GSMA Intelligence

# Mission sustainable

## 5G efficiencies and the green network

Microsoft

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www.gsmaintelligence.com

info@gsmaintelligence.com

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**Authors**
**Tim Hatt,** Head of Research and Consulting
**Emanuel Kolta,** Senior Analyst

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# Executive summary

Sustainability is now fundamental in how operators design and implement networks. In the telco toolbox are efficient network technologies, renewables and circularity. However, a number of outstanding questions and, in some cases, barriers could hold back industry progress towards net zero by 2050. Those operators that do not invest sufficiently in this green transformation are also risking their long-term competitiveness.

This is the first in a two-part series from GSMA Intelligence in partnership with Microsoft on embedding environmental sustainability into the telecoms sector operating model. This report focuses on strategies to lower energy consumption using technology in the 5G era and renewables.

The second report, to be published in September 2022, looks at the partnership models needed to address the circular economy, as well as emissions reporting and 6G network standards.

## Momentum behind the green agenda continues, unevenly

Momentum continues to build across the telecoms industry for investments in sustainable technology and a reduction in carbon emissions from directly controlled operations. For telecoms operators, the rationale is twofold:

- to play – and be seen to play – an active role in supporting national governments in the fight against climate change
- to mitigate ongoing cost pressures in a low revenue-growth environment.

Commitment rates to key international benchmarks have increased over the last 12 months, underlining a move from talk to action. Carbon-neutral targets, for example, are now embedded in operators that account for 50% of global telecoms revenue, compared to only 3% in 2020. Many glidepaths are also now on more aggressive timelines (to 2035 or 2040) than the 2050 end point for net zero.

The remaining 50%+ of the industry that has not yet committed to a target or the Science Based Targets initiative (SBTi) are mostly in populous, high-growth markets in Asia, Africa and Latin America. These regions will continue to experience emissions pressures over the next decade from their high-growth economies and reliance on fossil fuels where renewable energy capacity is limited. For the telecoms industry to remain on course for net zero by 2050 (which requires a 50% $CO_2$ emissions reduction between 2020 and 2030), climate action must spread south and east over the near term.

## Operators grapple with the 5G paradox

The '5G paradox' describes how 5G will drive a disproportionate rise in mobile data traffic and energy consumption despite its energy efficiency versus 4G. Trials and field test results from major equipment suppliers suggest the efficiency improvement is 50% or more on a national scale (macro cell). However, without intervention, individual data consumption rises will feed through to an increased strain on network capacity and power usage. Higher speeds and bandwidth-heavy applications (video streaming, AR and VR) will drive monthly data usage per customer up nearly 3× versus 4G smartphones. Although global 5G adoption will only be 25% of total connections by 2025, the impact on overall data traffic levels will be disproportionately higher.

## Energy efficiency becomes a core purchasing priority

Energy efficiency is a top purchasing priority among operators in the design and operation of mobile networks. GSMA Intelligence survey evidence indicates this factor is extremely or very important for more than 85% of operator network buyers.

The key technologies at hand to achieve greater energy efficiency include the following:

- **AI** – AI will become ever more important for efficiently analysing, processing and translating data into actionable insights. However, adoption is not widespread, constrained by various factors depending on the operator group, including cost, data availability and cultural inertia.
- **Software and network virtualisation** – Efforts over the last decade around software-defined networking (SDN) have helped centralise network intelligence and control at the software layer, in turn standardising hardware. 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.
- **Site simplification** – With 5G deployments scaling and the spectrum refarming possible from 2G/3G shutdowns, vendors have prioritised solutions that support site simplification. This offers a lean and streamlined power supply.

## How to manage the transition ahead

The next 10 years will be a period of significant activity and change to decarbonise. The difficulty is how this is done, and what barriers need to be addressed.

The impact of technology in helping other industries decarbonise is paramount. GSMA Intelligence modelling suggests that, over the 10 years to 2030, approximately 40% of required $CO_2$ emissions to be avoided in manufacturing, transport, buildings and power can be enabled by mobile and digital technology. These sectors comprise 80% of global $CO_2$, so the technological effect is significant. However, more disclosure on trials, results and return on investment (RoI) is needed to spur investment.

Renewable power sources and the drive to increase energy efficiency in telecoms networks and supporting infrastructure are two sides of the same coin. Renewables are a fundamental part of the transition to a low- and eventually zero-carbon economy because of their vastly reduced emissions profile. However, the story so far has again been one of strong adoption in Europe and the US, with other regions showing a more mixed fuel-usage profile.

The renewables imbalance is mirrored in commitment rates on climate benchmarks. Overall, operators representing 50% of global telecoms revenue have committed to a carbon-neutral target. However, because this is heavily dominated by higher income markets in Europe and North America, the operators represent only 25% of subscribers globally.

There are many reasons for this imbalance, some of which are interrelated and complex. A key outstanding question is the extent to which technology – and technology standards – can incentivise a switch to more sustainable networks. This includes the use of open RAN equipment as part of broader network virtualisation. It also includes embedding efficiency into 6G standards which will be researched and promulgated in the latter half of the 2020s.

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# Building the case for a zero-carbon future

## The green pivot: sound logic, clear progress but uneven commitments

Momentum continues to build across the telecoms industry for investments in sustainable technology and a reduction in carbon emissions from directly controlled operations.

