for developing a common Union Toolbox for connectivity (link); 2018 European Commission report on the implementation of the Broadband Cost Reduction Directive (link); 2017 BEREC report on the Implementation of the Broadband Cost Reduction Directive (link); BEREC report on pricing for access to infrastructure and civil works according to the BCRD (link);
[183] Study on implementation and monitoring of measures under the BCRD (SMART 2015/066); White paper on EU broadband Plan challenges and opportunities, Analysis Mason 2019 (link);
[184] Fit for Future Platform Opinion 2022/SBGR1/01 of 5 December 2022

- **stakeholders' consultations**:
    - stakeholder feedback for the Roadmap/Inception Impact Assessment (19 June 2019- 17 July 2020);
    - public consultation (02 December 2020 – 02 March 2021) covering both backward and forward looking aspects. A factual report was published and the detailed analysis of the responses was done using stakeholder mapping[185];
    - online participatory workshops on network deployment: drivers and barriers for network deployment on 27 January 2021 (summary report) and on institutional aspects of BCRD on 22 February 2021 (summary report);
    - BEREC's opinion on the revision of the Broadband Cost Reduction Directive covering both backward and forward looking aspects;
    - targeted consultation of local and regional authorities (2nd meeting of Committee of the Regions-European Commission Broadband Platform of 15 June 2021, online workshop with Living-in.EU signatories of 28 October 2021 (event report). This was carried out as not sufficient representativeness of sub-national authorities was ensured through the rest of the consultation activities and in order to have more robust and comprehensive data;
    - bilateral meetings, including with market stakeholders and their associations.

[185] The open public consultation, covering both the evaluation (backward looking) and the impact assessment (forward looking), was addressed to the following categories of stakeholders: (1) electronic communications network operators; (2) physical infrastructure operators; (3) other network operators (energy, transport, water); (4) competent authorities dealing with permit granting procedures for civil works and/or access to public property or other elements; (4) competent authorities in charge of transposition, implementation and enforcement, in particular the tasks of dispute resolution and single information point; (6) property owners and managers; (7) suppliers of electronic communications equipment and related services; (8) undertakings in the building and civil works sector; (9) stakeholders with a general interest in the deployment of very high capacity networks (VHCN) and services, including citizens, social and economic organisations/groups and non-governmental bodies; (10) stakeholders with an interest in environmental protection, including citizens, social and economic organisations/groups and non-governmental bodies; (11) experts, including academia and think tanks.

ANNEX 2: STAKEHOLDER CONSULTATION (SYNOPSIS REPORT)

1. INTRODUCTION

The Commission has carried out an evaluation of the current measures under the Broadband Cost Reduction Directive and the impact assessment of a possible revised instrument, in a back-to-back process.

In this context the Commission organized a stakeholders' feedback exercise through 'Have you Say' webpage (June/July 2020), carried out a public consultation and organized also participatory workshops on network deployment (Q1 2021). Moreover, on 11 March 2021, the Board of European Regulators for Electronic Communications (BEREC) provided an opinion .

The public consultation involved 96 respondents from 25 countries (22 Member States, UK, Norway and China). The respondents' profiles reflect the self-selecting nature of public consultations and call for caution when interpreting the results, since they cannot be considered as a representative sample of all European stakeholders or of all stakeholders within a category of stakeholders, nor do their comments represent equal weight. Three NRAs participated in the public consultation.

2. GENERAL REMARKS

All stakeholders agree high quality connectivity plays a vital role in the current COVID-19 crisis and the economic recovery. COVID-19 crisis has increased data consumption. Accordingly, electronic communications networks ('ECN') operators experienced an increase in connection demand and data traffic. Business associations assert BCRD review has to be coherent with the EECC, and the EU should provide harmonized rules to foster investment on network deployment while, at the same time, avoid excessive regulation and obligations towards operators.

A large group of operators and most business associations recall the need for further harmonization and regulation at EU level, especially regarding administrative procedures such as permit granting to overcome market fragmentation. Whereas a smaller number of operators indicate the need for allowing Member States leeway to implement and enforce EU legislation. Meanwhile, a vast majority of public authorities is more reluctant than operators regarding measures at EU level.

All respondents stress at least one of the following areas in which public administrations could facilitate the deployment of electronic communications networks besides public funding: administrative burdens, access to publicly owned infrastructure and relevant information for deployment.

3. EVALUATION OF THE OVERALL FUNCTIONING OF THE BROADBAND COST REDUCTION DIRECTIVE

There is a general heterogeneity in stakeholders' views regarding to what extent the BCRD has been effective to achieve its general objective to reducing the cost for high-speed electronic communications networks deployment.

Only limited effectiveness is recognized by the ECN operators as regards reinforced coordination of civil works, which is considered burdensome and leading to delays in projects' deployment, despite the procedures and deadlines for agreeing the coordination of civil works between operators introduced by the BCRD. The lowest progress, is registered in reduction of time and cost of permit granting.

In BEREC's view, the BCRD provisions have no impact on SMP regulation, which can be considered to be a stricter framework. For instance, the pricing principle for SMP regulation is typically cost orientation, whereas for BCRD access it is 'fair and reasonable'. As regards symmetric regulation under Art. 61(3) EECC, BEREC considers that there is a certain overlap, in particular with Art. 9 BCRD on access to in-building (physical) infrastructure.

4. SUBJECT MATTER AND SCOPE

According to the majority of stakeholders, BCRD concepts and definitions should be aligned with the European Electronics Communication Code (EECC). Most stakeholders are of the view that the BCRD review is timely as it must take into consideration technological, market and regulatory developments. The revised text should also be aligned with the objectives of the Gigabit Society Communication and the current scope of the Directive should be updated, e.g. the threshold of 30 Mbps which was the target set in 2010 is perceived as inappropriate for today's needs.

Overall, the measures covered by the Directive are perceived as relevant. Effective permit granting procedures are the most critical aspect for a timely and efficient deployment of electronic communications networks. The availability of relevant information is affecting network deployment.

BEREC advises caution on a possible change of scope of the rights and obligations under the BCRD from high-speed electronic communications networks to VHCNs, which could lead to methodological problems.

5. ACCESS AND AVAILABILITY OF PHYSICAL INFRASTRUCTURE AND OF IN-BUILDING PHYSICAL INFRASTRUCTURE

The lack of availability of suitable physical infrastructure, the lack of information on existing physical infrastructure, the difficulty to agree on terms and conditions of access with owners of physical infrastructure and the relatively slow dispute resolution process led to a more costly or lengthy network deployment. Costs linked to access to physical infrastructure are in the range of 60% to 80% of the overall costs of fixed network deployment and of 40% to 60% in the cased of mobile networks.

Most alternative ECN operators and their associations, including those owned by local authorities, consider the current access obligations as appropriate, but argued that their imposition would best suit SMP operators if imposed exclusively on them. SMP operators and their associations call for stricter rules, in order to avoid cases of refusals or high prices, which increase costs and slow down deployment and complain that the same assets are often subject to both BCRD and SMP-based access obligations. Irrespective of their market position, many ECN operators have requested the extension of such obligations to non-network physical infrastructure held by public bodies.

A significant number of stakeholders disagree with the suggestion that the ‘fair and reasonable’ principle for access to physical infrastructure has been applied effectively. Many operators and associations argue that the ‘fair and reasonable’ principle is not sufficiently precise and leaves a wide margin of discretion to dispute settlement bodies, thereby reducing predictability on the outcome. To increase effectiveness and efficiency, operators and their associations call for guidelines at national or at the EU level on the ‘fair and reasonable’ principle and for stronger enforcement of the deadlines for dispute settlement. On the other hand, a number of public authorities are of the view that the principle has been applied effectively and efficiently.

BEREC evaluates the overall functioning of the DSB as very positive and considers that DSB decisions have provided guidance to market participants beyond the specific case by setting references for fair and reasonable terms and conditions[186]. BEREC is of the view that the adoption of specific guidelines or rules by national authorities to assist the DSB in applying the BCRD contributes to the efficient and effective functioning of the dispute resolution process.

There is in general a strong support for the criteria provided in Article 3 for refusing access to existing physical infrastructure. However, for the availability of viable alternative means of access, fewer stakeholders expressed support. Mainly SMP operators argue this criterion might undermine the objectives of the BCRD by incentivizing the deployment of dark fiber in order to refuse access to ducts. Other operators, such as wholesale-only and fibre operators, consider this criterion not only appropriate, but in fact, crucial for the viability of their business model. There is a call for more guidance on the application of the criteria to prevent undue refusals for access.

BEREC considers that the reasons for access refusal are already well developed and that there is no need for more specific rules.

Stakeholders consider that the in-building infrastructure can be an important bottleneck for the deployment of new networks and its importance is likely to increase in the future. There is a call for enhancing the current provisions and also to propose an obligation for building owners to deploy and give access to in-building fibre wiring. In BEREC’s experience, problems have been found when in-building infrastructures are built in such a way that they do not technically allow third party access.

6. COORDINATION OF CIVIL WORKS

A vast majority of stakeholders agree coordination of civil works may bring benefits for the joint deployment of networks, in terms of cost reduction, more sustainable network deployment and low burden on citizens. Nevertheless, ECN operators’ associations express certain caution as regards coordination of civil works with utilities arguing synergies with non-telecommunications are limited because of different work methods and timing and the subsequent requirements for maintenance while the network is in operation. BEREC is of the view that coordination of civil works has a high potential for cost savings, the exact level of which depends on several factors.

[186] In BEREC view, ‘fair and reasonable’ concept includes taking into account the impact of the requested access on the business case of the access provider. BEREC points out that reference to recovery of cost has led some DSB to explicitly interpret ‘fair and reasonable’ as ‘cost orientation’.

Although the coordination of civil works is perceived as burdensome and time and human resource consuming, it is recognized as a driver of efficiency and cost savings. Timely information sharing on planned civil works and civil works coordination at reasonable costs is essential.

BEREC stresses the importance of good data availability on planned construction works and suggests fostering it further as well as DSB guidance on costs allocation.

BEREC considers that the obligation to coordinate should be imposed on all network operators, irrespective of source of financing, as this would increase the possibilities to share costs of civil engineering. Such an extension may require the implementation of more precise criteria on a refusal of coordination.

7. TRANSPARENCY MEASURES

There is merit in making available information through the single information point ('SIP'). Majority of stakeholders, including BEREC, consider that the availability of constantly updated information via the SIP on planned civil works and on physical infrastructure is relevant to network deployment.

ECN operators value access to information through the SIP, notably as regards: (i) physical infrastructure from public bodies, (ii) civil works in progress or planned by public authorities, (iii) acquisition and construction of sites for the deployment of mobile base stations, and on (iv) physical infrastructure from ECN operators. BEREC is of the opinion that the gathering of information on physical infrastructure is hindered by the way the process is currently foreseen in the BCRD, i.e. on a request basis and mostly optional via the SIP. As regards the entities that are under obligations to provide information, BEREC considers it appropriate that also organisations other than public sector bodies (e.g. network operators) make information on existing physical infrastructure available via the SIP. On planned civil works, BEREC points out that the current provisions in the BCRD do not oblige a database of planned civil works by network operators that are fully or partially financed by public means. In BEREC's view, an obligation for all network operators to proactively make available via the SIP the relevant information on planned civil works would increase coordination and respectively decrease investment costs.

8. PERMIT GRANTING PROCEDURES

The difficulty in obtaining permits is seen as a factor which can slow down deployment considerably. As regards factors that negatively impact the complexity and length of permit granting procedures to deploy or upgrade electronic communications networks, majority of stakeholders pointed towards the lack of coordination between the various authorities competent for granting permits, the multiplicity of permits needed for ECN deployment, the lack of electronic means/procedures for permit applications and the non-respect of the deadline to grant all ECN deployment related permits, including those for rights of way. The factor which all stakeholders consider as the less important to negatively affect permit-granting is the lack of explicit rules.

As regards potential measures for streamlining the permit granting procedures, the majority of stakeholders indicated the availability of an integrated permit granting procedure that encompasses all different procedures of each of the competent authorities involved and of the possibility to submit permit applications by electronic means; a single entry point (one-stop-shop), acting as an intermediary, routing permit applications to any competent authority (national, regional or local); coordination and monitoring by a single body (or set of bodies) of permit granting procedures by all the authorities' in charge; the harmonization of permit procedures at Member State level or at EU level and the centralisation of the competence for all permits in one authority within the Member State.

In BEREC's view, it would be easier for operators to apply for permits at a single point, as they would not need to know the (local) authority for granting the permit. This role could be played by the SIP.

BEREC is of the view that it would not be appropriate to establish the SIP as a centralised permit granting authority. BEREC notes that NRAs are (typically) not permit granting authorities and, in case the tasks of the SIP were assigned to the NRA, this would change the tasks of NRAs completely.

A large majority of stakeholders agree simplified permit procedures facilitate network deployment and propose some measures. For instance, tacit approval/deemed consent is well considered by ECN and other type of operators, whereas a vast majority of public authorities don't mention or discard such approach. As regards public authorities' feedback, a vast majority agree on simplifying permit procedures.

9. ENVIRONMENTAL IMPACT OF ELECTRONIC COMMUNICATIONS NETWORKS

Less than half of stakeholders consider that the deployment and operation of networks could have a moderate or more significant environmental impact. Conversely, most stakeholders consider the environmental impact of deployment and operation of networks as less significant.

Stakeholders agree that both energy efficiency and carbon intensity of used energy have at least some contribution to greenhouse gas emissions resulting from the operation of electronic communications networks.

Feedback provided suggests that a single criterion might not be sufficient or appropriate, and that a combination of criteria might be required to qualify networks as environmentally sustainable.

10. GOVERNANCE AND ENFORCEMENT: COMPETENT BODIES AND OTHER HORIZONTAL PROVISIONS (PENALTIES, DISPUTE RESOLUTION)

The appropriateness of the dispute settlement system provided in the Directive is seen more critically by network operators than by public authorities. Stakeholders were more positive regarding disputes related to access to existing physical infrastructure and in-building infrastructure compared to other provisions. In general, more stakeholders found the current dispute resolution mechanism as appropriate for the access to infrastructure or coordination of civil works (respectively Art. 3 and 5) than for the respective transparency disputes (Art. 4 and 6).

According to BEREC, the principle of the dispute settlement process foreseen in the BCRD is appropriate, but the effects in different Member States depend on the pre-existing legal framework and/or market conditions.

11. LEGAL INSTRUMENT

The choice made of a Directive as a legal instrument to regulate the measures to reduce the cost of deploying electronic communications networks is seen as appropriate by most public authorities (81%). The views from network operators (including ECN operators) are mixed, with 40% of stakeholders finding the choice of a Directive as a legal instrument to be appropriate, 30% disagreeing and more than 27% being neutral.

With regard to the choice of instrument for the future, 39% of the respondents would support a shift to a regulation with 35% of respondents disagreeing, while the choice of a directive with maximum harmonization is supported by a limited number of respondents (25%). 47% of respondents consider that a minimum harmonization directive (similar to the current situation) is the best way forward, while 29% of respondents disagree.

ANNEX 3: WHO IS AFFECTED AND HOW?

1. PRACTICAL IMPLICATIONS OF THE INITIATIVE

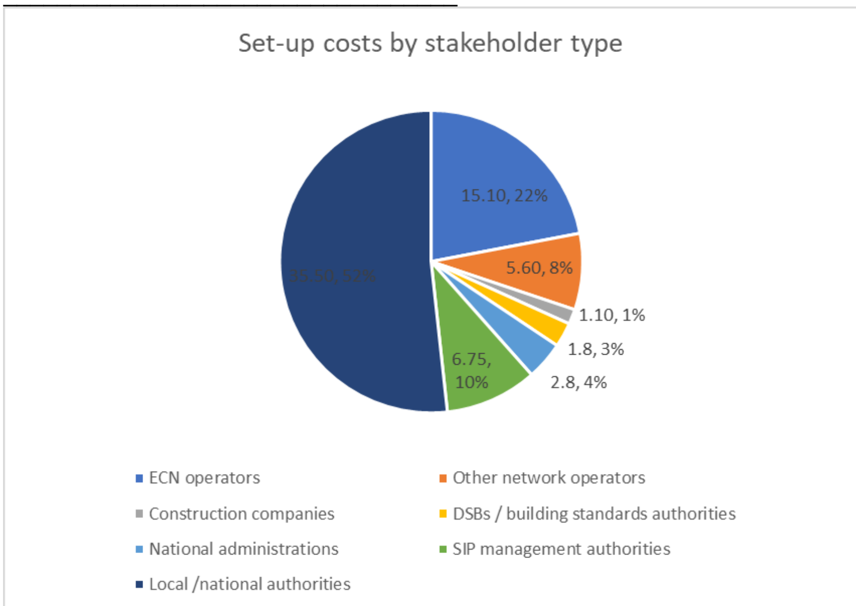
The proposed changes to the BCRD would not introduce any obligations directly impacting SMEs as purchasers of Gigabit services. SMEs acting as ECN operators or other (non-ECN) network operators may be impacted the same way as other businesses under those categories of stakeholders (see Annex 2 of support study for more information). SMEs acting as ECN operators or other network operators may in particular include certain small scale local fibre investors or local utilities which are present in some Member States. Effects which are specific to SMEs acting as ECN or other network operators are highlighted in this section.

1.1. Costs to stakeholders

The introduction of the preferred option is expected to entail set-up costs in particular in relation to the streamlining and digitisation of permit granting procedures and systems and the adaptation of SIPs to include up-to-date and georeferenced information from public authorities and network operators including information about non-network facilities suitable for ECN deployment (such as public buildings, street furniture). Some (more limited) set-up costs may also be incurred in relation to the development of rules and any associated EU Guidelines for PIA, access to in-building and civil works co-ordination as well as standards for in-building infrastructure.

As a rough approximation based on assumptions that are described in more detail in this Annex, the preferred option might involve quantifiable set-up costs of around EUR70m. The estimated distribution of set-up costs amongst the different stakeholder types is shown in the following figure.

<u>Figure 4: Set-up costs by stakeholder type</u>



Source: support study

The large proportion (roughly EUR35m in total) estimated in relation to local authorities relates to changes to permit granting procedures (including the introduction of new categories of permit-exempt works) and the introduction of digital platforms for permit granting in those countries where it is not otherwise envisage. However, it is likely that a portion of this cost would be borne by national administrations (potentially with support from EU funding for digitisation programmes). It is also likely that local authorities will incur costs to digitise information about their assets (those which are suitable for ECN deployment) for inclusion in the SIP, but the level of this cost is difficult to determine, and depends on the degree to which information is already available in electronic form, which is compatible with submission to a digital platform. The provision for exemptions based on proportionality should also serve to limit costs to public authorities of making available information about their facilities in cases where they would clearly be unsuitable or there is insufficient demand to justify the costs incurred, for example.

SIP management authorities are estimated to incur incremental set-up costs due to the improvements to the SIP platform associated with the preferred option of around EUR6.75m, and may also incur around EUR3.5m annually in related maintenance and enforcement.

The cost implications to DSBs arising from the preferred option are expected to be relatively limited amounting to some EUR0.7m in set-up costs (in connection with the preparation of EU level guidelines on PIA, in-building infrastructure and civil works co-ordination) and an additional EUR0.4m in recurring costs across the EU. The increased workload is expected to result from the inclusion of public non-network facilities within the scope of the dispute settlement process. However, this is expected to be offset by a reduction in the number of disputes due to the adoption of EU-level guidelines on PIA, civil works co-ordination and access to in-building physical infrastructure.

EUR1.1m in set-up costs might be incurred by DSBs and/or authorities responsible for building standards in the development of national standards for in-building infrastructure in countries where such standards are not already in place, while recurring costs of around EUR2.2m per annum might be incurred in related enforcement activities.

One can anticipate that ECN operators across the EU might incur around EUR15m of set-up costs in connection with their input into permit granting systems and SIPs (alongside associated changes to internal processes and data gathering methods) as well as their contributions to the development of standards for in-building infrastructure and EU-level Guidelines. For larger operators, the main impacts are likely to be associated with changes to the permit granting system and the need (in a few countries) to submit information about existing and planned deployment in georeferenced format directly to the SIP. Smaller ECN operators as well as other non-ECN network operators may also be required to submit information about existing and planned physical infrastructure directly to the SIP in some countries as a result of the preferred option. However, impacts could be limited if exemptions to the obligations are provided for on the grounds of proportionality. As regards the costs of providing input regarding Guidelines and standards, experience suggests that SME ECN operators may limit the costs their incur individually by relying more on trade associations for representation.

Other non-ECN operators may also have set-up costs of around EUR5.6m relating to new requirements in a few countries to submit information directly to the SIP and their input into the development of Guidelines on PIA and civil works co-ordination. Smaller non-ECN operators in a few countries would (like larger players) need to submit information about existing physical infrastructure to the SIP for the first time. In some cases e.g. for local utilities, this may require the digitisation of information about their network, and common formats to submit information about planned works. The precise costs of this process are difficult to estimate, but may be limited if as described above, there is the possibility for exemptions based on proportionality.

Finally, one can estimate that representatives of construction companies may incur costs of around EUR1.1m providing input to the development of standards for in-building infrastructure including fibre, in those countries where such standards are not yet in place.

It should be noted that a large part of the costs that may be incurred by local authorities, SIP management authorities and DSBs are likely to be passed to ECN operators in the context of fees for permit applications, dispute resolution and access to the SIP platform. Incremental costs to construction companies of deploying in-building fibre (estimated at around EUR50 per household) are also likely to be passed to consumers and SMEs in the context of building purchases or rental fees.

Tower companies and other private owners of non-network facilities (such as commercial building owners) are not expected to incur significant costs as a result of the preferred option.

1.2. Benefits

Consumers and SMEs purchasing VHCN are expected to be the main beneficiaries of the implementation of the preferred option, as (depending on how cost savings are distributed) they could benefit from potential price reductions for Gigabit broadband and/or the expansion of Gigabit services to cover a greater proportion of premises (around 6.5% additional premises if FTTH is deployed or 9.1% if savings are reinvested in 5G FWA). A recent study found that having access to superfast broadband was associated with an increase in wellbeing worth around EUR260 per household per year.[187] Accelerated deployment of mid-band 5G could also improve access for SMEs to innovative IoT services, which may offer new business opportunities or support productivity gains.

ECN operators are expected to benefit from significantly reduced administrative burdens and cost savings in VHCN deployment, which could enable them to further expand their networks or engage in retail price reductions to boost take-up. Specifically, due to better access to existing physical infrastructure and civil works co-ordination the required private investment (CAPEX) needed from ECN operators to reach 90% FTTH coverage under the preferred option is estimated to be around EUR12bln lower than under a status

[187] 'Subjective wellbeing analysis of the Superfast Broadband programme', which sits as part of a wider report 'Evaluation of the Economic Impact and Public Value of the Superfast Broadband Programme' (2018). In the study, the amount was reported in British pounds (£222.25). See Annex C https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/734860/BDUK_SF_EVAL_ANNEX_C_-_SUBJECTIVE_WELLBEING_ANALYSIS_-_TECHNICAL_REPORT.pdf

quo in which there is more limited infrastructure re-use and collaboration,[188] while ECN operators could also accelerate deployment of mid-band 5G. The benefits described would apply in particular to ECN operators without their own nationwide physical infrastructure, including regional and local players, which may be SMEs. In addition, ECN operators which invest in their own network infrastructure are expected to save an estimated EUR40m in administrative costs annually as a result of improvements in the permit-granting regime as well as enhanced clarity and improved access to physical infrastructure in general and to public facilities in particular. The introduction of measures such as permit exemptions and tacit approval, where not already mandated, should also significantly cut times (and reduce administrative costs) for ECN operators to obtain a permit for VHCN deployment. The reductions in bureaucracy in permit granting and improved access to public non-network facilities could also benefit tower companies seeking to install additional infrastructure.

Local authorities are also expected to benefit from the proposed changes to the BCRD, as implementation of permit exemptions, tacit approval (where feasible) and the introduction of digital platforms for permit granting is expected to lead to significant efficiencies in the medium to long term.[189] Precise estimates are difficult to make, but it is possible that the introduction of permit exemptions and digital permit granting systems could reduce annual costs to local authorities associated with processing deployment permits by EUR3.5m or more in those countries which are not otherwise planning to streamline permit granting processes. Although the BCRD applies specifically to ECN, it is not excluded that local authorities and national administrations could choose (if this is not yet the case) to extend the principles applied to ECN to increase efficiency in administrative procedures for other sectors, benefiting both the authorities and stakeholders concerned.

Member States also gain from potential savings of EUR2.4bln in subsidies that would otherwise have been required to deploy FTTH to 90% of households. These savings could be reinvested to achieve increased VHCN coverage or deliver benefits in other sectors.

Lastly, it should be noted that there are potential benefits to be gained for construction companies from the installation of in-building fibre, if certification is accompanied by labelling schemes which could serve to boost the value of property,[190] and for other

[188] Estimated savings assume the deployment of FTTH in areas remaining to be served, by an ECN operator without its own existing nationwide physical infrastructure.

[189] A number of public authorities which have implemented a digital platform have observed that this led to administrative efficiencies in the processing of individual permit applications, which presumably could also translate into cost savings or the reallocation of municipal resources to other services. For example, the Gigabitbüro in **Germany** reports that following the implementation of digital systems by a region in Northern Germany, the time taken for building permits was reduced by 30%. According to Digital **Denmark** Digitalization saves 296 million euro per year, Ministries in Denmark have reduced case processing time by 30% and transparency in Ministries and organizations increased 96%. Meanwhile, in **Ireland**, the MapRoad Roadworks Licensing (MRL) system has contributed to a turnaround time of just 30 days for the majority (80%) of licences for which applications were received, with an overall average of 17 days in 2019. Public authorities in **Lithuania** also report that their digital permit granting system allows for permits to be processed for just EUR100 per application.

[190] The building certification scheme in South Korea is considered to have been successful, with benefits also accruing to building companies. For example, a report by Ovum for the World Bank notes that “the initiative [the certification program] has been welcomed by developers as it has allowed them to charge more for buildings with broadband services, and it has resulted in many partnerships between

network operators, if they are able to benefit from increased revenues or cost-savings associated with facility sharing or if they can exploit the presence of VHCN to engage in digitisation activities benefiting their own operations (e.g. smart energy, smart waste management, etc.).

2. SUMMARY OF COSTS AND BENEFITS

An overview of the main benefits and quantifiable costs associated with the preferred option compared with the status quo are provided in the following tables. For the assessment of other benefits and costs which may be less significant or less readily quantifiable please refer to Annex 2 of the support study. Please note that not all the data presented below would be relevant for the offsetting exercise following the approach of the one-in-one-out principle.

In the table concerning costs, the symbols '+' and '-' are used respectively to indicate cost savings and additional costs in cases where the amounts cannot be readily quantified. '+ /-' is used to indicate situations where costs might increase or decrease depending on the situation e.g. the introduction of requirements for public authorities to make available access to their physical infrastructure on fair and non-discriminatory terms might either lead to increased or reduced administrative costs depending on whether the Member States concerned make use of measures to standardise terms and potentially co-ordinate interactions between ECN operators and the public authorities concerned.

Figures provide an indication of the approximate costs linked to the implementation of the preferred option. In particular for costs relating to permit granting processes and platforms as well as the SIP, significant differences in cost between countries are likely depending on whether the countries concerned already have or are planning to take the measures that would be mandated under the preferred option. This has been taken into account in the estimations to the extent feasible. It should be noted that all figures are estimates, and should be considered as directional indicators concerning the impact, rather than definitive conclusions concerning the costs to be incurred. The assumptions behind the estimates are explained in the relevant sections. All cost estimations are based on FTE at the level of ISCO 2 (professionals) except for costs related to the processing of permit applications, which are assumed to be conducted by staff at the level of ISCO 3 (technicians and associated professionals). An 8 hour day and 225 working days per year are assumed. A summary table is also provided showing the assumptions regarding the number of FTE (and number of countries assumed affected by cost) in each case.

construction firms, ISPs, and telecom services providers". Other studies suggest that "The system provides builders with a means for differentiating their products—a useful feature in so highly competitive an industry". More information is contained in the relevant section.

