GSMA Intelligence

RADAR

The sustainable telco

GSMA Intelligence

The GSMA is a global organisation unifying the mobile ecosystem to discover, develop and deliver innovation foundational to positive business environments and societal change. Our vision is to unlock the full power of connectivity so that people, industry, and society thrive. Representing mobile operators and organisations across the mobile ecosystem and adjacent industries, the GSMA delivers for its members across three broad pillars: Connectivity for Good, Industry Services and Solutions, and Outreach. This activity includes advancing policy, tackling today's biggest societal challenges, underpinning the technology and interoperability that make mobile work, and providing the world's largest platform to convene the mobile ecosystem at the MWC and M360 series of events.

We invite you to find out more at gsma.com

Follow the GSMA on Twitter: @GSMA

GSMA Intelligence is the definitive source of global mobile operator data, analysis and forecasts, and publisher of authoritative industry reports and research. Our data covers every operator group, network and MVNO in every country worldwide – from Afghanistan to Zimbabwe. It is the most accurate and complete set of industry metrics available, comprising tens of millions of individual data points, updated daily.

GSMA Intelligence is relied on by leading operators, vendors, regulators, financial institutions and third-party industry players, to support strategic decision-making and long-term investment planning. The data is used as an industry reference point and is frequently cited by the media and by the industry itself.

Our team of analysts and experts produce regular thought-leading research reports across a range of industry topics.

www.gsmaintelligence.com

info@gsmaintelligence.com

Published December 2021

Authors
Tim Hatt, Head of Research and Consulting
Peter Jarich, Head of GSMA Intelligence
Emanuel Kolta, Senior Analyst

This report was conducted by GSMA Intelligence and supported by Supermicro and Capgemini.

Contents

The bottom line

Climate-related activity in the telecoms sector has accelerated markedly over the last 18 months. The focus has been on improving network energy efficiency and instigating a broader culture change, elevating sustainability to a core plank of corporate strategy. While the industry has a favourable balance of energy usage in relation to GDP, consumption has nevertheless been on a sustained upward path in the smartphone era as people spend more time streaming video and digital media and network densification rises.

Energy costs now represent 20–40% of telecoms opex – and even higher in diesel-heavy markets in Southeast Asia and Africa. This trend will be exacerbated as 5G takes hold, with average data usage expected to rise 4× by 2025. Combined with the urgency of achieving CO_2 reductions to meet net zero deadlines and a confluence of pressure from investors, clients and consumers, the sector is in the midst of a large-scale paradigm shift towards fully committing to sustainable business practices. This report examines what this will look like and mean in practice.

Decarbonising telecoms' own house

The clear demand among telcos for energy-efficient solutions has invited a significant level of innovation among equipment vendors and others in the supply chain. One can think of these improvements as targeting different levels in a telecoms business:

- **Radio access network (RAN):** Accounting for 70% of energy consumption, the RAN is the largest source of electricity usage for operators – and the lowest hanging fruit. Generally, 'simplicity' has been the dominant development trend around the RAN, driven by the telco demand for lighter weight, shorter installation times, less energy usage and lower site rental costs. This includes the concept of 'zero touch provisioning', in which cloud-native RAN equipment is upgraded, set up and authenticated remotely, therefore saving on truck rolls and the human personnel that go with those. Network reconfiguration can happen with common, aggregated resources. More efficient batteries (lithium-ion) and cooling systems for passive infrastructure are also firmly in play.
- **Core networks and data centres:** Centralised structures, virtualisation and economies of scale, modular upgrades, and workload sharing all underpin a more energy-efficient layout and a decrease in power consumption, heat production and air conditioning.
- **Operations outside the network:** With the help of AI, operators can reduce the size of crews conducting drive tests of network performance and the associated fossil fuel and electricity costs. Incremental gains can also be achieved from lesser known but equally important touchpoints such as eco-SIM cards made from recycled plastic and handset trade-in schemes. Other incremental gains include the use of electric vehicles (EVs) and sustainable building/campus design with IoT-enabled heating and cooling systems.

Efforts over the last decade around software-defined networking have shifted network intelligence and control to the software layer – and indeed reshaped the telecoms infrastructure identity towards the cloud companies as much as traditional mobile networks. While the cost benefits from virtualisation are well established, there are also sustainability benefits. For one, older physical equipment does not need to be disposed of as quickly in cases where it can be upgraded via software in modular fashion. The decline of hardware-centric innovation also decreases the need for physical activity such as site visits, logistics, shipping, service and maintenance.

Finally, AI and machine learning (ML) are becoming key enablers to a ubiquitous system-level approach that improves energy efficiency across hardware and software. The optimism about AI's role in helping networks become more sustainable is clear: GSMA Intelligence survey data from operators across the world indicates that nearly 70% expect energy savings of over 10% from AI in the next two years. The cost-saving and agility benefits are apparent, so those that are not planning to use AI-driven energy management risk having a long-term competitive disadvantage.

The net effect is that 5G network design and linkage with cloud infrastructure is purpose-built to be the most environmentally friendly of any mobile technology so far.

Decarbonising other industries

For any country or company to get to net zero by 2050, reductions of 50% will be required in each successive decade leading up to that point. The decade to 2030 will be the toughest. With global CO_2 emissions now at approximately 53 gigatonnes (Gt) per year, the required cut this decade is around 27 Gt. Put in context, that is 27 billion tonnes of carbon, or 3 tonnes of CO_2 taken out of circulation for every person on earth by 2030.

To this end, beyond the investments operators make to improve the energy efficiency of their own mobile and fixed networks, a larger proportionate impact is available through the digitisation of other industries. This is premised on a so-called 'enablement effect', in which mobile connectivity, associated digital infrastructure and AI improve productivity in other industries an order of magnitude more than for the telecoms sector directly.

Our modelling suggests that mobile and digital technology could enable just under 40% of the required CO_2 reductions needed by 2030 within the top four largest-emitting industries. These four industries – manufacturing, power and energy, transport, and buildings – account for 80% of global emissions. Investment costs and integration complexities are the main headwinds. However, while the RoI to recoup upfront investments is likely to be realised over a longer-term horizon (5–10 years), this must be considered against the productivity and environmental benefits that accrue indefinitely.

Supply-chain partnerships – below the tip of the iceberg

While the reporting of supply-chain emissions is patchy, estimates suggest that they represent the biggest share of most companies' carbon footprint, at over 70%. In other words, this means that efforts to create a greener telco supply chain promise to deliver proportionately larger impacts. Mobile devices have so far been the largest target because they are the primary conduit to telco services, have high shipment volumes and are the focus of much consumer marketing efforts. Device energy efficiency, recycling and sustainable manufacturing practices have emerged as key purchasing criteria for handset buyers beyond traditional performance attributes. The next phase of supply-chain alignment is likely to extend to network equipment suppliers through a combination of direct mandates (i.e. requirements in RFP processes), best practice sharing, reporting alignment and overall shifts towards a circular economy. The good news is that we're already seeing movement in this direction.

As consumers increasingly prioritise activities that have a positive impact on the environment, it's only natural for operators to prioritise activities that resonate with them. But with less visible supply-chain components – such as manufacturing and production – constituting the most significant source of supply chain-related emissions, operators will eventually need to focus their efforts accordingly and educate consumers on the 'why' behind their efforts – which ultimately comes down to sustainability being a core part of good business from now on.

SUPERMICRO

Performance Begins Now

Better. Faster. Greener.

Accelerating Innovation from Edge to Cloud
Featuring 3rd Gen Intel® Xeon® Scalable processors

intel XEON PLATINUM

Learn More at www.supermicro.com

SUPERMICRO

1

A low-carbon future is the only future

Climate-related activity in the telecoms sector has accelerated markedly over the last 18 months. The focus has been on two main areas: improving network energy efficiency and a broader culture change to make sustainability a core plank of corporate strategy. These changes are being driven by the global fight against climate change – with COP26 in Glasgow providing a crucial staging ground – and persistent cost structure pressures associated with rising data traffic and a low revenue growth environment.

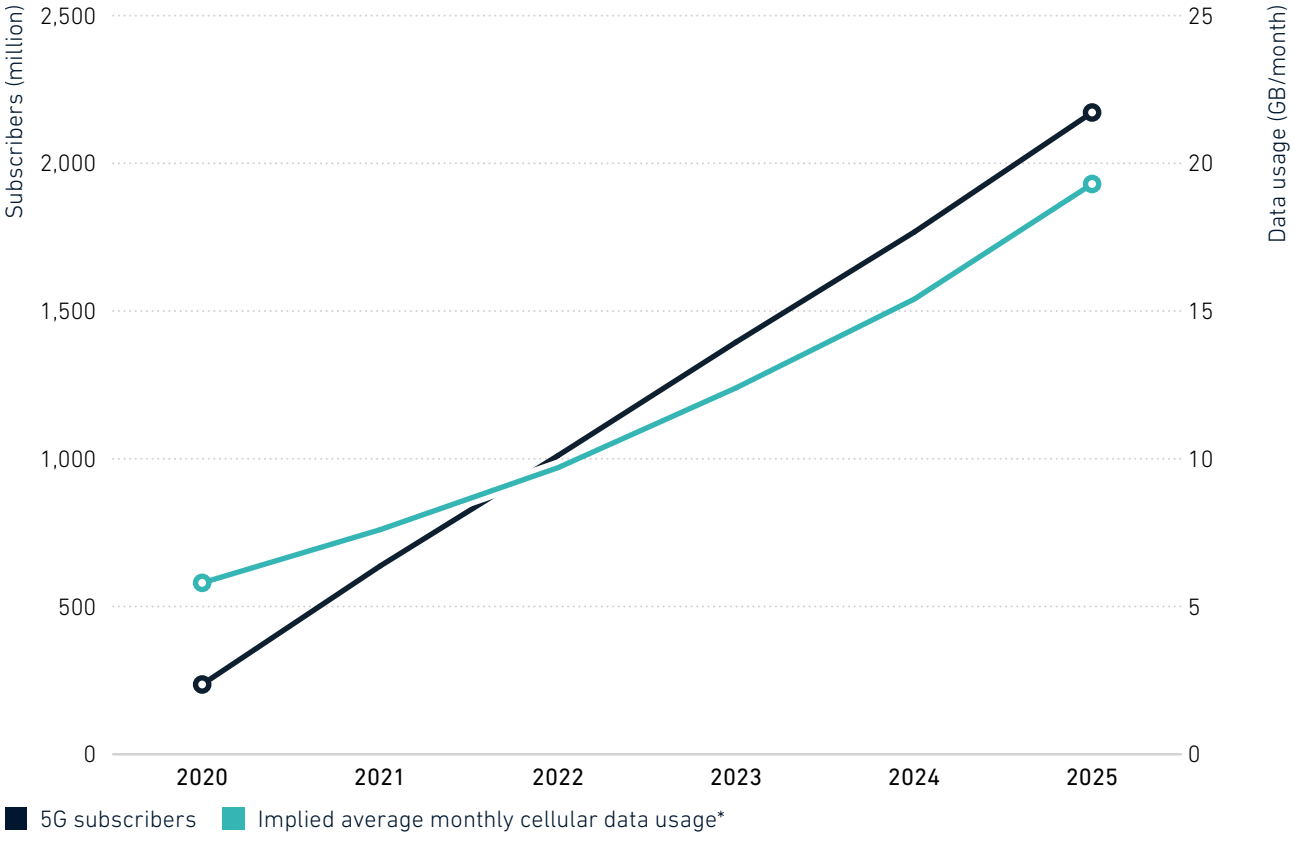
Climate, costs and investment pressures are driving the decarbonisation story