To some extent, action has been spurred by the COP26 conference in Glasgow, where corporate leaders, politicians and regulators committed to operationalise the aspirations of the Paris Agreement from 2015. However, the underlying rationale for the green pivot has remained consistent, driven by two main factors:

- to play – and be seen to play – an active role in supporting national governments in the fight against climate change
- to mitigate ongoing cost pressures in a low revenue-growth environment.

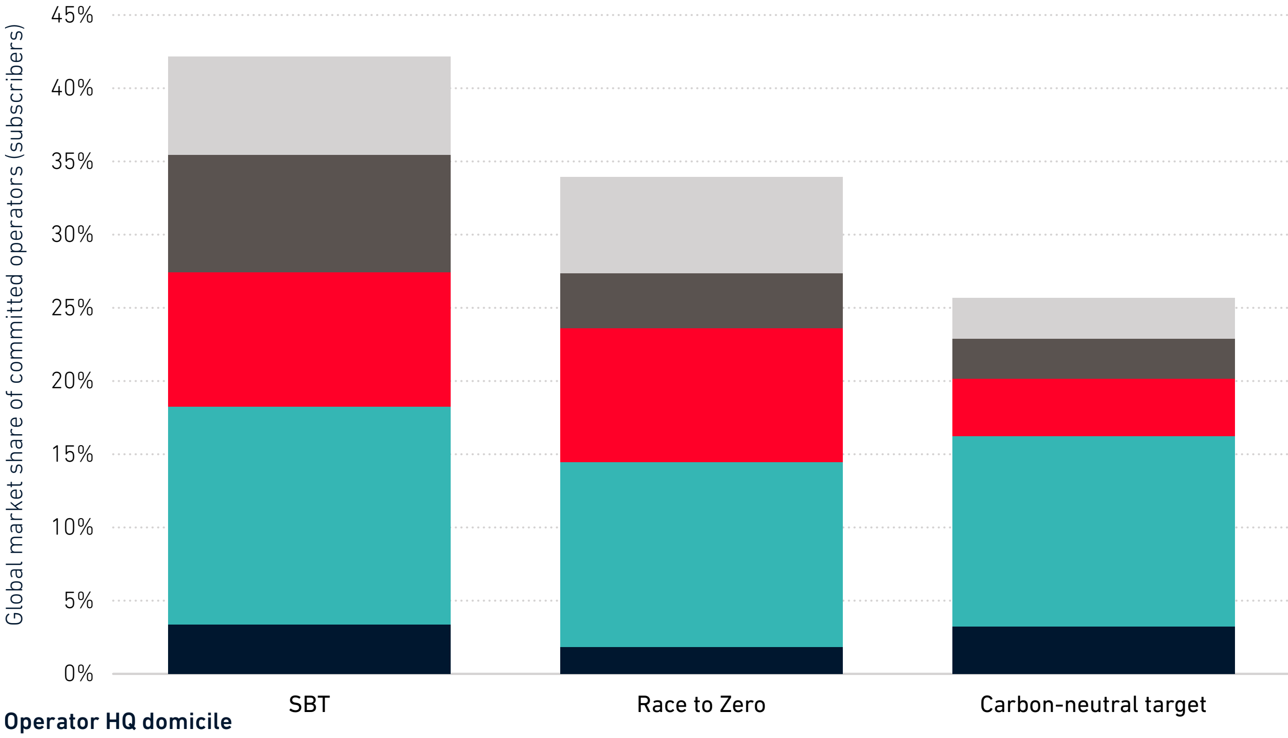
This will be exacerbated as a result of an ongoing customer mix effect – first in the US, Europe and other high-income countries and then emerging markets – in which growing 4G and 5G subscribers drive multifold data traffic increases and consequent strains on network capacity and energy usage.

Other factors are also influencing sustainability commitments – notably, pressure from institutional investors with environmental, social and governance (ESG) criteria. As with commitments from telco senior management becoming a core part of corporate strategy, ESG and climate covenants have moved from a fringe issue among a small band of activist investors five years ago, to a key part of the asset allocation decisions of large fund managers. This has encouraged operators and companies in other industries towards public commitments on carbon-reduction targets and (less developed but equally important) standardised reporting methodologies.

In telecoms, commitment rates are moving in the right direction overall but are still uneven globally (see Figure 1). Across three of the main internationally recognised climate targets, 25–40% of the telecoms industry (by subscriber market share) has committed. Science-based targets (SBTs) have attracted the highest level, at around 40%. At the other end of the scale, carbon-neutral targets have been set by 25% of the industry, while the UN's Race to Zero campaign sits in-between.

Figure 1

## Some 25–40% of the telecoms industry is committed on the major climate indicators




**Operator HQ domicile**
US/Canada  Europe  India  Asia (excluding India)  Other regions

Note: To prevent double counting, market shares for an operating company that is a subsidiary of a parent company are expressed based on the domicile of the parent (e.g. T-Mobile US's commitment to SBTs is reflected in Deutsche Telekom's figures in the Europe bars in the chart).
Source: CDP, GSMA Intelligence

Positively, commitment rates have increased in each category over the last 12 months, underlining the move from talk to action. Carbon-neutral targets, for example, are now embedded in operators that account for 50% of global telecoms revenue, compared to only 3% in 2020. Many glidepaths are also now set to more aggressive timelines (2035 or 2040) than the 2050 end point for net zero.