Table 15: Main benefits to stakeholders to 2030

<table>
<tr><th colspan="10">I. Overview of benefits – Preferred option</th></tr>
<tr><th></th><th>ECN operators</th><th>Other network operators</th><th>Tower companies</th><th>Construction companies</th><th>Member States</th><th>DSBs / SIP management authorities</th><th>Local Authorities</th><th>Citizens/ Consumers</th><th>SMEs (ECN and users)</th></tr>
<tr><td>PIA guidelines, extension to non-network facilities</td><td rowspan="3">~EUR12bln reduced capex in VHCN deployment. Annual savings of ~EUR24m in administrative costs</td><td rowspan="3">Revenue and cost saving opportunities, synergies with digitisation of core business (e.g. smart energy)</td><td></td><td></td><td rowspan="3">Reduced subsidy requirements to reach 90% coverage with FTTH ~ EUR2.4bln</td><td rowspan="2">Fewer disputes and less resources needed to resolve disputes if clear guidance available</td><td rowspan="2">Revenue and cost saving opportunities, synergies with digitisation of core business (smart cities)</td><td rowspan="4">Reduced Gigabit broadband prices or increased Gigabit coverage (by 6.5% if FTTH or 9.1% if 5G FWA)</td><td rowspan="3">Same as consumers. SME ECN Operators without own physical infrastructure reap most benefits from BCRD cost reductions</td></tr>
<tr><td>Clarification of civil works obligation and guidelines on cost allocation</td><td></td><td></td></tr>
<tr><td>Improvements to SIP</td><td></td><td></td><td>Digital platforms increase operational efficiency</td><td>Support for urban planning and smart city development</td></tr>
<tr><td>Strengthened provisions on permit granting</td><td>Accelerated deployment, annual savings of EUR15m in administrative costs</td><td>Accelerated deployment and saved administrative costs if MS extend digital platforms to cover all networks</td><td>Accelerated deployment, reduced administrative costs</td><td></td><td>Medium term efficiencies / cost savings</td><td></td><td>Medium term efficiencies / cost savings – potentially around EUR3-4m per year</td><td>Reduced burdens for SME ECN operators</td></tr>
<tr><td>Mandated in-building FTTH</td><td>Accelerated deployment, savings of around EUR200 for new / renovated premises</td><td></td><td></td><td>Increased property value / rental income</td><td></td><td></td><td></td><td>Reduced FTTH connection costs, increased infrastructure competition</td><td>As for consumers and ECN operators</td></tr>
</table>

Source: support study

Table 16: Overview of Benefits (total for all provisions) – Preferred option

I. Overview of Benefits (total for all provisions) – Preferred Option		
Description	***Amount***	***Comments***
	Direct benefits	
Member States	~ EUR2.4billion	Cost savings in VHCN deployment leading to the opportunity to reduce subsidies for FTTH deployment by EUR2.4bln
Electronic Communication Network (ECN) operators:	~EUR12billion	Reduced capex in VHCN deployment Cost savings due to improved access to existing infrastructure and co-deployment opportunities
Local Authorities	EUR3-4m savings per annum	The savings come from: • Digitisation of permit-granting processes, permit exemptions and tacit approval • Requirements to provide access to non-network public facilities Strengthened information requirements for civil works co-ordination
	Indirect benefits	
Increased VHCN		Additional 6.5% households served by FTTH or 9.1% by 5G FWA if cost savings are reinvested in VHCN
Improved job opportunities	627,000 jobs EU-wide	
Improved economic prosperity	~EUR109billion	Uplift in GDP in the period to 2030 if cost savings are reinvested in FTTH
	Administrative cost savings related to the 'one in, one out' approach*	
Electronic Communication Network (ECN) operators:	~EUR40m savings per annum	Administrative cost savings from streamlining of access negotiations / reductions in disputes (~EUR24m per annum) Administrative cost savings from streamlined permit application processes (~EUR15m per annum)

Source: support study

Table 17: Overview of costs- Preferred option

II. Overview of costs – Preferred option								
		Citizens/Consumers		**Businesses**		**Administrations**	
		One-off	**Recurrent**	**One-off**	**Recurrent**	**One-off**	**Recurrent**
Action (a)	Direct adjustment costs	EUR50 per installation		Electronic Communication Network (ECN) operators: * EUR15m[191]		Local Authorities: * EUR35-40m DSBs/SIPs	

[191] These cost include the stakeholders' participation in preparing guidelines. There is no obligation for participation and therefore bearing such cost would be at entire decision of the stakeholders.

				Other network operators: * EUR5-7m[192] Construction companies: * EUR1-2m[193]		managemen t Authorities: * EUR10-15m	
	Direct administrative costs						DSBs/SIPs management Authorities: * EUR6-7m per year
	Direct regulatory fees and charges						
	Direct enforcement costs						
	Indirect costs						
Costs related to the 'one in, one out' approach							
Total	Direct adjustment costs			Administrative costs, such as the transparency obligations (implementing georeferencing, providing information about existing physical infrastructure, pro-active notification of planned civil works)[194]			
	Indirect adjustment costs						
	Administrative costs (for offsetting)						

Source: support study

[192] These cost include the stakeholders' participation in preparing guidelines. There is no obligation for participation and therefore bearing such cost would be at entire decision of the stakeholders.

[193] These cost include the stakeholders' participation in preparing guidelines. There is no obligation for participation and therefore bearing such cost would be at entire decision of the stakeholders.

[194] These could not be adequately estimated at this stage. According to the support study, the administrative costs related to these obligations are expected to be limited as only few Member States do not have those requirements already in place or some of them plan to implement them in the near future

3. IMPLICATIONS FOR ECN OPERATORS

3.1. Obligations impacting ECN operators

ECN operators are impacted by nearly all the planned changes to the BCRD under the preferred option including:

- Clarification that assets subject to access obligations under EECC or State Aid would not also be subject to BCRD obligations
- Clarifications around the scope of the civil works co-ordination obligations and potential to deny requests
- The extension of physical infrastructure access obligations to include access to public non-network facilities (not limited to SAWAP)
- Requirement for fully digitised SIPs, requirement for network operators to provide information to the SIP, improvements to information available on the SIP (e.g. through georeferencing, pro-active updating) and its extension to public non-network facilities
- Greater clarity on the rules regarding physical infrastructure access wholesale pricing and cost allocation for civil works co-ordination
- Streamlining of the processes to obtain permits and Rights of Way including exemptions, tacit approval (where feasible), the introduction of digital platforms, and the limitation of fees to administrative cost
- Requirements for the installation of FTTH in-building physical infrastructure and fibre and associated standards and rules/guidance for access conditions
- Associated reporting obligations

3.2. Costs

Option 3 does not entail significant new implementation costs for ECN operators. However, ECN operators are also likely to be involved in the elaboration of new Guidelines and implementation of new procedures, which may result in these stakeholders incurring certain set-up costs, as follows.

Improvements to the SIP

Significant participation by ECN operators may be required in Member States consultations on improvements to the operation of the SIP to include information directly from ECN and other network operators (where this is not already the case) and to expand its current scope.,. However, a significant proportion of Member States already have or are planning to develop SIPs meeting these requirements, limiting ECN operator efforts. An average of 1 FTEs from amongst the ECN operators and trade associations in each Member State over 1.5 years[195] would imply a cost to engage in this development of around EUR 2.1m EU-wide.

In the implementation phase, the requirement to provide information in georeferenced format might imply additional costs for some ECN operators, since ECN operators

[195] The approximate time that may be taken to engage in consultation exercises and provide input during the updating of the SIP.

without records in this format would need to update their records. However, it seems reasonable to assume that many ECN operators would already have georeferenced network information and at least 16 Member States already have or plan to implement georeferencing.[196] Nonetheless, for some operators that were not planning to introduce this measure, this obligation is likely to result in set-up costs. The precise level of cost is difficult to quantify in the absence of information about how many of the records are already georeferenced.

The incremental costs of obligations for network operators to provide pro-actively, directly to the SIP, information concerning existing infrastructure and about planned civil works are likely to be limited because there are few countries which do not already have these requirements in place or are planning to introduce them.[197] Moreover, ECN and other network operators in all EU Member States are already obliged to respond to information requests under the BCRD. In addition, ECN operators should also in principle already have information about planned works in the context of planning procedures which could be provided to a SIP. Costs of providing this information could be limited if there is agreement on a standardised format for the information to be used in the context of both planning applications and submission to the SIP for civil works co-ordination.

There is also in principle a possibility that by some ECN operators use newly required information about planned civil works from other ECN operators to pre-empt VHCN deployments planned by their rivals, but this effect could be limited if, as proposed, a VHCN operator could deny civil works co-ordination in cases where there has been no announcement about the intention to deploy by the requesting party, whether in the context of Article 22 EECC or a consultation procedure in the context of the award of State Aid.

Streamlining of processes to obtain permits and RoW

Experience from the implementation of the permit exemptions for SAWAPs shows that ECN operators are likely to be very active in providing input into the definition of permit exemptions at EU level, in supporting the implementation of exemptions in the different Member States, and in ensuring the effective implementation of digital systems for permit granting for VHCN deployment. Moreover, ECN operators may need to create or adapt interfaces and train personnel to interact with any new digital permit granting systems. If industry contributes 3FTE per MS over a 2 year period for the above tasks,[198] the set-up cost would be EUR 8.4m.[199] ECN operators (as well as any other users of a digitised permit granting system) could potentially be called upon to meet all or part of the expenses associated with the implementation of a digital permit granting system.

[196] 10 Member States report that georeferencing is already fully or partly implemented (BG, CY, CZ, EE, HR, LT, LU, MT, PL, PT) and another 6 report that they plan to introduce this requirement (AT, BE, DE, FI, IE, IT). Only 3 Member States reported that they did not have this measure in place and did not have concrete plans (ES, DK, LV).

[197] Only HR, DK, EL, IE, LT, MT and SK do not require network operators to provide information directly to the SIP. In some cases, this is because there is no SIP operational for the moment e.g. IE, DK (but other systems perform the same function). All member States submitting Roadmaps in the context of the Connectivity Recommendation stated that they plan to require pro-active notification of planned civil works, with the exception of IE, where this measure is under discussion.

[198] Estimated implementation timeframe.

[199] Based on ISCO2.

However, if the significant upfront costs of the digitising the system are distributed over a sufficient number of years and if as expected digitisation reduces ongoing operational costs the cost for individual permit applications would decline.[200] Moreover, where the costs for the development of digital permit granting systems are covered by eGovernment support programmes (including EU funds which have been made available for this purpose), there might not be a need to recover these costs from ECN operators (or the national budget).

Access to physical infrastructure and civil works co-ordination Guidelines

ECN operators are likely to be called upon to contribute in the elaboration of EU Guidelines concerning Access to physical infrastructure, civil works co-ordination, and access to in-building infrastructure. Their contribution might be required at two or three discrete stages in the process. If, over a period of 2 years, for each Member State 1 FTE from across the industry is involved in elaborating guidelines on PIA and 0.25 FTE for the aspect of the Guidelines concerning cost allocation in civil works co-ordination, the one-off costs would be EUR 2.8m and EUR 0.7m respectively.

In-building infrastructure

ECN operators will also need to engage in the development of national standards for in-building infrastructure in those countries where standards do not already cover the requirements for in-building fibre. Based on information provided by national administrations in the context of the WIK ICF questionnaire in Q1 2021, at least 10 Member States have standards which cover in-building fibre or could be readily adapted to support in-building fibre,[201] whilst 9 Member States did not have such standards in place. Information was not available for the remaining 8 countries**.** If 1 FTE from amongst ECN operators is engaged in this topic for 1.5 year in 14 Member States, the cost would be approximately EUR1.1m**.**

Reporting obligations

It is assumed that ECN operators will be requested to provide data once every 3 years to the authorities (concerning usage of access to physical infrastructure and civil works co-ordination) and to consultants possibly employed by the European Commission (concerning their perceptions regarding the effectiveness of the provisions of the BCRD).

Since NRAs already gather data on the use of SMP PIA and other wholesale indicators in the context of market reviews, the incremental cost to ECN operators of gathering such data should not be significant, In cases where it is clearly indicated by ECN operators that they are reliant on certain key providers of access or co-ordination under the BCRD, such as a major utility, information could be collected from this source rather than from multiple ECN operators, in order to reduce the administrative cost of data gathering.

[200] For example average costs of just EUR100 per application are reported in Estonia, which benefits from a digital system.

[201] Lithuania requires the installation of cable trays and ducting that should be capable of supporting FTTH installation.

Summary of costs

Overall, quantifiable set-up costs of approximately EUR 15m might be incurred by ECN operators across Europe in connection with the implementation of mandatory elements of the preferred option, of which the major part is expected to be linked to improvements to permit granting systems and the SIP. Additional costs might be incurred in particular to produce georeferenced records in cases where this is not planned to be required and is not already in place amongst ECN operators. However, this cost is not readily quantifiable. Recurring costs are likely to be minimal for this group of stakeholders.

A summary of the potential costs that could be incurred by ECN operators in connection with the preferred option is shown below. Where the measures give rise to cost savings, these are discussed in relation to the section on "benefits" below.

Estimate of quantifiable administrative costs (and cost savings) for ECN operators: BCRD preferred option.

		ECN operators	
		One-off	**Recurrent**
PIA guidelines, extension to non-network facilities	Direct costs	EUR2.8m	EUR24m
	Indirect costs	N/R	N/R
Clarification of civil works obligation and guidelines on cost allocation	Direct costs	EUR0.7m	++
	Indirect costs	N/R	N/R
Extended transparency, digitised SIP	Direct costs	EUR2.1m (+ imp cost)	Potential, but limited
	Indirect costs	N/R	Strategic response
Strengthened provisions on permit granting	Direct costs	EUR8.4m	EUR15m
	Indirect costs	N/R	N/R
Mandated in-building FTTH	Direct costs	EUR1.1m	+++
	Indirect costs	N/R	N/R
Total quantifiable		15.10	

Source: support study

Note: Negative figures represent cost savings

3.3. Benefits

ECN operators are expected to benefit from improved access to existing physical infrastructure, improved opportunities for civil works co-ordination, more comprehensive information concerning existing infrastructure and improved availability of in-building physical infrastructure and fibre. This should reduce the costs of deployment for ECN operators. The preferred option is estimated to reduce the total cost of deploying FTTH to 90% of households by 2030 by around EUR14.5bln compared with the status quo[202]. **The required private investment (CAPEX) needed from ECN operators to reach 90% FTTH coverage under this option is estimated to be around EUR12bln lower than under the status quo.** These CAPEX savings could be passed onto customers to foster

[202] The precise assumptions concerning the impacts of the different options on infrastructure re-use, civil works co-ordination and savings associated with in-building FTTH are set out in the methodological annex of the support study.

increased take-up of FTTH connections by consumers, or could be used by ECN operators to extend coverage into areas which would otherwise be considered unprofitable.

The preferred option is also likely to reduce administrative costs for ECN operators in relation to access negotiations. Whilst the resourcing requirements for ECN operators for negotiating access to physical infrastructure are expected to increase, notably in connection with the deployment of 5G small cells other than SAWAPs under the status quo, [203] this impact would be counteracted under the preferred option by **the inclusion of non-network public facilities within the scope of the revised legal instrument and provision of clear guidelines at EU level concerning terms and conditions for access**. Clearer rules at EU level could also reduce the need for dispute resolution in relation to network access to physical infrastructure and civil works co-ordination in the significant number of countries where there are no existing guidelines in these respects.[204] **This could amount to cost savings compared with the status quo of around EUR24m across Europe, if on average resourcing in access negotiation departments amongst MNOs would otherwise need to increase by around one third**[205] **to handle the additional sites.**

The preferred option could also reduce ongoing expenses associated with permit applications and RoW for both fixed and mobile VHCN deployments[206]. If the streamlining of permit granting applications reduces resourcing needs for permit applications within ECN operators by around **one third,**[207] counteracting expected increases resulting from additional applications for 5G mid-band deployment, this could **reduce administrative costs for ECN operators associated with permit granting across the EU by an estimated EUR31m to around EUR61m Of these, cost savings specifically linked to the BCRD might account for around EUR15m per annum, taking into account existing plans to streamline permit granting systems.**[208]. The requirement that fees for permits should be limited to administrative cost should also reduce the cost for ECN operators in those cases where fees are currently considered to

[203] The number of small cell sites is expected to increase from around 500 in 2019 to more than 4,000 by 2025 Figure 3.2 Analysys Mason (2019) What are key considerations for 5G sites and assuming that the number of sites reported for Western Europe and developed Asia Pacific might be equivalent to the EU as a whole. The Small Cell Forum reports that hundreds of thousands of small cells might be deployed across Europe by 2026. Although projections differ, it is clear that this will be a substantial growth area in the period up to 2030

[204] Guidelines at national level are present on PIA in AT, DE, DK (partially), FI, HU, PT, with plans in CY, ES, HR, NL, PL. Guidelines on civil works co-ordination are present in CY, DE, DK, FI, HU, LT, PT, SE, SK.

[205] An estimated additional 17FTE across the EU.

[206] An alternative fixed operator in a large country reported that it outsources the permit application process to an external party at a cost which is equivalent to EUR3-5 per premise passed, a non-negligible proportion of the connection charge for an FTTH service. Meanwhile, a vertically integrated incumbent in a medium sized country reported that it employs 16 FTE to handle 3,800 planning applications annually, while a mobile only operator in a medium sized country reports that it employs 15 FTE to handle 1,000 planning applications annually and a local FTTH provider employs 1 FTE to handle 250 permits in a single region.

[207] This is a conservative estimate, noting that the implementation of a digital platform in the Netherlands reported enabled a large utility to reduce resourcing in its permit granting department by 25FTE based on an interview conducted for this study with a digital platform provider.

[208] **Assuming 17 MS would act in the absence of revisions to the BCRD to implement digital platforms but permit exemptions were implemented unevenly.**

be set at excessive levels, and it should ensure that future cost savings in permit granting are passed on to ECN operators. However, the level of such savings is difficult to estimate in the absence of information about the degree to which permit granting charges currently exceed above administrative cost.

It is expected that improvements in the completeness and accuracy of information via SIPs should also reduce resourcing needs amongst ECN operators in network planning. However, the precise degree of savings depends inter alia on how much information is made available about non-network public facilities, for which information requirements would be subject to “proportionality” rules and is therefore difficult to estimate, .

The improvements in permit granting procedures as well as the expansion of obligations to access public facilities should enable ECN operators to accelerate the deployment of mid-band 5G. They should cut about 8 months from the estimated 5 year timeframe to achieve 75% coverage of the population with 5G based on 3.6 GHz frequencies and enable an expansion in mid-band 5G deployment to reach 77% of the population by 2030 (compared with 75% in the baseline).Increased coverage of mid-band 5G and the associated support for mid-band IoT applications could in turn support expanded business opportunities and revenues within the sector, although projections around the specific scale of the opportunities vary.[209] Deployment of services based on millimetre waves would also be facilitated.

The preferred option would also reduce the potential overlapping of obligations applying to SMP operators and ECN operators with obligations under State Aid, by clarifying that BCRD obligations should not apply to the same assets that are subject to access obligations under SMP or State aid decisions. Finally, ECN operators deploying VHCN (even if publicly financed) would also be able to deny requests for civil works co-ordination (thereby reducing the obligations that would otherwise apply) if they offer a suitable alternative and/or if the requesting operator had not declared its intention to deploy in the context of infrastructure surveys (Art 22 EECC) or consultation procedures conducted during the award of State Aid.

[209] See discussion in Ericsson 5G for business: a 2030 market compass https://www.ericsson.com/en/5g/5g-for-business/5g-for-business-a-2030-market-compass.

An overview of the estimated quantifiable benefits to ECN operators is provided in the following table.

Estimated quantifiable benefits to ECN Operators by 2030

II Overview of Benefits (ECN Operators) by 2030 – Preferred Option		
Description	**Amount**	**Comments**
Direct benefits		
Cost savings due to improved access to existing infrastructure and co-deployment opportunities	EUR12bln reduced CAPEX enabling addition 6.5% coverage of FTTH	
Administrative cost savings from streamlining of access negotiations / reductions in disputes	EUR24m per year	Cost savings compared with status quo where resourcing for access negotiations would be expected to increase due to 5G small cell deployments
Administrative cost savings from streamlined permit application processes	EUR15m per year	
Waiver on BCRD PIA obligations for assets regulated under SMP / State Aid	Not quantifiable – but linked to increased certainty, reduced administrative burden	
Reduced obligations on publicly funded VHCN deployments to engage in civil works co-ordination (where requestor has not previously declared intention to deploy)	Not quantifiable, but may support VHCN business case for State Aid funded operators	
Indirect benefits		
Increased revenue opportunities from 5G IoT	Significant, but estimations vary	

Source: support study

4. IMPLICATIONS FOR OTHER NETWORK OPERATORS

4.1. Obligations impacting other network operators

Other network operators (besides ECN operators) are not expected to face significant changes to their current obligations as a result of the implementation of the preferred option. Some changes will however apply as follows:

- Changes in transparency obligations imply that non-ECN network operators will need to provide information about physical infrastructure to the SIP directly, with pro-active notification of planned civil works and georeferencing of all information
- The adoption of more specific rules and associated EU level Guidelines concerning terms and conditions for access to physical infrastructure (Article 3) and cost allocation for civil works co-ordination (Article 5), may affect terms and conditions for access and co-ordinated deployment.
- Clarification of the scope of the civil works co-ordination obligation (e.g. deployments which are fully or partly publicly funded) may also affect some non-ECN network operators.

4.2. Costs on other network operators

It is assumed that other (non-ECN) network operators, like ECN operators, would engage in the development of any EU-level guidelines concerning the terms and conditions for access to physical infrastructure and civil works co-ordination. Although the focus of other network operators would be on the terms and conditions for access to network facilities specifically (and not on non-network facilities which would be covered for the first time under the BCRD), , it is assumed that the same resources would be devoted as those provided by ECN operators (i.e. 2.5 FTE in total over the duration of the process). given the diversity of actors involved in different sectors.

It is possible that the introduction of more precise rules and/or EU Guidelines may lead to reductions in wholesale charges for non-telecom access to physical infrastructure in some cases (e.g. if wholesale charges were previously excessive or if only incremental costs are required to be covered in case CAPEX is recovered elsewhere). On the other hand, it is also possible that other network operators might be required to bear a higher proportion of costs in the case of civil works co-ordination than under the status quo, if the existing cost allocation arrangements are found not to be reasonable. The net effect of these developments may be positive for other network operators (in terms of overall cost reductions and potentially increases in profits) if greater certainty over, and potentially lower charges lead to greater utilisation of access to physical infrastructure and civil works co-ordination than under the status quo and if the pricing regimes applied permit other network operators to benefit from increased revenues and / or cost reductions.

It is not possible to quantify any potential costs (or benefits) from potential changes to the pricing regime for other network operators, because they depend on the precise definition of the new rules and associated Guidelines and their application alongside the impact on the take-up of access to physical infrastructure and civil works co-ordination. Negative effects are however expected to be limited. Non-ECN network operators might also benefit from reduced administrative costs linked to the easier negotiation of access to physical infrastructure and civil works co-ordination, if the introduction of clearer rules on terms and conditions (including price) and/or potential Guidelines at EU level, reduce reliance on dispute resolution.

Non-ECN network operators may be called upon to provide input concerning the improvement of the SIP, and may need to invest in changes to their systems to reflect new requirements. If providing input on changes to the SIP entails the use of 1 FTE over 1.5 years per Member State, then the total "set-up" cost would be EUR2.1m across the EU27 (equivalent to the resourcing provided by ECN operators).

The requirement to provide information in georeferenced format imply set-up costs for some non-ECN operators just like for ECN operators (see above). Equally, requirements for network operators to provide information to the SIP directly concerning existing infrastructure and provide information about planned civil works pro-actively could also increase recurring administrative costs for non-ECN network operators just like they do for ECN network operators (see above).

A summary of the estimated cost impacts to other network operators is provided in the following table.

Estimated administrative costs for other network operators linked to the preferred BCRD option.

		One-off	Recurrent
PIA guidelines, extension to non-network facilities	Direct costs	EUR2.8m	+
	Indirect costs	N/R	+ / -
Clarification of civil works obligation and guidelines on cost allocation	Direct costs	EUR0.7m	N/R
	Indirect costs	N/R	+ / -
Extended transparency, digitised SIP	Direct costs	EUR2.1m	Potential, but limited
	Indirect costs	N/R	N/R
Strengthened provisions on permit granting	Direct costs	N/R	N/R
	Indirect costs	N/R	N/R
Mandated in-building FTTH	Direct costs	N/R	N/R
	Indirect costs	N/R	N/R
Total quantifiable		5.60	

Source: support study

4.3. Benefits to other network operators

Non-ECN network operators would not be the direct beneficiaries of changes to the BCRD. However, they may benefit indirectly from increased utilisation of their physical infrastructure and expanded and more efficient civil works co-ordination (if an increased use outweighs any potential price decreases and if they are allowed to retain some of the profits from these activities). They could also exploit the presence of VHCN to engage in digitisation activities which support productivity and sustainability within their own operations (e.g. smart energy, smart waste handling, connected and automated mobility). Other network operators could also benefit from accelerated digitisation of the permit granting process if Member States chose to pursue solutions which apply beyond the electronic communication sector.

It should be noted that the clarification that the civil works co-ordination obligation applies only to works that are publicly funded, rather than operators which may be partly or wholly publicly owned, could exclude certain works which were previously captured by this obligation under national legislation.

Overall, it is not possible to quantify the benefits as they depend to a large extent on precise access terms and how Member States choose (or not) to implement requirements beyond the ones required in the revised legal instrument.

Estimated benefits for other network operators linked to the preferred BCRD option.

II Overview of Benefits (Other network operators) – Preferred Option			
Description	**Amount**	**Comments**	
Direct benefits			
Indirect benefits			
Increased re-use of infrastructure and civil works co-ordination	Increased revenue and cost-saving opportunities from facility sharing. Benefits potentially significant, but difficult to quantify and depends on precise access terms. Potential to accelerate digitisation initiatives.		
Potential acceleration of digital permit platforms	Potentially significant, but difficult to quantify and depends on application by MS of platforms beyond ECN	Potentially significant benefits if MS choose to implement digital platforms for all network operators	

Source: support study

5. IMPLICATIONS FOR CONSTRUCTION COMPANIES

5.1. Obligations impacting construction companies

The main obligation impacting construction companies is the requirement in the preferred option to make new buildings and major renovations FTTH-ready by deploying suitable in-building infrastructure, including dark fibre, and complying with national standards.

5.2. Costs on construction companies

10 out of 19 Member States which responded to the WIK ICF questionnaire reported that they already have standards in place at national level concerning in-building infrastructure. A review of a selection of these standards tends to confirm that in most cases they are suitable for FTTH, because they encompass the installation of FTTH (the majority of cases) or (e.g. in Lithuania) require the installation of cable trays and ducting that could easily support FTTH installation. Nevertheless, for at least a further 10 countries (and potentially more) an obligation to deploy FTTH-ready in-building infrastructure would require construction companies to change existing practices, as well as to contribute to the development of the new standards.