The telecoms sector has a relatively favourable balance on energy relative to GDP. Our analysis suggests mobile and fixed networks account directly for around 0.6% of global electricity consumption against 2–3% of GDP. However, energy consumption has been on a sustained upward path in the smartphone era as people spend increasingly more time streaming video and digital media and network densification rises. Energy costs represent 20–40% of telecoms opex – and even higher in diesel-heavy markets in Southeast Asia and Africa. Combined with the heavy capex required to build out new 5G networks and maintain existing LTE ones, energy rates have been one of the proximate reasons for the pressure on free cash flows in the last five years. This is supported by our recent survey of mobile operators,[1] with 92% of operators rating energy efficiency and sustainability as a very or extremely important factor in their network transformation plans, meaning they are effectively seen as a hygiene factor, alongside security and reliability, and more important than technical gains such as edge compute.

This view will be strengthened as 5G takes hold. The number of 5G mobile subscribers will reach 2 billion, or 25% of the global customer base, by 2025 and the consequential effect on data traffic will be significant. Adjusting cellular data traffic forecasts from Ericsson to a per customer level, the implied data usage for the average mobile subscriber is projected to increase almost 4× to around 20 GB/month by 2025 (see Figure 1). It is worth emphasising that this is an average across the global customer base, so data usage per month would be much higher for LTE and 5G, the latter being nearer to 40 GB/month.

Figure 1

The rising number of 5G customers will drive up average data usage by almost four times



* Weighted average of all customers (2G, 3G, LTE and 5G)
Source: GSMA Intelligence

1 Network Transformation 2021, GSMA Intelligence, 2021

In addition to network costs, there are other factors influencing the recalibration of telco operations and supply-chain activity in the shift to sustainability:

- **ESG[2] pressures from investors:** While sustainability priorities used to be the preserve of a small minority of activist shareholders, most major institutional investors now offer dedicated ESG funds or place ESG criteria within other funds such that constituent holdings (telcos included) must conform to a given standard for inclusion. Combined with ESG targets now being part of CEO and executive compensation packages, there is a direct incentive for management to deliver on committed targets.
- **Pressures from enterprise clients for sustainable tech (information technology and operational technology):** Perhaps less appreciated is the influence and purchasing power of corporate and enterprise-sector clients of telecoms operators. Manufacturing groups such as Bosch and Siemens are, for example, among the leaders investing in digitisation to improve productivity and lower energy consumption. Their effect on telcos can be direct through issuing green pre-conditions for contract awards (such as for supplying 5G connectivity to a factory or warehouse) or indirect via joint ventures and partnerships. BT's partnership with Bosch (Worcester, UK) and Vodafone's collaboration with Lufthansa to supply private network services for aircraft inspection in Germany are two examples among many. Partnerships are also being formed in other sectors, including transportation, power and utilities (especially solar and wind grid operators), and commercial office buildings.
- **Societal and consumer values:** As climate action has risen up the political agenda and the public consciousness, being seen to be in step has become an important aspect of brand power, particularly among the millennial demographic, whose priorities extend well beyond price and value to ethics, provenance and sustainability. Capgemini research suggests 80% of consumers are altering their purchases based on these factors – presenting a yawning gap with the small share of companies that believe consumers are willing to vote with their wallet. As household brands on the receiving end of substantial consumer discretionary spend, mobile operators are among the companies for whom this matters most.

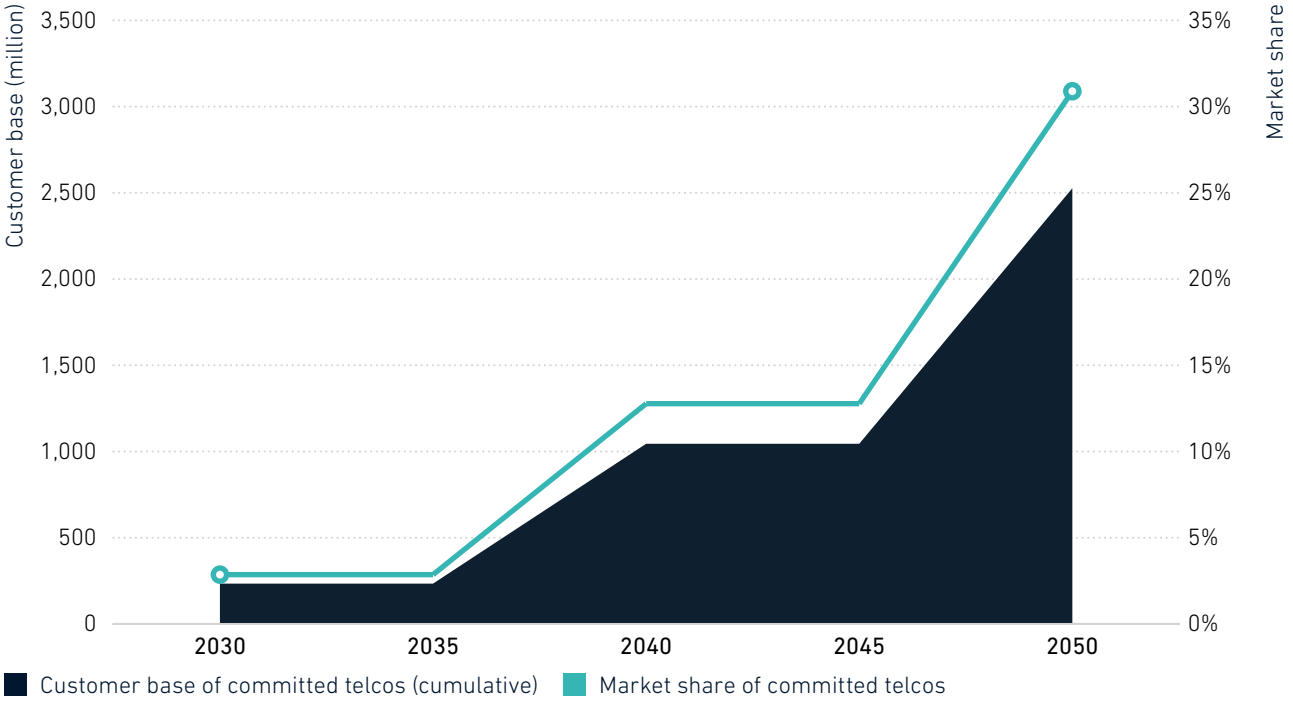
Walking the walk

On the axiom that credibility is earned through action, focus is now shifting from the act of setting CO_2 reduction targets to reporting progress on them (see Chapter 3 for more details). Net zero commitments have been made by telcos that together cover one third of global market share, although we expect this proportion to rise in the coming months in the wake of COP26 (see Figure 2).[3] The majority of commitments are for 2050, implying the need for CO_2 reductions of 50% in each successive decade until then. Some groups have set even more ambitious targets, including Vodafone (2040), Verizon (2040), Telefónica (2030) and Telia (2030), enabled by a rapid substitution of renewable energy in place of fossil fuels, especially in Europe. In general, the rest of the industry have only expressed their intent to make commitments (it takes time to formulate a carbon strategy), with most expected to eventually adopt a 2050 target in line with the Paris Agreement. But there remain pockets where commitments extend beyond 2050 (e.g. China) or are non-existent.

2 Environmental, social and governance (ESG) refers to a catchment of themes under the banner of socially responsible investing where institutional investors determine asset allocation on the basis of criteria related to these topics.
3 See also Mobile Net Zero, GSMA, 2021

Figure 2

A third of the global telecoms sector by market share (covering 2.5 billion subscribers) has public net zero targets



Source: GSMA

Within the context of energy efficiency and net zero strategies, it is important to understand how CO_2 emissions are categorised:

- **Scope 1: CO_2 emissions that result directly from a company's own operations.** For mobile operators, the vast majority (90%) of these emissions come from the network and owned data centres, with the rest arising from the power needed to run campuses. For manufacturing companies, scope 1 would include factory operations, while for oil and gas it would primarily be comprised of energy extraction and refinement.
- **Scope 2: CO_2 emissions that result indirectly from the purchase of electricity used to run a company's business.** While not emitted from a company's premises – rather, from an electricity grid – these count towards a company's overall carbon footprint because the company is the demand source.
- **Scope 3: CO_2 emissions associated with the supply chain and consumer use of products and services made by a given organisation.** Scope 3 emissions are the largest slice of the pie and also the most difficult to mitigate because they require coordination on emissions reduction strategies with suppliers and distribution partners and, harder still, changes in consumer behaviour.