While European telecoms groups remain the global leaders in sustainability, this is broadening out. US and Canadian operators have made major strides (with AT&T, for example, pledging a climate-neutral target by 2035), as have Jio and Airtel in India, which collectively account for just under 10% of global mobile subscribers.

However, the other 50%+ of the industry that has not yet committed to a target or the SBTi are largely in populous, high-growth markets in Asia, Africa and Latin America. Over the next decade, these regions will continue to experience emissions pressures from high-growth economies and a reliance on fossil fuels where renewable energy capacity is generally less available. Mobile operators globally account for around 0.8% of global electricity consumption. From an emissions perspective, this will be unevenly weighted to countries more reliant on grid-based fossil fuels and diesel power – many of which sit in the high-growth markets listed above. For the telecoms industry to remain on course for net zero by 2050 (which requires a 50% $CO_2$ emissions reduction between 2020 and 2030), climate action must spread south and east over the near term.

We expect the geographic distribution to gradually even out, though there is uncertainty as to whether countries in some less developed regions do so fast enough. Presenting a clear economic logic for investing in sustainability as 5G scales will be a key factor affecting how quickly this happens.

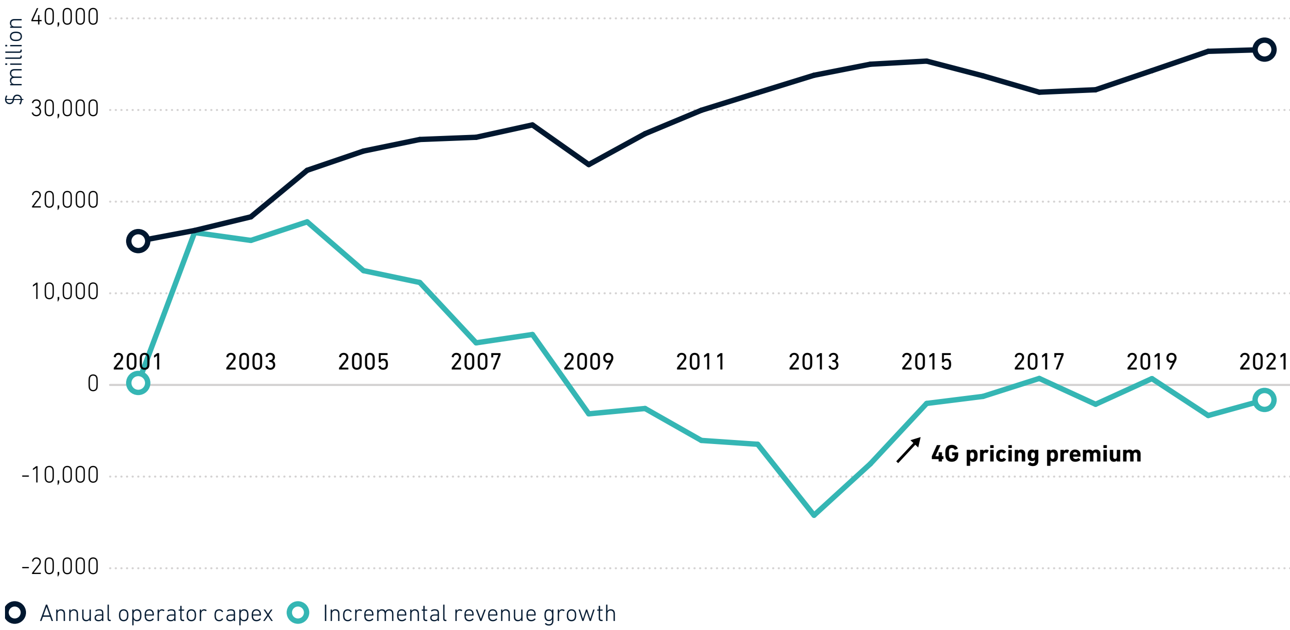
## The 5G paradox

For operators, the other part of the equation is how to mitigate cost pressures in a low revenue-growth environment. Telecoms is an infrastructure business driven by scale. In good times, growing revenues accrue against a fixed cost base, generating positive operating leverage. However, this has not been the case over the last five years. Mobile revenue growth has generally been in low, single digits (or negative territory) in saturated markets, except for a short period of growth from 4G price premiums in 2015–2017 (see Figure 2).

Low growth has overlapped with the investment ramp-up phase for 5G networks. In Europe alone, operators now spend around €33 billion (approximately $35 billion) on network capex per year; over 80% is for 5G sites and equipment. This equates to around 20% of revenue, or sometimes higher, which means margin pressure for as long as fixed and mobile revenue growth remains subdued.