If the development of standards for in-building infrastructure involves 1 FTE from the construction sector in 14 Member States working the equivalent of fulltime for 1.5 years alongside experts from ECN operators and from building standards authorities, the total cost for the constructor sector would be around EUR1.1m EU-wide.[210] Furthermore, it is possible that the standards adopted might affect the materials and increase the costs

210 Based on ISCO 2 working 8 hours per day for 225 days per year.

associated with internal ducting (and potentially the deployment of wiring by construction companies) in newly build houses and major renovations compared with the status quo. Estimates from ECN operators suggest that the greenfield cost to install VHCN-ready in-building infrastructure could vary between EUR100-EUR450 per household depending on the cost of labour and type of housing.

This might appear to be a significant amount that would fall on construction companies when renovating or building homes, especially when one considers that the EU is seeking to renovate 35m buildings by 2030 in conjunction with targets to reduce building-related GHG emissions.[211] However, the actual cost would be significantly less because not all renovations are sufficiently profound to trigger the obligation. Also, additional costs would only apply for countries which do not already have FTTH-based standards in place and – importantly - the additional cost to a construction company would likely be considerably less because it would have anyway needed to deploy some form of in-building infrastructure to house energy and other cables, even in the absence of standards for FTTH in buildings. Moreover, the standardisation of the requirements might lead to cost-savings by limiting the time spent on designing bespoke solutions.

In any case, it should be kept in mind that building owners would pass on the cost of these deployments to purchasers of the property, residents or network operators. Thus, this obligation should not result in a net increase in one-off costs for construction companies, although they might contribute to marginally higher sale costs or maintenance costs.[212] Building companies may however be subject to compliance costs linked to the monitoring and enforcement of this requirement. The level of these costs is difficult to quantify as it would depend on the nature of the enforcement regime, and the degree to which the requirement would demand additional documentation, as opposed to adjustments to documentations which are already mandatory.

5.3. Benefits to construction companies

In addition to the benefits from streamlining and simplification that standardisation of in-building requirements could bring, construction companies could potentially benefit from increased valuations if a labelling scheme is introduced to market buildings as “FTTH-ready”. The potential benefits of this approach can be seen in South Korea which introduced a Certification Programme for Broadband Buildings, including a voluntary labelling scheme in 1999.[213]

The Korean labelling system is applied to multi-dwelling residential buildings with more than 50 residential units, and commercial buildings with a surface area exceeding 3300 m^2. The scheme is considered a success, with benefits also accruing to building companies. For example, a report by Ovum for the World Bank notes that “the initiative [the certification program] has been welcomed by developers as it has allowed them to charge more for buildings with broadband services, and it has resulted in many partnerships between construction firms, ISPs, and telecom services providers”[214]. Other studies suggest that

[211] https://ec.europa.eu/energy/sites/ener/files/eu_renovation_wave_strategy.pdf
[212] The amount attributed to the FTTH deployment is likely to be limited in comparison with the purchase price or overall maintenance costs.
[213] https://www.infodev.org/infodev-files/resource/InfodevDocuments_934.pdf
[214] http://www.infodev.org/infodev-files/resource/InfodevDocuments_934.pdf

"The system provides builders with a means for differentiating their products—a useful feature in so highly competitive an industry"[215].

Although it is not possible to quantify the potential benefits of such a scheme, if introduced in Europe, it seems reasonable to expect that any financial benefits associated with increased property prices would more than outweigh the limited incremental cost to property developers of installing FTTH in-building.

Estimated benefits for construction companies linked to the preferred BCRD option.

II Overview of Benefits (total for all provisions) – Preferred Option			
Description	**Amount**	**Comments**	
Direct benefits			
Requirement for new and renovated buildings to be FTTH-ready based on standards defined at national level	Standards for in-building infrastructure could streamline and simplify the construction process		
Indirect benefits			
Requirement for new and renovated buildings to be FTTH-ready based on standards defined at national level	Potential increased value from the sale or rental of property	Requires associated labelling system	

Source: support study

6. IMPLICATIONS FOR OWNERS OF PRIVATE NON-NETWORK FACILITIES

6.1. Applicable obligations

The changes to the BCRD proposed in the preferred option would not involve the imposition of any new obligations on stakeholders which are not public bodies and/or which do not fall within the definition of "network operators" in the context of the BCRD.[216] Thus, for example, private owners of non-network assets, such as tower companies and owners of commercial buildings, would continue to lie outside the scope of the BCRD.

[215] https://fsi.fsi.stanford.edu/sites/default/files/Yun.pdf ; similar passage found in https://www.brookings.edu/blog/techtank/2015/05/27/embracing-broadband-policy-innovation-from-abroad/;

[216] Under Article 2(1) of the BCRD a 'network operator' means an undertaking providing or authorised to provide public communications networks as well as an undertaking providing a physical infrastructure intended to provide a service of production, transport or distribution of gas, electricity, heating, water and transport.

6.2. Costs for owners of private non-network facilities

The preferred option would not result in significantly increased administrative costs for the owners of private non-network facilities. However, infrastructure owners such as tower companies or commercial building operators might find that requirements which aim at improving transparency and conditions for access to non-network public facilities (such as the rooftops of public buildings, street furniture, potentially publicly owned land) may give rise to increased competition for the provision of hosting. The impact of this is difficult to assess. Feedback from stakeholders in the context of the WIK ICF workshop as well as input to the Commission public consultation suggest that there is unlikely to be significant competitive impact on operators of commercial buildings, since ECN operators specifically favour access to public infrastructure because of the number of facilities involved, spacing (e.g. in relation to street furniture) and common ownership – at least within a specific municipality. The impact on tower companies may depend on the value added facilities they provide.

6.3. Benefits for owners of private non-network facilities

Certain owners of private non-network facilities, and specifically tower companies may benefit from some of the provisions in the preferred option – in particular those which serve to improve conditions to obtain permits for civil works (including construction) needed to deploy elements of VHCN, or exclude certain categories of works from the need for a permit. Tower companies might also themselves benefit from improved access to public non-network facilities, if they are allowed by Member States to also use such access to install their infrastructure.

7. IMPLICATIONS FOR NATIONAL, REGIONAL OR LOCAL PUBLIC AUTHORITIES

7.1. Obligations impacting national, regional or local public authorities

A number of the obligations planned under the preferred option would impact the activities of national, regional or local authorities, and give rise to costs and/or benefits for this group of stakeholders.

The extension of the access to physical infrastructure obligation to cover non-network public facilities would require public authorities (and/or other owners of public property) to meet reasonable requests for access to infrastructure suitable for the installation of VHCN. These authorities would be required to follow the directions of the dispute resolution body in cases where agreement on terms and conditions cannot be found.

The extension of the transparency obligation to include information about non-network public facilities, where proportionate, would require public authorities (and/or other owners of public property) to identify and provide information about the location of their facilities which are suitable for the deployment of VHCN.

Requirements to pro-actively notify planned works would apply to local or other public authorities (in their capacity as network operators) planning works to roads and any other infrastructure covered by the provisions on civil works coordination in the revised legal instrument .

The requirements concerning permit granting and Rights of Way would require local authorities to collaborate, together with national administrations and other stakeholders, on the definition of permit exemptions. Local authorities would need to adapt processes for handling Rights of Way over public property so that these processes work in tandem with permit applications, and to overhaul current (potentially manual) systems for permit applications so that processes are consistent at national level and applications for ECN construction (at a minimum) are conducted via a digital platform. There would also be a new intermediate deadline to declare whether or not applications are complete, and would require Member States to pursue where possible an approach of "tacit approval" in cases where no decision is made within 4 months. Local authorities would need to work with other relevant authorities involved in permit granting to ensure that all relevant inputs are taken into account within the period permitted for permit granting.

Local authorities would also be affected by the obligation to set charges for permit applications at levels which do not exceed administrative cost, and may be affected by the requirement that ECN operators could seek compensation for damages if the timeframes for permit applications are not met.

Finally, local authorities may be impacted by reporting obligations which require them to provide data on the numbers of applications and associated timeframes etc.

7.2. Costs on national, regional or local public authorities

The preferred option is expected to give rise to significant short-term implementation costs for national, regional or local public authorities in some countries, in particular in relation to permit granting measures and information requirements for public non-network facilities. Other measures are unlikely to result in significant cost increases compared with the status quo, and there is a significant potential for the measures imposed on local public authorities via the BCRD to deliver overall cost savings and public benefits in the medium to long term, as discussed in the "benefits" section.

Measures relating to permits and Rights of Way

The requirement for a **digital platform for permit granting** together with the requirement for consistency at national level of permit granting procedures are likely to have the greatest impact on short term implementation costs for national or regional/local public authorities. This obligation is likely to require investments in IT systems for those countries which do not already have and are not already planning to implement a digital system for permit granting. According to the Roadmaps submitted by public authorities as well as responses to the WIK ICF questionnaire 5 Member States already have a fully digitised system for permit granting,[217] and another 6 report that their system is partially digitised.[218] 7 Member States report that they have plans to digitise their permit granting system or expand existing digital systems.[219] However, this still leaves 9 Member States out of the 27 which produced roadmaps by November 2021 that would have to introduce digitised systems because of the legislative proposal. Moreover, it is not clear how many of the other Member States will implement fully digitised permit granting platforms, and target dates have not been given in all cases.

[217] BG, DK, EE, LT, LV.
[218] BE, CY, FI, HR, IT, NL.
[219] CY, CZ, DE, EL, HU, IT, SI.

It is difficult to identify the specific costs associated with implementing digital systems for permit granting from national accounts, because public authorities often only report a global budget for digitisation, without giving the necessary details.[220] However, there is a wide variety of costs, which may depend in particular on the scope of the system and the efficiency of implementation. For example, the cost of implementing a fully digital permit granting system in the Netherlands is said to have ballooned from an initial estimate of EUR300m to EUR2bln.[221] However, this system is intended to cover all types of permits, and much lower costs have been reported in other cases. In another example, the Belgian authorities report that their digital platform for permit granting had a set-up cost of EUR1.2m.[222] Moreover, commercial solutions e.g. MOOR-WOW are offered to municipalities by organisations such as Visma Roxit Netherlands for EUR0.25 per inhabitant.[223] Overall, based on interviews conducted for the study including interviews with the developers of permit granting systems, the cost of establishing a digital platform for permits required by network operators in a medium-sized country is estimated at EUR2m with ongoing resourcing estimated at around 25FTE. Such a platform would cover utility and water networks as well as ECN.

If changes to the Directive result in 10 Member States needing to invest in digital permit granting systems, and if the cost is EUR1m in each case for the platform (for the aspect linked to ECN permits), the resulting EU-wide total set-up cost for the platform alone would be EUR10m**.** However, additional costs might be incurred by local public authorities to align the underlying processes for permit applications and train staff about the new system. If around 25 FTE are involved per Member State concerned over a period of 2 years additional procedural related costs linked to digitising the permit granting process may amount to a total of EUR20m**.** However, transformation costs are unlikely to be entirely met by local Government. Development of the platform could be led by the national Government and some or all of the related activities could be paid for under programmes linked to eGovernment for which EU funding is available. Even where the costs are born by local government**,** they could ultimately be recovered from ECN operators (and potentially others depending on the scope of the system) in permit application fees.

The implementation of a uniform EU-wide system for (minimum) permit exemptions, which goes beyond the current exemptions applying to SAWAP under Article 57 of the EECC, may also give rise to short term implementation costs, since local authorities need to adapt existing processes and systems to reflect these new exclusions. For example, a

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220 See for example https://www.onlinezugangsgesetz.de/Webs/OZG/DE/umsetzung/nachnutzung/nachnutzung-node.html#doc14143420bodyText2

221 https://www.rijksoverheid.nl/documenten/kamerstukken/2021/03/12/kamerbrief-integraal-financieel-beeld-stelselherziening-omgevingswet

222 Responses to WIK ICF questionnaire Q1 2021.

223 MOOR-WOW's platform provides a one-stop-shop to request permits for both underground and overground telecoms infrastructure including masts. ECN and utilities subscribe to the platform to file permit applications, which are then processed digitally for those municipalities which subscribe to the system (85% of Dutch municipalities using MOOR), and manually for other authorities involved in permit processing which do not have digital processes. In addition to allowing permit applications, the platform provides information about the status of the applications, and enables those municipalities which participate to directly signal via the platform to ECN (and other network) operators when there are missing elements or further information is required.

local authority representative interviewed for the study suggested that 50 FTE had been involved in establishing processes for the handling of Article 57 EECC by local authorities within their medium sized country, equivalent to a cost of around EUR2.6m per annum over a number of years. They expressed concerns that a similar cost could be incurred if the BCRD expands on Article 57 EECC and is associated with additional permit exemptions as well as expanding on the access requirements for public facilities. If the estimated EUR2.6m cost per annum were replicated across the EU 27 and the process took 3 years overall, then a total cost of EUR210m might be incurred.

However, this estimate is likely to be too high. A number of Member States already have extensive exemptions for the deployment of ECN networks, while other Member States are planning permit exemptions in the context of the implementation of their Roadmaps under the Connectivity toolbox,[224] to the extent that only 5 Member States have not announced any plans to implement this measure. The costs are likely to be further reduced as a result of the changes to IT systems and processes that have already been introduced in the context of implementing permit exemptions for small cells under Article 57 EECC and the parallel requirement to introduce digital systems for permit granting. Ultimately, if 10 Member States are required to introduce or change existing permit exemptions as a result of new requirements for permit exemptions at EU level, and if they each require 5 FTE to do so, the total additional cost would be approximately EUR2m.

It is possible that aligning timeframes to grant Rights of Way and permits might also entail an initial set-up cost for public authorities as they adapt internal procedures. However, especially in cases where it is the same authority which is responsible for both granting Rights of Way on public property and permits (e.g. a local public authority), there should be some efficiencies associated with this alignment from an operational perspective. On the other hand, where there are different bodies involved, more resources might be required as the alignment would require co-ordination between the bodies, and the potential need to resolve disputes if there are differences of view between the parties. On balance, it is reasonable to expect that the effect overall in terms of ongoing administrative costs for public authorities of an alignment between RoW and permit granting processes would be neutral, but with differences between Member States depending on the starting point.

The requirement for local public authorities to provide a declaration of completeness for permit applications within a given period may require changes to the prioritisation of resources to ensure that this initial step is completed in the required timeframe. However, if tacit approval is introduced at the same time (see benefits), this could allow resources to be refocused without the need to increase overall resourcing for permit granting activities relating to ECN.

The potential for ECN operators to sue for damages in case permit granting applications exceed the required period is not expected to give rise to major new costs because other

[224] Exemptions from the requirement to obtain permits in the context of deploying ECN networks are reported to be present already in BG, DE, DK, EE, EL, IT, LT, and SI, with more limited exemptions reported in BE, ES, FR, HU, IE, PL, PT and SE. Furthermore, there are already plans to introduce or expand on existing exemptions in CY, CZ, ES, HR, LV, MT, PL. Information from roadmaps prepared in the context of the Connectivity Toolbox and responses to the WIK ICF survey.

measures are likely to significantly reduce the number of permit applications (exemptions) and aid compliance with deadlines where permits are required (digital platforms, tacit approval), decreasing the probability that the required period is exceeded.

Requirements to limit charges for permit applications to administrative cost would only affect those authorities where there is not already a requirement of this nature, and where costs are currently above administrative cost. It is not possible to quantify the impact of this measure.

Provision of information about non-network public facilities to the SIP

The expansion of the SIP to include information about public non-network facilities is likely to entail implementation and recurring costs for the diverse set of bodies which hold information about public assets, including local authorities. The administrative costs are likely to be most significant in cases where information about public assets is not yet available in electronic form or where the format of the information is not consistent. Given historic experience with SIPs, the process of integrating information on street furniture, public and commercial buildings is likely to take considerable time. In view of these cost and time implications for public authorities, it would be necessary to clearly define (at Member State level) which information should be provided and limit the inclusion of information to non-network facilities which are likely to be useful for the purposes of ECN network deployment. For example, it may not be proportionate to require the inclusion of street furniture which is not capable of accommodating 5G small cells due to power or weight restrictions.[225] In addition, if information about public sector facilities is readily available in a separate SIP (distinct from the SIP established under the BCRD), it may not be proportionate to require it to be integrated into a single SIP, as the same result could be achieved by a less intrusive measure, i.e. including links to the websites where that information can be found.

Provision of access to non-network facilities

As the new rules and Guidelines on access to physical infrastructure will encompass access to non-network physical infrastructure, including assets owned by local public authorities, local public authority representatives will be called upon to contribute to the development of these guidelines. It can be assumed this would involve similar resources (from representative bodies) as has been assumed for those applicable to other stakeholders, i. e. around EUR2.8m. Local public authorities could also usefully contribute to the guidelines concerning civil works co-ordination.

Furthermore, each municipality and regional authority is likely to require resourcing to handle the expected additional requests for access to non-network public facilities, which would be included in the BCRD under the preferred option. However, some requests of this kind (relating specifically to SAWAP and the facilities listed in the EECC) would arise in conjunction with Article 57 EECC, regardless of any amendment to the BCRD, and thus the effect of the preferred option would only relate to any additional requests not

[225] Representatives from the Dutch authorities note for example that street furniture may not be automatically suitable for the deployment of ECN networks if it is not permanently or sufficiently powered, or lacks the load-bearing capability to accommodate ECN equipment. Moreover, significant costs could be incurred by public authorities if they are required to validate which infrastructure is suitable for the deployment of ECN networks.

falling within the scope of Article 57. Moreover, it should be noted that requests for access to public infrastructure would be likely to occur in connection with 5G deployment (for small cells, including but not limited to SAWAP and other network elements) irrespective of whether public authorities have an obligation to handle these requests under the BCRD or not. It is therefore not clear that the extension of access obligations to non-network public facilities would by itself generate additional administrative costs that would not otherwise be incurred by the public sector or (if requests from public authorities are refused) by private property owners. These administrative costs are likely to be recoverable from access seekers and thus it is access seekers that would ultimately bear the burden of their request.

Moreover, the preferred option envisages a scenario whereby public authorities could appoint a co-ordinating body to develop standard contracts and manage contacts between access seekers and public property owners. It seems likely that this would generate considerable efficiencies and cost savings if it avoids even a fraction of the resources that would otherwise be spent by individual local authorities, noting that there are a total of 87,182 municipalities across the EU.[226] For example an office staffed by an average of 2 FTEs to support the co-ordination of access requests to public bodies (similar to the current average resourcing of DSBs in the EU), would cost a total of EUR2.8m across the EU 27,[227] whereas if each local authority saves 0.5% of an FTE through the introduction of standardised processes and a co-ordinating body for network operators, this would save around EUR14m.[228] Thus, it seems reasonable to expect that the introduction of a co-ordination mechanism as recommended in the preferred option would reduce costs compared with a status quo in which multiple requests for access to public facilities are made, but no co-ordination mechanism exists.

Whilst it is possible that local authorities could receive lower fees for access to public facilities due to the introduction of guidelines for access to such facilities and associated enforcement by DSBs, the introduction of a system to access public facilities alongside dispute resolution procedures could also increase demand of the use of public facilities by ECN operators relative to the use of privately owned facilities. This could lead to a new revenue stream for these facilities which could be beneficial for local authorities. The effects and direction of the net impact would depend on the nature of the rules and guidance concerning wholesale charges for access to public facilities.

Pro-active notification of civil works

The obligation to provide proactive notification for planned civil works, might affect local public authorities in their capacity as “network operators”. However, this requirement is unlikely to give rise to significantly increased costs for local public authorities in view of the fact that local public authorities would normally be expected anyway to give advance notice of roadworks. Some adaptations might be required however to agree on a common format and procedure for notification for the purposes of possible civil works co-ordination.

226 https://www.oecd.org/regional/EU-Local-government-key-data.pdf

227 Assuming ISCO 2 working 8 hours per day for 225 days per year.

228 Assuming ISCO 4 (clerks) working 8 hours per day for 225 days per year.

Monitoring

Reporting by local public authorities concerning use of public facilities and permit granting may require the establishment of reporting mechanisms and online tools with which to gather information. These could nevertheless be developed at the same time as other digitisation measures such as the provision of digital records to the SIP and the development of digital permit granting platforms. It can be assumed in any event that local public authorities have a record of the number of permits granted of differing types. Standardising the format for reporting and including information concerning the timeframe should not only beg useful for the evaluation of the revised BCRD but also assist local public authorities in evaluating administrative efficiency.

Information will be needed concerning newly built apartments and major renovations in the context of assessing the effectiveness of measures on in-building infrastructure and wiring. There may be other reasons for local public authorities to ensure that such information is recorded on a standardised basis, since information about renovations is also relevant to green building targets,[229] and thus significant incremental costs are not expected.

Overview

An overview of the potential scale of costs for national, regional or local public authorities resulting from the preferred option compared with the status quo is provided in the following table. It should be noted, however, that a large portion of this cost relates to provisions in the preferred option to digitise and improve processes for permit granting, which could be provided in part by national administrations and/or supported by EU funding on digitisation.

Estimated administrative costs to national, regional or local authorities linked to the preferred BCRD option.

[229] https://ec.europa.eu/energy/topics/energy-efficiency/energy-efficient-buildings/renovation-wave_en

		National, regional or local Authorities	
		One-off	Recurrent
PIA guidelines, extension to non-network facilities	Direct costs	EUR2.8m	+
	Indirect costs	N/R	+ / -
Clarification of civil works obligation and guidelines on cost allocation	Direct costs	EUR0.7	+
	Indirect costs	N/R	+ / -
Improved transparency, improved SIP	Direct costs	-- Public facility info	+
	Indirect costs	N/R	N/R
Strengthened provisions on permit granting	Direct costs	EUR32m	-EUR3.5m
	Indirect costs	N/R	N/R
Mandated in-building FTTH	Direct costs	N/R	N/R
	Indirect costs	N/R	N/R

Source: support study

7.3. Benefits on national, regional or local public authorities

National, regional or local authorities are not the direct beneficiaries of the revised legal instrument. However, introducing the required measures could bring benefits to the efficiency of these authorities, notably local authorities, in the medium to long term and contribute to their provision of value added services to their local communities.

Regarding permit granting procedures, a number of public authorities which have implemented a digital platform have observed that this led to administrative efficiencies in the processing of individual permit applications, which presumably could also translate into cost savings or the reallocation of municipal resources to other services. For example, the Gigabitbüro in Germany reports that following the implementation of digital systems by a region in Northern Germany, the time taken for building permits was reduced by 30%.[230] According to Digital Denmark digitisation saves 296 million euro per year, Ministries in Denmark have reduced case processing time by 30% and transparency in Ministries and organisations increased by 96%.[231] Meanwhile, in Ireland, the MapRoad Roadworks Licensing (MRL) system has contributed to a turnaround time of just 30 days for the majority (80%) of licences for which applications were received, with an overall average of 17 days in 2019.[232] Public authorities in Lithuania also report that their digital permit granting system allows for permits to be processed for just EUR100 per application.

It should also be noted that the provisions under the preferred option to harmonise at EU level further categories of permit exemptions (beyond SAWAPs) and to mandate tacit approval (where possible) should in principle reduce the administrative burden on local public authorities by reducing the number of required permits and by limiting the need for proactive decisions. If the average number of permits requested per Member State per

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230 https://gigabitbuero.de/praxisbeispiel/der-digitale-bauantrag-im-landkreis-diepholz-eine-case-study/

231 https://digitaldenmark.dk/digital-timeline/; https://en.digst.dk/policy-and-strategy/cutting-red-tape-in-denmark

232 https://ptfs-oireachtas.s3.amazonaws.com/DriveH/AWData/Library3/Documents%20Laid/pdf/HPLGdoclaid241120_241120_120145.pdf; https://maproadroadworkslicensing.ie/MRL/help/mrl_version-5_2_la.htm

year under the status quo is 7,500[233] and the widening of permit exemptions leads to a reduction in the number of permits required by around 20% (reversing increases in applications that might otherwise have incurred in connection with the deployment of 5G mid-band infrastructure (including, but not limited to SAWAP)), and assuming that processing each remaining permit application costs EUR100 following the implementation of digital platforms (rather than an estimated EUR130 in the status quo), then savings of around EUR9.5m annually could be achieved by local public authorities compared with the status quo across the EU (or EUR3.5m if one takes into account only the reduced costs in the approximately 10 countries[234] which have not yet announced concrete plans to digitise their permit systems and/or introduce wide permit exemptions).

As previously noted, the consolidation of processes for RoW and permits, when conducted by the same authority could also give rise to cost savings, once the necessary procedural changes have been made.

Regarding the provision of information on non-network public facilities, it should be noted that public authorities which are not yet producing electronic records might benefit from the availability of information about public facilities in an electronic and possibly geo-referenced format in relation to their other tasks, too, such as maintenance of street furniture, or provision of new services to citizens in the context of smart city developments. Indeed, the digitisation of records and updating of public facilities to be able to accommodate ECN equipment could form part of a smart city strategy, which could in turn contribute to improvements in citizens' welfare as well as potentially to economic growth.[235]

Likewise, the provision of access to public facilities might increase available revenues for those facilities, enabling investment in more modern facilities, although this potential benefit would depend on the terms of access to public facilities.

The provision of pro-active notification of planned works to foster civil works co-ordination could limit the need to process multiple applications for civil works in the same area and limit disturbance for local residents. In addition, depending on the applicable guidance concerning cost allocation, it is possible that increased use of civil works co-ordination could reduce the costs of roadworks for local authorities or other authorities responsible for maintaining transport infrastructure in their capacity as transport network operators.

[233] Assumption based on feedback concerning the number of permit applications from an incumbent, mobile operator and small operator in medium sized countries – extrapolated across the EU.
[234] Equivalent to around 9 FTE per country.
[235] See for example OECD (2020) Smart Cities and Inclusive Growth https://www.oecd.org/cfe/cities/OECD_Policy_Paper_Smart_Cities_and_Inclusive_Growth.pdf

An overview of the benefits is provided below.

Expected benefits to national, regional or local authorities linked to the preferred BCRD option.

II Overview of Benefits (total for all provisions) – Preferred Option		
Description	**Amount**	**Comments**
Direct benefits		
Digitisation of permit-granting processes, permit exemptions and tacit approval	Reduced timescales and cost for processing permit applications	Benefits are likely in the medium-long term
Requirements to provide access to non-network public facilities	Potential new revenue opportunities supporting investment in public facilities	Depends on the terms of access
Strengthened information requirements for civil works co-ordination	Reduced costs for roadworks due to contributions from ECN operators	
Indirect benefits		
Information gathering and provision of access to non-network facilities	Acceleration of smart city initiatives	

Source: support study

8. Implications for national administrations, Dispute Settlement Bodies and SIP management authorities

8.1. Obligations impacting national administrations, DSBs and SIP management authorities

The preferred option would require a number of adaptations to the activities of national administrations, DSBs, SIP management authorities and potentially other Government agencies. These include:

- Contribution to the development and enforcement of EU Guidelines concerning PIA and civil works co-ordination.
- Dispute resolution concerning access to public non-network public facilities (beyond the disputes arising in connection with Article 57 EECC)
- Requirement for public bodies to enter information about existing physical infrastructure on a SIP as well as elaboration of the SIP to include information about non-network public facilities, geo-referencing, pro-active notification of planned civil works, and co-ordination between the different SIPs
- Contribution to the development of national standards for in-building infrastructure and EU guidelines concerning access to in-building infrastructure.
- Contribution to the development of streamlined processes for permit granting (including consistency at national level, exemptions, tacit approval and alignment of RoW and permit granting timescales) and the development of a digital platform.
- Costs associated with monitoring

8.2. Costs for national administrations, Dispute Settlement Bodies and SIP management authorities

Costs associated with dispute resolution and associated Guidelines on access to physical infrastructure and civil works co-ordination

Expanding the scope of BCRD access obligations to cover non-network elements could lead to additional administrative costs for DSBs as a result of the expansion in their remit and the ensuing increase in the range and number of disputes. However, it should be noted that such costs would be additional to the status quo only to the extent that they result in requests for access to non-network public facilities (and associated dispute resolution where terms are not agreed) for assets that go beyond those covered in Article 57 of the EECC. This would likely concern in particular to seek access to rooftops (as not expressly covered under the transposition of Article 57) and to facilities which do not fall within the category of physical infrastructure suitable to install SAWAPs under the EECC.[236]

As noted in the BCRD Evaluation report study,[237] based on responses to a questionnaire from national administrations, it is estimated that around 2.5 FTE per DSB on average have been engaged in handling access to physical infrastructure disputes, amounting to 70 FTE across the EU27. If DSBs are additionally required to handle disputes about access to public non-network infrastructure, this might reasonably be expected to increase the PIA-related caseload by up to 1 FTE per DSB – i.e. potentially an additional 27 FTE. However, it is possible that around half of this increase (i.e. 13.5 FTE) might have been anticipated in the context of the implementation of Article 57 EECC, as a result of DSBs resolving disputes around access to public facilities suitable for the deployment of SAWAP.