The relative share of scope 1, 2 and 3 emissions will differ for each industry and reliable estimates are hampered by a lack of reporting. This is particularly the case for scope 3 given the complexities in collating the data in line with internationally recognised frameworks such as the GHG corporate protocol and Science Based Targets Initiative (SBTi). The MSCI index is, however, a reasonable barometer, reporting a split of 10% scope 1, 15% scope 2 and 75% scope 3 from 2020 as an average across a selection of industries (see Chapter 4 on supply chains).

Our focus in this report is primarily on scope 1 and 3 for the telecoms sector and its supply-chain partners. In Chapter 2, we provide an analysis of network innovation kit and implementation strategies to improve energy efficiency. In Chapters 3 and 4, we look at the enablement effect of connectivity and IoT on vertical sector industries, supply-chain partnerships and the circular economy to help address scope 3 emissions.

2

Telco network green innovation

Network infrastructure energy efficiency is a big deal for operators. While the direct operations of telcos account for only 10% of their carbon footprint, an outsized proportion of their focus is placed on network energy efficiency. Networks represent 90% of energy consumption; more importantly, they are something telcos can visibly exert influence on.

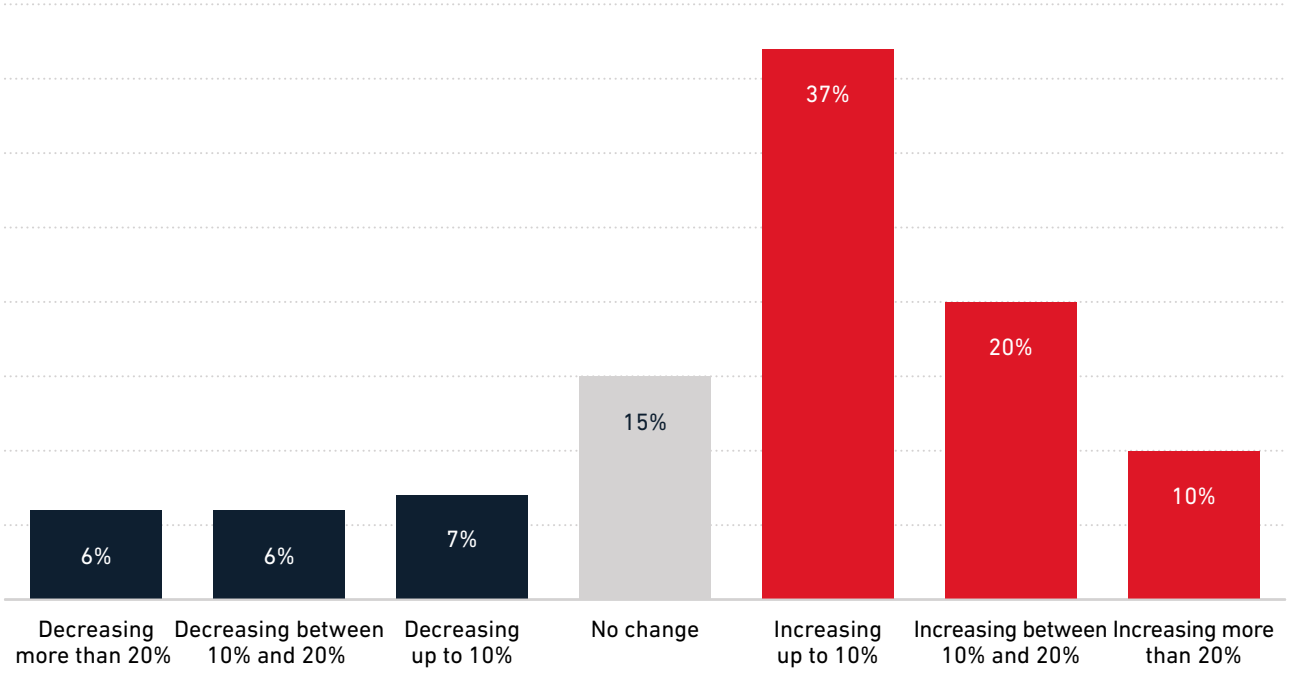
A wide range of innovation areas can help improve energy efficiency in mobile networks. Beyond the progress around dozens of various energy-management-related subtopics, there has also been a broader paradigm shift concerning the importance of cloudification and virtualisation for energy efficiency and sustainability. Holistic end-to-end solutions are therefore placing energy management and sustainability as foundations in the age of 5G, software-led innovation and AI.

The importance of network energy efficiency is gaining momentum

Energy usage for mobile operators has become an urgent issue as 5G has scaled. Despite 5G being more energy efficient per gigabyte than previous mobile technologies, increasing network usage, new 5G use cases and power-hungry active antennas can outweigh these efficiencies. New business cases, the spread of private networks, and additional network functions and complexity are also expected to raise the importance of energy management for mobile operators. This is reflected in our survey data, in which nearly 70% of operators said they expected energy costs to rise over the next three years (see Figure 3). Meanwhile, over 90% rated energy efficiency and sustainability as an important priority in their network transformation strategy.

Figure 3

How do you expect your network energy costs to change in the next three years?
Percentage of operators



Source: GSMA Intelligence AI and Energy Efficiency Survey 2021

Where and how do operators consume energy?

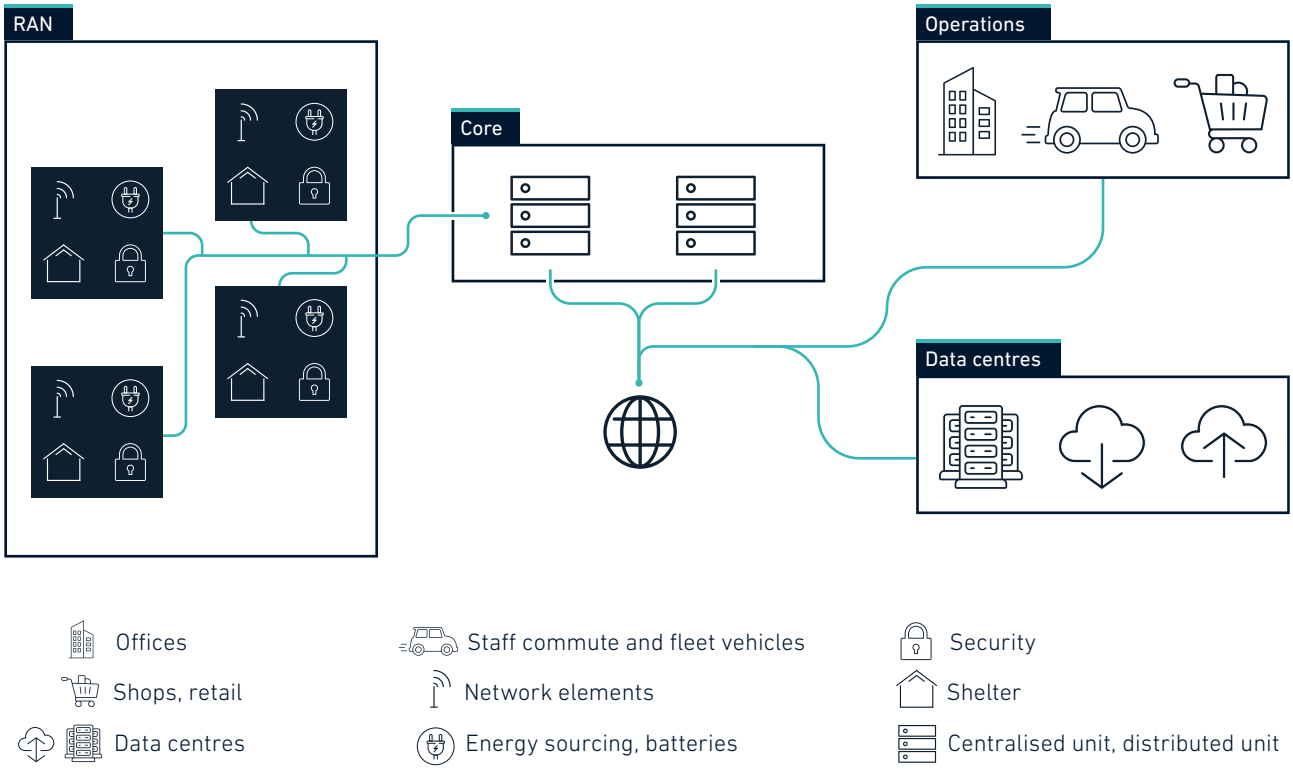
Mobile operators consume energy in a unique way: the energy consumption is geographically diverse because of the scattered distribution of base stations; demand for digital services varies dynamically every hour; rural coverage is nuanced; and core network nodes are not always situated near end users. Besides these spatial and temporal factors, the number of customer connections is generally increasing and operators need to satisfy exponentially increasing data traffic demand.

The constantly changing environment, including consumer habits and new network technologies, is further increasing complexity. Although every mobile network is different, the direct energy consumption of operators can be categorised into four main groups:

- **RAN energy consumption:** This includes energy consumed by base transceiver stations, radios and supporting equipment (NodeB and eNodeB for LTE, and gNodeB for 5G), as well as baseband energy usage. It also includes all associated infrastructure energy usage such as from air conditioning, inverters, rectifiers, repeaters and backhaul transport.
- **Core energy consumption:** This includes power for core network functions such as subscriber authentication and call switching, and all associated infrastructure energy usage such as cooling. It excludes energy usage from BSS and OSS.
- **Data centre energy consumption:** Data centres are the physical sites that host operators' IT, including OSS, BSS and intranet infrastructure. Increasingly, these also handle telco network functions in the RAN and core as virtualisation and cloudification takes hold. Our quantification only includes data centres wholly owned by operators (9% of mobile network energy consumption), although many groups lease significant capacity on the public cloud from AWS, Microsoft and others, meaning the overall share of power consumption is higher.
- **Other operations:** This includes energy consumed by the mobile operator for its own operations, including offices, shops, retail activity and fleets/ logistics.

