Reducing the Cloud: How can MNOs reduce their carbon emissions?

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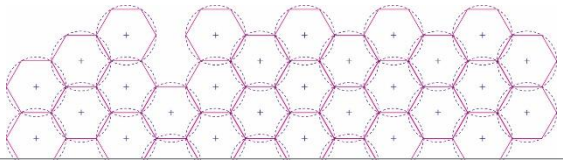


With a current worldwide focus on climate change and environmental impacts, the telecommunications sector is being asked to examine how it can reduce its emissions and be more environmentally responsible. This paper details the steps that mobile network operators (MNOs) will need to take in order to reduce their carbon emissions, and how they should assess the financial and environmental impact of possible policies before implementing them. The paper also suggests some options for governments and regulators to incentivise climate sensitive telecommunications policy. However, it is important that MNOs' emissions are considered in the wider context of the telecommunication industry, and the economy as a whole.

Climate change is one of the most pressing issues facing the world today, leading to catastrophes like glacier melts, wildfires, disastrous floods, and thunderstorms. A number of international conferences have been held, and treaties signed, in an attempt to avert this challenge. At the COP26 conference in Glasgow in 2021, the main goal was to secure a commitment to global net zero by 2050 and keep a maximum of 1.5°C of warming within reach[1]. Prior to this, the Paris Agreement (2015) was the first to set the target of global temperature rise to less than two degrees Celsius above pre-industrial levels by the year 2100[2].

Alongside these global agreements, Goal 13 of the UN SDGs (2030) seeks urgent action from countries to slow down climate change[3]. The EU Green Deal (2019) aims to have no net emissions in the EU region by 2050[4], and the European Climate Law aims to make the emissions target legally binding[5].

Against this background, it is vital that all industries consider how they are able to make a difference to their environmental impact. The telecommunications sector is no exception, and indeed it can provide tools that other industries can use to reduce their impacts.

Climate change and the role of the ICT sector

ICT sector plays a two-pronged role when it comes to climate change – it is a potential carbon emissions emitter, and a means to reduce emissions across all sectors.

To reduce emissions, the ICT sector can reduce the need for physical travel to work, and automate various business operations and supply chains for different industries. Further, smart meters help monitor real-time energy consumption and could induce behavioural changes to consume less energy.

On the flipside, policy makers should be cautious about any rise in the carbon footprint resulting from the sector. According to some estimates, digital technologies account for 4% of the global emissions[6]. A study by Belkhir & Elmeligi (2018)[7] estimated that the ICT sector could account for up to 14% of global emissions by 2040 if left unchecked, with 24% of that coming from communications networks alone.

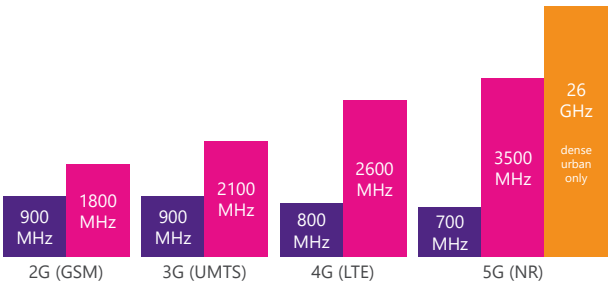
Small cells have an environmental impact

According to the most recent ITU data from 2020, the world's average mobile broadband penetration is 75.52% compared to fixed broadband penetration at only 16.89%[8]. This imbalance is particularly true in developing countries, which typically have no history of fixed networks and therefore no legacy network to build from.

Building on the existing ubiquity of mobile networks, the introduction of higher speed broadband technologies like 5G and potentially 6G in the future will require mobile networks to become denser, with an increased deployment of small cells which are needed to provide a consistent high quality of service. While an individual small cell is energy efficient by itself, the production and deployment of these cells in large numbers will necessarily increase the overall emissions of a mobile network. For example, in New York city alone it is estimated that at least 3,135,200 small cells will need to be deployed to support 5G services[9].

These small cells will be in addition to the current macro networks which support greater coverage. Indeed, when looking at a standard 5G network plan, there will be three layers of network to run (in low-band, mid-band and mmWave spectrum) simultaneously, all while still supporting UMTS and LTE networks for legacy users.

Figure 1: Illustrative relative base station requirements[10]



Denser broadband networks are therefore expected to have a higher carbon footprint, as well as requiring additional network infrastructure for legacy networks. It is unsurprising that the Radio Spectrum Policy Group (RSPG) notes that wired broadband technologies are likely to be more energy efficient in comparison to wireless technologies[11].

Some MNOs (especially in the European region) have already started to work on framing climate action plans. GSMA reports that 29 operator groups representing 30% of the mobile connections worldwide are committed to science-based reduction targets. For example, O2 UK has set a target of net-zero emissions by 2025[12], Orange aims to achieve 30% emissions reduction between 2015-2025.[13]

How to set MNO specific emission targets?