In addition, by providing greater clarity to stakeholders engaged in commercial negotiation, the introduction of EU-level Guidelines on access to physical infrastructure, civil works co-ordination and in-building access to physical infrastructure could reasonably be expected to reduce the number of disputes and their complexity and therefore reduce resourcing requirements amongst DSBs compared to a situation where decisions are taken on a case-by-case basis at national level. If as a result of the Guidelines, only 10 FTE (rather than an estimated 13.5 as previously noted) are required by DSBs across the EU to handle disputes regarding access to non-network public infrastructure, and if clarity also reduces disputes concerning access by network infrastructure by a further 2 FTE EU-wide, the additional cost for operating the DSB compared with the status quo would be around EUR0.4m per annum EU-wide.

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236 Article 2(23) of the EECC defines a 'small-area wireless access point' means low-power wireless network access equipment of a small size operating within a small range, using licenced radio spectrum or licence-exempt radio spectrum or a combination thereof, which may be used as part of a public electronic communications network, which may be equipped with one or more low visual impact antennae, and which allows wireless access by users to electronic communications networks regardless of the underlying network topology, be it mobile or fixed; However, SAWAP has been more precisely defined in the context of the Commission's Implementing Regulation of 2020 https://digital-strategy.ec.europa.eu/en/news/commission-adopts-implementing-regulation-pave-way-high-capacity-5g-network-infrastructure

237 See the Evaluation Report of the support study associated with the review of the BCRD.

As regards the cost of developing the guidelines themselves, if an average of 0.5 FTE is engaged in providing input to these Guidelines in each of the Member States over the duration of the process,[238] the total "set-up" cost to national administrations/DSBs would be around EUR0.7m, of which the majority may be focused on access to physical infrastructure.[239]

Costs associated with standards for in-building infrastructure

Another provision that would incur administrative costs is the requirement to introduce standards at national level for in-building physical infrastructure including fibre[240]. Given the technical nature of these standards, implementing this requirement could involve a number of senior experts working sporadically over a period of 1-2 years. For example**,** if the development of standards for in-building infrastructure involved 1 FTE in 14 Member States working the equivalent of fulltime for 1.5 years in conjunction with representatives from the construction sector and from ECN operators, the total cost would be around EUR1.1m EU-wide.[241]

There will also be costs associated with the ongoing monitoring of compliance with standards and associated enforcement action. However, additional costs will only be incurred in countries which do not currently have standards for in-building infrastructure and associated compliance regimes, and costs could be limited through the use of self-certification. If nonetheless, an average of an additional 3 FTE are engaged in monitoring and compliance with in-building infrastructure standards in 14 Member States, this would result in recurring costs of around EUR2.2m.

Costs associated with SIP development

Set-up costs would be incurred for SIP management authorities under the preferred option to upgrade transparency requirements to provide for fully digitised platforms for the SIP, gather information from all network operators on the SIP (rather than only public information held by public bodies) and information from public bodies holding non-network public facilities, as well as to establish georeferencing and pro-active notification of planned civil works.

The obligation for SIP platforms to be fully digitised will entail investment in software to enable information to be directly posted onto the SIP by information providers rather than processed by hand, as well as ensuring that relevant information is shown automatically and digitally, e.g. on a map, in response to a user query. Examples of digital platforms include SIPs established in Germany and Portugal. Although precise information about the number of platforms which are not yet fully digitised is not available, it seems likely that a number of SIPs would require updating to bring them into line with this requirement.

According to information provided by national administrations, set-up costs for SIPs vary widely across the EU from EUR15,000 to more than EUR2.5m.[242] It can be assumed that many of the SIPs today (and especially those involving higher set-up costs) are already

[238] The effort, especially by Member States is likely to be concentrated around certain periods.
[239] Based on 50% ISCO 1 and 50% ISCO 2 working 8 hours per day for 225 days per year.
[240] See 5.2 above, « costs for construction companies »
[241] Based on ISCO 2 working 8 hours per day for 225 days per year.
[242] Respectively in the Czech Republic and Hungary.

fully digitised, and Roadmaps provided by national administrations show that many SIPs already include or will be updated to include geo-referencing and the pro-active notification of planned civil works.[243] Nevertheless, it is possible that additional expenditure would be required for some of the SIPs which were less costly and used manual back-ends. Effective platforms would also need to be established in the few countries which do not yet have an operational SIP.[244] If EUR250,000 is needed on average to upgrade or build new SIPs to meet the requirements of full digitisation across the EU, as well the other requirements (taking into account that some countries already meet or are planning to meet this criterion while in others investment would be needed to meet the conditions of the preferred option), the total one-off cost of updating SIPs for SIP management authorities across Europe would be around EUR6.75m**.**

These upgrades could also incorporate introducing the potential to accept information from network operators and public authorities directly for those few countries in which network operators do not already submit information to the SIP. A fully digitised SIP should lead to reduced operational costs. However, increased efforts may be needed to ensure compliance with requirements to submit information, including in countries where network operators have not yet been directly required to provide this information. Recurring resources employed for SIP management range currently from 1FTE to more than 20FTE in Germany, with an estimated average of around 5 FTE. If on average an additional 2.5 FTE are required in each Member State to support the operation of the expanded SIP and associated enforcement, the preferred option could be associated with additional costs of around EUR3.5m.

<u>Costs associated with streamlining the permit granting process</u>

National administrations and/or DSBs would be involved in the development of EU-level exemptions for permit granting. If 1 FTE is involved over a 2 year period per Member State, the cost for this activity would be around EUR2.8m.

National administrations, and potentially also other bodies such as DSBs, BCOs and/or SIP management bodies, are likely to need to co-ordinate or support local and regional authorities in the development of nationwide consistent and streamlined processes for permit granting and exemptions as well as the development of digital platforms for permit granting. The costs associated with developing the platforms and processes are noted in the section relating to "local authorities". The proportion of costs attributed to different types of authorities (and the source of the funding, including potential use of EU funding to support such initiatives) is likely to vary between Member States.

[243] Only 1 out of 25 Member States which provided information on this subject in the context of the Connectivity Toolbox Roadmap reported that they did not have systems which already comply with the requirement to implement pro-active notification of planned civil works or concrete plans to put this requirement in place. In nearly all cases, Member States reported that they would introduce this requirement by 2025, and therefore amendments to the BCRD would have the effect of holding Member States to their commitments, as opposed to introducing new costs. The incremental cost of implementing georeferencing in the SIP is also likely to be limited, because this practice is already relatively widespread, with 10 Member States reporting that this is already fully or partly implemented and another 6 reporting that they plan to do so. Only 3 Member States reported that they did not have this measure in place and did not have concrete plans.

[244] Specifically, data gathered in the context of the evaluation of the BCRD, shows that 21 out of 27 Member States which provided information had already introduced a SIP with plans to do so in an additional 2 Member States.

Monitoring

A pre-requisite for the effective monitoring of the revised BCRD is the centralised gathering of data per Member States by DSBs, and where applicable SIP management authorities, an exercise which has not yet taken place.[245] Hence, it is necessary for Member States to assign responsibility for the centralised gathering of data concerning permit granting and civil works co-ordination. This could for example be done by the same body as might be assigned for the co-ordination of requests for access to public facilities, or the BCO or DSB.

DSBs could limit the incremental cost of data gathering exercises by timing data gathering to align with other data gathering exercises, e.g. in the context of market information or reviews. In cases where it is clearly indicated by ECN operators that they are reliant on certain key providers of access or co-ordination under the BCRD, such as a major utility, information could be collected from this source rather than from multiple ECN operators, in order to reduce the administrative cost of data gathering.

Information about the number of buildings with in-building FTTH should be available from the authority responsible for enforcing building standards and regulations, and could be obtained by examining the number of buildings receiving certification (or self-certification).

Overall, the cost of data gathering in relation to the BCRD can in general be limited by integrating data collection in the course of regular data gathering, monitoring and enforcement activities.

Overview

An overview of the costs of the preferred option to national administrations, DSBs, SIP controllers and/or other Government agencies are shown in the following table. The total set-up costs of the reforms are estimated at roughly EUR8.1m, with recurring annual costs of around EUR7.4m EU-wide. These costs would however not be evenly distributed, but would depend on the current status of SIP digitisation within the Member States and the existence (or otherwise) of standards for in-building infrastructure.

245 It is notable that, despite a similar recommendation being made in the context of the 2018 WIK VVA study on Implementation and monitoring of the BCRD, very few Member States provided concrete data in answer to questions around these indicators.

Estimated costs to national administrations, DSBs, SIP controllers linked to the preferred BCRD option.

		National administrations, DSBs / SIP management authorities, other authorities	
		One-off	**Recurrent**
PIA guidelines, extension to non-network facilities	Direct costs	EUR0.6m	EUR0.5m
	Indirect costs	N/R	N/R
Clarification of civil works obligation and guidelines on cost allocation	Direct costs	**EUR0.1m**	**-EUR0.1m**
	Indirect costs	N/R	N/R
Improved transparency, improved SIP	Direct costs	EUR6.75m SIP dev.	EUR3.5
	Indirect costs	N/R	N/R
Strengthened provisions on permit granting	Direct costs	EUR2.8m (+ % LA costs)	N/R
	Indirect costs	N/R	N/R
Mandated in-building FTTH	Direct costs	EUR1.1m	EUR2.2m
	Indirect costs	N/R	N/R

Source: support study

8.3. Benefits for national administrations, Dispute Settlement Bodies and SIP management authorities

The main direct benefit to national administrations of the preferred option is the potential to reduce the subsidies required to achieve extensive deployment of FTTH. In particular, it is estimated that the preferred option could allow savings in subsidies of EUR2.4bln across the EU.

If they choose to reinvest these savings to increase VHCN coverage, national administrations could also derive benefits (including consumer satisfaction) from the potential for increased VHCN coverage and take-up, acceleration of 5G IoT applications and the ensuing boost to GDP and jobs as well as specific reductions in inequality (in particular between urban and rural areas).

In addition, DSBs could also benefit from administrative cost savings resulting from EU-level rules and Guidelines, which should increase legal certainty and thus reduce the number and complexity of disputes, although resourcing needs for DSBs are expected to increase overall due to the expansion of the scope of access to physical infrastructure to cover non-network facilities. Investment in digitisation should also reduce administrative costs for those SIP management authorities which currently rely on a manual system to process and update information.

Expected benefits to national administrations, DSBs, SIP controllers linked to the preferred BCRD option.

II Overview of Benefits (total for all provisions) – Preferred Option		
Description	**Amount**	**Comments**
Direct benefits		
Cost savings in VHCN deployment	Opportunity to reduce subsidies for FTTH deployment by EUR2.4bln	
Indirect benefits		
Increased VHCN	Additional 6.5% households served by FTTH or 9.1% by 5G FWA if cost savings are reinvested in VHCN	
Improved job opportunities	627,000 jobs EU-wide	
Improved economic prosperity	EUR109bln uplift in GDP in the period to 2030 if cost savings are reinvested in FTTH	

Source: support study

9. IMPLICATIONS FOR CUSTOMERS

9.1. Obligations impacting consumers

The proposed changes to the BCRD would not introduce any obligations directly impacting consumers.

9.2. Costs for consumers

The only provision in the preferred option which could give rise to costs for consumers is the obligation to install FTTH in-building for new and majorly renovated buildings. Although the cost of this element may not be expressly identified, it is likely that the cost to construction companies of meeting this obligation would (at least in part) be passed on to consumers through increased pricing for the property or in rental charges. The cost of equipping a building with the necessary in-building ducting and wiring is estimated at EUR200 on average on the basis of interviews with ECN operators. However, there is already an obligation within the BCRD to equip new and majorly renovated buildings with in-building infrastructure (ducts and cable trays) which is estimated to account for at least EUR150 of this cost. Thus, the incremental cost may be around EUR50 per household purchasing or renting a new or renovated building.

However, the pre-installation of in-building wiring is also likely to reduce the connection charge for a FTTH-based service by a similar amount and by 2030 more than 90% of households are expected to be passed by FTTH (or up to 96% if the cost savings from the BCRD are reinvested in FTTH), and legacy infrastructure is expected to have been largely switched off (in the case of copper) or upgraded to FTTB (in the case of cable). Thus, the obligation to make new or renovated buildings FTTH-ready is unlikely to lead to additional costs, but rather influence the timing of costs for consumers, resulting in a payment during the building or renovation phase rather than potentially in connection with the subscription to a broadband service..

9.3. Benefits for consumers

Consumers should experience direct benefits from the preferred option linked to the requirement to install in-building physical infrastructure and notably wiring. The availability of in-building wiring could accelerate the process of subscribing to a Gigabit-capable broadband service, and reduce the connection costs for consumers at the point of subscription. Consumers in more densely populated areas could also benefit from increased competition in Gigabit-capable broadband services, as – by removing what would otherwise be a significant element (and bottleneck) of the deployment cost - the availability of in-building wiring should improve the business case for alternative providers of Gigabit services to deploy to the household concerned. The introduction of standards for in-building physical infrastructure and wiring should also remove the need for costly duplication of in-building infrastructure or renovation of in-building infrastructure in cases where the initial installation was not suitable for FTTH, thereby reducing the costs to consumers of subscribing to an alternative infrastructure-based Gigabit broadband provider.

Another important direct benefit of the measures concerning access to physical infrastructure and civil works co-ordination is that it should reduce the noise and disruption associated with construction works, notably due to the reduction of the number of civil works undertaken.

Consumers are also likely to experience significant indirect benefits from the preferred option. The nature of these benefits will depend on how cost savings achieved as a result of preferred option are distributed.

For example:

- Cost savings to ECN operators could be passed on to consumers through lower prices for broadband, while reductions to the State Aid and/or EU funding required could be used to fund increased VHCN coverage or to subsidise other infrastructure or services.
- If cost savings resulting from the preferred option are reinvested in VHCN, consumers (especially those in rural areas) could benefit from improved coverage and better quality broadband. Modelling carried out as part of the support study suggests that, if the funds saved are reinvested in FTTH, this could result in an additional 6.5% of households having access to FTTH (taking total household coverage of FTTH to 96.5% by 2030). Alternatively, even greater coverage could be achieved of VHCN if the saved funds are reinvested in 5G FWA. This could result in 99.1% coverage of VHCN by 2030 with 9.1% provided on the basis of FWA.

Knock-on effects for consumers, particularly benefitting those in rural areas, include improved job opportunities and economic prosperity. The increased network reach of Gigabit infrastructure has also been shown to significantly support the provision of advanced healthcare, education and social services to more remote areas. These benefits are further elaborated in the Impact Assessment (Chapter 7).

Overview of estimated benefits to consumers – preferred option.

II Overview of Benefits to consumers – Preferred Option		
Description	**Amount**	**Comments**
Direct benefits		
Requirements and standards for in-building physical infrastructure and wiring	Faster and better quality connection to Gigabit services. Increased opportunities for infrastructure-based choice (in more densely populated areas). Reduced need for multiple installations of in-building infrastructure, saving cost	
Indirect benefits		
Cost savings	Potential reductions in connection charges for VHCN	
Increased VHCN coverage	Additional 6.5% households served by FTTH or 9.1% by 5G FWA if cost savings are reinvested in VHCN	
Improved job opportunities	627,000 jobs EU-wide	
Improved economic prosperity	EUR109bln uplift in GDP in the period to 2030 if cost savings are reinvested in VHCN	

Source: support study

10. IMPLICATIONS FOR SMEs

10.1. Obligations impacting SMEs

The proposed changes to the BCRD would not introduce any obligations specifically impacting SMEs as purchasers of Gigabit services. SMEs acting as ECN operators or other (non-ECN) network operators may be impacted as described in the sections relating to those categories of stakeholders. SMEs acting as ECN operators or other network operators may in particular include certain small scale local fibre investors or local utilities which are present in some Member States. Those effects that are specific to SMEs acting as ECN or other network operators are highlighted in this section.

10.2. Costs for SMEs

SMEs acting as ECN operators would be subject to the same costs that apply to other ECN operators, except where/if proportionality measures are introduced to reduce the burden on smaller operators. Requirements to submit information about existing infrastructure directly to the SIP and to proactively notify planned civil works are likely to be in place for SME ECN operators (as for other operators) in many Member States already,[246] while obligations for information to be in georeferenced format are also in place or planned in a number of Member States. The cost to ECN and non-ECN network operator SMEs of meeting these requirements could be reduced if provisions are made to exempt certain players and/or size of works from obligations on the basis of proportionality, which may require an assessment of the cost to the players concerned of providing this information in relation to the demand (or absence of demand) for access to this information. The cost to SMEs of providing the information may – despite their limited administrative staff - however be low in cases where they already have the data available in the appropriate georeferenced format.

[246] Only HR, DK, EL, IE, LT, MT and SK do not require network operators to provide information directly to the SIP. In some cases, this is because there is no SIP operational for the moment e.g. IE, DK (but other systems perform the same function). All member States submitting Roadmaps in the context of the Connectivity Recommendation stated that they plan to require pro-active notification of planned civil works, with the exception of IE, where this measure is under discussion.

SME network operators may choose to limit their involvement in the development of Guidelines and standards or rely on trade associations to provide input to these developments on their behalf, in order to reduce the administrative burden applying to them.

As regards indirect costs, some very localised SMEs acting as ECN operators may face increased competition from larger ECN operators or even other SMEs operators active in the same market if the simplification of permit granting procedures and RoW facilitates expansion by other operators.

SMEs acting as purchasers of Gigabit services would be subject to the same costs as apply to other consumers. Specifically, SMEs may be charged by construction companies or building operators for the cost of installing FTTH in-building infrastructure and wiring. As previously noted, the cost of equipping a building with the necessary in-building ducting and wiring is estimated at EUR200 on average on the basis of interviews with ECN operators. However, there is already an obligation within the BCRD to equip new and majorly renovated buildings with in-building infrastructure (ducts and cable trays) which is estimated to account for at least EUR150 of this cost. Thus, the incremental cost of installing in-building physical infrastructure and wiring may be around EUR50 per SME purchasing or renting a new or renovated building.

However, the pre-installation of in-building wiring is also likely to reduce the connection charge for a FTTH-based service by a similar amount and by 2030 more than 90% of premises are expected to be passed by FTTH (or up to 96% if the cost savings from the BCRD are reinvested in FTTH), and legacy infrastructure is expected to have been largely switched off (in the case of copper) or upgraded to FTTB (in the case of cable). Thus, the obligation to make new or renovated buildings FTTH-ready is unlikely to lead to additional costs, but rather influence the timing of costs for SMEs, resulting in a payment during the building or renovation phase rather than in connection with the subscription to a broadband service, if the broadband service provider chooses to apply charges in full.

10.3. Benefits for SMEs

Certain SMEs acting as ECN operators (those which are independent from utilities) are likely to have limited physical infrastructure of their own. These players are likely to be the primary beneficiaries of the improved access to physical infrastructure and associated cost reductions which are associated with the preferred option. SMEs acting as ECN operators and other network operators could reap benefits from the development of clearer rules and guidelines around access to physical infrastructure and civil works co-ordination, as this could lead to the reduction in the need for costly dispute resolution and to accelerated access to physical infrastructure and civil works coordination.

In addition, SMEs should benefit from reduced overbuild of their VHCN networks in less dense areas due to improved clarity concerning their potential to deny the possibility for civil works co-ordination (in cases where the requesting party had not previously announced their intention to deploy or where they offer alternative access options). Clearer rules and guidelines concerning wholesale pricing of access to physical infrastructure may also ensure that the impact on the business case for SMEs deploying VHCN of offering access to physical infrastructure is consistently and coherently taken into account across the EU. Many of the other measures under the preferred option which will benefit ECN operators more generally (such as improvements to access to public non-network facilities and permit granting procedures) are likely to provide significant benefits to SMEs acting as ECN operators because today, due to their small scale, such operators may be disproportionately impacted by administrative costs, complexity and delays associated with obtaining permits, Rights of Way and access to public facilities. Indeed, reducing the administrative burden in these areas could facilitate SMEs which currently focus in specific local areas to expand their network to other regions.

SMEs acting as consumers of Gigabit broadband services should experience direct benefits from the preferred option linked to the requirement to install in-building physical infrastructure and notably wiring. The availability of in-building wiring could accelerate the process of subscribing to a Gigabit-capable broadband service, and reduce the connection cost at the point of subscription. SMEs in more densely populated areas could also benefit from increased competition in Gigabit-capable broadband services, as – by removing what would otherwise be a significant element of the deployment cost - the availability of in-building wiring should improve the business case for alternative providers of Gigabit services to deploy to the premise concerned. The introduction of standards for in-building FTTH ready physical infrastructure should also remove the need for costly duplication of in-building infrastructure or renovation of in-building infrastructure in cases where the initial installation was not suitable for FTTH, thereby reducing the costs to small businesses of subscribing to an alternative infrastructure-based Gigabit broadband provider.

SMEs are also likely to experience significant indirect benefits from the preferred option. The nature of these benefits will depend on how cost savings achieved as a result of preferred option are distributed.

For example:

- Cost savings to ECN operators could be passed on to consumers including SMEs through lower prices for broadband, while reductions to the amount of State Aid and/or EU funding required could be used to fund increased VHCN coverage or to subsidise other infrastructure or services
- If cost savings resulting from the preferred option are reinvested in VHCN, SMEs (especially those in rural areas) could benefit from improved coverage and better quality broadband. Modelling from the study team suggests if the funds saved are reinvested in FTTH, this could result in an additional 6.5% of premises having access to FTTH (taking total household coverage of FTTH to 96.5% by 2030). Alternatively, even greater coverage could be achieved of VHCN if the saved funds are reinvested in 5G FWA. This could result in 99.1% coverage of VHCN by 2030 with 9.1% provided on the basis of FWA.

Knock-on effects for SMEs, particularly affecting those in rural areas, include the potential for productivity gains and improved access to the digital economy. SMEs could also benefit from the accelerated deployment of mid-band 5G, which may provide scope for additional and enhanced IoT services.

Overview of estimated benefits to SMEs – preferred option.

II Overview of Benefits (total for all provisions) – Preferred Option		
Description	**Amount**	**Comments**
Direct benefits		
Improved PIA and civil works co-ordination conditions	Reduced costs for SMEs deploying VHCN, more consistent interpretation of rules ensuring that PIA pricing takes into account the impact on the business case of operators deploying VHCN	
Clarification of terms under which civil works co-ordination may be denied	Reduced threat of overbuild, improving business case	
Requirements and standards for in-building FTTH physical infrastructure and wiring	Faster connection for SMEs to Gigabit services. Increased opportunities for infrastructure-based choice (in more densely populated areas). Reduced need for multiple installations of in-building infrastructure, saving cost	
Indirect benefits		
Cost savings	Potential reductions in connection charges for VHCN	
Increased VHCN coverage	Additional 6.5% premises served by FTTH or 9.1% by 5G FWA if cost savings are reinvested in VHCN	
Accelerated mid-band 5G	Earlier / more widespread opportunities to benefit from 5G IoT	
Improved productivity and economic prosperity	EUR109bln uplift in GDP in the period to 2030	

Source: support study

11. RELEVANT SUSTAINABLE DEVELOPMENT GOALS

No significant impact of the review of the BCRD regarding the UN sustainable development goals can be anticipated though, by fostering widespread advanced connectivity, it would indirectly constitute an enabler towards some of the goals, mainly industry, innovation and infrastructure (goal 9) as well as sustainable cities and communities (goal 11), climate action (goal 13), good health and well-being (goal 3), quality education (goal 4), reduced inequality (goal 10), clean energy (goal 7), and decent work and economic growth (goal 8).

ANNEX 4: DETAILED DESCRIPTION OF THE FOUR POLICY OPTIONS

Option 1 would involve a limited set of changes focused on (i) update of the scope to more advanced networks, (ii) clarification of certain provisions/obligations, which may have been implemented in differing ways across the Member States; and (iii) mandating certain measures that are currently voluntary, but which the assessment of detailed options, including Member States Connectivity Toolbox best practices suggests could contribute to achieving effective outcomes. This option includes:

- Objectives (Article 1)
- Updating the Directive objectives so that they are aligned with the EECC and the new Digital Decade connectivity targets, in particular replacing 'high-speed electronic communications networks' with 'very high capacity networks'.
- Clarifications on existing provisions (Articles 3, 5 and 7)
- Clarifying that physical infrastructure assets which are subject to access obligations under the EECC or under state aid obligations would not also be subject to access obligations under the BCRD;
- Clarifying that the obligation to meet reasonable requests for civil works coordination is associated with civil works projects which are wholly or partially publicly financed, and does not refer to the public/private character of the ownership of the network operator concerned;
- Clarifying that obligations related to permits including the requirement that permits should be granted within 4 months from the receipt of the application, and should include all permits necessary to deploy and operate electronic communications networks.
- Transparency for physical infrastructure (Article 4)
- Mandating the provision of information held in electronic format by public bodies on existing physical infrastructure of any network operator via the SIP, thereby making the current voluntary provision obligatory.
- Permit granting (Article 7)
- Mandating that permit applications should be submitted by electronic means and that operators can claim compensation for damages incurred as a result of delays in the permit granting procedures, making the current voluntary provisions concerning permit granting obligatory.

Option 2 would include all the amendments associated with option 1. It would additionally provide that VHCN-related assets and deployments should be excluded from access obligations and obligations to co-ordinate civil works (to avoid disincentivising network investment) and at the same time extend the scope of the directive to enable ECN operators to benefit from access to and information regarding non-network elements owned or controlled by public authorities, which are suitable for the deployment of ECNs. It would also address requests of ECN operators to strengthen obligations concerning the timing of the processing of permits and would require

Member States to define the scope of deployments which should be exempted from permits.

Specifically, in addition to the provisions described in option 1, option 2 would involve the following measures.

- Access to existing physical infrastructure (Article 3)
- Extending the scope of the BCRD access obligations to cover non-network physical infrastructure owned or controlled by public authorities which is suitable for the deployment of ECN (including rooftops of public buildings, street furniture, etc.) and which is suitable for the deployment of ECN, with some exemptions to ensure proportionality. Member States could optionally facilitate the implementation of this measure by appointing a coordinating body which could develop model contracts and facilitate contracts and access;
- Exempting physical infrastructure assets that have been deployed for the purpose of hosting a VHCN from the obligation to provide access to existing physical infrastructure.
- Transparency for physical infrastructure (Article 4)
- Providing for the inclusion of information about non-network physical infrastructure owned or controlled by public authorities within the SIP (reflecting the extension of physical infrastructure access obligations to include these assets), but with some exceptions where needed to ensure the proportionality of these obligations[247].
- Coordination of civil works (Article 5)
- Exempting VHCN deployments from the obligation to coordinate civil works.
- Permit granting (Article 7)
- Establishing an interim deadline within which permit granting authorities should determine the completeness of applications, and requiring Member States to specify in advance the reasons justifying an extension of the deadlines;
- When both permits and right of ways are necessary, requiring that a decision on both is made within the same 4-month deadline as from the reception of a complete application;
- Requiring Member States to define the scope of deployments which may benefit from an exemption from permits.