Figure 4

Energy use by mobile operators



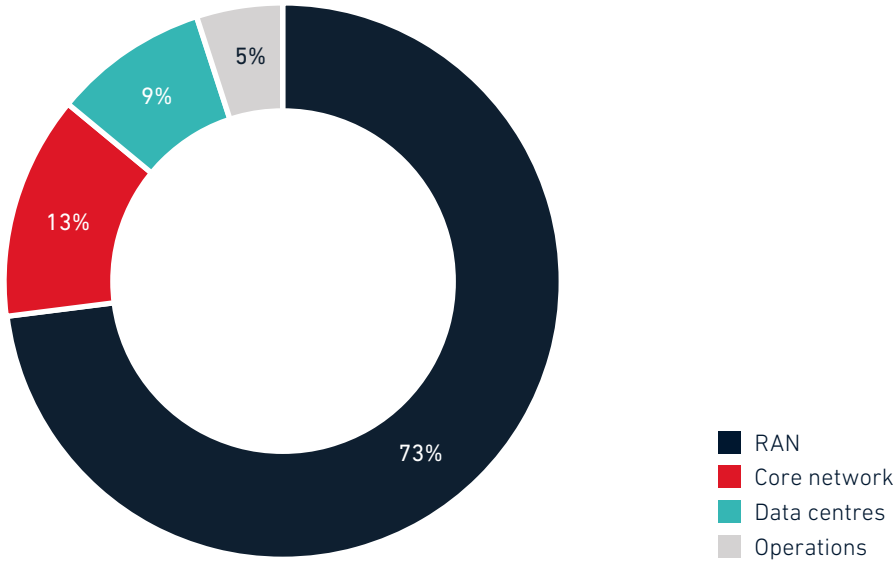
Source: GSMA Intelligence

The RAN is by far the main source of energy consumption in a mobile network, accounting for around 70% of the total. For this reason, the RAN is the easiest target for innovation. The energy use of base stations can also be split into active and passive parts.

Active infrastructure is the core element of the wireless communication: network elements that receive and transmit radio signals. Passive infrastructure includes supporting buildings, cooling and heating, security, back-up generation, and other supporting technical premises.

Figure 5

Distribution of energy use by mobile operators[4]



Source: GSMA Intelligence N = 31 telecoms operating companies

Network-level innovations and strategies: mapping the course

The fragmentation and diversity in operators' energy use and the increasing appetite for energy-efficient solutions have fuelled significant innovation among equipment vendors. We have mapped these innovations to each category of operators' energy consumption (as previously outlined in Figure 4).

Lean and simplified – RAN

Generally, 'simplicity' has been the dominant development trend around the RAN. This is driven by telco demand for lighter weight, shorter installation times, less energy usage and lower site rental costs. Decreasing the number of onsite cabinets, using multi-band and multi-generational equipment, and placing everything into one single mast can all help reduce the carbon footprint of a base station, alongside real-estate efficiencies. The most recent antenna innovations are related to power amplifiers and natural cooling, such as bionic heat dissipation and butterfly designs of the equipment to enable natural cooling.

Passive infrastructure is also a focus area for many operators, especially those with a higher number of bad-grid (sites with little or no access to an electricity grid) or hard-to-reach sites. In some circumstances, mobile operators are forced to use diesel generators to guarantee the reliability of the power supply for base stations. This is less than ideal considering generators emit high levels of carbon dioxide and have onerous cost implications associated with refuelling, particularly if they are located in hard-to-reach, sparsely populated areas that require labour call-outs and security protection. Lithium batteries have emerged as a more

4 For more information, see Going green: benchmarking the energy efficiency of mobile, GSMA Intelligence, 2021

environmentally friendly and cost-efficient alternative. These have a smaller and lighter form factor compared to traditional lead-acid batteries, saving space after installation. Lithium batteries have a significantly longer expected lifespan (up to three years) than their lead-acid predecessors. Voltage boosting is also an option with lithium technology; this can help operators increase voltage, save on energy transportation and serve newly installed 5G antenna units from longer distances more efficiently.

Virtualisation and open interfaces are impacting the sustainability of radio networks in different ways. Mobile operators can deploy one without the other, but technology is becoming available to combine RAN virtualisation with open interfaces. Virtualisation can offer better economics and energy efficiency through capacity aggregation, cloudification and use of refurbished kit, while open interfaces can offer more choice and vendors with the hope of more innovation in the supply chain. This includes the concept of 'zero touch provisioning', in which cloud-native RAN equipment is upgraded, set up and authenticated remotely, therefore saving on truck rolls and the human personnel that go with those. Network reconfiguration can happen with common, aggregated resources. Finally, common equipment can be and is being used for the RAN, mobile edge computing and some IoT connectivity such that future upgrades can utilise the base components again without the need for new supply, avoiding needless waste of hardware into landfills.

Pulled together – core networks and data centres

A significant number of network operators are now taking steps and forging partnerships to enable them to run some part of their operations and services in a centralised cloud. Thanks to the centralised structure and economies of scale, a more energy-efficient layout can be achieved due to the decrease in power consumption, heat production and air conditioning. This centralised architecture – along with baseband unit pooling and efficient DC solutions and chips – can help operators to distribute resources more efficiently and save on energy. Virtualisation can select the best parameter combination for achieving the optimal energy-saving effects on the entire network. Pooling together processing capacity leads to a less complex network architecture with a smaller environmental footprint.

Smaller steps in the right direction – operations

One of the major sources of emissions outside the network continues to be from vehicle fleets for equipment installation, deliveries and network drive testing. Constant testing and mapping of users' experience under different conditions at different times of the day is essential to provide high-quality telecoms services. With the help of AI, operators can reduce the size of testing crews, travel time and the related fossil fuel and electricity costs. Network tuning and virtual test drives can rely on real-time traffic data, as every user can become a tester and feed the network management platform with real-time data. The network management platform can form actionable insights and significantly reduce the need for physical test drives.

Incremental gains can also be achieved from lesser known and appreciated factors. These include launching eco-SIM cards made from recycled plastic, handset trade-in schemes and e-waste recycling. Cycle-to-work schemes, bike couriers and EVs are gains that can be made in the transport domain. Additional incremental gains can come from sustainable office buildings and campus designs with IoT-enabled heating and cooling systems.

SUPERMICRO

Greener
5G Infrastructure

Reduce your TCO and Environmental Impact with Resource-Saving Power, Cooling and Modular Refresh featuring 3rd Gen Intel® Xeon® Scalable processors

intel. XEON PLATINUM

Better. Faster. Greener.

Learn More at www.supermicro.com

SUPERMICRO

Softwarisation: modular upgrades have proven cost benefits, but environmental aspects are less appreciated

Efforts in the last decade around software-defined networking have helped centralise the network's intelligence and control to the software layer. This started to standardise the underlying hardware. The opportunity for infrastructure vendors to compete on hardware-feature innovation has consequently become less relevant as software features allowing control and modular upgrades become the default.

From a sustainability perspective, there are clear benefits to the software story. For one, older physical equipment does not need to be disposed of if it can be upgraded via software. This reduces e-waste, a major hidden environmental cost. As an indirect impact, the decline of hardware-centric innovation decreases the need for physical activity such as site visits, logistics, shipping, service and maintenance. Less physical activity limits the climate impact of upcoming network updates and new features.

Cloud-based solutions also reduce dependency on hardware swap-outs. Newly built data centre components such as motherboards and chassis can be reused in future upgrades. This offers cheaper, more frequent and customised innovation, reducing manufacturing and transport emissions associated with the supply chain. Cloud also enables almost real-time post-deployment architecture optimisation: workloads can be moved and functions can be upgraded in a more flexible 'as-a-service' model.

Outlook: the essential role of AI in improving energy efficiency

Our analysis has so far covered specific levels of the telco network stack: the RAN, core network and data centre infrastructure. Efficiency opportunities are also available through 'horizontal' levels via AI and ML. These allow network equipment to perceive, reason, intuit and provide new ways of solving technical challenges. Holistic and end-to-end AI and ML can provide a ubiquitous system-level approach that improves energy efficiency across hardware, software and algorithms. Sustainability and energy management are particularly data-intensive areas, and operators cannot efficiently process information and make real-time decisions at scale without the use of AI. As energy consumption is a key opex cost for all mobile operators, those that are currently not planning to use AI-driven energy management risk having a long-term competitive disadvantage.