Figure 2

Recouping network investments is a long running challenge (Europe view)



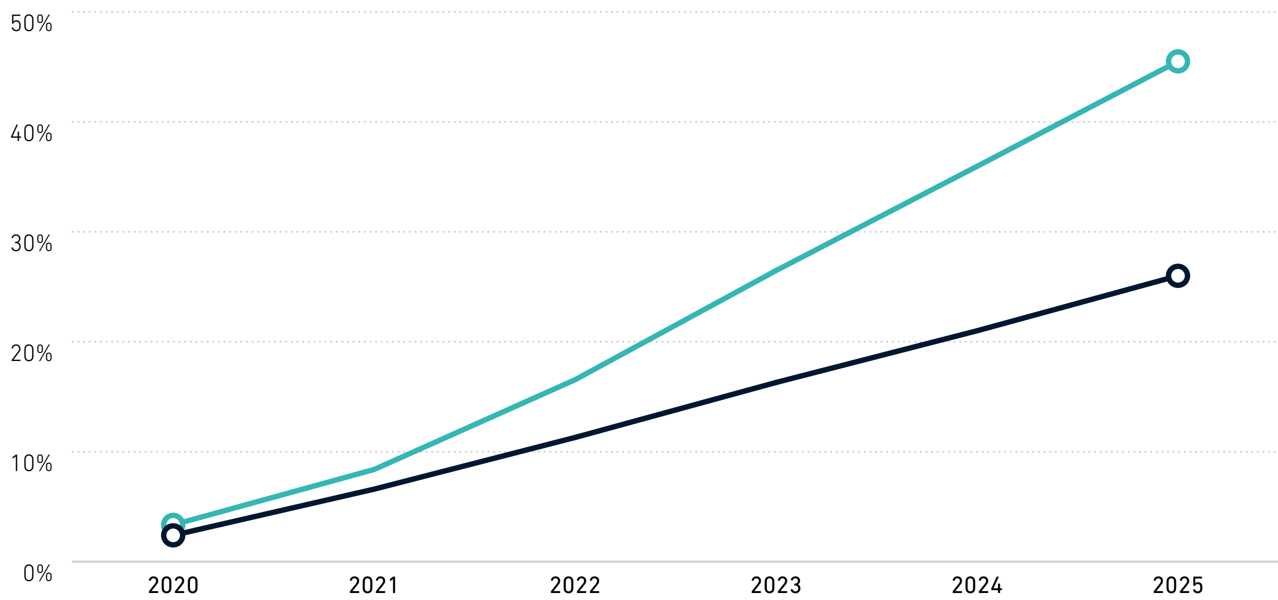

Source: GSMA Intelligence

In the '5G paradox', 5G drives a disproportionate rise in mobile data traffic and energy consumption despite its energy efficiency versus 4G. Trials and field test results from all the major equipment suppliers suggest the efficiency improvement is 50% or more on a national scale (macro cell).

Without intervention, rises in individual data consumption in the 5G era will feed through to increased strain on network capacity and power usage. 5G adoption rates will reach around 25% of the global customer base by 2025, heavily skewed to a small number of leading countries, notably the CJK group (China, Japan, South Korea), the US, the GCC states and parts of western Europe where rates will be 50% or higher. Faster speeds and bandwidth-heavy applications (video streaming, AR and VR) will drive monthly data usage up 3× versus 4G smartphones. 5G will consequently account for nearly half of all cellular data traffic by 2025, despite representing only a quarter of the customer base. See Figure 3.

Figure 3

## Despite being more spectrally efficient, 5G will drive a disproportionate rise in mobile data traffic in the telecoms industry




**Forecast 5G share of...**
Mobile subscribers
Mobile data traffic

Note: data shown is on a global basis
Source: GSMA Intelligence, Ericsson

Operators face the challenge of reconciling this difference, overhauling network operations so that they maximise the energy efficiency of 5G networks and reduce net $CO_2$ emissions. The modern architecture of mobile networks, with functions largely virtualised in the cloud and increasingly shifting to open RAN, means this is a problem (and opportunity) for the ecosystem – not just operators. We analyse the main areas of innovation in the next chapter.

# 2

# The telco toolbox: efficient networks, renewables and circularity

## Energy rising to the top of the network agenda

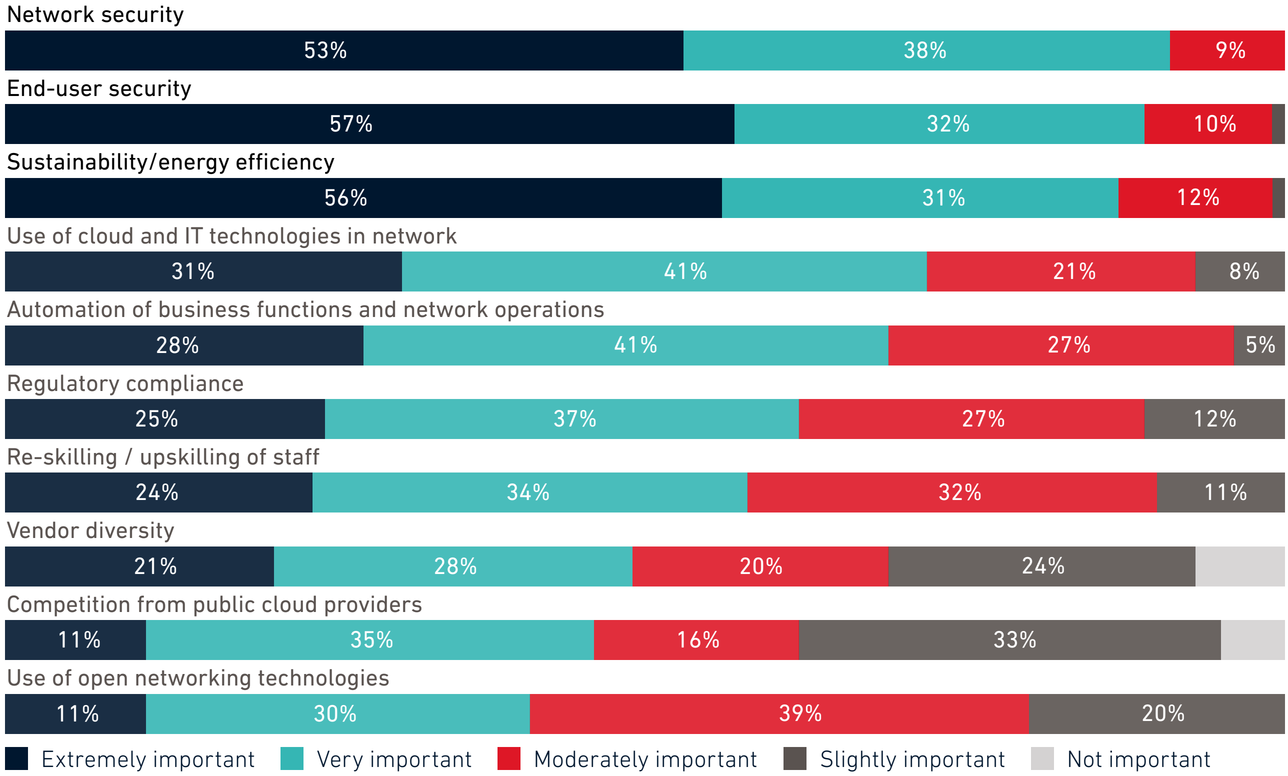
Energy efficiency is a top purchasing priority among telecoms operators in the design and operation of mobile networks. GSMA Intelligence survey evidence indicates it is extremely or very important for around 85% of operator network buyers (see Figure 4).