Option 3 would include all the amendments associated with option 1 and as option 2 would also involve an adjustment of the scope of the current BCRD, extending access and transparency obligations to assets held by public bodies and strengthening permit provisions. However, instead of exempting VHCN deployments/assets from physical infrastructure access and civil works co-ordination obligations, it would address concerns about investment incentives (as well as about potentially excessive wholesale charges) through legal provisions accompanied by more detailed guidance. There would be EU

[247] The interpretation of proportionality in this context could be elaborated in a recital, but might for example include consideration of whether there is demand for access to the infrastructure concerned based on a consultation with stakeholders and whether the infrastructure has basic characteristics that would make it suitable to host network elements such as whether it has the requisite power or load bearing capabilities to support active equipment.

level guidance for access and civil works related aspects, fostering more harmonisation, and at the national level for access to in-building physical infrastructure to facilitate adaptations based on national circumstances. On transparency and permit granting, this option would build on options 1 and 2, with new provisions aimed at fostering the implementation of best practice solutions (provision of information by network operators, proactive notification of civil works, georeferenced information, digitised SIPs for physical infrastructure and civil works where possible interconnected). It would also mandate national standards.

This option would also establish consistent rules and processes on permit granting at national level supported by a 'one-stop-shop' based on a single national digital platform, tacit approvals of permit requests, and limit permit fees to the level of administrative cost. Deployments subject to exemption from permit granting would be specified at EU-level, thereby addressing the problems of high complexity, timeframes and costs to obtain permits in a more harmonised manner. Finally, in order to address problems of lack of or access to suitable in-building infrastructure and to ensure every EU household has access to Gigabit connectivity, this option would mandate fibre in-building in every new (or majorly renovated) household as well as standardisation of in-building physical infrastructure at national level and guidance on access to in-building infrastructure at EU level (together and consistent with that of access to physical infrastructure).

Specifically, in addition to the measures already described in option 1, option 3 would involve the following measures:

- <u>Access to existing physical infrastructure (Article 3)</u>
  - Extending the scope of the BCRD access obligations to cover non-network physical infrastructure owned or controlled by public authorities (including rooftops of public buildings, street furniture, etc.) and which is suitable for the deployment of ECN, with some exemptions to ensure proportionality. Member States could optionally facilitate the implementation of this measure by appointing a coordinating body which could develop model contracts and facilitate contacts and access;
  - Specifying rules and developing guidance at EU level on the application of the provisions on access to existing physical infrastructure, which would elaborate on:
    - the application of the 'fair and reasonable' access conditions including price with recommendations on how DSBs should set charges in different circumstances, with the aim of ensuring that wholesale charges are not excessive, while also taking into account the impact on the access provider's business case when establishing access prices;
    - the circumstances in which it would be reasonable for ECN operators to deny access to physical infrastructure on the basis that they provide an 'alternative means of access' which is available on 'fair and reasonable conditions';
- <u>Transparency for physical infrastructure (Article 4)</u>
  - Providing for the inclusion within the SIP of information about non-network physical infrastructure owned or controlled by public authorities (reflecting the extension of obligations for access to existing physical infrastructure to

include these assets), but with some exceptions where needed to ensure the proportionality of these obligations;

  - Providing for the inclusion within the SIP of existing physical infrastructure by all network operators (public and private), with some exceptions to ensure proportionality;
  - Requiring information in the SIP to be geo-referenced;
  - Requiring that SIPs for existing infrastructure and planned civil works are set up as fully digitised platforms, interconnected where possible.

- <u>Coordination of civil works (Article 5)</u>
  - Specifying rules and developing guidance at EU level on the application of the provisions on coordination of civil works, including in particular the apportioning of costs between the ECN operator requesting co-ordination and the network operator undertaking the civil works;
  - Defining the circumstances in which civil works coordination can be denied; for instance in cases where suitable physical infrastructure is ensured and/or where there has been no prior interest to deploy in that area expressed by the requestor in the context of an Art. 22 procedure under the EECC or in the context of a state sid procedure.
- <u>Transparency in civil works co-ordination (Article 6)</u>
  - Requiring both public and private network operators to proactively notify their planned civil works;
  - Requiring information in the SIP to be geo-referenced.
- <u>Permit granting (Article 7)</u>
  - Establishing an interim deadline within which permit granting authorities should determine the completeness of permit applications and requiring Member States to specify in advance reasons justifying an extension of the deadlines;
  - When both permits and right of ways are necessary, requiring that a decision on both is made within the same 4-month deadline as from the reception of a complete application;
  - Mandating Member States to apply the principle of tacit approval after the 4 months deadline for permit granting is passed wherever feasible;
  - Requiring Member States to ensure that permit granting procedures for the purposes of ECN deployment are processed and coordinated via a digital platform (‘one-stop-shop’), noting that such a platform should not necessarily be limited to ECN permits but could also be used for other sectors;
  - Requiring Member States to ensure that any rules regarding permits for civil works (including rights of way) are nationally consistent and published in advance;
  - Requiring charges for permit applications to be limited to administrative cost;
  - Empowering the EC to define deployments which are subject to an exemption from the need for a permit.

- In-building physical infrastructure and access to in-building physical infrastructure (Articles 8 and 9)

- Mandating FTTH in-building wiring for new buildings and buildings subject to extensive renovation, subject to possible exemptions for MS in areas/cases where the obligation would be disproportionate;
- Requiring Member States to establish standards (at national level) and certification (allowing for self-certification) of in-building VHCN/FTTH-ready physical infrastructure for new and renovated buildings;
- Specify rules and develop EU level guidance on the application of the provisions on access to in-building physical infrastructure.

- **Option 4** builds on option 3, but goes further in terms of EU harmonisation, and extends obligations under the Directive, such that obligations on civil works coordination would apply to privately financed as well as publicly financed projects, and obligations to provide access to non-network assets would apply to commercial actors as well as public bodies. It also sets ambitious goals regarding digitisation of digital platforms. Specifically, option 4 involves the following measures, in addition to those set out under option 1. This option would mandate the establishment of a combined single digital platform for existing physical infrastructure, planned civil works and, optionally, permit procedures. Finally, this option would mandate standardisation of in-building physical infrastructure at EU level.

- Access to existing physical infrastructure (Article 3)
  - Extending the scope of the BCRD access obligations to cover non-network physical infrastructure owned or controlled by public authorities (including rooftops of public buildings, street furniture, etc.) and suitable for ECN deployment, with some exemptions to ensure proportionality, as well as assets owned by private entities which are suitable for VHCN deployment such as commercial buildings and non-network assets owned by tower companies. Member States could optionally facilitate the implementation of this measure by appointing a coordinating body which could develop model contracts and facilitate contacts and access. This measure goes beyond those outlined in options 2 and 3 through the inclusion of privately owned non-network assets.
  - Specifying rules and developing guidance at EU level on the application of the provisions on access to existing physical infrastructure, which would elaborate on:
    - the application of the 'fair and reasonable' access conditions including price with recommendations on how DSBs should set charges in different circumstances, with the aim of ensuring that wholesale charges are not excessive, while also taking into account the impact on the access provider's business case when establishing access prices;
    - the circumstances in which it would be reasonable for ECN operators to deny access to physical infrastructure on the basis that they provide an 'alternative means of access" which is available on 'fair and reasonable conditions'.
- Transparency for physical infrastructure (Article 4)
  - Providing for the inclusion within the SIP of information about non-network physical infrastructure owned or controlled by public authorities as well as by

private entities (reflecting the extension of physical infrastructure access obligations to include these assets as well as the extension of access obligations to private networks operators too), but with some exceptions where needed to ensure the proportionality;

  - Providing for the inclusion within the SIP of existing physical infrastructure by all network operators (public and private), with some exceptions to ensure proportionality;
  - Requiring information in the SIP to be geo-referenced;
  - Requiring information about existing physical infrastructure and planned civil works to be consolidated into a single digital platform.

- Coordination of civil works (Article 5)
  - Expanding the obligation to engage in civil works co-ordination to also cover privately financed civil works carried out by network operators;
  - Defining the circumstances in which civil works coordination can be denied; for instance in cases where suitable physical infrastructure is ensured and/or where there has been no prior interest to deploy in that area expressed by the requestor in the context of an Art. 22 procedure under the EECC or in the context of a state aid procedure. This is already in option 3;
  - Specifying rules and developing guidelines at EU level on the application of the provisions on coordination of civil works, including in particular the apportioning of costs between the ECN operator requesting co-ordination and the network operator undertaking the civil works.
- Transparency for planned civil works (Article 6)
  - Requiring both public and private network operators to proactively notify their planned civil works;
  - Requiring information in the SIP to be geo-referenced;
  - Requiring information about existing physical infrastructure and planned civil works to be consolidated into a single digital platform.
- Permit granting (Article 7)
  - Establishing an interim deadline within which permit granting authorities should determine the completeness of permit applications and requiring Member States to specify in advance reasons justifying an extension of the deadlines;
  - When both permits and right of ways are necessary, requiring that a decision on both is made within the same 4-month deadline from the reception of a complete application;
  - Mandating Member States to apply the principle of tacit approval after the 4 months deadline for permit granting is passed wherever feasible;
  - Requiring Member States to ensure that permit granting procedures for the purposes of ECN deployment are processed and coordinated via a digital platform (‘one-stop-shop’), noting that such a platform should not necessarily be limited to ECN permits but could also be used for other sectors. Optional provision to integrate the processing of digital permit applications into the

single digital platform for information on existing physical infrastructure and planned civil works;

- Requiring Member States to ensure that that any rules regarding permits for civil works (including rights of way) are nationally consistent and published in advance;
- Requiring charges for permit applications to be limited to administrative cost;
- Empowering the EC to identify deployments which are subject to an exemption from the need for a permit.

• <u>In-building physical infrastructure and access to in-building physical infrastructure (Articles 8 and 9)</u>

- Mandating FTTH in-building wiring for new buildings and buildings subject to extensive renovation;
- Standardisation at EU level and certification (possibly allowing for self-certification) of in-building VHCN/FTTH-ready physical infrastructure for new and renovated buildings;
- Define rules and develop EU-level guidelines on the application of the provisions on access to in-building physical infrastructure including the interpretation of fair and reasonable terms and conditions, including price.

Table: Summary of policy options in detail

	Option 1: Update, clarify and align	**Option 2: Extend and strengthen, exclude VHCN from obligations**	**Option 3: Extend and strengthen with partial harmonisation**	**Option 4: Extend and strengthen with full application to private assets and full harmonisation**
Main provisions	Minimal update mainly to align and ensure coherence with EECC, make some clarifications and make some provisions mandatory	Option 1+ Extension of access obligations to non-network physical infrastructure assets, exemptions from physical infrastructure and coordination for VHCN deployments to address investment incentive problems (e.g. fear of overbuild), strengthening of obligations on public authorities	Option 1+ Rules and EU guidance to clarify access to physical infrastructure (incl. in-building) and for civil works co-ordination conditions and take into account impact on business case , strengthening of permit granting procedures and national standards for in-building infrastructure	Option 3+ Extension of obligations to all private operators and, where relevant, certain non-operators (for access and for in-building infrastructure) and standards for in-building infrastructure at EU level
Art 1 Scope	**Update objectives** to VHCN	Update objectives to VHCN	Update objectives to VHCN	Update objectives to VHCN
Art 3 Access to existing **physical infrastructure** – obligation to meet reasonable requests	Clarify that **assets subject to access obligations under EECC or State Aid** would **not also be subject to BCRD obligations**	Extend access obligations to **public non-network physical infrastructure** and optionally set up **a coordinating body**	Extend access obligations to public non-network physical infrastructure and optionally set up a coordinating body	Extend access obligations to public ***and private*** **non-network** physical infrastructure, and optionally set up a coordinating body
		Clarify that assets subject to access obligations under **EECC or State Aid would not also be subject to BCRD obligations**	Clarify that assets subject to access obligations under EECC or State Aid would not also be subject to BCRD obligations	Clarify that assets subject to access obligations under EECC or State Aid would not also be subject to BCRD obligations
		Exempt PI hosting VHCN from obligation for access to physical infrastructure	**Specify rules and develop EU-level guidance** on application of provisions for **access to physical infrastructure including pricing and grounds for denial of access**	Specify rules and develop EU-level guidance on application of provisions for access to physical infrastructure including pricing and grounds for denial of access
Art 4 Transparency (access-related)	**Mandate public bodies** holding data in electronic format to provide it to the SIP	Mandate public bodies holding data in electronic format to provide it to the SIP	**Mandate public bodies and *all network operators*** (with exceptions for proportionality) holding data in electronic format to provide it to the SIP	Mandate public bodies and *all network operators* holding data in electronic format to provide information to the SIP

	Option 1: Update, clarify and align	**Option 2: Extend and strengthen, exclude VHCN from obligations**	**Option 3: Extend and strengthen with partial harmonisation**	**Option 4: Extend and strengthen with full application to private assets and full harmonisation**
provided by Member States		Extend information / SIP obligations to **public non-network physical infrastructure** with some exceptions to ensure proportionality	Extend information / SIP obligations to public non-network physical infrastructure with some exceptions to ensure proportionality	Extend information / SIP obligations **to public *and private* non-network physical infrastructure** with some exceptions to ensure proportionality
			Require information to be **georeferenced**	Require information to be georeferenced
			Require **SIPs** for existing infrastructure and planned civil works to be set up as **fully digitised platforms**, and where possible interconnected	Require **SIPs** for existing infrastructure and planned civil works to be **consolidated** into a single digital platform
Art 5 *Civil works coordination* – right to negotiate and reasonable access to (partially) publicly financed networks	**Clarify** that obligation applies to "civil works" which are publicly financed	Clarify that obligation applies to "civil works" which are publicly financed	Clarify that obligation applies to "civil works" which are publicly financed	Extend obligation so that network operators are required **to meet reasonable requests for civil works co-ordination for all civil works (publicly or privately funded)**
		Exempt VHCN deployments from civil works co-ordination obligation	Define **circumstances under which civil works co-ordination may be denied** (e.g. where suitable access to physical infrastructure is ensured and/or where there has been no prior interest to deploy declared in context of Art 22 EECC / State Aid)	Define circumstances under which civil works co-ordination may be denied (e.g. where suitable access to physical infrastructure is ensured and/or where there has been no prior interest to deploy declared in context of Art 22 EECC / State Aid)
			Specify rules and mandate EU level guidance concerning cost allocation for civil works co-ordination	Specify rules and mandate EU level guidance concerning cost allocation for civil works co-ordination
Art 6 Transparency *by network operators* concerning planned civil works			Require **pro-active notification of planned civil works for both publicly and privately funded deployments**	Require pro-active notification of planned civil works for both publicly and privately funded deployments
			Require **information to be georeferenced**	Require information to be georeferenced
			Require **SIPs for existing infrastructure and planned civil works to be set up as fully digitised platforms**	Require SIPs for existing infrastructure and planned civil works to be **consolidated** into a single digital platform

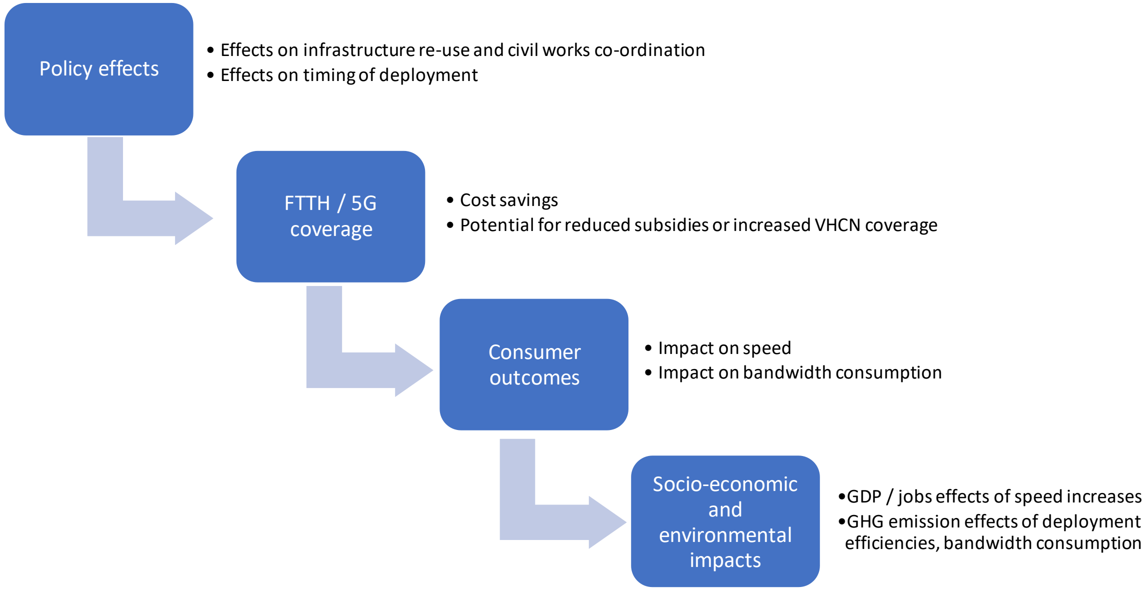
	Option 1: Update, clarify and align	Option 2: Extend and strengthen, exclude VHCN from obligations	Option 3: Extend and strengthen with partial harmonisation	Option 4: Extend and strengthen with full application to private assets and full harmonisation
Art 7 Permit granting procedures duration and compensation for damages	Clarify that timeframes and associated obligation apply to all permits required to deploy and operate ECN networks	Clarify that timeframes and associated obligation apply to all permits required to deploy and operate ECN networks	Clarify that timeframes and associated obligation apply to all permits required to deploy and operate ECN networks	Clarify that timeframes and associated obligation apply to all permits required to deploy and operate ECN networks
	Mandate permit applications by electronic means	Mandate permit applications **by electronic means**	Mandate the **set-up of a digital platform** for permit granting procedures	Mandate the set-up of a digital platform for permit granting procedures **with optional integration into the consolidated SIPs for physical infrastructure and civil works co-ordination.**
	Mandate right to claim compensation for damages incurred as a result of delays in the permit granting procedures	Mandate right to claim compensation for damages incurred as a result of delays in the permit granting procedures	Mandate right to claim compensation for damages incurred as a result of delays in the permit granting procedures	Mandate right to claim compensation for damages incurred as a result of delays in the permit granting procedures
			Require MS to ensure that **all rules for permit granting are nationally consistent and published in advance**	Require MS to ensure that all rules for permit granting are nationally consistent and published in advance
		Establish **deadline for declaration of completeness of applications** and require **MS to specify in advance reasons** for extension of deadlines	Establish deadline for declaration of completeness of applications, require MS to specify in advance reasons for extension of deadlines, **and mandate MS to apply the principle of tacit approval, wherever feasible**	Establish deadline for declaration of completeness of applications, require MS to specify in advance reasons for extension of deadlines, and mandate MS to apply the principle of tacit approval, wherever feasible
		Require that both processes for permits and rights of way **are done within 4 months**	Requiring that both processes for permits and rights of way are done within 4 months	Requiring that both processes for permits and rights of way are done within 4 months
		Require MS to define the scope of deployments **exempt** from permits	Empower EC to define deployments **benefitting** from permit exemptions	Empower EC to define deployments benefiting from permit exemptions
			Limit charges for permit applications to administrative cost	Limit charges for permit applications to administrative cost

	Option 1: Update, clarify and align	**Option 2: Extend and strengthen, exclude VHCN from obligations**	**Option 3: Extend and strengthen with partial harmonisation**	**Option 4: Extend and strengthen with full application to private assets and full harmonisation**
Art 8 Al buildings equipped with in-building physical infrastructure			Mandate FTTH **in-building wiring for new buildings and buildings subject to major renovations,** subject to possible exemptions.	Mandate FTTH in-building wiring for new buildings and buildings subject to major renovations.
			Require **MS to establish standards at national level and certification** of in-building VHCN/FTTH-ready physical infrastructure for new and renovated buildings	**Empower the EC** to establish standards and certification of in-building VHCN/FTTH-ready physical infrastructure for new and renovated buildings
Art 9 Right to roll out and access on reasonable request to in-building physical infrastructure			Require **EU** to **adopt guidance** concerning access to in-building physical infrastructure	Require EU to adopt guidance concerning access to in-building physical infrastructure

ANNEX 5: ANALYTICAL METHODS

This annex describes the four steps used in the modelling that is referred in section 6, further details can be found in the support study.

The quantification of economic and environmental impacts associated with the different options for the revision of the BCRD is based on a four-step process as shown in the following diagram.



Source: support study

In the first step, the effects of the different policy options on infrastructure re-use and civil works co-ordination as well as the impact on the timing of VHCN deployment is assessed.

In a second step, these parameters are used as input to the WIK's cost and viability model, which in turn provided estimates regarding the potential cost savings or increased VHCN (FTTH and 5G) coverage that could be achieved by 2030 as a result of the different options.

In a third step, it is estimated what the projected increases in VHCN coverage would mean for consumers in terms of the average speeds they would enjoy and the per user (and total bandwidth) that would be consumed.

In the finally step evaluates the:

- Implications of the increased speeds on macroeconomic outcomes such as GDP and jobs; and
- Implications of the increased bandwidth use alongside the increased re-use of infrastructure on environmental outcomes such as Greenhouse Gas Emissions

The results of the analysis as well as the high level assumptions underlying steps 1, 2 and 4, and detailed assumptions for step 3 are presented in chapter 7 of the support study.

Step 1: Estimating the impact of the different options on cost reductions and increased deployment

In this chapter, we describe the assumptions which were made concerning the effect of the different options on infrastructure re-use, civil works co-ordination and the speed of deployment.

Assumptions underlying the Impact Assessment models

An overview of the assumptions made concerning the impact of the different options on outcomes concerning infrastructure re-use and other factors is shown in the following table. The different elements of each option are listed alongside assumptions regarding the directional effects (showed using + and -). These are then used to adjust the model inputs for factors such as the proportion of shared ducts and poles, and civil works co-ordination, the wholesale charge for PIA, etc. References to small cells include but are not limited to small cells which fall within the definition of SAWAP under Article 57 EECC. The focus is on the effects of the BCRD review on FTTH and mid-band 5G deployment but note that it could also influence the ease of deployment of 5G in the millimetre wave band.

Table 18: Assumed effects of regulatory options in detail

Status as of December 2030															
		Shared use of ducts (% new VHCN deployment in existing PI)	Shared use of poles (% new VHCN deployment in existing PI)	% new deployment based on civil works co-ordination	Wholesale price for access to existing physical infrastructure (wholesale price per metre for duct access)	Wholesale price for access to existing physical infrastructure (wholesale price per metre for pole access)	Total sites needed to provide universal low frequency 5G coverage	Cost of deploying macrocells (cumulative present value of costs EUR)	Cost of deploying small cells (average cost per installation EUR)	Cost of in-building infrastructure per premise (greenfield)	% premises for which there is a reduction in cost for in-house infrastructure	% cost reduction compared with newly built infrastructure	Wholesale market share attainable in less dense areas (where duplication is not viable)	Average time taken to achieve 90% FTTH coverage from a baseline of 65%	Average time taken to deploy full 5G to achieve 75% population coverage (via 3.6 GHz) from a baseline of 30% coverage months
Baseline	Status quo	5%	15%	3%	0.05	0.04	5275	110,000	34,000	EUR 200	10%	30%	70%	60	60
Option 1	Minimum revisions	6%	17%	3%	0.05	0.04	5275	110000	34000	200	12%	35%	70%	60	59
Art 1	Update objective to VHCN	0	0	0	0	0	0	0	0	0	+	+	0	0	0
Art 4	Mandatory SIP for info held by public bodies	+	+	0	0	0	0	0	0	0	0	0		0	0
Art 7	Clarify scope, permit granting by electronic means, compensation for damages	0	0	0	0	0	0	0	0	0	0	0	0	+	+

Status as of December 2030															
		Shared use of ducts (% new VHCN deployment in existing PI)	Shared use of poles (% new VHCN deployment in existing PI)	% new deployment based on civil works co-ordination	Wholesale price for access to existing physical infrastructure (wholesale price per metre for duct access)	Wholesale price for access to existing physical infrastructure (wholesale price per metre for pole access)	Total sites needed to provide universal low frequency 5G coverage	Cost of deploying macrocells (cumulative present value of costs EUR)	Cost of deploying small cells (average cost per installation EUR)	Cost of in-building infrastructure per premise (greenfield)	% premises for which there is a reduction in cost for in-house infrastructure	% cost reduction compared with newly built infrastructure	Wholesale market share attainable in less dense areas (where duplication is not viable)	Average time taken to achieve 90% FTTH coverage from a baseline of 65%	Average time taken to deploy full 5G to achieve 75% population coverage (via 3.6 GHz) from a baseline of 30% coverage months
Option 2	Extend and strengthen some provisions, exclude VHCN deployments	6%	17%	3%	0.05	0.04	5275	99000	29000	EUR 200	12%	35%	75%	57	54
Art 1	Update objective to VHCN	0	0	0	0	0	0	0	0	0	+	+	0	0	
Art 3, 4	Extend PIA to non-network public infrastructure, with associated information	0	0	0	0	0	0	+	+	0	0	0	0	0	++
Art 3	Mandatory SIP for info held by public bodies	+	+	0	0	0	0	0	0	0	0	0	0	0	0
Art 7	Permit exemptions, clarifying permit deadlines, simultaneous RoW	0	0	0	0	0	0	0	0	0	0	0	0	+	+++

Status as of December 2030															
		Shared use of ducts (% new VHCN deployment in existing PI)	Shared use of poles (% new VHCN deployment in existing PI)	% new deployment based on civil works co-ordination	Wholesale price for access to existing physical infrastructure (wholesale price per metre for duct access)	Wholesale price for access to existing physical infrastructure (wholesale price per metre for pole access)	Total sites needed to provide universal low frequency 5G coverage	Cost of deploying macrocells (cumulative present value of costs EUR)	Cost of deploying small cells (average cost per installation EUR)	Cost of in-building infrastructure per premise (greenfield)	% premises for which there is a reduction in cost for in-house infrastructure	% cost reduction compared with newly built infrastructure	Wholesale market share attainable in less dense areas (where duplication is not viable)	Average time taken to achieve 90% FTTH coverage from a baseline of 65%	Average time taken to deploy full 5G to achieve 75% population coverage (via 3.6 GHz) from a baseline of 30% coverage months
Art 3, 5	Exclude VHCN deployments from PIA and from co-deployment obligations	-	0	-	0	0	0	0	0	0	0	0	+	0	0
Option 3	Extend and strengthen all provisions, targeted harmonisation	8%	20%	5%	0.04	0.03	5275	94000	24000	EUR200	17%	75%	75%	54	52
Art 1	Update objective to VHCN	0	0	0	0	0	0	0	0	0	+	+	0	0	0
Art 3, 4	Extend PIA to non-network public infrastructure, with associated information	0	0	0	0	0	0	+	+	0	0	0	0	0	++
Art 4	Mandatory digital SIP, info from all network operators	+	+	0	0	0	0	0	0	0	0	0	0	0	0