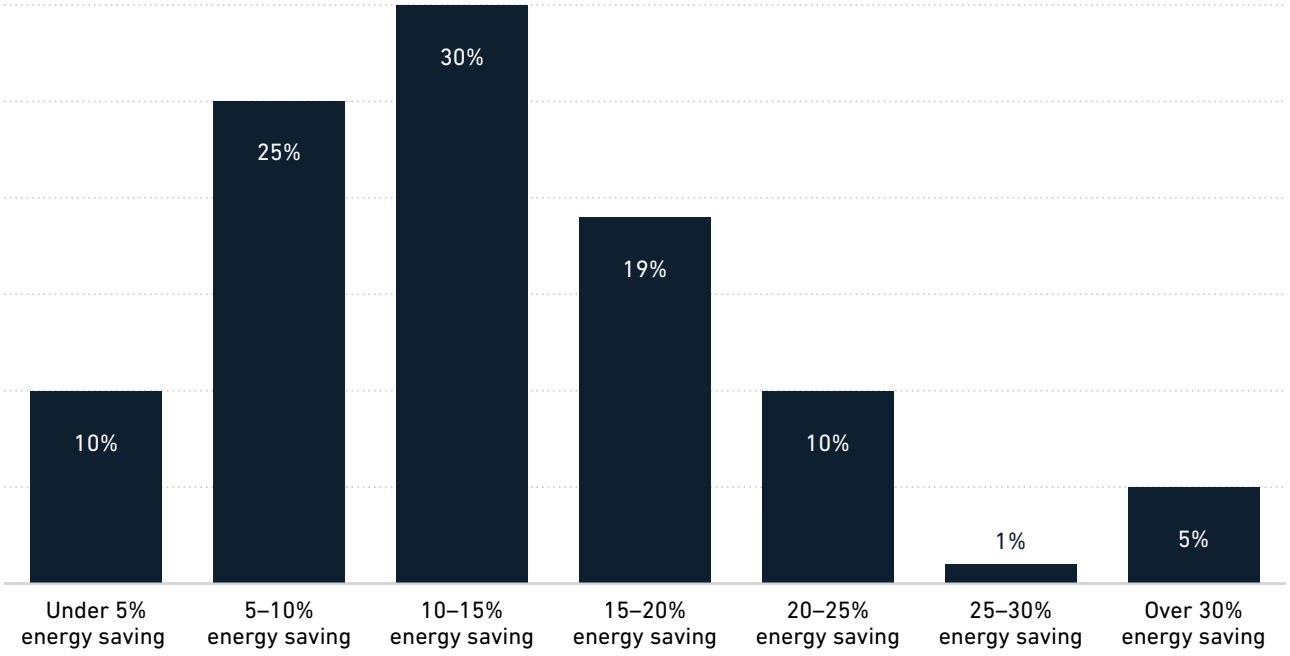
There is significant optimism about the performance of AI-driven network management solutions within the operator community. Our survey data suggests around two thirds of operators expect energy savings of over 10% from AI over the next two years (see Figure 6). The use of AI and ML is not particularly new, but relatively few operators have reached large-scale commercial deployment. Of those that have launched commercially, most have focused on shutdown solutions in the RAN.

AI- and ML-driven applications are following the same S-shaped adoption curve as most new technologies. After the first wave of innovators, the early adopters and early majority are expected to drive the adoption of the new technology to scale.

Figure 6

Over the next 24 months, what level of energy saving do you expect from your AI-driven energy management solutions?

Percentage of operators



Source: GSMA Intelligence AI and Energy Efficiency Survey 2021

3

Decarbonising other industries: how versus how much

Beyond the investments that telecoms operators make to improve the energy efficiency of mobile and fixed networks, a larger proportionate impact is available through the digitisation of other industries. This is premised on a so-called 'enablement effect', in which mobile connectivity, associated digital infrastructure and AI improve productivity in other industries by an order of magnitude more than that of the telecoms sector directly. This results in lower energy consumption and therefore the avoidance of CO_2 emissions that otherwise would have occurred.

The process of effecting carbon reductions is now commonly referred to as decarbonisation. The magnitude of savings from decarbonising other industries is potentially substantial. For 2018, the GSMA and Carbon Trust estimated a level of CO_2 avoided emissions that was 10× that of the telecoms sector.

Fast forward to the present and, while the premise remains the same, the urgency for achieving CO_2 reductions has never been greater. For any country or company to get to net zero by 2050 – that is, no net emissions of CO_2 into the atmosphere – reductions of 50% will be required in each successive decade leading up to that point. The first decade to 2030 will be the toughest. With global CO_2 emissions now approximately 53 gigatonnes (Gt) per year, the required cut this decade is around 27 Gt. Put in context, that is 27 billion tonnes of carbon, or 3 tonnes of CO_2 taken out of circulation for every person on earth by 2030.

How should we think about the quant side?

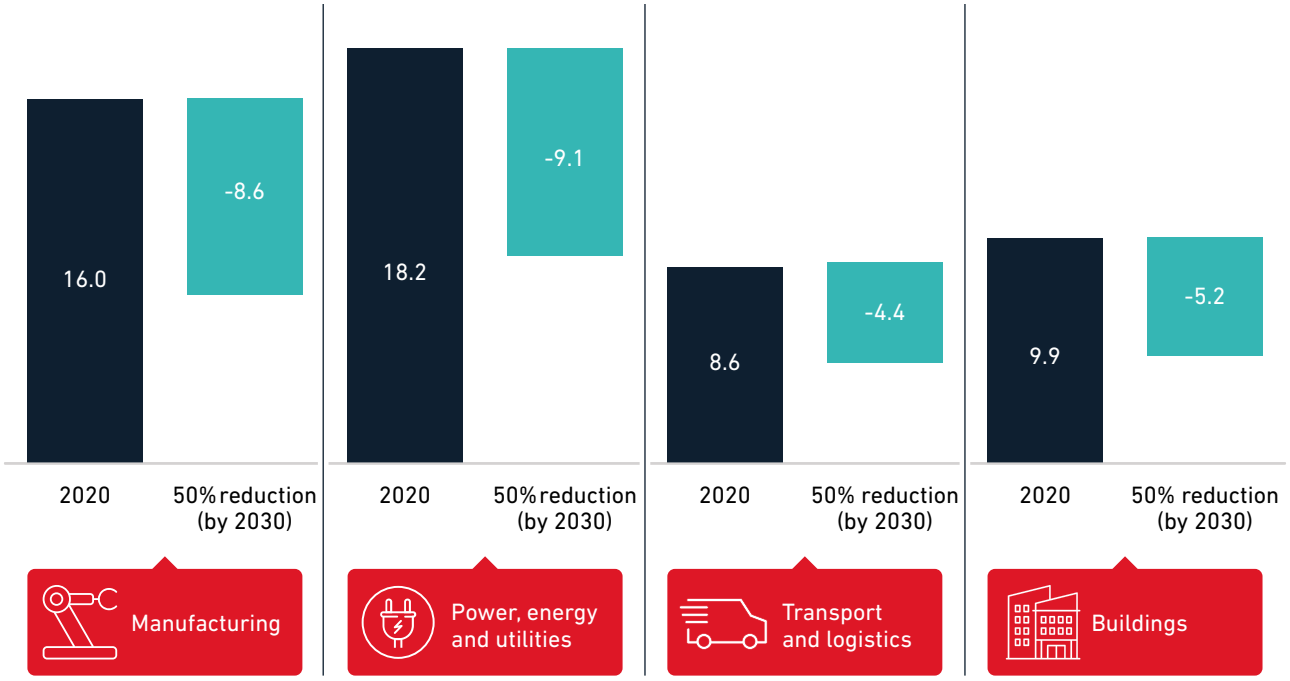
To illustrate how connectivity is aiding decarbonisation, our focus is on four industries that make up 80% of global emissions):

- **Manufacturing:** factories and warehouses.
- **Power, energy and utilities:** smart grids and residential energy.
- **Transport and logistics:** haulage, maritime and ports, electric vehicles, smart cities, and the indirect effects of labour shifts to work from home.
- **Buildings:** residential homes, office buildings and industrial campuses.

Figure 7

A 50% cut by 2030 in the four largest-emitting sectors requires 27 Gt of CO_2 saved

CO_2 emissions (Gt)



Note: 50% reductions on 2020 levels are approximate.
Source: GSMA Intelligence, Exponential Roadmap, Carbon Trust

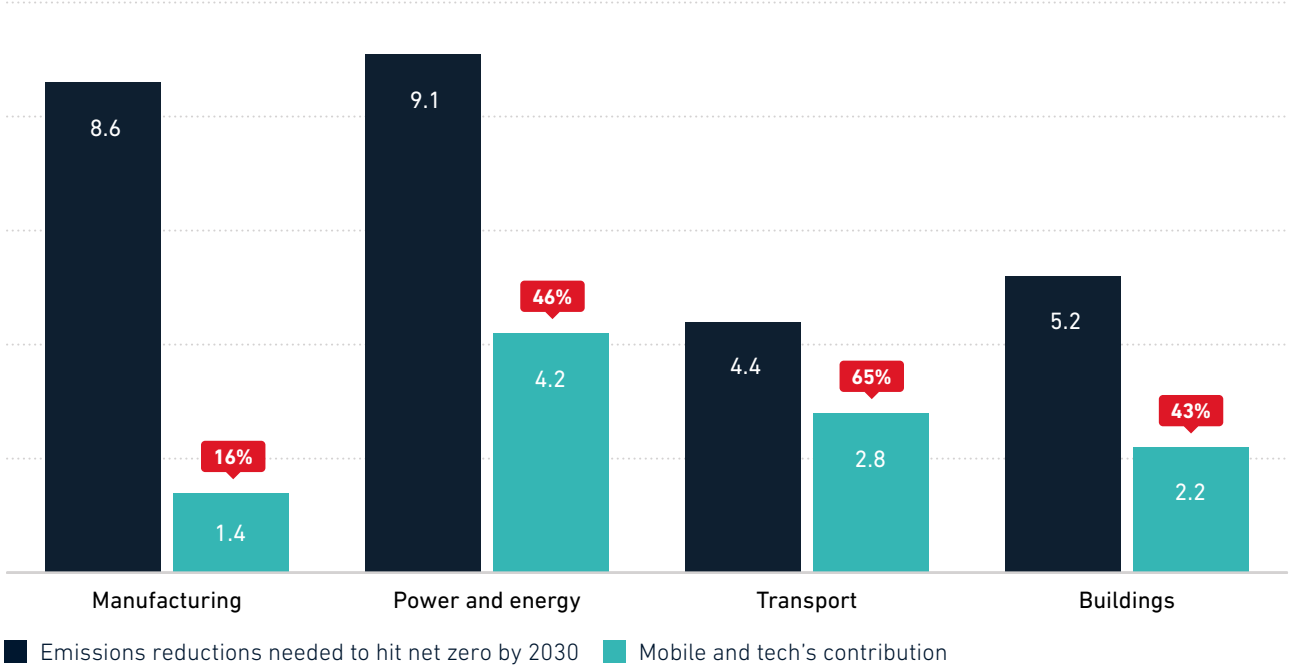
Our modelling suggests that, in aggregate, the CO_2 emissions savings for the four largest-emitting industries enabled by mobile and digital technology could amount to just under 40% of the required total reductions by 2030 (see Figure 8).