ITU-T study group 5[14] classifies the carbon emissions from the ICT sector into three categories, in common with UN classifications.

Scope 1: direct emissions from the company's own assets;

Scope 2: emissions related to the generation of electricity purchased by the company; and

Scope 3: supply chain emissions.

ITU-T L.1470 notes that ICT sector footprint is 80% dependent on the use of electricity and its carbon intensity[15], and therefore fits into Scope 2. As data on energy consumption is relatively easy to source, emission targets can be set accordingly.

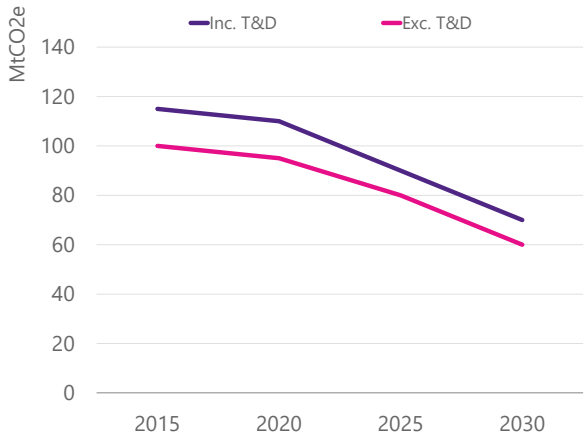
To set the targets, firstly the baseline emissions need to be calculated. This can be done by multiplying the units of electricity consumed with the grid emission factor to obtain a value of carbon emissions (CO2e). ITU-T study group 5 has researched and estimated these values based on world average emission factors as per the data reported by International Energy Agency (IEA).

The extent to which the operators can gather data on electricity on Scope 1, 2 and 3 would determine how comprehensive the emission target is. There are likely to be more gaps in the data on Scope 3 because of the vast multitude of mobile networks' supply chains. As such, there might be a need for the operators to work together with their suppliers to source data on the electricity they consume to allow for the development of a thorough estimate and emission target.

Once the base line is calculated, it can be projected forward to see the trend in the absence of any environment friendly intervention. This should then be compared with the emission trajectory targets set out by the ITU-T study group 5 in L.1470 (cited above) and succeeding studies for the mobile networks. These trajectories have been developed keeping in mind the IPCC target of keeping the global temperature rise to 1.5°C by 2100. These are mid-term (less than 15 years) targets with 20% reduction by 2025 and 50% by 2030. This would put the companies in a good spot to achieve net zero thereafter by 2050. Figure 2 lays out the expected carbon emission trajectories for mobile networks up to 2030 as in L.1470.

Comparing the projected no environmental intervention scenario with L.1470 targets, would provide the operator with a vision of 'what ought to be' in terms of the emissions and targets and as such allow them to formulate their specific targets in line with international expectations.

Figure 2: MNO carbon emissions trajectories[16]



Potential options to achieve reduction targets

The approach suggested above only focuses on emissions from electricity use in the mobile networks. In reality, mobile network operators should also be more ambitious and holistic in their outlook and include emissions due to manufacturing of equipment, network deployment, extraction of rare metals used, and associated transportation to mention. An often-used method to estimate carbon emissions for these sources is the Department for Business, Energy, and Industrial Strategy's (BEIS) carbon valuation guidance.[17]

To reduce Scope 3 emissions operators would need to work closely with their supply chain partners and urge them to take steps to reduce their emissions. Scope 2 emissions can be reduced by switching to renewable sources of electricity. A few options for MNOs to reduce Scope 1 emissions are better spectrum assignment, infrastructure sharing, decommissioning legacy networks, use of Software Defined Networks (SDN), and network virtualisation.

However, it is important to determine the overall net emissions impact of these options before implementing them. For example, while 5G technology is more advanced than previous mobile generations and would emit less per unit of data consumed, it would also result in consumption of more data because of availability of high bandwidth applications. This would increase the overall emissions from the 5G network. Further, as described previously, deploying 5G would require

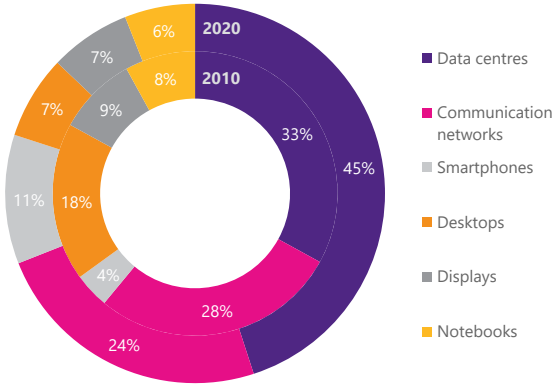
installation of additional infrastructure, all of which will have an environmental cost.

As such, it becomes important for an MNO to conduct an impact assessment of both environmental and financial aspects before undertaking any intervention to reduce its Scope 1 emissions. Figure 3 below highlights potential costs and benefits which an MNO would need to quantify to see the net impact of the proposed option in monetary terms. Carbon emissions can be monetised using BEIS's carbon valuation data tables (or international equivalents.