Status as of December 2030															
		Shared use of ducts (% new VHCN deployment in existing PI)	Shared use of poles (% new VHCN deployment in existing PI)	% new deployment based on civil works co-ordination	Wholesale price for access to existing physical infrastructure (wholesale price per metre for duct access)	Wholesale price for access to existing physical infrastructure (wholesale price per metre for pole access)	Total sites needed to provide universal low frequency 5G coverage	Cost of deploying macrocells (cumulative present value of costs EUR)	Cost of deploying small cells (average cost per installation EUR)	Cost of in-building infrastructure per premise (greenfield)	% premises for which there is a reduction in cost for in-house infrastructure	% cost reduction compared with newly built infrastructure	Wholesale market share attainable in less dense areas (where duplication is not viable)	Average time taken to achieve 90% FTTH coverage from a baseline of 65%	Average time taken to deploy full 5G to achieve 75% population coverage (via 3.6 GHz) from a baseline of 30% coverage months
Art 3, 5	EU Guidelines on conditions for PIA and for civil works co-ordination	+	+	+	+	+		+	+	0	0	0	+	+	+
Art 4, 6	Proactive notification of planned civil works, georeferencing of information and integration of SIPs (common digital platform) on existing infrastructure and planned civil works	+	+	+	0	0	0	0	0	0	0	0	0	0	0
Art 3, 5	Clarification on potential to refuse PIA / civil works co-ordination in case of a VHCN deployment	-	0	-	0	0	0	0	0	0	0	0	0	0	0

Status as of December 2030															
		Shared use of ducts (% new VHCN deployment in existing PI)	Shared use of poles (% new VHCN deployment in existing PI)	% new deployment based on civil works co-ordination	Wholesale price for access to existing physical infrastructure (wholesale price per metre for duct access)	Wholesale price for access to existing physical infrastructure (wholesale price per metre for pole access)	Total sites needed to provide universal low frequency 5G coverage	Cost of deploying macrocells (cumulative present value of costs EUR)	Cost of deploying small cells (average cost per installation EUR)	Cost of in-building infrastructure per premise (greenfield)	% premises for which there is a reduction in cost for in-house infrastructure	% cost reduction compared with newly built infrastructure	Wholesale market share attainable in less dense areas (where duplication is not viable)	Average time taken to achieve 90% FTTH coverage from a baseline of 65%	Average time taken to deploy full 5G to achieve 75% population coverage (via 3.6 GHz) from a baseline of 30% coverage months
Art 7	Permit exemptions defined at EU level, Digital platform for permit granting, clarify deadlines and simultaneous RoW	0	0	0	0	0	0	0	0	0	0	0	0	++	+++
Art 8, 9	Mandate in-building FTTH, Standards at national level for in-building infrastructure, guidelines on access to in-building infrastructure	0	0	0	0	0	0	0	0	0	++	+++	0	0	0
Option 4	Extend to private bodies, full harmonisation	8%	20%	7%	0.04	0.03	5275	92000	23000	EUR 200	15%	75%	75%	56	54
Art 1	Update objective to VHCN	0	0	0	0	0	0	0	0	0	+	+	0	0	0

Status as of December 2030															
		Shared use of ducts (% new VHCN deployment in existing PI)	Shared use of poles (% new VHCN deployment in existing PI)	% new deployment based on civil works co-ordination	Wholesale price for access to existing physical infrastructure (wholesale price per metre for duct access)	Wholesale price for access to existing physical infrastructure (wholesale price per metre for pole access)	Total sites needed to provide universal low frequency 5G coverage	Cost of deploying macrocells (cumulative present value of costs EUR)	Cost of deploying small cells (average cost per installation EUR)	Cost of in-building infrastructure per premise (greenfield)	% premises for which there is a reduction in cost for in-house infrastructure	% cost reduction compared with newly built infrastructure	Wholesale market share attainable in less dense areas (where duplication is not viable)	Average time taken to achieve 90% FTTH coverage from a baseline of 65%	Average time taken to deploy full 5G to achieve 75% population coverage (via 3.6 GHz) from a baseline of 30% coverage months
Art 3, 4	Extend PIA to non-network public infrastructure, with associated information	0	0	0	0	0	0	++	++	0	0	0	0	0	++
Art 3, 5	EU Guidelines on conditions for PIA and for civil works co-ordination	+	+	+	+	+	0	+	+	0	0	0	+	+	+
Art 4	Mandatory digital SIP, info from all network operators	+	+	0	0	0	0	0	0	0	0	0	0	0	0
Art 7	Permit exemptions defined at EU level, Digital platform for permit granting, clarify deadlines and simultaneous RoW	0	0	0	0	0	0	0	0	0	0	0	0	++	+++

Status as of December 2030															
		Shared use of ducts (% new VHCN deployment in existing PI)	Shared use of poles (% new VHCN deployment in existing PI)	% new deployment based on civil works co-ordination	Wholesale price for access to existing physical infrastructure (wholesale price per metre for duct access)	Wholesale price for access to existing physical infrastructure (wholesale price per metre for pole access)	Total sites needed to provide universal low frequency 5G coverage	Cost of deploying macrocells (cumulative present value of costs EUR)	Cost of deploying small cells (average cost per installation EUR)	Cost of in-building infrastructure per premise (greenfield)	% premises for which there is a reduction in cost for in-house infrastructure	% cost reduction compared with newly built infrastructure	Wholesale market share attainable in less dense areas (where duplication is not viable)	Average time taken to achieve 90% FTTH coverage from a baseline of 65%	Average time taken to deploy full 5G to achieve 75% population coverage (via 3.6 GHz) from a baseline of 30% coverage months
Art 5	Extend civil works co-ordination obligation to private network operators	0	0	+	0	0	0	0	0	0	0	0	0	0	0
Art 4, 6	Requiring information from public and private network operators about physical infrastructure + pro-active notification of planned civil works by all operators with integrated SIP for existing and planned infrastructure	+	+	+	0	0	0	+	+	0	0	0	0	0	0
Art 7	Permit exemptions defined at EU level, Digital platform for permit granting, clarify deadlines and simultaneous RoW	0	0	0	0	0	0	0	0	0	0	0	0	++	+++

Status as of December 2030															
		Shared use of ducts (% new VHCN deployment in existing PI)	Shared use of poles (% new VHCN deployment in existing PI)	% new deployment based on civil works co-ordination	Wholesale price for access to existing physical infrastructure (wholesale price per metre for duct access)	Wholesale price for access to existing physical infrastructure (wholesale price per metre for pole access)	Total sites needed to provide universal low frequency 5G coverage	Cost of deploying macrocells (cumulative present value of costs EUR)	Cost of deploying small cells (average cost per installation EUR)	Cost of in-building infrastructure per premise (greenfield)	% premises for which there is a reduction in cost for in-house infrastructure	% cost reduction compared with newly built infrastructure	Wholesale market share attainable in less dense areas (where duplication is not viable)	Average time taken to achieve 90% FTTH coverage from a baseline of 65%	Average time taken to deploy full 5G to achieve 75% population coverage (via 3.6 GHz) from a baseline of 30% coverage months
Art 8, 9	Mandate FTTH in-building, Standards at EU level for in-building infrastructure, EU-level guidelines on access to in-building infrastructure	0	0	0	0	0	0	0	0	0	+	+++	0	0	0

Source: support study

Impact of measures on access to physical infrastructure

The assumptions regarding re-use of physical infrastructure and civil works co-ordination are based on data concerning the use of these techniques from DSBs and ECN operators and expectations about how this use might evolve under given policy measures. For example, reliance on duct access under the BCRD is currently estimated to be relatively limited. According to estimations provided by national authorities, it covers less than 1% of the total length of the reach of the incumbent network in Germany and Finland, and is estimated at only 2.3% in Hungary.[248] Figures are understood to be considerably higher for Poland and Italy, but still lie at 20% or less as a proportion of the length of the incumbent duct network.[249] Pole sharing is expected to be more widely used in part because there is historic experience of using utility poles for VHCN deployment in several countries (including FR, PT) and the conditions for SMP pole access tend to be less well established than for duct access.[250] Figures available from countries such as Hungary and Poland[251] put the use of pole sharing at around 10% of the total length of the incumbent aerial network, while some operators deploying FTTH in rural areas with support from State Aid report[252] much higher use of utility poles up to 70% or more. Increased transparency is expected to support some increased duct and pole re-use under the BCRD compared with the status quo for Options 1 and 2. Additional duct and pole re-use under the BCRD is expected for Options 3 and 4 due to the introduction of rules and potentially guidelines on terms and conditions for PIA at the EU level, which many ECN operators consider would contribute to increased take-up of BCRD PIA. The adoption of EU level rules is also expected to contribute to wholesale price reductions for PIA (when considered on average).[253] An example of wholesale charges for BCRD PIA before and after regulatory intervention can be seen in Italy, where charges by Enel, the energy utility for a 20 year IRU for a miniduct were initially set at around EUR8 (approx. EUR0.03 per meter and month), but these levels were reduced subsequently to around annually EUR4.51 per miniduct following dispute resolution (approx. EUR0.02 per meter and month), with significantly lower charges for subsequent miniducts.[254]

Impact of measures on civil works co-ordination

The proportion of deployment based on civil works co-ordination is expected to remain low in comparison with PIA. Interviews conducted for this study suggest that networks based on joint deployment make up around 10% of new deployments in Sweden and 25% in Slovenia. However, these countries are at the forefront of best practice in civil works co-ordination, with municipalities which actively engage in encouraging co-ordinated deployment.[255] The degree of deployment based on civil works co-ordination is estimated at close to zero in other countries which provided

[248] Responses by DSBs to the WIK ICF questionnaire Q1 2021.

[249] Information from DSBs and stakeholders based on interview.

[250] WIK (2017) Best practice for passive infrastructure access https://www.wik.org/fileadmin/Studien/2017/best-practice-passive-infrastructure-access.pdf

[251] Responses by DSBs to the WIK ICF questionnaire Q1 2021.

[252] Interviews conducted in the context of this study.

[253] We assume under the status quo that charges for BCRD PIA may be set in some cases above the cost-based levels, while they may be set at cost-based levels in cases where action has been taken by the DSB to resolve disputes or where there are clear guidelines or benchmarks concerning applicable wholesale sales, although the method for cost orientation would likely vary from incremental cost through to cost with an added mark-up (to account for common costs or implications on the business case)

[254] Source: interviews and BoR (18) 163.

[255] See the Evaluation Report of the support study associated with the review of the BCRD.

information and the degree of usage of this measure was reported as low by the vast majority of ECN operators in the context of the WIK ICF survey conducted in Q1 2021.[256] Some improvements are expected, because a number of Member States reported in the context of Connectivity Toolbox Roadmaps that they are planning to introduce pro-active notification of planned civil works.[257] However, not all Member States are planning to introduce this measure and timelines for implementation may slip. Moreover, in the absence of harmonised guidelines concerning the conditions for such co-ordination and in particular the allocation of cost, and given the existence of alternatives (such as BCRD PIA and SMP PIA), the take-up of civil works co-ordination under the status quo is expected to be limited. Some increased use of civil works co-ordination is expected under Option 3 as a result of the introduction of EU-level rules and improved transparency about planned civil works. Further use of civil works co-ordination is expected under Option 4 due to the extension of civil works co-ordination obligations to privately financed assets.

Impact of measures relating to non-network facilities

Some of the scenarios modelled in the WIK NGA model include the deployment of wireless infrastructure in combination with FTTH or on a standalone basis. We assume in the base case that the total investment requirement for a macrocell is around EUR110,000 and EUR34,000 for a small cell. These estimates are based on available literature concerning the costs for the different elements associated with deploying 5G wireless infrastructure. In a June 2020 research paper, drawing on case studies from the UK and Dutch markets[258] Li and Forzati estimate capex and opex associated with 5G macro cell upgrades and the deployment of 5G small cells. This reflects a total investment cost of EUR110,127.80 for a macrocell and around EUR50,000 on average for a small cell (assuming an equal proportion of urban and rural sites).[259] Our reduced estimate of EUR34,000 for a small cell,[260] takes into account the effects of Article 57 EECC which should lead to reductions in the cost for civil works on small cells due to the exclusion of small cells from permit requirements and improvements in access conditions resulting from Article 57(4) EECC.[261] Interviews in the German market conducted in the context of the preparation of regulatory cost models, suggest that the average investment required to deploy a microcell is EUR140,000 and small cell is EUR45,000, while a 2018 Accenture study puts the average deployment cost per small cell in the US at USD33,460 (around EUR28,850), of which as much as 29% (EUR8,366) was

256 Only three DSBs provided information on this point in the context of the questionnaire. Of these 3 only one reported any use of civil works co-ordination (Finland).

257 Pro-active notification of planned civil works is currently practiced in BE, BG, EE, FI, LV, MT, NL and SI, with partial implementation of this measure reported in PL, PT, DK, FR and SE. In addition concrete plans have been announced to introduce this measure in the context of the Connectivity Roadmap in CY (Q4 2023), CZ (2023), EL (Q4 2022), ES (2025), HE (2022), HU (2026), IT (2022), LT (Q2 2021). Discussions or plans without a concrete deadline have been reported in DE, IE, LU.

258 Oughton et al. 2019, https://www.researchgate.net/publication/330190823_ "Assessing_the_capacity_coverage_and_cost_of_5G_infrastructure_strategies_Analysis_of_The_Netherlands", Oughton et al. 2018, https://ideas.repec.org/a/eee/telpol/v42y2018i8p636-652.htm, "The cost, coverage and rollout implications of 5G infrastructure in Britain"

259 Depreciation period of 10 years and interest rate of 5% is assumed.

260 Average between the investment cost for a small urban cell at EUR39,826.07 and small rural at EUR28,243.47.

261 Specifically, in the base case, we assume that capex associated with small cell civil works would be EUR10,000 rather than the EUR15,000 assumed by Li et al (due to reduced need for greenfield deployment and reduced costs due to permit exemptions) and that the cost of renting small cell sites would be EUR3,500 in an urban area and EUR2,000 in a rural area as a result of the application of the "fair and reasonable pricing" obligation on public authorities under Article 57(4) EECC.

estimated as being associated with regulatory approvals.[262] Our estimate for the small cell cost lies between these two figures. We assume that the extension of PIA to cover public non-network facilities and the requirement for Member States to adopt permit granting exemptions at a national level under Option 2 could contribute to cost reductions for the installation of macrocells and small cells. Costs would be further reduced under Option 3 due to the adoption of EU-level rules concerning terms and conditions for PIA (including non-network facilities) and the introduction of further EU-level permit exemptions. Additional cost reductions could be achieved under Option 4 due to the extension of PIA to cover private non-network facilities.

Impact of measures relating to in-building physical infrastructure and wiring

Interviews suggest that the cost involved in deploying in-building infrastructure and in-building fibre could range from EUR100-EUR450 per premise in a greenfield scenario (with significant variations linked to the type of building (e.g. SDU vs MDU) as well as differences in labour costs across the EU). In the absence of widespread standards and enforcement for in-building infrastructure, the fact that in-building infrastructure will only apply to new buildings and major renovations, along with the fact that the BCRD refers only to "high-speed-ready" infrastructure (and not VHCN or FTTH-ready), we assume that only 10% of premises connected by ECN Operators will already contain suitable in-building infrastructure across the EU by 2030 in the base case. For those premises, we further assume, drawing on interviews conducted for this study that only a part of these dwellings also have suitable in-building fibre and the quality of in-building infrastructure may be variable (especially in the absence of standards), and thus that cost-reductions of 30% could be achieved in deploying in-building infrastructure compared with the absence of any in-building infrastructure. Some limited improvements to in-building infrastructure could be expected under Options 1 and 2 due to the updating of the objective for the BCRD, such that in-building infrastructure would be required to be "VHCN-ready" rather than "high-speed broadband" ready. Further significant reductions could be expected to the costs to ECN operators of deploying in-building infrastructure and wiring in new and renovated buildings under Options 3 and 4, because they would require the installation of in-building fibre in such buildings with associated standards. Option 3 is expected to deliver these benefits more quickly than option 4 (and thereby enable more new and renovated premises to be addressed) because it would rely on standards adopted at national level, rather than EU-level standards which may take more time to adopt and may require a further implementation step and potential changes to existing standards currently applied at national level. Options 3 and 4 could also increase the proportion of households for which savings can be achieved for ECN operators in the deployment of in-building infrastructure and wiring due to the introduction of EU-level rules and/or guidelines concerning access to in-building infrastructure, including infrastructure which may have been installed by ECN operators in buildings which are not new or renovated, or were constructed prior to the entry into force of the revised BCRD. The cost reductions estimated for in-building infrastructure and wiring reflect a balance between premises where ECN operators would not incur any costs because all costs would have been met by the building operator / tenant and premises where ECN operators would need to make a contribution to the cost (to another ECN operator), but cost reductions could be achieved by sharing this in-building infrastructure.

Impact of measures concerning overbuild

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[262] Accenture 2018 Impact of Federal Regulatory reviews on small cell deployment https://ecfsapi.fcc.gov/file/10313451806005/180313%20CTIA%20Accenture%20Report%20Small%20Cell%20Regulatory%20Review%20Costs.pdf

70% take-up of FTTH access lines is assumed by 2030. This relatively high figure reflects the fact that most of the lines that will be built between 2026 and 2030 will be in less dense areas where only one network is viable, and assumes gradually increasing rate of subscriptions to broadband as well as copper switch-off and transfer of existing broadband customers onto the new fibre network by 2030. Options 2-4 could potentially enable ECN operators deploying VHCN to achieve a higher take-up rate by restricting the potential for the BCRD to be used to overbuild VHCN. In the case of Option 2, this would be achieved by excluding assets hosting VHCN from PIA and civil works co-ordination obligations entirely, while under Options 3 and 4, this would be achieved in areas where network duplication is not viable through EU-level rules and guidelines and clarifications on the circumstances in which a request for civil works co-ordination may be rejected.

Impact of measures concerning permit granting and Rights of Way

The base case for fixed (FTTH) deployment assumes that FTTH deployment will proceed at the same pace as currently (with a linear trajectory) and that coverage will reach around 65% in 2025 and 90% of households by 2030.[263] As regards the timeframes for 5G deployment, available literature and experience with the deployment of previous generations of mobile technology, suggest a timeframe of around 5 years for the deployment of basic 5G (on lower frequencies),[264] with coverage expected to be largely complete by 2025/6.[265] As regards "full" 5G based on midband spectrum, deployments are not expected to begin in earnest until 2023, and the main deployment phase is expected to lie between 2025-2030.[266] For the purposes of the Impact

[263] These projections concerning FTTH coverage are consistent with projections made by Analysys Mason in June 2020 "Full fibre access as strategic infrastructure: strengthening public policy for Europe", and reflect the fact that while 8 Member States have already achieved fibre coverage levels of more than 70%, the current low EU average FTTH penetration levels (of around 42%) are influenced by a number of countries which have limited FTTH penetration today, but where incumbents and other investors have plans to increase this penetration within the coming years. For example, Deutsche Telekom plans to reach 10m homes with FTTP by 2024 (https://www.fiercetelecom.com/operators/deutsche-telekom-boosts-it-fiber-build-outs), and analysts predict that it will serve 60% of households by 2030, complementing coverage by other players in the German market, which would be likely to extend coverage further. Open Fiber has stated its intention to serve 19.5m households by 2024 (74% of the total households in Italy). Credit Suisse (https://www.sipotra.it/wp-content/uploads/2020/09/European-Fibre-Networks-V-Building-the-gigabit-society-%E2%80%93-incumbent-deployments-accelerating.pdf) also expects incumbents in Ireland, Italy, Belgium and the Netherlands and to expand their fibre coverage to more than 40% of households by 2024, while the French incumbent is expected to achieve FTTH coverage of more than 90% within this timeframe.

[264] Analysys Mason (2021) Costs and benefits of 5G geographical coverage in Europe https://www.analysysmason.com/consulting-redirect/reports/filling-europes-5g-coverage-gaps/) notes that there are likely to be successive phases in the deployment of 5G, as MNOs gradually expand capacity and upgrade the network to meet demand. Specifically, Analysys Mason expects deployment of 2.6GHz, 1400MHz and 2300MHz spectrum for 5G on a portion of existing sites (60% of sites, from different points in time in the network, starting with 2024 for 2.6GHz, then 2025 for 2300MHz and 2026 for 1400MHz). They note that they expect that deployment on these spectrum bands will be phased across 2-3 years from the initial date specified.

[265] See for example https://spectrummattersindeed.blogspot.com/2020/10/which-demand-curve-for-5g-3g-or-4g.html - citing JHA, Saha. This expectation is confirmed by a 2021 study for Ericsson and Qualcomm by Analysys Mason (https://www.analysysmason.com/consulting-redirect/reports/filling-europes-5g-coverage-gaps/) which suggests that 700MHz will be deployed across the entire grid in all countries by 2026, achieving more than 99% population coverage and more than 80% geographical coverage. They suggest that most of the costs for the deployment of enhanced mobile broadband (eMBB) will have been incurred by 2025/26.

[266] Based on feedback from interviews. See also Analysys Mason (2021) Costs and benefits of 5G geographical coverage in Europe https://www.analysysmason.com/consulting-redirect/reports/filling-europes-5g-coverage-gaps/. In the report, Analysys Mason notes that that under the base case, deployment of 5G based on 3.5GHz, is expected to be deployed on a commercial basis to sites in urban areas reaching 30-60% of the population (<10% of the geographic area). They additionally examine a scenario in which further sites are installed to expand 3.5GHz 5G coverage to address the use cases of agriculture, transport and suburban / rural FWA with deploying starting in 2025 and concluding in 2030. They assume a linear roll-out, which they consider is more realistic for rural areas, reflecting the use of public subsidies for these use cases.

Assessment, under the status quo, two deployment “waves” are expected for 5G, the first (between 2020-2025 in the shape of an “s” curve) resulting in relatively complete coverage of basic eMBB, and the second (a linear deployment between 2025-2030 involving significant expansion in the number of small cells) supporting rural coverage, transport and agriculture use cases. Ongoing upgrades to increase bandwidth and performance can be expected in between these periods.

Permits are assumed to be an important factor affecting the timeframe to deploy fixed and (to an even greater extent) wireless networks. Rights of Way and access negotiations can also add time to the deployment process. Stakeholders responding to the WIK ICF questionnaire report that the timeframes associated with obtaining the necessary sites and permissions for the deployment of wireless infrastructure can range from 4 months to as long as 2 years.[267] Option 1 is expected to lead to some limited time saving focused on wireless deployment, due to the clarification that all permits are within the scope of Article 7 of the BCRD.[268] Option 2 is expected to further accelerate deployment (in particular although not only) for wireless technologies as a result of provisions on non-network PIA, Rights of Way and permit granting exemptions at national level. Further acceleration is expected as a result of the strengthened permit granting provisions in Options 3 and 4 including digital permit granting platforms, the requirement for tacit approval (where possible), and permit exemptions at EU level.

Step 2 and 3: Estimation of cost reductions and coverage effects: The WIK NGA-Model

The WIK NGA model

The assumptions described in the previous chapter have been entered into the WIK-NGA model, which was developed to calculate investments, costs and profitability of FTTH deployment. Since WIK only have reliable data on the precise distribution of households and network architecture for Germany, detailed cost modelling was carried out for Germany and is then extrapolated to other countries in the EU, subject to adjustments to key parameters to reflect country-specific features, which are further described in the following sections.

The profitability of fibre optic roll-out depends to a large extent on the costs of the access network per subscriber and is therefore dependent on the number of households or connections per route kilometre. The costs (investments and operating costs) when combined with the revenues (calculated based on take-up and ARPUs) enable an assessment of the number of connections or the resulting market share that must be achieved in order to supply a given area with FTTH on an economically viable basis.

With the NGA cost model, the architecture of an FTTH-P2P (point-to-point)[269] access network was modelled. The model is based on extensive processing of spatial data[270] based on a scorched node approach. This means that the existing central office (HVT) locations (access points to the Telekom Germany copper network) are retained in Germany and will function as MPoP (Metropolitan Point

[267] Based on timeframes estimated by ECN operators operating wireless networks in France, Denmark and Austria in the context of their responses to the WIK ICF questionnaire 2021 and interviews.

[268] Interviews suggest that it is mostly wireless deployments that are subject to additional permissions that may not have been reflected in practice in national implementation of the BCRD

[269] Only the single-fiber variant of the FTTH network was modelled, as the most cost-effective architecture and do not represent a multi-fiber approach.

[270] At the end of this process there are geocoded data for HVt (main distributor), buildings, streets, etc., with which the WIK route optimization tool can be started.

of Presence) in a fiber optic world[271]. The Deutsche Telekom network architecture is thus used as a blueprint. The results are only intended as a guide, as network architectures and possible access points can differ depending on the operator.