This provides a reference point for the ways that operators, their suppliers and enterprise customers are integrating mobile and digital technology as core components of CO_2 reduction roadmaps.

Figure 8

40% of the emissions savings can come from mobile and digital tech

CO_2 reduction (Gt)



Percentages represent the share of CO_2 savings that can be enabled by mobile and digital tech.

Source: GSMA Intelligence, Exponential Roadmap, Carbon Trust

How does mobile tech drive emissions savings?

Achieving climate reduction targets will require a mix of behavioural change, regulation, legislative commitments and technology. Technology has many facets, sometimes simplified under broad banners of 'green' or 'clean' tech. The core commonality, however, is that the benefits of decarbonisation are directly linked with digitisation and associated productivity gains.

In absolute terms, the highest enabled impact would come from the power industry at 4.2 Gt, driven primarily by rising electricity generation capacity from renewables. Solar and wind installations are increasingly being integrated with national grids and the last mile through IoT sensors and battery storage solutions. The mechanism for savings from IoT comes from monitoring energy distribution in real time to cut down on wastage, preserving unspent power, and providing a platform for micro-grid operators to sell renewables (which by default carry zero emissions) back into the main national grid. IoT penetration is around 35% in solar and 10% in wind, but this will increase steadily as a result of legislative commitments on renewables that mean a strong majority of grids (75%) will be connected by 2050. European countries are at the forefront of this transition and will skew higher on the above numbers, although China (as the world's leading solar producer) and India are also now substituting fossil fuels. As outlined at COP26, India's glide path is particularly ambitious.

The next greatest impact would be in transport, at just under 3 Gt – though this is the largest proportionate impact, with digital technology potentially enabling 65% of the emissions savings needed by 2030. The structural phasing out of petrol and diesel vehicles and the transition to EVs is a major contributor. The connectivity link here comes from IoT connectivity embedded in EV charging points (currently under 1% of IoT volumes) and telematics applications onboard that optimise routing and fuel consumption by 3–5% compared to other vehicles. Similar fuel efficiencies are also available in the road and maritime logistics industries. Port authorities sit at the junction of haulage and shipping. Private LTE networks are gaining traction here to provide the high-grade, low-latency connectivity needed for, say, robotic cranes and optimising ship arrival and departure times such that they directly align with truck capacity. Less appreciated but potentially highly material are the CO_2 savings that may arise as more of the labour force works from home (10% of the transport sector's required reduction). This is, of course, dependent on having adequate connectivity at home. This will mostly be anchored in fibre in high-income countries, while LTE connections and, potentially, fixed-wireless will service rural households and developing countries where fibre infrastructure is less prevalent and affordable relative to incomes.

The impact in manufacturing is similarly scalable through a mix of equipment, including private networks, sensors, edge compute infrastructure, augmented reality (AR) and AI. Our IoT forecasts suggest smart manufacturing connections will rise by three times to 1.5 billion by 2025. This is one of the largest vertical sector growth rates and chimes with telco and vendor sentiment of its prospects. There are many implementation options within an automation strategy: robotic equipment; automated guided vehicles (AGVs) to move parts within a factory and perform routine maintenance and fault repair; and AR to enable remote diagnostics and maintenance. LTE private networks are increasingly being used to ensure a guaranteed QoS across a factory footprint, with the option to upgrade to 5G. Case study reporting from live smart factories is early and variable, but a reasonable estimate is savings of 10–20% in energy consumption per year compared to industrial settings without connected technology.

Efficiencies in buildings are generated through a mix of factors. This involves sustainable design and use of repurposed materials in the construction phase. Smart electricity and gas meters (or integrated units) fitted with sensors in buildings can automatically moderate temperatures and lighting based on occupancy levels and external climate readings. In the residential domain, smart meters have been found to generate savings of 3–5% for households versus unconnected premises, on the basis that tracking can identify unnecessary usage (e.g. TV or lights being left on) and can offer incentives for shifting consumption to non-peak hours (e.g. using a washing machine overnight). Of course, non-mobile tech implementations, notably heat pumps, will also be a part of the solution, but these should be seen holistically as part of smart energy systems rather than individual products per se.

These use cases and their implications are research topics in their own right. Our purpose in highlighting a selection here is to illustrate the mechanism for decarbonisation through technology and the synergistic relationship with economic productivity. The RoI to recoup upfront investments is likely to be realised over a longer-term horizon (5–10 years) given the deployment times, but this must be considered against the productivity and environmental benefits that accrue indefinitely.

4

Supply-chain sustainability: complex but critical

Network energy efficiencies and industry decarbonisation are both high-profile components of the discussion around telco sustainability, in part because they are under the (relatively) direct control of operators. Operators, in turn, spend plenty of time promoting their work on these fronts. However, supply-chain and scope 3 emissions are a trickier topic, often outside the control of operators. It's even more critical to consider the role of supply chains in telco sustainability efforts, using one of the industry's most visible components – smartphones and devices – as a case study.

Why the supply chain matters

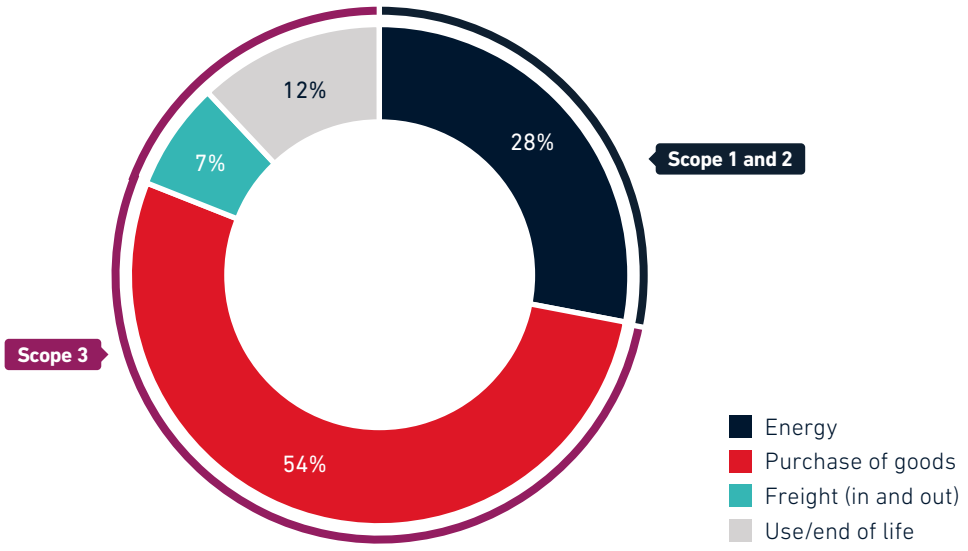
Only a few years ago, the concept of the 'supply chain' might have seemed irrelevant or otherwise opaque. If political discussions around the intersection of vendor choice and national security didn't change that, pandemic-induced silicon (as well as furniture, toilet paper and gas) shortages surely did for the average consumer.

From a sustainability standpoint, however, the supply chain (and related to that, scope 3 emissions) matters for several key reasons:

- **The magnitude of scope 3:** While the reporting of supply-chain-related scope 3 emissions is inconsistent at best, estimates suggest that they represent the biggest share of most companies' carbon footprint. In other words, this means that efforts to create a greener telco supply chain promise to deliver bigger benefits than efforts aimed elsewhere – even if those efforts will be complicated.
- **The complexity of measurement and partnerships:** Labelling attempts to limit supply-chain-related emissions as 'complicated' can rightly be considered a massive understatement. Measuring the carbon footprint of your company's operations and the impact of those operations on other industries is relatively straightforward, backed by plenty of guidelines. Measuring the footprint of your company's suppliers – much less working to reduce them – requires a high degree of transparency and close partnerships.
- **The visibility of commitment:** The effort required to make progress on supply-chain-related carbon emissions, combined with the RoI from these efforts (the opportunity to impact the largest share of emissions) makes a clear statement that an operator is committed to sustainability in a very real way. This degree of visible commitment is important for the entire communications industry and the global climate. At the same time, as consumers increasingly consider sustainability in their purchasing decisions, an operator's profile on this front can be a key competitive advantage.

Figure 9

How do emissions split out between scope 1, 2 and 3?



Source: Schneider Electric (based on 25 industrial sites)[5]

5 See https://perspectives.se.com/blog/how-to-calculate-ghg-emissions-from-scope-3

It's natural to ask about progress on supply-chain-related emissions reductions, given that they are a potential marketing win for operators and supply-chain-related emissions are the major contributor to carbon footprints. Here, the experience of investment community advisors MSCI is telling: its own estimates show that the intensity of scope 3 carbon emissions was almost three times the intensity of scope 1 and 2 emissions combined. At the same time, MSCI notes that "investors concerned about climate change have traditionally focused on scope 1 and scope 2 emissions", while (perhaps more worrying) "reporting on scope 3 emissions remains sparse, incomplete and at times highly volatile".[6]

Regrettably, telco and mobile ecosystems aren't immune to a general lack of reporting or measuring the impact of supply-chain emissions. This makes it all the more important to understand them and how they are being addressed.