This means green equipment and solutions are essentially equivalent to the default need for water-tight security, and have a higher rating than upgrades to cloud and automation software. For vendors, the implication is that sustainability has firmly moved to a core part of competitive differentiation. Network operators that do not invest sufficiently in green transformation are risking their long-term competitiveness.

Figure 4

Rankings for network transformation priorities, 2021

How important are the following priorities as a part of your network transformation strategy?




Source: GSMA Intelligence Operators in Focus: Network Transformation Survey 2021

## Adopting solutions to reduce carbon footprint

To reduce their environmental footprint, operators can consider three main methods:

- lower energy consumption through improved energy efficiency (primarily in networks)
- use more renewable energy
- reuse and repurpose network equipment and devices.

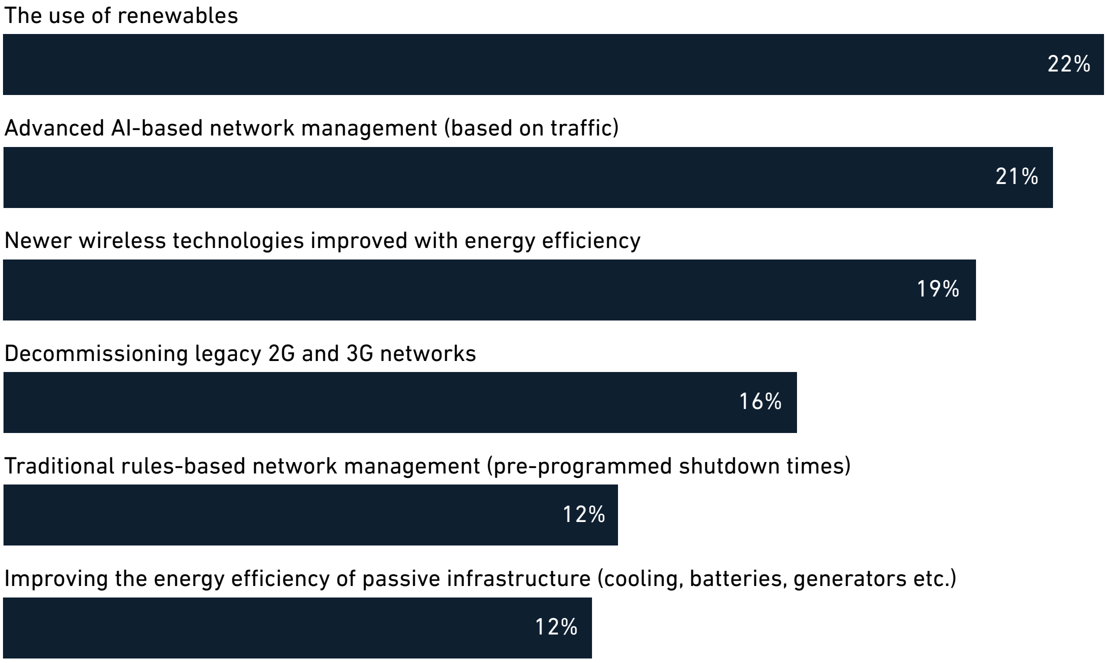
This report focuses on the first two points. The second report in this series, to be published in September 2022, delves into reuse and repurposing as part of the circular economy.

If available, the use of renewable energy sources is a quick and effective way to reduce environmental footprints while not necessarily requiring significant investments. $CO_2$ emissions are almost negligible and, provided supply shortages are not incurred, there is no risk to network quality and service.

Reflecting this, our survey data indicates around 20% of operators rate renewables as the single most important tool for reducing emissions (see Figure 5). However, there are significant regional differences in the take-up of renewables. Access to renewables depends on external factors such as climate, availability (sometimes dependent in turn on regulatory mandates) and prevailing prices through the grid.