Modelling approach

FTTH-P2P	In principle, fiber optic architectures can be distinguished in terms of the topology of the passive access network and the active network components that illuminate the fibers in the central office and at the end customer. On the one hand, there is point-to-point (point-to-point, P2P) topology, in which all households are connected to the central office, the MPoP, with their own fiber optics. As in the previous copper connection network, this line does not have to share with other connections. On the other hand, there is the so-called point-to-multipoint (point-to-multipoint, P2MP) topology, in which there is a dedicated line for each connection only on a section of the connection between the connection and MPoP. The traffic of the connections is concentrated at any point in between (the distribution point) and transmitted together on one fiber to the MPoP. In this study, only a point-to-point (point-to-point, P2P) topology is modelled because this is the most future-oriented connection technology on the market. The subscriber access network consists exclusively of a continuous fiber optic connection from the central optical distribution frame (ODF) at the Metropolitan Point of Presence (MPoP) to the end point.
Bottom-Up-Modelling	For the NGA model, investments that are necessary to set up and operate an FTTH network are determined bottom-up. In total, the costs for: the access network from the MPoP to the end customer, the active technology (in the MPoP and at the end customer), the concentration and core network. The model converts all investments into monthly cost values, taking into account the different lifetimes of assets and the weighted average cost of capital (WACC). This means that the costs already include an appropriate return on the capital employed. Operating costs are for the most part added to investment values by means of surcharges, but sometimes also explicitly calculated bottom-up (e.g. energy costs of active technology in the MPoP and square meter requirements of the MPoPs). Other items are included directly as costs and are not shown on the investment side (concentration and core network, sales). Overhead costs are included via a surcharge on investment and operating costs.
Steady State	The present model is based on a steady-state view, i.e. the gradual migration from copper to fiber optic access networks is not taken into account. A flat rate of 70% is assumed as the maximum addressable demand. This takes into account the fact that, on the one hand, in individual households only mobile phone services are used and, on the other hand, there are also households that do not want and request broadband access. The focus of the analysis is based on a medium to long-term competitive situation and the requirements for penetration and ARPU, which result from the cost structure of fiber optic networks.
ARPU	The profitability of the fiber optic roll-out is determined using the costs associated with the roll-out on the one hand and the expected income from

[271] Based on the geospatial data, for each MPoP, among other things, Data on the route lengths, the number of branching areas, the number of customers and buildings, as well as the subscriber density.

	realized services on the other. The monthly income assumed here (Average Revenue per User, ARPU) results proportionally from income for single play (VoIP), double play (VoIP and Internet data service) and triple play (VoIP, Internet, IPTV). Based on experience, we assume an average monthly ARPU of EUR38.18 for FTTH networks in Germany.
WACC	The WACC (Weighted Average Cost of Capital) is assumed to be 5.2% in the model. For the sensitivity analysis performed in this study, a more precise value is not needed, as only the relative delta results are considered.
Market Share	The maximum achievable demand per connection area is estimated at 70% of households for the status quo. For the remaining 30% of households per connection area, it is assumed, as already explained above, that they either use an alternative infrastructure provider, a mobile radio solution or are not interested in a broadband connection and therefore do not appear as a demand on the market.
In-house cabling	The model takes into account the installation of optical fibers within the building, the in-house cabling, as the costs of the optical fiber roll-out, which in the base scenario was assumed to be borne by the network operator, which is to be covered by the ARPU. They are only incurred when the first customer in the building has been acquired, and not already when an expansion area is being developed across the board. This parameterization of the model therefore reflects the worst case, which is economically less favourable for the network operator. If in-building infrastructure is available in the building, only cabling costs and potentially connectors and splices are required. In cases where there is no suitable in-building infrastructure including most existing buildings, the cable routing systems have to be retrofitted or the cables are laid directly (possibly under plaster or in suspended ceilings). In Europe, building infrastructures are often found on the outer wall (facade cabling (but also waste water)).
Cable laying	Civil engineering works generally make up the largest share of investments in the construction of a new network. For model results of high quality, it is therefore crucial to map this position as precisely as possible. Route lengths and prices for civil engineering and laying work, which represent relevant initial values for this, were included in the calculation of civil engineering investments. Expenses for branch sleeves, cable ducts and their average distance from one another are explicitly taken into account in the model as investment parameters. According to WIK's assessment, the determined price level as well as the structural parameters of the civil engineering installation differ from connection area to connection area. In sparsely populated areas, for example, the relative share of unpaved areas is higher, which lowers the average price per meter of laying compared to urban areas. It can also be assumed that there will be smaller cable ducts in rural areas, because the number of households and thus the number of fibers per km² will decrease here. The route lengths were determined in a route length determination model that uses an optimization algorithm. Along the course of the road, this algorithm determines the optimal route length between the building and the central office or cabinet or shaft. It also optimizes the bilateral and one-sided laying along the road. The consideration that the cheaper alternative is always laying on one side does not go far enough. For example, if there are buildings on both sides of the street, one-sided laying could be the more cost-intensive

	option, because here buildings on the other side of the street could only be connected with comparatively cost-intensive street crossings. Considerations like this make it clear with which accuracy route lengths were determined. The route lengths were determined individually for each connection area of the network, so that a total of around 1,500 iterative calculations were included in the parameterization. Each connection area is assigned to a cluster according to its connection density. Aerial cables are another option for fiber optic connections in buildings. Relatively low investments are associated with this type of laying, which is relevant from the network operator's point of view. The study therefore only takes into account the use of aerial cables for the fiber optic network in individual scenarios.
Variable Cost per Customer	In general, we assume that a network operator will roll-out a cluster to 100% of the addressable customers, because each of them could in principle be won as a customer and its connection should not be delayed by long-lasting construction work (100% homes passed). Nevertheless, there are also variable costs for connecting the individual customers. The network operator only provides active equipment for implemented and connected customers (e.g. the subscriber port in the Ethernet switch of the MPoP (FTTH) and the CPE). The model therefore treats expenses for this equipment as variable investments. The costs for in-house cabling are also variable in the case of FTTH. With FTTH, the model records optical distributors in the MPoP in such a way that each household is stored on ports on the household side. The ports pointing to the network side, however, grow with the number of actually implemented customers. If required, the operators install a port and a patch cable for each customer. The variable costs per customer differ depending on the architecture, but are low in comparison with the costs that the basic roll-out (homes passed) requires in the roll-out area.
Number of MPoP	For the entire access network of Germany we have mapped a number of 7896 MPoP and thus access areas, parametrized and calculated individually.
Cable sizes, conduits and cable trenches	In principle, a standard trench is provided that can accommodate up to eight cables in ducts. The standard assumption here is installation in empty ducts. If there is more demand, the model endogenously determines the corresponding extensions.
Greenfield- and Brownfield-Approach	The modelling takes place on the basis of a greenfield scenario in which all civil engineering work has to be carried out from new. Potentially existing, usable empty duct infrastructures to reach the access point are not taken into account or are rented at replacement costs. As part of a sensitivity analysis, we estimate the investment savings when using existing ducts and determine the impact on the costs of such a brownfield installation. The assumptions regarding duct and pole re-use in the status quo and alternative scenarios are described in more detail in the previous chapter.
5G Basestations	Normally the WIK NGA-Model is only used to calculate investment, cost and profitability for a fibre network serving households and business with access to broadband. But it is possible to additionally calculate fiber connections to basestations of a mobile network and take into account the cost for the basestation. Therefore the number and cost of basestations need to be estimated in parametrized in the model. For the estimation of cost for the basestations we have estimated the number of required “regular basestations” on one hand and for “small cells” on the other hand. With that we have performed a rough estimate of the mixed cost

per basestation.

"Regular basestations" are assumed to provide basic coverage of the whole area, while "small cells" are used to provide additionally needed capacity in residential areas. The number of "regular basestations" was estimated by the area to be covered and the covered area of one basestation based on the assumed frequency for the individual area. For more dense areas (<550 inhabitants per km² [urban]) we have assumed a covered radius of 0.7km per basestation. For medium dense areas (<2550 inhabitants per km² [suburban]) we have assumed a covered radius of 1.4km per basestation. For low density areas (>=2550 inhabitants per km² [rural]) we have assumed a covered radius of 3.5km per basestation. The number of "small cells" in addition to the "regular basestations" was estimated for the fraction of area with buildings by using different radii depending on the household density of the area.

Calculation of the Impact of Options for Germany

Four different Options in addition to the baseline have been defined in order to reflect the impact of combinations of measures. Option 0 is the baseline, while Options 1 to 4 consider different potential policy measures. Each of the Options 1 to 4 are compared against the base case of Option 0.

The impact of each of the 5 Options is assessed in the WIK NGA model for Germany in 3 different ways resulting in 15 calculations:

A) FTTH only scenario, not considering the 5G base stations and small cells

B) Combined scenario, considering 5G together with household coverage of FTTH

C) 5G only scenario in the absence of FTTH coverage

A summary of the results for Germany is provided in the following chart.

Germany		Users	Connections	Reduction of Invest	Increased Coverage %
No	Name	Subscribers	Passed		
1	Option0 FTTH only	households	44.213.737		
2	Option1 FTTH only	households	44.213.737	3%	2%
3	Option2 FTTH only	households	44.213.737	1%	6%
4	Option3 FTTH only	households	44.213.737	10%	12%
5	Option4 FTTH only	households	44.213.737	12%	13%
6	Option0 Combined	households + basestations	44.258.262		
7	Option1 Combined	households + basestations	44.258.262	3%	2%
8	Option2 Combined	households + basestations	44.258.262	1%	7%
9	Option3 Combined	households + basestations	44.258.262	10%	13%
10	Option4 Combined	households + basestations	44.258.262	12%	15%
11	Option0 5G only	basestations	44.525		
12	Option1 5G only	basestations	44.525	3%	1%
13	Option2 5G only	basestations	44.525	7%	7%
14	Option3 5G only	basestations	44.525	16%	14%
15	Option4 5G only	basestations	44.525	20%	17%

Extrapolation of model results to EU27

The model estimates the impacts on cost and potential increased VHCN deployment of the different policy options for all countries across the EU. Results for each country and each NUTS3 region within each country are available, but are to be characterised as estimates. **Germany has been used as a baseline** as the consultants had prepared cost models for the German regulatory authority and thus have extremely detailed and granular information about the costs of deployment in different areas and for different types of deployment (e.g. in ducts / aerial) – sufficient to support charge control calculations, and withstand a high degree of scrutiny on that basis.

The results from Germany are not merely assumed to apply to other countries (i.e., there is no simple extrapolation), but rather have been mapped so that **the modelling of costs in countries other than Germany reflects the types of areas present in each country** (by population density from dense urban to rural), **as well as differences in labour cost and WACC**, which are the main drivers of deployment cost. In addition, the model also considers the existing FTTH coverage in each NUTS3 area in each country, and calculates the additional cost required to achieve 90% FTTH coverage per country on that basis. The modelling assumes (reflecting the actual decision-drivers of ECN operators) that lowest cost premises will be deployed first leaving the least profitable 10% of households unserved under the baseline. All options include an assessment not only of the cost savings to serve 90% compared with the status quo, but also what percentage of households beyond the 90% could be additionally served by reinvesting those savings in additional VHCN coverage in the least profitable areas.

After the detailed calculations with the WIK NGA model were performed for all of the approx. 8000 access areas of Germany, the results were assigned to 8 regional cluster. Then for each of the 15 calculations estimation formulas were developed, based on household density to create country specific estimations for:

- Investment per household
- Cost per household
- WACC

During the application of the estimation formulas, the country specific labour cost was taken into account.

Regional Clusters

Depending on the household density [HH/km²] each German access area as well as each EU27 NUTS3 region can be assigned to one of the eight Regional Clusters:

Table 19: Regional Clusters

Regio-Cluster	Households/km²	
	min	max
1 Dense Urban	4000	∞
2 Urban	1600	4000
3 Less Urban	800	1600
4 Dense Suburban	470	800
5 Suburban	280	470
6 Less Suburban	150	280
7 Dense Rural	60	150
8 Rural	0	60

Source: support study

Investment

The estimation formula for Investment is developed for each of the 15 calculations. The formula estimates the investment per household [EUR/HH] per household density [HH/km²].

Cost

The estimation formula for Cost is developed for each of the 15 calculations. The formula estimates the Cost per household per month [EUR/HH] per household density [HH/km²].

WACC

In order to determine the country specific adaption of the WACC all of the 15 calculations have been again calculated with a different WACC within the WIK NGA model. The result is an individual slope of the linear relationship regarding the WACC. With this slope the extrapolated cost per household and month, based on the WACC for Germany, can be adapted to the country specific WACC.

Additional calculations

Additional calculations were performed to estimate the required investments to reach a coverage of 90% for FTTH under the 5 options (Option 0 to 4). Then based on this the saving of each of the Options (Option 1 to 4 compared to Option 0) was either used (re-invested) to build additional FTTH or used to build additional 5G FWA.

Total investments and subsidies to reach 90% FTTH coverage from current coverage

For this calculation, the investments per household, the cost per household and month and the subsidy need per household of the calculations performed for the option 0, called "status quo" (baseline) in the previous step were taken together with the current FTTH coverage of each of the NUTS3 regions to calculate the values for a desired coverage of 90%. As some of the NUTS3 regions already have a current coverage of 90% or even more, the starting point is not exactly 90%, but 90,6%.

For this calculation the number of missing households (from current coverage to coverage of 90%) was added to the number of already covered households and then set in ratio to all households of EU27.

FTTH coverage achievable if the savings are re-invested in more FTTH

For this calculation, the reduced cost linked to applying options 1 to 4 to the missing households was assessed. Then the savings due to the reduced cost by using the options was used to calculate the additional coverage which was possible with the savings. In this case the savings were re-invested in additional FTTH coverage of households.

Table 20: FTTH only

FTTH only				
Option 0	**Option 1**	**Option 2**	**Option 3**	**Option 4**
90,6%	91,6%	93,5%	96,5%	96,8%

Source: support study

FTTH and 5G FWA coverage if the savings are re-invested in 5G FWA

For this calculation, the reduced cost linked to applying options 1 to 4 to the missing households was assessed. Then the savings due to the reduced cost by using the options was used to calculate the additional coverage which was possible with the savings. In this case the savings were re-invested in additional coverage of households with 5G FWA.

Table 21: FTTH up to 90% coverage and then FWA

FTTH up to 90% coverage and then FWA				
Option 0	Option 1	Option 2	Option 3	Option 4
90,6%	97,0%	98,5%	99,1%	99,2%

Source: support study

Step 4a: Methodology for the estimation of GDP and employment impacts

Impact on GDP

There is widespread literature on the topic of economic impact of improved broadband quality in terms of GDP growth and job creation[272]. Literature suggest that the increased availability of VHCN that could be supported through the revision of the BCRD is likely to create positive spill-over effects as digitisation is used to improve energy efficiency in other highly polluting sectors such as buildings and transport. In addition, a key driver of economic benefits from 5G is expected to come from knock-on effects in other sectors resulting from 5G applications (including IoT), such as in healthcare, manufacturing, transport, energy or agriculture. However, these effects could not be quantitatively assessed.

Drawing on the literature, the support study assessed the economic impact based on a theory-based model estimating how expected increases in fixed and mobile speeds resulting from the different policy options for the revision of the BCRD might impact GDP. The modelling approach draws on the elasticities estimated respectively by the 2SLS model in Bohlin Rohman Kongaut (2017) for FTTH and Edquist *et al.* (2018)[273] for the impact of 5G. The main results of the contractor's theory-based modelling exercise are provided in this section.

[272] To cite some of them as referred to in the support study (WIK, Ecorys and VVA (2016) support for the Commission in the Impact Assessment for the Review of the EU framework for electronic communications SMART 2015/0005), one study of OECD countries dating from 2012 estimated that doubling the connection speed related to an additional 0.3 percentage points to annual GDP growth (Rohman, I.K. and E.Bohlin (2012), Does broadband speed really matter for driving economic growth? Investigating OECD countries, SSRN.2034284). WIK, together with Ecorys and VVA also identified a correlation between broadband speeds across the EU and Total Factor Productivity across a number of sectors in the context of a 2016 study supporting the Impact Assessment for the EU Electronic Communications Code, and concluded that if past relationships between broadband speed and GDP growth were to be replicated going forwards, an accelerated deployment of FTTP/B infrastructure which resulted in 55% of households using FTTP by 2025 could result in GDP levels 0.54% higher than the status quo (WIK, Ecorys and VVA (2016) support for the Commission in the Impact Assessment for the Review of the EU framework for electronic communications SMART 2015/0005). An OECD report which examined the effect of fibre networks in 290 municipalities in Sweden for the period 2010 – 2012 further found that on average 10% higher FTTP/FTTB penetration is correlated with a 1.1% higher employment rate, when controlling for other significant factors such as urbanisation level, population evolution, income, education level and business creation (Mölleryd, B. (2015), Development of High-speed Networks and the Role of Municipal Networks, OECD Science, Technology and Industry Policy Papers, No. 26, OECD Publishing, Paris). A European Commission (2016) Report estimated the cumulative 2021-2030 economic output of 5G at EUR 401 billion and 2.3 million jobs created within the EU 27 + UK area (European Commission Final Report "Support for the preparation of the impact assessment accompanying the review of the regulatory framework for e-communications", 2016, page 352).

[273] Edquist H., Goodridge P., Haskel J., Li X., Lindquist E., "How important are mobile broadband networks for the global economic development?", Stockholm, Sweden, 2018, page 18. Available at: https://www.sciencedirect.com/science/article/pii/S0167624517301695?casa_token=1bgDcPUBOz0AAAAA:l6bubQB3Xe9pmMyebwnRrc9jGZzW6L8dnejxrkfQ3EFQy0iqBiGxEyCSgfTr5UDJZG9M_ryOu_8.

In order to assess the impacts of the different options on GDP, the effects of each option on the potential increased deployment of FTTH and 5G were assessed, and these were transformed into projections concerning the evolution in the share of different technologies, which were then converted into average broadband speeds.

The theory-based model, used in the support study, was built on literature review to estimate how expected increases in fixed and mobile speeds resulting from the different policy options for the revision of the BCRD might impact GDP. The modelling approach incorporates the estimated elasticities estimated respectively by the 2SLS model in Bohlin Rohman Kongaut (2017) for FTTH and Edquist *et al.* (2018)[274] for the impact of 5G. TFP and employment enter the production function as input variables rather than outputs.

Edquist et al. (2018) found that a 1% increase in coverage results in 0.02% GDP growth per capita. The authors made use of data for 4G technology from the OECD countries panel. This means that the impact can be described by the following formula:

$$lnGDP_t = \beta_0 + \beta_1 * lnBB\ speed_t + \beta_2 * lnX_t + \mu_t$$

where $lnGDP_t$ is the GDP in year t in natural logarithm, $lnBB\ speed_t$ is the speed of broadband in year t in natural logarithm and X_t are a set of determinants of GDP variables such as productivity, employment, etc., in natural logarithms. As the variables in the equation are expressed in natural logarithms, β_1 can be understood as an elasticity as below:

$$Elasticity_{\frac{GDP}{BB}speed} = \frac{\%\Delta GDP}{\%\Delta BB\ speed}$$

Therefore, BB speed contributes to GDP growth. Projected increases in broadband download speeds arising from the different options were then converted to GDP impacts based on the equation above. Calculations were made for each year between 2020-2030 and the results are resented in the main report.

Impact on employment

Various studies have identified links between FTTH or faster broadband and employment.

An OECD report which examined the effect of fibre networks in 290 municipalities in Sweden for the period 2010 – 2012 further found that on average 10% higher FTTP/FTTB penetration is correlated with a 1.1% higher employment rate, when controlling for other significant factors such as urbanisation level, population evolution, income, education level and business creation.[275]

Using a two-way fixed effects regression model on a panel of 3,142 U.S. counties for the period 2001 – 2013, Lapointe (2015)276 shows that a 10% increase in the percentage of households with access to fibre (FTTP/B) network is associated with a 0.13% increase in total employment and a 0.1% increase in the number of firms at the county-level.

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[274] Edquist H., Goodridge P., Haskel J., Li X., Lindquist E., “How important are mobile broadband networks for the global economic development?”, Stockholm, Sweden, 2018, page 18. Available at: https://www.sciencedirect.com/science/article/pii/S0167624517301695?casa_token=1bgDcPUBOz0AAAAA:l6bubQB3Xe9pmMyebwnRrc9jGZzW6L8dnejxrkfQ3EFQy0iqBiGxEyCSgfTr5UDJZG9M_ryOu_8

[275] Mölleryd, B. (2015), Development of High-speed Networks and the Role of Municipal Networks, OECD Science, Technology and Industry Policy Papers, No. 26, OECD Publishing, Paris.

[276] Lapointe, P. (2015), Does speed matter? The employment impacts of increasing access to fiber Internet, Georgetown University.

Canada, Singer et al. (2015)[277] investigate the effect of FTTP rollout on employment on the basis of the deployment experiences in 39 regions between 2009 and 2014. They estimate that fibre deployment to 100% of a region is associated with an increase in employment of about 2.9% – even if the region already previously benefited from a broadband infrastructure.

Relying on panel data covering more than 36,000 municipalities located in metropolitan France over 6 years, from 2010 to 2015, Hasbi (2017) also observes a positive average effect on unemployment reduction resulting from the deployment of Next Generation Access Networks.[278]

As regards the effects of Gigabit speeds, utilizing a panel of 496 U.S. counties sampled from 2011 to 2014, Bai (2017)[279] found that increasing broadband speeds from 100 Mbit/s to 1 Gbit/s was more effective in boosting country employment than increasing speeds from 3 Mbit/s to 100 Mbit/s., Similar to the findings that GDP effects may be subject to diminishing marginal returns, Bai found that increasing broadband speeds beyond 1 Gbit/s would have a smaller, although still positive, effect on employment. However, it is also possible that new applications and the increased bandwidth requirements associated with teleworking in the wake of the COVID pandemic, might increase the employment effects and productivity gains[280] associated with speeds above 1Gbit/s.

A number of studies have been also completed in the last few years that include forecasts of the employment impact of 5G. Tech4i2 (2019) estimates for Switzerland that 5Genabled output will be supporting 137,000 jobs (1.5% of the population) in 2030.[281] Omdia (2019) forecasts a slightly more conservative net positive impact by 5G on employment of 0.6% of the population across five countries analysed by 2030.[282]

Research has started into the next generation of mobile technology 6G. However, it is not expected that this technology will be deployed until after 2030[283] beyond the timeframe covered by this study.

Theory-based modelling for the quantitative impacts

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277 Singer, H., Caves K. and A.Koyfman (2015) Economists Incorporated: The Empirical Link Between Fibre-to-the-Premises Deployment and Employment: A case study in Canada, Annex to the Petition to Vary TRP 2015-326, Bell Canada.

278 Hasbi, M. (2017), Impact of Very High-Speed Broadband on Local Economic Growth: Empirical Evidence. https://www.econstor.eu/bitstream/10419/168484/1/Hasbi.pdf.

279 Bai, Y. (2017), The faster, the better? The impact of Internet speed on employment, Information Economics and Policy, 40, 21-25.

280 Although it does not specifically look at ultrafast broadband, on the basis of survey data from 166 businesses in Wales, WERU (2017), Superfast broadband business exploitation project: Economic impact report, Cardiff University. argues that SMEs with superfast broadband are more likely to engage in innovation activity than standard broadband users. The report also finds that superfast broadband users tend to be characterised by higher labour productivity growth.

281 Tech4i2 (2019) 5G socio-economic impact in Switzerland, https://asut.ch/asut/media/id/1465/type/document/Study_Tech4i2_5G_socioeconomic_impact_switzerland_February_2019.pdf.

282 Omdia (2021), 5G Impact 2030, https://5glab.orange.com/wp-content/uploads/sites/37/2021/05/5g-impact-2030.pdf

283 See discussion and literature review in WIK (2019) Analysis of the Danish Telecommunication Market in 2030 https://www.wik.org/fileadmin/Studien/2020/Analysis_of_the_Danish_TK_Market_in_2030.pdf.

Drawing on the literature, a theory-based model to estimate how expected increases in fixed and mobile speeds resulting from the different policy options for the revision of the BCRD might impact GDP was developed as part of the support study. The modelling approach draws on the estimated elasticities estimated respectively by the 2SLS model in Bohlin Rohman Kongaut (2017) for FTTH and Edquist *et al.* (2018)[284] for the impact of 5G. TFP and employment enter the production function as input variables rather than outputs.

For the impact of increased fixed broadband speeds on GDP, two scenarios are considered:[285]

- **Scenario A**: All savings from infrastructure sharing and co-ordination of civil works is reinvested in additional FTTH coverage beyond the base case in which case FTTH coverage is assumed to reach 90% by 2030
- **Scenario B**: All savings from increased infrastructure sharing are reinvested in deploying 5G FWA in unserved areas (beyond the 90% coverage assumed in the base case scenario) rather than deploying FTTH or maintaining ADSL or FTTC/VDSL in those areas.

Accumulated impact (2021-2030) of FTTH on GDP (EUR billion)

Scenario	Option 0	Option 1	Option 2	Option 3	Option 4
A	2,835	2,852	2,876	2,911	2,915
B	2,835	2,847	2,846	2,845	2,845

Source: support study

Scenario A appears to have a greater GDP impact than scenario B across all policy options, suggesting that the impact of the increases in VHCN coverage that could be achieved by focused on 5G FWA rather than FTTH in rural areas are counteracted by the reduced speeds that would be achieved by serving rural customers with FWA instead of FTTH.[286] However, policy-makers might consider that equity-gains might exceed economic gains in the second scenario. More generally, there is an ongoing debate in the literature between an equity-efficiency trade-off considering that investing in rural areas would address the digital divide but at the expense of giving up efficiency gains. The theory of efficient markets indicates that resources should be allocated where the return on investment is maximized[287]. In contrast, investing in rural areas would improve digital equity by reducing such disparities. However, the final results on the GDP of both scenarios are uncertain given the number of factors intervening. For example, a lower digital divide could result in higher convergence of regional GDP where rural areas could catch up with a higher return on investment

[284] Edquist H., Goodridge P., Haskel J., Li X., Lindquist E., "How important are mobile broadband networks for the global economic development?", Stockholm, Sweden, 2018, page 18. Available at: https://www.sciencedirect.com/science/article/pii/S0167624517301695?casa_token=1bgDcPUBOz0AAAAA:l6bubQB3Xe9pmMyebwnRrc9jGZzW6L8dnejxrkfQ3EFQy0iqBiGxEyCSgfTr5UDJZG9M_ryOu_8.

[285] Mixed approaches whereby FTTH is deployed in some areas and 5G in others could also be envisaged, and would result in impacts in between those shown.

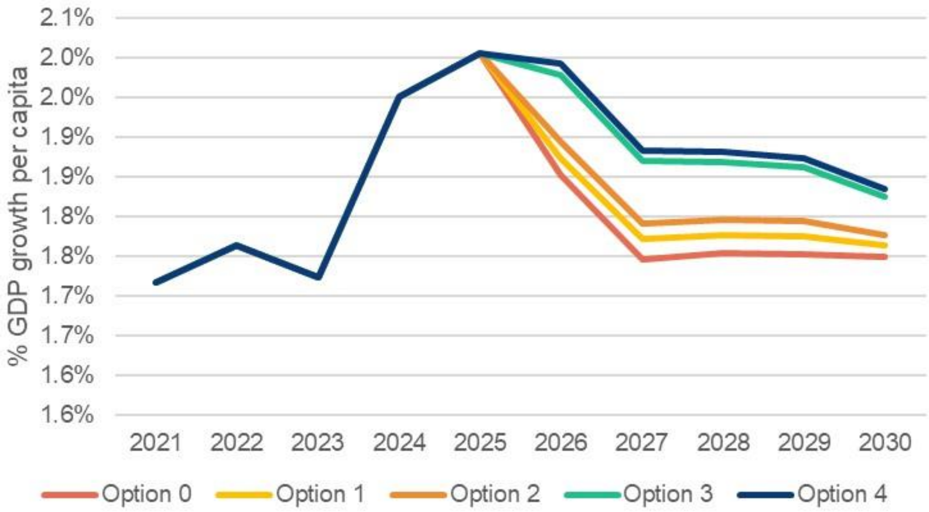
[286] The speed gap between FTTH and FWA offers is very significant in most cases. If speeds made available via FWA increase by more than expected the gap between the two scenarios could be less.

[287] Pereira J.P.R., 2016. Broadband Access and Digital Divide. In: Rocha Á., Correia A., Adeli H., Reis L., Mendonça Teixeira M. (eds) New Advances in Information Systems and Technologies. Advances in Intelligent Systems and Computing, vol 445. Springer, Cham. https://doi.org/10.1007/978-3-319-313078_38.

assuming that the stock of capital accumulation in these areas is lower than more mature urban areas where economic growth rates tend to be smaller[288]. In other words, while underdeveloped areas receive investment the growth is at a high speed and then as accumulation reaches its maximum rates tend to decrease.

The figure below shows the anticipated impact on GDP growth per capita of FTTH download speed over 10 years (2021-2030) for scenario A, based on the elasticity of GDP growth per capita – estimated at 0.08% GDP increase per each point of broadband speed by Bohlin Rohman Kongaut (2017). Such results are consistent with the literature, highlighting FTTH role in enhancing economic performance.

Scenario A - FTTH download speed impact on GDP growth



Source: support study

[288] Quah, D.T., 1996. Empirics for economic growth and convergence. European economic review, 40(6), pp.1353-1375.

The figure below shows the same for scenario B. The expected economic growth is a multiple of the FTTH download projections, that is, an elasticity coefficient multiplies the projected download speed. The GDP growth curve reflects the marginal increase in FTTH deployment (year on year). The series peak in 2025 reflects reduced marginal growth as deployment extends to areas which are more challenging and/or require State Aid. Prior to 2026, all policy options are aligned, as this represents the time period before the revised BCRD comes into effect.

Scenario B - download speed impact on GDP growth

Source: support study

Literature concerning the effects of FTTH deployment on jobs have varied outcomes, which may be associated with differences in the specific communities that they consider. If we take a midpoint between the effects described by Mölleryd, B. (2015),[289] and Lapointe (2015),[290] and assume that a 10% increase in FTTP/B penetration is associated with a 0.5% increase in employment, then the options described could have the following effects on jobs compared with the status quo.