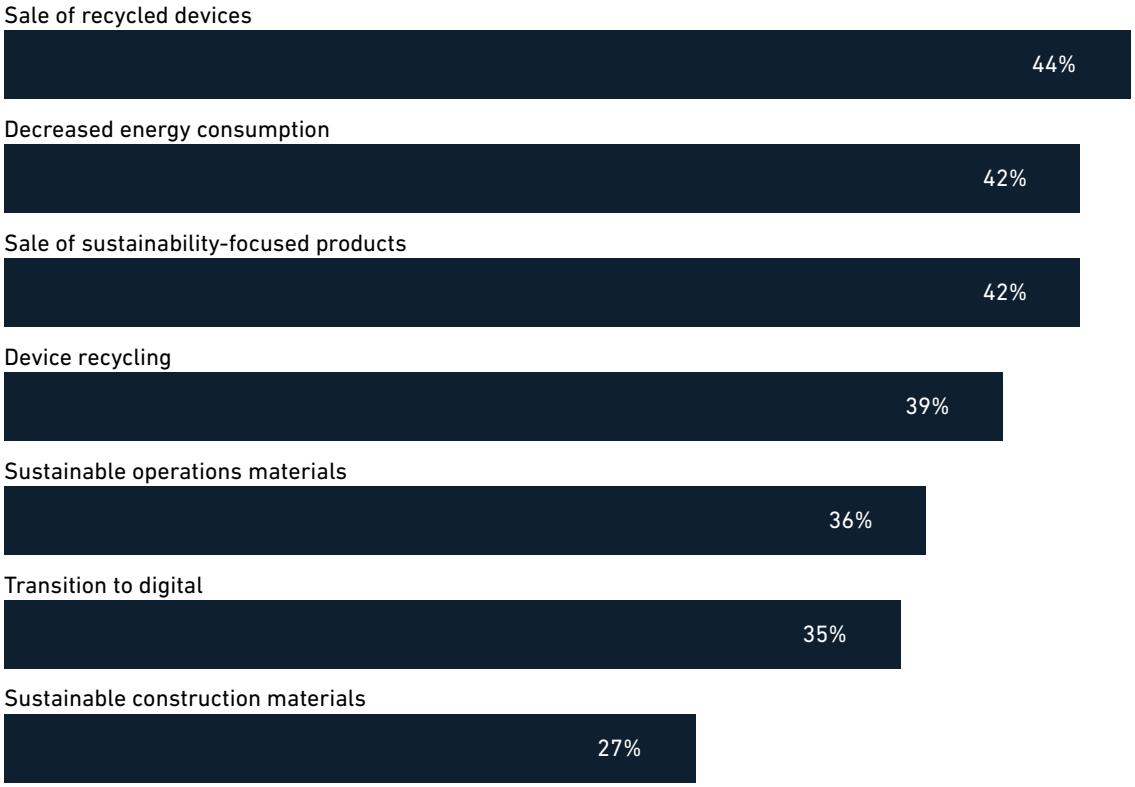
The sustainable device supply chain

As operators look to optimise the sustainability and energy efficiency of their supply chain, there are a number of areas they could focus on, including infrastructure suppliers, IT services suppliers and facilities support. In fact, when queried about the sustainability efforts tied to their retail operations, operators from a global GSMA Intelligence survey stated that the supply chain is already a critical component of their efforts (see Figure 10).

Figure 10

What sustainability practices have you put into place for your retail presence/locations?

Percentage of operators



Source: GSMA Intelligence Operators in Focus: Retail Strategies Survey 2021 N = 100 operators

6 "Scope 3 Carbon Emissions: Seeing The Full Picture", MSCI, September 2020

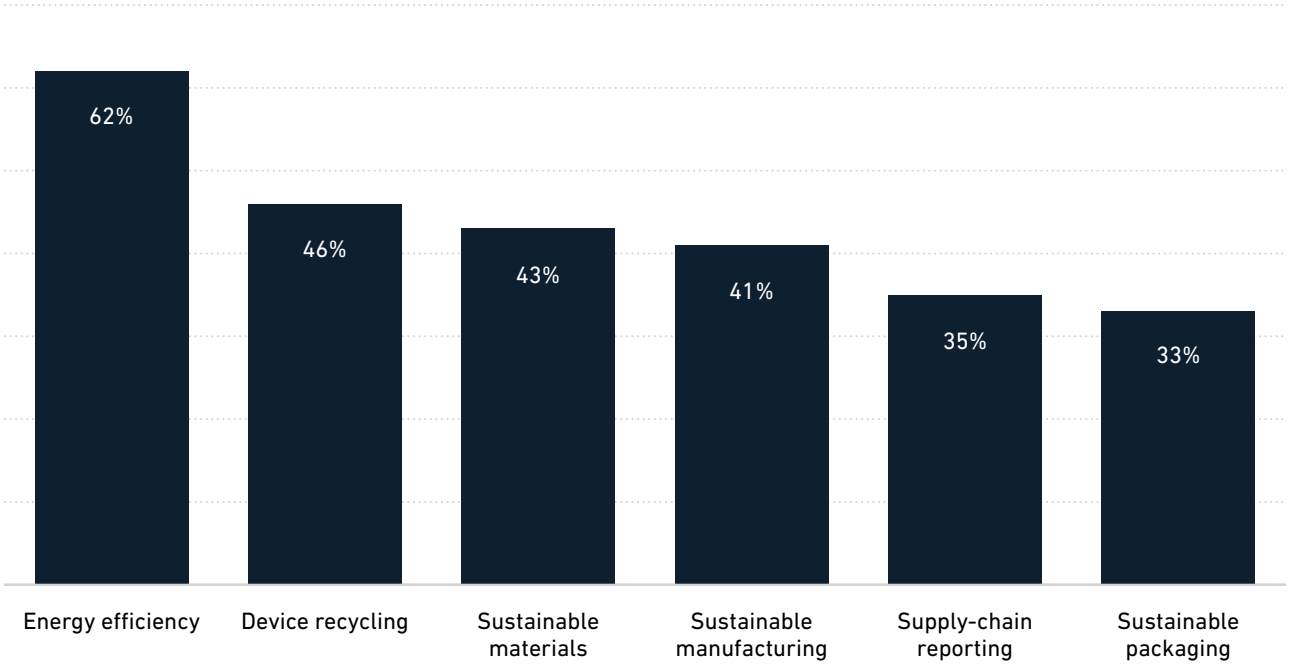
Much of the sustainability activity seen in Figure 10 relates to direct telco operations, such as the transition to digital operations or use of sustainable materials.

However, three of the top four activities relate to customer-facing devices, including their sale, re-purposing and end of lifecycle process.

Figure 11

What sustainability practices are you requiring of your mobile device suppliers?

Percentage of operators



Source: GSMA Intelligence Operators in Focus: Retail Strategies Survey 2021 N = 100 operators

There are strong reasons for operators to focus on the carbon footprint implications of their device strategies. As the primary conduit to telco services, and the subject of massive marketing campaigns, devices represent a high-profile part of operators' businesses. Perhaps more importantly, operators sell and service billions of devices – between handsets, fixed customer premises equipment units and IoT equipment – representing a potentially massive emissions impact and reduction opportunity. While that opportunity includes a number of direct activities (device sales and shipment), the potential for device supply-chain efficiencies is even greater – in line with the relative magnitude of scope 3 emissions.

Returning to GSMA Intelligence's operator survey, the sustainability-focused demands being made of device suppliers highlight operators' supply-chain priorities (though many of these priorities are about more than just sustainability):

Energy efficiency

From the perspective of scope 1 emissions, operators spend considerable effort on optimising the energy efficiency of their networks and network infrastructure. It's only natural then that the energy of their device portfolio would be the top demand placed on mobile device suppliers. Although the energy consumption of modern smartphones is relatively meagre, a rise in data-intensive and processing-intensive applications (e.g. video, gaming, mixed reality) will drive this up. Perhaps more importantly, energy-efficient devices will stay charged for longer, delivering a better user experience and more network usage, ultimately benefiting operators.

Recycling and lifecycle closure

While the average replacement cycle for mobile devices has trended longer in many markets over the past few years (driven by rising average selling prices and SIM-only service offers), the disposal of billions of devices every year carries a sizeable e-waste footprint. Global e-waste is estimated by Capgemini to have reached 54 million tonnes in 2019, a rise of 21% over the prior five years, with this expected to grow further to 74 million tonnes by 2030. However, only a small fraction (17%) of that waste is recycled. As the number of smart devices sold by operators proliferates – particularly lower-cost wearables and accessories – this risk only escalates. Recycling efforts, whether by the device manufacturer or the operator, represent a visible strategy for mitigating the impact of e-waste, and they put downward pressure on the resource-intensive production of new devices. At the same time, where recycled devices can be resold (in the home market or abroad), they may represent a new revenue opportunity and a way to extend access to lower-income users.

Materials and repairability

A focus on sustainable materials in device manufacturing makes for a powerful, consumer-friendly marketing message. It is also closely related to both e-waste and manufacturing impacts. The use of sustainable materials can help keep less sustainable materials out of landfills, particularly where device manufacturing involves a long list of rare-earth materials that are often mined in resource-intensive ways. More broadly, however, a focus on sustainable materials and construction extends to the repairability and durability of devices. Durable and/or repairable devices can be kept in service longer, reducing the consumption, production and disposal of new devices. While battery and screen replacements are now commonplace options for many device models, sustainability-focused manufacturer Fairphone has extended the focus on repairability to include camera module replacements, earpiece and speaker replacements, a committed lifespan for software updates and the use of fairtrade gold in manufacturing.

Manufacturing and reporting

Factors directly impacting device usage or the consumer experience might be higher profile, but device production is estimated to account for about 80% of a smartphone's carbon footprint. Apple, as an indicative example, highlights that production accounts for somewhere between 78% and 86% of the CO_2 emissions of iPhones from the iPhone 7 up through the iPhone 12 series. 'Production' includes the materials being used (discussed above); however, it also includes the energy used in manufacturing and the sustainability of manufacturing processes. Given the outsized role of the manufacturing process in the carbon footprint of mobile devices, we might expect it to rank higher on the list of demands operators make of their supply chain. But the reality is that some processes are inherent to the production of modern devices, whereas there may be flexibility in others – including the amount and type of energy used. This makes common reporting measures on mobile handset and equipment production critical to understand how manufacturing is taking place and where there is room for improvement.