Figure 5

Which strategy/method do operators expect to reduce the environmental footprint of their networks the most?




Source: GSMA Intelligence AI and Energy Efficiency Survey 2021

Meanwhile, product improvements and R&D investments are being used to enable network efficiency gains. This applies holistically, including the radio access network, core, data centres and assets outside the network (notably retail, offices, warehouses and fleets). A range of sustainable solutions, including batteries, AI-driven shutdown software, solar panels and advanced signal processing, can affect areas across the organisation.

## Assessing the role of AI

Energy management and optimisation is a particularly data-intensive area. As AI allows vast amounts of data from different sources to be analysed quickly and efficiently, it expands the potential for energy-saving opportunities across the network. If algorithms can assess data related to real-time demand, traffic patterns and network resource availability, AI can enable quick, automated decision-making, facilitating a range of use cases. These include managing and allocating resources in a more energy-efficient way and planning new networks more efficiently.

AI-driven network management applications are not a new concept. The first dedicated large-scale deployments of AI-driven energy management solutions began in 2017/2018. The main global equipment vendors were active by this time (for example, Ericsson's Green Radio designs and Huawei's PowerStar), but deployments were mostly in Europe and on a testing basis. Since then, adoption has grown but is not widespread, constrained by various factors including cost, data availability and cultural inertia. Apart from a small proportion that have reached commercial deployment at scale, most operators are still in the process of planning and testing.

The change from five years ago is the increased scale of network virtualisation that enables software control. Operators are expected to handle an increasing amount of information in the future with regard to their network operations. AI will become increasingly important for efficiently analysing, processing and translating this data into actionable insights.

## How AI can save energy for mobile network operators

AI can save energy across different areas of a mobile network operator. Overall, it can help optimise the amount of resources used to satisfy the rapidly changing needs of customers and networks. Unlike physical network equipment, AI-driven network optimisation software can be acquired from different sources. Options include the operator developing it internally or purchasing it as a service. Compared to hardware, software has a lower market entry cost, and less capex is needed to develop network optimisation software.

AI-driven shutdown and sleep solutions in the RAN can be particularly impactful. These solutions can forecast data traffic based on historical patterns, weather, local events and other factors, before identifying the necessary thresholds and activation/sleep periods. Based on the information, the algorithm can shut down power amplifiers, transceivers and other large network elements to save energy.

Besides shutdown solutions, AI will be able to improve energy efficiency through new features such as load balancing, more intelligent beamforming, reducing interference and better spectrum utilisation.

AI-enabled reductions in site visits and energy-related outages can also help to save on unnecessary transportation and fuel consumption. Site visits and the refilling of generator diesel tanks require significant resources from operators and their vendors, as sites are often located in hard-to-reach areas. Network outages are often caused by energy-related issues, so more effective energy management driven by AI could help improve quality of service and customer satisfaction. Even a short, unexpected disruption to mobile services can significantly affect the consumer experience.

### Beyond the low-hanging fruit

Unlike other products that operators purchase, such as antennas, batteries and fibre-optic cables, AI-driven energy-saving solutions are bespoke according to individual deployment scenarios. The enormous diversity in different operators' regulatory environments, climates and status of legacy networks means vendors need to offer customisable solutions.

Currently, AI-driven energy efficiency solutions are focusing on shutdown applications in the RAN. Base stations are the 'low-hanging fruit' for such applications, as they account for more than 70% of total energy consumption. However, operators are expected to start using AI outside of the RAN and offer more than just shutdown solutions, including the following:

- predictive maintenance and enhanced troubleshooting to reduce the number of site visits and save on fuel and staff resources
- network planning support to save on resources and achieve optimal end results
- optimised fuelling and reduction of generator running hours
- equipment lifespan optimisation (from a broader sustainability perspective).

There is significant optimism about the performance of AI-driven network management solutions in the operator community. Applications driven by AI and machine learning (ML) 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 adoption of the new technology to scale.

This acceleration is based on several factors, including:

- the availability of more real-time data from adding more sensors, especially to passive infrastructure
- new, more advanced AI algorithms
- the requirement for more complex and data-intensive energy management because of the increased data traffic from 5G and more diverse deployment scenarios.

## Moving to the cloud

Over the past few decades, several consumer and enterprise computing applications have been moved to the cloud, with users doing more in the cloud than ever before. Audio and video consumption, gaming, corporate governance systems and content sharing are just a few examples of where cloud is already dominating. 5G is expected to boost this trend further.

Moving workloads to the cloud has a significant potential impact on the climate. Exponentially increasing data traffic will increase energy consumption, and new cloud-native architecture requires more physical infrastructure. Network densification and a larger number of smaller data centres are also essential to support latency-sensitive use cases, such as AR and VR.

However, there are also a range of benefits of moving workloads to the cloud. Processing and cooling are more energy-efficient in a pooled, centralised environment, compared to the silos of PCs, phones and other devices. User equipment also needs less distributed processing and storage capacity, so designing and producing it is less resource-intensive, which can radically reduce e-waste. Less dependency on hardware also expands the lifespan of devices as capacity updates can be carried out centrally. Meanwhile, 5G will help increase speeds, lower latency and reduce the cost of wireless communication, making cloud and hyperscale architecture more favourable from a climate perspective, permitting multiple compute workloads to be processed simultaneously.

## Embracing softwarisation

Efforts over the last decade around software-defined networking have helped centralise the network's intelligence and control at the software layer, in turn standardising 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 will likely become the default.