Estimated effects of options on jobs[291]

	Option 1	Option 2	Option 3	Option 4
% increase compared with base case	0.0008%	0.0018%	0.0033%	0.0034%
Additional jobs	154,000	338,000	627,000	656,000

Source: support study

[289] Mölleryd, B. (2015), Development of High-speed Networks and the Role of Municipal Networks, OECD Science, Technology and Industry Policy Papers, No. 26, OECD Publishing, Paris.

[290] Lapointe, P. (2015), Does speed matter? The employment impacts of increasing access to fiber Internet, Georgetown University.

[291] Based on baseline EU employment figures as of Q1 2021 Eurostat, and the estimated increases in FTTP deployment that could be achieved if cost savings are reinvested in FTTP.

The impact of 5G on GDP

The estimated impact of 5G on GDP is obtained using the GDP-elasticity to mobile coverage broadband estimated by Edquist *et al*. (2018). The authors found that a 1% increase in coverage results in 0.02% GDP growth per capita. The authors made use of data for 4G technology from the OECD countries panel. Given the limited availability of quantitative studies on 5G related to the novelty of such technology, this study seems the most appropriate at the moment. However, it should be noted that relying on these results, presupposes that the positive GDP effects of speed increases associated with 4G will continue to apply as speeds increase further with increasing take-up of 5G. The annual change decreases in time as the projections assume a positive but decreasing growth rate.

The overall impact for the different options over the reference period is summarized in the table below. The results are consistent with the literature, including IHS Markit (2019)[292] which estimates an increment of EUR 13.5 trillion for global GDP and the Accenture report [293] which estimates an impact of EUR 1 trillion over the period 2021-2025 for the EU.

Cumulative 5G impact on GDP 2023-2030 (in EUR billion)

Option 0	Option 1	Option 2	Options 3	Option 4
2,060	2,064	2,075	2,089	2,089

Source: support study

Finally, the table below displays the overall increment to GDP resulting from increased fixed VHCN and 5G deployment compared with the baseline and distinguishing scenarios A and B for fixed network reinvestment.

Incremental impact options on GDP up to 2030 (billion EUR) for 5G and fixed VHCN

Scenario	Option 1	Option 2	Option 3	Option 4
5G + fixed VHCN (A)	21	56	105	109
5G + fixed VHCN (B)	16	26	39	39

Source: support study.

Although difficult to quantify, it is expected that there will be a spillover effect on different sectors of the economy from 5G and IoT. For example, new IoT applications in fields ranging from Connected Automotive Mobility, smart cities to smart factories, smart agriculture and smart grids, can impact productivity in those sectors and bring competitive advantages for business while also creating jobs. Such effects could have a multiplier effect with different rounds of impacts as discussed by the literature[294][295]. These possible 5G-specific effects have not been included in the

[292] IHS Markit "The 5G Economy: how 5G will contribute to the global economy." November 2019. page 20.

[293] Accenture "The Impact of 5G on the European Economy", February 2021.

[294] Prieger, J.E., 2020. An economic analysis of 5G wireless deployment: impact on the US and local economies.

[295] Fahn, M. and Yan, S., 2021, April. Analysis of the Impact of 5G Development on the Macroeconomy. In 2021 6th International Conference on Social Sciences and Economic Development (ICSSED 2021) (pp. 255-259). Atlantis Press.

calculations due to the significant uncertainties associated with measuring impacts of technologies that are not yet widely deployed and for which there is thus limited empirical evidence, but could provide an additional upside over the effects outlined in the study.

Step 4b: Methodology for the estimation of environmental impacts

In order to estimate the environmental impact of increased FTTH and full 5G coverage, we first derived estimates for increases in bandwidth consumption associated with the increased deployment and associated take-up of different technologies, as well as deriving (from the WIK NGA model) the total km of deployment conducted in new trenches vs deployment based on re-use of existing infrastructure and co-ordination of civil works. The bandwidth use per technology and degree of infrastructure sharing was then translated into environment impacts based on linkages identified in literature. The details are provided below.

Fixed broadband operation

To investigate the impact of the BCRD on the amount and timing of annual bandwidth consumption across wired access networks, utilize the findings by Oberman (Nachhaltigkeitsvergleich der Zugangsnetz-Technologien FTTC und FTTH, 2020). The electricity consumption across different types of access network technologies was investigated.

The improvement in energy efficiency is not explicitly included as the access network speeds have been assumed to increase. This leads to an electricity efficiency improvement of approximately 23% per year.

Based on the numbers (see [WIK IA Study]) we identify an electricity intensity of 0.26 kWh per GB in 2020 falling to 0.02 kWh/GB in 2030. This is not far from the figures used by Andrae & Edler (On Global Electricity Usage of Communication Technology: Trends to 2030, 2015) of 0.11-0.28 kWh/GB in 2020 and 0.061–0.17 kWh/GB in 2030. It is also well within the range identified by Coroama et al. (The energy intensity of the internet: home and access networks, 2015) 0.006-136 kWh/GB noting that these values represent different scopes and boundaries.

Estimating the emissions from the access network technologies, we account for the shift in electricity generation in the EU from fossil fuels to renewables. This has been done based on calculations made by Buck, et al., (European Energy Transition 2030: The Big Picture, 2019) showing decrease from 0.362 kg CO_2e per kWh in 2015 to 0.159 kg CO_2e per kWh. We assume a linear path from between the two years.

Fixed broadband deployment

In assessing the environmental impact of the BCRD across the different options, we have assessed the emissions associated with different types of fixed broadband deployment. Specifically, we assess conventional deployment, use of existing ducts and poles, and civil works coordination.

Solivan (Life Cycle Assessment on fiber cable construction methods, 2015) assessed the environmental impact associated with different deployment techniques. The share of trenching in greenfield is approximately 10-40%, hence we assume an average of 25%. With the remaining 75% being done in conventional excavation in asphalt.

In the case of use of existing ducts, Ecobilan (Developing a generic approach for FTTH solutions using LCA methodology, 2008) calculated the environmental impact associated with this. We use their results to estimate the emissions for use of existing ducts and for deployment on new poles.

No explicit data is available for use of existing poles, so we assume a similar emissions profile to ducts can be achieved.

The emissions figures used are summarized in Table 22.

Table 22: Emissions from deployment of fixed broadband

kg CO_2e	New ducts (25% greenfield)	Existing ducts & poles	Civil works coordination	New poles
Per 1km	5358	197	3555	3029

Source: support study

Mobile broadband operation

To investigate the impact of the BCRD on the amount and timing of annual bandwidth consumption across networks, we build upon the model developed by (Andrae & Edler, 2015). Here the electricity consumption for 4G (LTE) is found to be 0.6 kWh per GB in 2010 (Malmodin, Lundén, Moberg, Andersson, & Nilsson, 2014). As a best estimate the energy efficiency is assumed to improve by 22% annually until 2020 and 5% until 2030.

For 5G we refine the model to differentiate between basic 5G and full 5G. Laidler (Curtailing carbon emissions - can 5G help?, 2019) estimates that a 5G cell has 8-15% the electricity intensity compared to a like-for-like 4G cell. mmWave 5G has potential to fall to 1-2% of a 4G cell, we therefore estimate that midband (3.6 GHz) may be able to obtain electricity intensity of 6.5% of 4G using the midpoints. We therefore estimate the energy intensity of 5G to be:

Basic 5G: 0.069 kWh per GB

Full 5G: 0.025 kWh per GB

We also account for the shift in electricity generation in the EU from fossil fuels to renewables. This has been done based on calculations made by Buck, et al., (European Energy Transition 2030: The Big Picture, 2019) showing decrease from 0.362 kg CO_2e per kWh in 2015 to 0.159 kg CO_2e per kWh. We assume a linear path from between the two years.

ANNEX 6: ENVIRONMENTAL IMPACT (DETAILS)

This annex provide additional details, from the support study on the environmental impact of the policy options described in section 6.

Fixed broadband operation

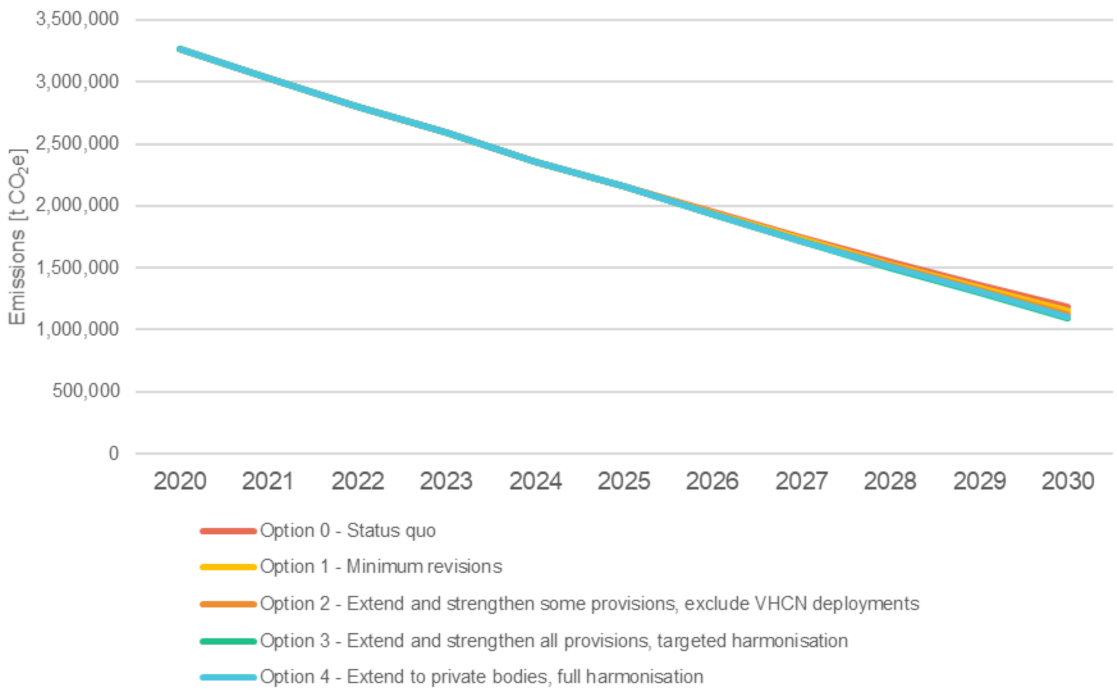
The results of the analysis in the support study show a significant reduction in electricity intensity for data traffic, kWh per GB. Across all the policy options it shows an average of 89% reduction from 2020 to 2030, with an electricity intensity that is 7% lower in policy option 3 compared to the Status Quo scenario.

The electricity intensity is estimated to be 0.22 kWh per GB in 2020 falling to 0.02 kWh/GB in 2030. This is not far from the figures used by Andrae & Edler[296]of 0.110.28 kWh/GB in 2020 and 0.061–0.17 kWh/GB in 2030. It is also well within the range identified by Coroama- et al.[297] 0.006-136 kWh/GB, noting that these values represent different scopes and boundaries.

The main driver of reduction in emissions from the Status Quo to Options 1-4 is the shift in subscribers from the less energy efficient ADSL, FTTC/VDSL and cable towards the more energy-efficient FTTH. Therefore options involving higher increases in FTTH result in lower overall emissions. The figure below maps the change in emissions across the policy options for the period of 2020-2030. As is clear from the graph the emissions are expected to be significantly less in 2030 compared to 2020. This is partly driven by the reduction in electricity consumption for the data traffic and partly by reduction in the emissions intensity of the electricity generation.

[296] Andrae & Edler (On Global Electricity Usage of Communication Technology: Trends to 2030, 2015)
[297] Coroama et al. (The energy intensity of the internet: home and access networks, 2015)

Figure 5: Fixed broadband network emissions 2020-2030



Source: support study

Fixed broadband deployment

Sharing infrastructure provides an opportunity not only to reduce costs but also to avoid a large amount of the environmental impact that otherwise would have been associated with creation and deployment of new infrastructure.

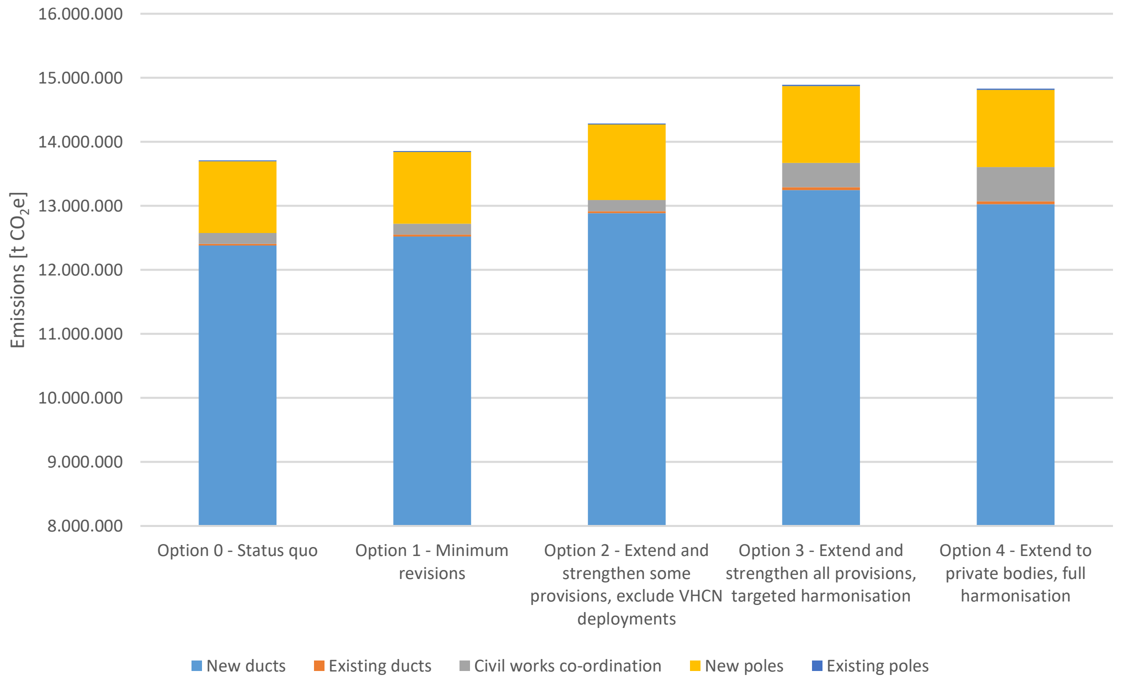
This is for example confirmed by Ecobilan[298] where blowing fibre between existing manholes has significantly lower impact compared to alternative deployments such as traditional civil works. This is mainly because restoring the affected surfaces is the largest driver of impact in deployment[299]. Therefore, where excavation of existing pavement can be avoided environmental impact is lowest.

Where sharing of existing infrastructure is not feasible, the choice of deployment technique can support in limiting environmental impacts of electronic networks. Based on Praticò et al.[300] road pavement has a carbon footprint of between 75 and 81.8 kg CO_2e per m^2. Micro trenching with a typical width of less than 25 mm[301] can therefore reduce the emissions from asphalt by up to 95% compared to conventional trenching with a width of 0.75 m, equivalent to over 50 tonnes CO_2e per km deployed. Where micro trenching may not be feasible, Narrow Trenching can still potentially achieve lower environmental impacts compared to the conventional excavation. Further reductions can be achieved if asphalt excavation can be avoided entirely such as through ploughing in a greenfield deployment[302].

The figure below illustrates the contribution of different deployment methods to the overall emissions. It is clear that conventional excavation accounts for the majority of emissions across all policy options (>90%). This is due to most new deployment happening in new ducts as well as conventional deployment having significantly higher (>30x) emissions per km. These are realistic assumptions for a new entrant deploying FTTH. However, there are scenarios under which emissions from deployment might be lower than shown. For example, infrastructure re-use could be higher if entrant operators are able to make significant use of SMP PIA in addition to PIA provided under the BCRD, or if a significant proportion of the new deployment is conducted by incumbent operators making use of their existing infrastructure. It should also be noted that it was assumed new ducts are excavated 75% in asphalt. If deployment is done in larger proportion in greenfield, the emissions would be lower.

[298] Ecobilan (Developing a generic approach for FTTH solutions using LCA methodology, 2008)
[299] Solivan (Life Cycle Assessment on fiber cable construction methods, 2015)
[300] Praticò et al. (Energy and Environmental Life Cycle Assessment of Sustainable Pavement Materials and Technologies for Urban Roads, 2020)
[301] Hashemian, Rezaei, & Bayat, 2017
[302] Solivan (Life Cycle Assessment on fiber cable construction methods, 2015)

Figure 6: Fixed broadband deployment emissions 2023-2030



Source: support study

Mobile / wireless broadband operation

The research in the support study suggest that the technological development across the mobile network generations show clear improvements in energy intensity for the data transferred. On an absolute level, however, this is counteracted by increases in traffic on the networks[303]. The growth in data traffic and which networks handles this traffic has a large influence on the energy consumption. However it is clear that introducing newer mobile network technologies and phasing out legacy systems appear to be an effective way to reduce energy consumption per unit of data and as a result environmental impact.

The support study has assessed total energy consumption of the access network based on number of total subscribers and data consumption over time across the different policy options[304].

Similar to the fixed broadband network, results show a significant reduction in electricity intensity for data traffic, kWh per GB. Across all the policy options it shows an average of over 93% reduction from 2020 to 2030. With an electricity intensity that is 2% lower in policy option 4 compared to the Status Quo scenario. This is reduction is due to assumed efficiency improvement as well as the shift of data traffic from LTE to 5G.[305]

The figure below maps the change in data consumption across the options (driven by the installation of more performant 5G technology) along with the associated change in emissions across the policy options for the period of 2023-2030. As is clear from the graph the emissions are expected to be significantly less in 2030 compared to 2023 even in the status quo. This is partly driven by the reduction in electricity consumption for the data traffic and partly by reduction in the emissions intensity of the electricity generation.

303 Bieser, et al.(2020). 5G networks in 2030 in Switzerland will lead to 11% higher GHG emissions than 2-4G networks in 2020. This driven by an increase in mobile data traffic of 650% despite an energy intensity decrease of 85%. Andrae & Edler (On Global Electricity Usage of Communication Technology: Trends to 2030, 2015), in their best estimate scenario found electricity consumption for wireless networks to double despite a growth in data traffic of over 550% from 2020 to 2030.

304 Electricity consumption was estimated based on the model developed by Andrae & Edler (On Global Electricity Usage of Communication Technology: Trends to 2030, 2015) and extended with data by Laidler (Curtailing carbon emissions - can 5G help?, 2019). Assessing the GHG emissions from the electricity, the electricity grid mix emissions were based on Buck, et al., (European Energy Transition 2030: The Big Picture, 2019).

305 The difference in emissions between the options is driven by total bandwidth consumption, as well as the split between usage of basic and full 5G over time. The savings from Option 2 are lower than the other options because it results in increased deployment of more energy efficient full 5G compared with Option 1, but without the additional acceleration effect of this deployment in Options 3 and 4, linked to improvements in access conditions and permit granting procedures.

Figure 7: Mobile / wireless broadband network emissions 2023 – 2030

	Baseline	Option 1	Option 2	Option 3	Option 4
Aggregate t CO_2e	4,015,672	4,015,268	4,015,587	4,014,551	4,014,551
Difference		-403	-85	-1,121	-1,121
Relative difference		-0.01%	0.00%	-0.03%	-0.03%

Source: support study

Mobile / wireless broadband deployment

Deployment of mobile networks will likely to contribute to GHG emissions and potentially other environmental impacts. However, the support study were not able to quantify the deployment-related impacts of the different options for mobile networks for a number of reasons. Firstly, it could be expected that certain options (in particular options 2-4) could accelerate mobile deployment, but in doing so would affect the timing of deployment compared with the status quo, rather than the extent of deployment. Thus, these options may only lead to a temporal shift in emissions. Secondly, literature on the environmental impact of 5G deployment is limited as this is still a developing field of research. Lastly, the majority of the impact of 5G deployments is expected to relate not to the towers, but to the deployment of backhaul. However, this is already captured within the assessment of the impact of fixed network deployment, and thus there would be a risk of double counting, if a separate mobile-specific analysis is performed.

Knock-on effects in other sectors

The knock-on effects that could arise from improved energy efficiency due to the accelerated deployment of 5G were not quantitatively assessed in the support study. However literature suggest that in addition to supporting the reduction of GHG emissions associated with ECN network deployment and operation, the increased availability of VHCN that could be supported through the revision of the BCRD is likely to create positive spill-over effects as digitisation is used to improve energy efficiency in other highly polluting sectors such as buildings and transport.

For example, a 2015 GeSi report on the carbon impact of mobile communications[306] argues that applications based on mobile communications can support a reduction in emissions which is approximately five times greater than the carbon emissions from mobile networks themselves. Specifically, the authors claim that mobile communications have enabled a reduction of 180 million tonnes of CO2e a year across the USA and Europe. They claim that 70% of these reductions have been driven by the use of machine-to-machine technologies in buildings, transport and the energy sector, where devices are able to communicate automatically with each other without requiring human intervention. In addition, the authors note that the use of smartphones has enabled behavioural changes in lifestyle and working, which contribute towards a further 20% decrease in emissions.

A similar finding is reported in a 2017 report by the IEA,[307] which examines the impact of digitalization on energy demand in transport, buildings and industry. The report also illustrates how digitalization has increased productivity in oil, gas, coal, and power supply. Bieser & Hilty[308] found 54 studies assessing indirect environmental effects of ICT. Most commonly the studies investigated “virtual mobility (e.g., telecommuting), virtual goods (e.g., digital media), and smart transport (e.g., route optimization)”.

[306] GeSi (2015) - GeSI Mobile Carbon Impact.

[307] IEA (2017) - Digitalization and Energy.

[308] Bieser & Hilty (Assessing Indirect Environmental Effects of Information and Communication Technology (ICT): A Systematic Literature Review, 2018)

ANNEX 7: POTENTIAL KEY PERFORMANCE INDICATORS (KPIS) FOR THE MONITORING SYSTEM

Table 23: Potential indicators

	Objective	Indicator	Definition	Type of indicator	Unit of measurement	Data source	Frequency of measurement	Baseline	Target 2030
Specific objectives	Reduced costs for fixed and mobile VHCN deployment	% cost reduction in VHCN deployment due to BCRD (separate fixed, mobile / wireless)	Perception of ECN operators concerning the cost reduction in VHCN deployment linked to the BCRD compared with the status quo	Qualitative	%	ECN operator survey (potentially complemented by results of theoretical model)	Every 3 years	Not available	10%
	Streamlined administrative procedures for network deployment	% administrative cost reductions linked to VHCN deployment due to BCRD	% reductions in FTE linked to administrative improvements in permit granting / access / transparency	Qualitative	%	ECN operator survey	Every 3 years	Not available	20%

	Objective	Indicator	Definition	Type of indicator	Unit of measurement	Data source	Frequency of measurement	Baseline	Target 2030
Operational objectives	Increased re-use of existing physical infrastructure	% network based on physical infrastructure re-use (separate ducts, poles)	% new underground and aerial network infrastructure (cables) deployed through re-use of existing physical infrastructure (excluding re-use based on SMP regulation)	Quantitative	km, %	MS questionnaire, ECN survey	Annual	Not available for most MS	28%
		Satisfaction with access to physical infrastructure for fixed deployment	ECN operator satisfaction with potential for access to physical infrastructure for fixed deployment (including backhaul) under new instrument	Qualitative	Ranking (-2 to +2)	ECN operator survey	Every 3 years	See evaluation report	1
		% new wireless sites based on access to public non-network infrastructure (separate macrocells, small cells - to be defined)	Proportion of sites newly deployed by ECN operators which make use of access to public non-network infrastructure	Quantitative	no. %	ECN operator survey	Annual	Not available	50% (for small cells)

	Objective	Indicator	Definition	Type of indicator	Unit of measurement	Data source	Frequency of measurement	Baseline	Target 2030
		Satisfaction with access to physical infrastructure for mobile network deployment	ECN operator satisfaction with potential for access to physical infrastructure for mobile deployment (active equipment) under new instrument	Qualitative	Ranking (-2 to +2)	ECN operator survey	Every 3 years	Not available	1
	Increased civil works co-ordination	% new network physical infrastructure deployed through civil works co-ordination	Proportion of physical infrastructure deployed in co-ordination with other ECN or other network operators	Quantitative	km, %	MS questionnaire, ECN survey	Annual	Not available for most MS	5%
		Satisfaction with civil works co-ordination	ECN operator satisfaction with potential for civil works co-ordination under new instrument	Qualitative	Ranking (-2 to +2)	ECN operator survey	Every 3 years	See evaluation report	1
	Increased availability and quality of information concerning existing infrastructure and planned civil works via the SIP	No. requests to the SIP for information about existing physical infrastructure (separate network physical infrastructure and	Record of the requests made for information about existing physical infrastructure on the SIP, as a measure of the quality / popularity / relevance of the SIP	Quantitative	No.	MS questionnaire	Annual	See evaluation report	nr

	Objective	Indicator	Definition	Type of indicator	Unit of measurement	Data source	Frequency of measurement	Baseline	Target 2030
		non-network physical infrastructure)							
		No. facilities relating to non-network public infrastructure reported on the SIP	Record of the amount of information gathered concerning non-network infrastructure, such as street furniture, rooftops, etc.	Quantitative	No.	MS questionnaire	Annual (3 yearly data gathering)	Not available	nr
		No. notifications concerning planned civil works	Record of the number of pro-active notifications concerning planned civil works	Quantitative	No.	MS questionnaire	Annual (3 yearly data gathering)	Not available	nr
		Satisfaction with transparency (separate network physical infrastructure, non-network physical infrastructure,	ECN operator satisfaction with availability of information on physical infrastructure and planned civil works under new instrument	Qualitative	Ranking (-2 to +2)	ECN operator survey	Every 3 years	See evaluation report	1

	Objective	Indicator	Definition	Type of indicator	Unit of measurement	Data source	Frequency of measurement	Baseline	Target 2030
		planned civil works)							
	Streamlined permit granting	% VHCN deployments not requiring a permit (separate mobile infrastructure, km fixed infrastructure / backhaul)	Assessment of scope of VHCN deployments which fall within permit exemptions	Qualitative	No. %	ECN operator survey	Every 3 years	Not available	25%
		Ave. and max. timeframe to receive all relevant permits (separate fixed and mobile deployments)	Assessment of absolute timeframes for permit delivery from the experience of ECN operators	Quantitative	Months	ECN operator survey	3 yearly	See evaluation report	Ave. below 4 months for fixed / mobile and in all MS. Maximum not above 6 months

	Objective	Indicator	Definition	Type of indicator	Unit of measurement	Data source	Frequency of measurement	Baseline	Target 2030
		% permits (incl RoW) delivered within 4 and 6 months (by tacit approval or otherwise)	Compliance with 4 month deadline as reported by MS	Quantitative	%	MS questionnaire	Annual (3 yearly data gathering)	Not available	90% permits delivered within 4 months
		Satisfaction with permit granting (i) timeframes; (ii) procedures; and (iii) fees	ECN operator satisfaction with permit granting	Qualitative	Ranking (-2 to +2)	ECN operator survey	3 yearly	See evaluation report	1
	All new and majorly renovated buildings to be equipped with in-building FTTH and wiring	% buildings FTTH-ready (including wiring)	% new and majorly renovated buildings equipped with fibre-ready infrastructure and wiring	Quantitative	%	MS questionnaire, ECN survey	Annual (3 yearly data gathering)	Not available	95% of new and majorly renovated buildings certified as FTTH-ready
		Satisfaction with (i) availability of in-building infrastructure and wiring; and (ii) access to in-building infrastructure and wiring	ECN operator satisfaction with in-building infrastructure	Qualitative	Ranking (-2 to +2)	ECN operator survey	3 yearly	See evaluation report	1

Source: support study

ANNEX 8: EVALUATION REPORT SWD

See separate document.