Packaging

Much like the use of sustainable materials in the construction of mobile devices, the use of sustainable packaging can help to keep waste out of landfills while making for a visible and easy-to-understand message to consumers. Device packaging, after all, is something consumers can touch and feel in a way that's not possible with device components or manufacturing processes. So, why is it relatively low on the list of operator device supply-chain priorities? The relative ease of sourcing sustainable packaging materials (compared with device component materials), combined with the fact that efficient packaging helps to lower shipping costs, means that this is a priority that sits foremost with device suppliers, regardless of operator demands.

As a sign of how these priorities play out in the real world, the extension of the Eco Rating scheme for mobile devices is notable. Initially launched in May 2021 by Deutsche Telekom, Orange, Telefónica, Telia and Vodafone, the aim of the scheme is to provide consumers with a consistent set of accurate data on the environmental footprint of their mobile devices broken down into five impact categories: durability, repairability, recyclability, climate efficiency and resource efficiency. Initially launched in 24 European countries, the scheme has since expanded to include South Africa and Brazil, with launches in other key Latin American markets expected to follow soon. With the recent addition of manufacturers Fairphone, Realme and Vivo (alongside major OEMs such as Samsung, Huawei, Xiaomi, OnePlus and ZTE), the 150 phones assessed in early November 2021 is nearly double the number at launch.

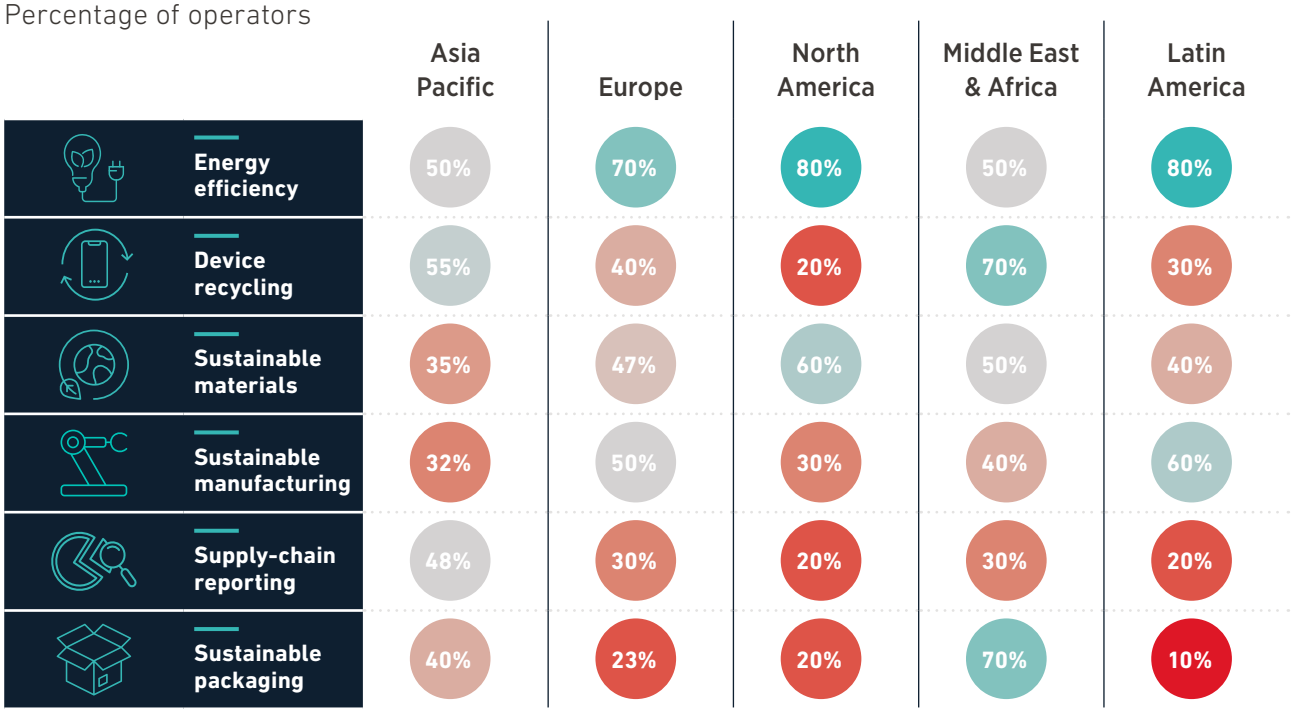
Extending Eco Rating beyond Europe underscores the perceived importance of device sustainability to consumers and the reality that supply-chain sustainability is a crucial consideration for telcos – across their device portfolios and more broadly. However, the fact that the scheme is still limited in geographical reach highlights that a focus on device supply-chain sustainability is not consistent across the world.

Breaking down our earlier survey results by region, we see this quite clearly (see Figure 12). Operators in different regions of the world may be naturally aligned on the importance of some supply-chain measures (e.g. energy efficiency) but less so on others (e.g. recycling and packaging). It's a reminder that diverse markets are driven by diverse consumer demands, which will impact where operators place their supply-chain priorities. At the same time, this suggests that much work remains to be done in educating operators on the supply-chain measures that will have the greatest sustainability impact.

Figure 12

What sustainability practices are you requiring of your mobile device suppliers?

Percentage of operators



Source: GSMA Intelligence Operators in Focus: Retail Strategies Survey 2021 N = 100 operators

What next: looking beyond devices and targets

Highlighting the way in which operators are thinking about their device-related supply chains, and the impact on emissions, does not imply that devices are the only important supply-chain sustainability consideration for telcos. Mobile devices – smartphones and other smart devices – simply provide a very tangible, visible example. And given the magnitude of devices being sold by operators (or being used to access their services), their impact is significant. At the same time, it's axiomatic that operators have a much better track record of recording KPIs around devices than many other parts of their businesses. This naturally extends to tracking the carbon impact of device supply chains.

Yet, we cannot ignore the fact that devices represent only one part of the telco supply chain and one contributor to telco scope 3 emissions.

Mobile infrastructure providers support operators through the manufacturing and delivery of millions upon millions of base stations, routers, microwave radios and associated gear; how efficiently they produce and deliver this kit is important. As we brought to attention earlier, we expect to see growing demands placed on infrastructure providers. As we move to an increasingly software-centric world, the roles of infrastructure provider, software provider and IT services provider become blurred. From a supply-chain sustainability perspective, however, it simply means that operators need to extend their focus to include all of them in their supply-chain footprint considerations. The same largely holds true for operator network siting and retail businesses. Much like telecoms networks, these too have been transforming. Operators have been steadily shedding their tower and other network real estate while pursuing retail strategies that increasingly rely on channel partners alongside their own retail stores. The disaggregation of some of these business functions across the value chain may make their carbon footprint more difficult to track, but that doesn't make it any less important.

In the face of a more complicated, rapidly-evolving supply chain, it may be tempting for operators to focus on direct emissions alone, or to assume that no consistent best practices exist for driving emissions efficiencies across a diverse supply chain. We see this view reflected in the fact that the impacts of supply-chain-related emissions aren't broadly or consistently tracked by mobile operators.

Nonetheless, there are a number of practices that operators can take (and, in some instances, are taking) to tackle the often 70%+ of their overall carbon footprint represented in their supply chain:

- **Direct mandates:** The purchasing power of operators gives them undeniable sway over the practices of their suppliers. As with the demands being made of device suppliers, sustainability-focused mandates can form part of the procurement decision-making across the supply chain. Telia's move to require suppliers put in place a goal for reaching zero CO_2 across their operations (and deliver on that goal by 2030) stands as a powerful example.
- **Best practice sharing:** BT has had a supplier sustainability programme in place for nearly a decade, following an estimate from the operator that scope 3 emissions represent more than two thirds of its end-to-end carbon footprint. Key to this programme is a focus on collaboration and best practice sharing across the operator's suppliers.
- **Reporting framework alignment:** Key to best practice and expertise sharing is alignment around emissions reporting, following Peter Drucker's adage that "you can't manage what you can't measure." Organisations such as the Science Based Targets Initiative (SBTi) provide clear guidance on this front and frameworks around which telcos and their partners can align. Beyond reporting, however, setting targets connected to timelines is critical for showing commitment across the supply chain.
- **Circular economy focus:** Device recycling/repair efforts can play a role in curbing the impact of e-waste and limiting the production of new devices. In embracing a broader circular economy focus, operators need to recognise the revenue potential of these efforts while looking beyond devices. Orange recently demonstrated this via a partnership with Nokia focused on the increased use of refurbished RAN gear across its footprint.

If our examination of operator demands from their mobile device supply chain tells us anything, it's that supply-chain sustainability is about much more than energy efficiency, and that operators will naturally prioritise efforts that deliver visible, consumer-facing benefits alongside a carbon footprint reduction. The impact of device production and manufacturing, for example, has a greater impact on carbon emissions than device energy consumption, but operators place greater demands on their suppliers for energy-efficient devices, reflecting a focus on what the end consumer can directly experience and benefit from.

As consumers increasingly prioritise activities that have a positive impact on the environment, it's only natural for operators to prioritise activities that resonate with them. But with less visible supply-chain components – such as manufacturing and production – constituting the most significant source of supply-chain-related emissions, operators will eventually need to focus their efforts accordingly and educate consumers on the 'why' behind their efforts – which ultimately comes down to sustainability being a core part of good business from now on.

gsmaintelligence.com

GSMA™
Intelligence

GSMA Head Office
Floor 2
The Walbrook Building
25 Walbrook
London EC4N 8AF
United Kingdom
Tel: +44 (0)20 7356 0600
Fax: +44 (0)20 7356 0601