From a sustainability perspective, there are clear benefits. 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. There is also an indirect impact in that the decline of hardware-centric innovation decreases the need for physical activity such as site visits, logistics, shipping, servicing 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. The cloud also enables workloads to be moved and functions upgraded in a more flexible, 'as-a-service' model.

## Simplifying sites and integrating equipment

Since the launch of 2G in the 1990s, most mobile operators have had to keep obsolete equipment and network layers to serve existing customers and avoid service interruption. Operating parallel 2G, 3G, 4G and 5G networks carries financial and environmental costs. The financial costs come from maintaining a higher number of antennas, remote radio units (RRUs), baseband units (BBUs), site rental and energy. The environmental costs arise from the higher power consumption of 2G and 3G networks compared to 4G or 5G.

With 5G deployments scaling and the spectrum refarming possible from 2G/3G shutdowns, vendors have prioritised solutions that support site simplification. These enable multiple bands and radio access technologies to be deployed on a single piece of equipment. Ultra-wideband antenna units and highly integrated radio units help operators simplify site constructions and minimise equipment density. For example, ultra-wideband active antenna units are available that support up to 400 MHz. Vendors have also started to offer highly integrated remote radio heads that can support three bands instead of one.

Future site layouts are also expected to be as simple as possible, with integrated network elements all deployed on one pole. This includes the antenna, RRUs, BBUs, power units and potentially even solar panels. Plug-and-play small cells the size of pizza boxes are also an energy- and cost-efficient way to densify cellular networks.

Finally, site simplification offers a lean and streamlined power supply. Instead of general-purpose rectifiers and older lead-acid batteries, operators can renew their sites with streamlined power linkages, tailor-made AC/DC-integrated power supplies and lithium-ion batteries.

# 3

# The view ahead

## The enablement effect on other industries

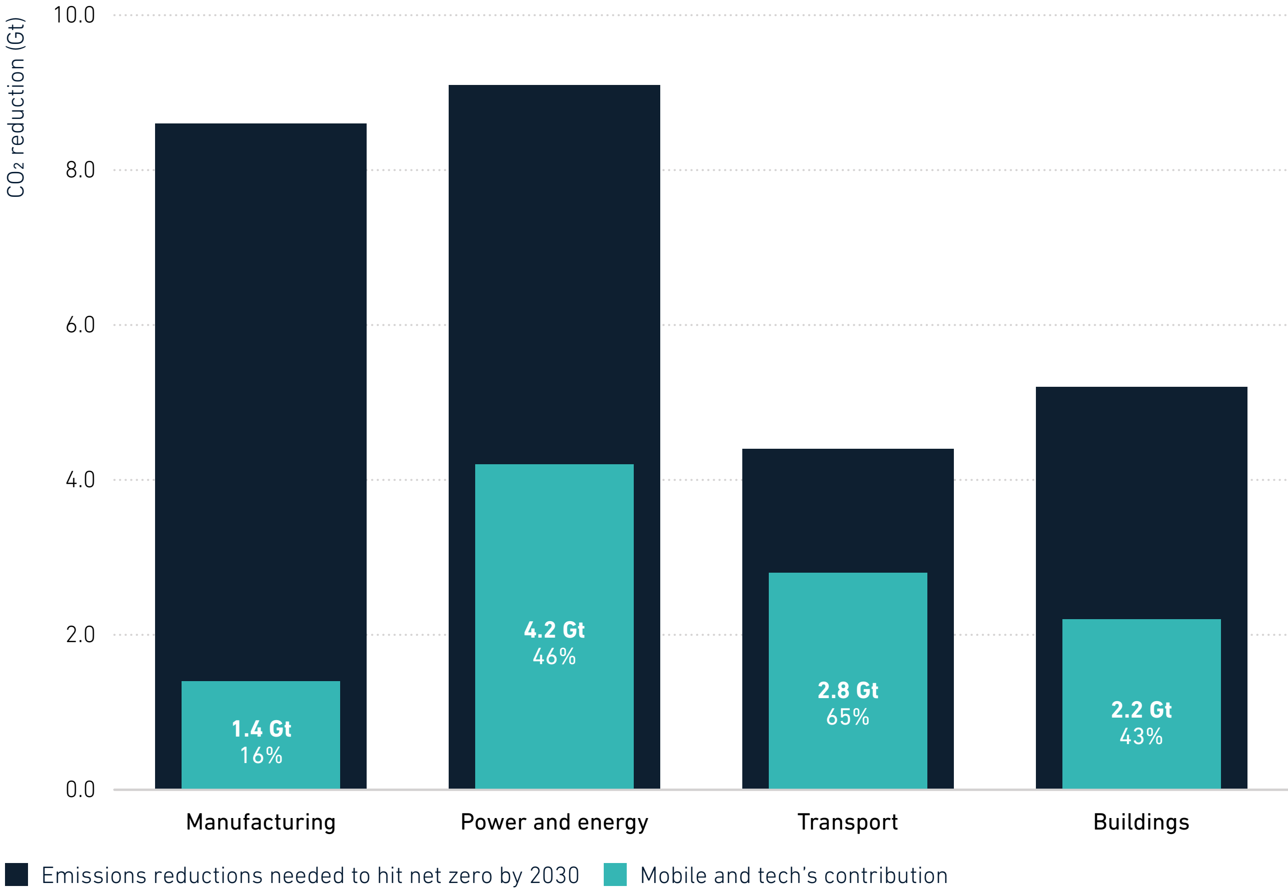
Beyond the investments that telecoms operators make to improve the energy efficiency of fixed and mobile networks, a larger proportionate impact is possible through the digitisation of other industries. This is premised on a so-called ‘enablement effect’ in which mobile connectivity, associated digital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