The sources of emissions

While it is important to consider how networks may be adapted to reduce the impacts on climate change, they are by no means the only contributor to emissions. Belkhir & Elmeligi (2018) highlight the contribution of the smartphones to the overall ICT footprint. They estimated it to grow from 4% (as a percentage of the overall ICT share) in 2010 to 11% by 2020, surpassing the individual contributions of other devices like laptops, desktops, and computer displays. This is partially explained by increasing energy efficiency and longer asset life for desktop machines, but it is linked to a generally increasing total emissions level from the industry.

Figure 4: Device carbon emissions share (2010, 2020)[18]



By far the largest contributor to emissions, and increasing in its importance, are data centres – with increased use of cloud computing and computationally-intensive applications, services

Figure 3: Carbon emissions reduction options potential costs and benefits

Options	Costs	Benefits
Switching to renewable sources of electricity	• Investment in new technology • Potential increase in electricity bills • Opportunity costs	• Any tax relief or subsidy • Reductions in carbon emissions and cost savings.
5G deployment	• New infrastructure investment • Opportunity costs	• Increased network capacity and QoS improvement • Potential increase in revenue due to provision of additional services • Reductions in carbon emissions and cost savings
Sustainable power solutions	• Replacement cost • New technology deployment • Opportunity costs	• Any tax relief or subsidy • Reductions in carbon emissions and cost savings
More spectrum deployment	• Spectrum fees • Investment in new technology • Fulfilling any roll-out obligations. • Opportunity costs	• Reduced cost of investment in additional physical infrastructure. • Other benefits are similar to as for 5G deployment
Infrastructure sharing	• Investment in new technology • Loss of service quality • Opportunity costs • Competition issues	• Similar to the spectrum deployment option
Decommissioning of legacy networks	• Technology replacement • Revenue loss from existing services • Transfer of existing services • Opportunity costs	• Potential increase in revenue from using the re-farmed spectrum to provide high bandwidth services • Increased network capacity and improved QoS • Reductions in carbon emissions and cost savings
Software Defined Networks, Network Virtualisation	• Cost of investment in new technology • Opportunity costs	• Network efficiency gains • Reduced cost of investment in additional physical infrastructure • Reductions in carbon emissions and cost savings

run over networks are becoming a much greater contributor to climate change. Anything that can be done to reduce these emissions – such as moving data centres to cooler climates to reduce air conditioning costs, or making use of more efficient quantum computing technologies, must be pursued.

This is important; despite the evidence that the environmental cost of networks themselves is increasing (as discussed above), this is still a decreasing proportion of total emissions. This analysis shows that while MNOs can and should do what they can to improve the environmental efficiency of their networks, there are other elements that need to be tackled as well – particularly on the services and content side of the industry.

Conclusions

MNOs should set emission reduction targets in line with the trajectories prescribed under ITU-L.1470, to contribute towards keeping the global temperature rise below 1.5°C by 2100. Their wide coverage and dense networks rightly make them a worthy candidate of taking a lead to de-carbonise within the ICT sector.

They should undertake a comprehensive assessment of the emissions reduction option to gauge, its financial viability and net environmental impact before implementing it.

Governments should support MNOs in greening their service provisions. This is likely to expedite the actions of the MNOs and also help in achieving the governments' environmental objectives. This should start with the telecommunications regulator and concerned government departments incorporating environmental responsibilities within its objectives, providing tax incentives or subsidies to adopt renewable sources of electricity, having disincentives like carbon tax in place and fostering debate. For example, ARCEP launched in 2020 an open platform on "digital technologies and environment"[19] to help identify and assess the drivers of ICT environmental footprint. At the time ARCEP also co-chaired a new group of experts dedicated to sustainability within BEREC (the body of European telecommunication regulators)[20]. France's commitment to environmental issues has led to ARCEP gaining powers to collect environmental data from market operators for use in regulation.

At the same time, regulators need to consider other polluters in the telecommunications industry and consider if there are grounds for intervention with other services. However, all regulation must be done with the knowledge that the industry has an important role in reducing environmental impact in other sectors, and so it is vital that any measures taken do not reduce the capability and prevalence of telecommunications services.

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[10] Source: Approximate analysis based on anonymised operator data. This should be taken as illustrative only.
[11] RSPG, 2021, RSPG Report on the role of radio spectrum policy to help combat climate change. Available at: https://rspg-spectrum.eu/wp-content/uploads/2021/06/RSPG21-026final_RSPG_Report_on_Climate_Change.pdf
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[16] Note: 'Inc. T&D' includes electricity emissions from transmission and distribution loss while 'Exc. T&D' exclude it.
[17] Department for Business, Energy& Industrial Strategy, Government of UK, October 2021, Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal. Available at:https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal
[18] Source: Belkhir & Elmeligi (2018)
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