Reducing carbon emissions is a multi-faceted process that depends on a mix of behavioural change (what we use and consume), technology and regulation. The mix effect will vary depending on the industry. Regulation, for example, will have a higher proportionate impact on heavy industries such as oil & gas, where the fundamental operating model is based on hydrocarbons. Behavioural change will have a potentially higher impact on agriculture, where emissions are heavily driven by meat consumption among people and the animal feed required to fuel that.

GSMA Intelligence modelling suggests that, over the 10-year period to 2030, approximately 40% of required $CO_2$ emissions to be avoided in manufacturing, transport, buildings and power can be enabled by mobile and digital technology. These sectors account for 80% of global $CO_2$, so the technological effect is significant (see Figure 6).

Figure 6

## Technology can drive 40% of reductions in industries that account for 80% of global $CO_2$




Percentages represent the share of $CO_2$ savings that can be enabled by mobile and digital tech.
Source: GSMA Intelligence, Exponential Roadmap, Carbon Trust

## Renewables: showing promise but uneven take-up geographically

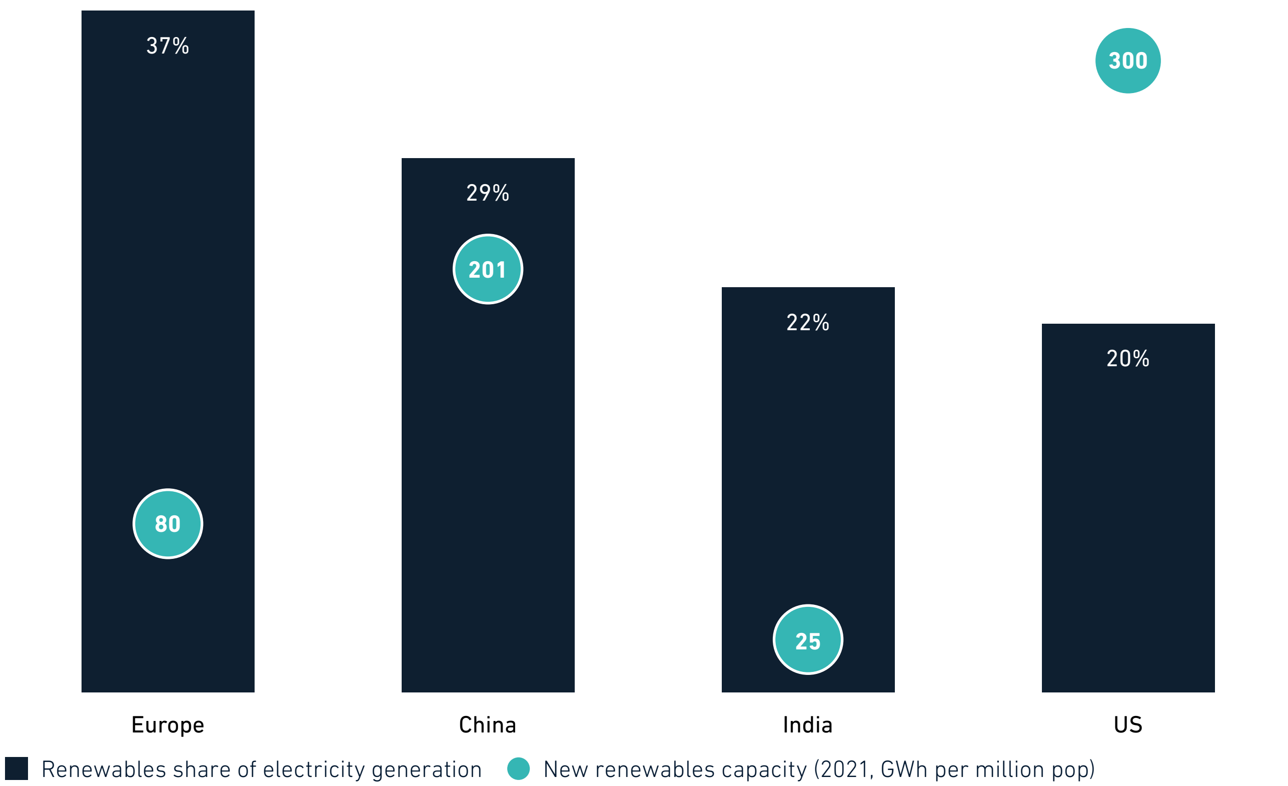
Renewable power sources and the push to increase energy efficiency in telecoms networks and their supporting infrastructure are two sides of the same coin. Renewables are a fundamental part of the transition to a low- and eventually zero-carbon economy because of their vastly reduced emissions profile. In industry parlance, this is referred to as their carbon abatement level. The story so far has again been one of strong adoption in Europe and the US, with other regions carrying a more mixed fuel-usage profile.

Across the different economic sectors, telecoms is one of the leading adopters of renewable energy, with a raft of commitments from tier-1 groups. In Europe, BT, Deutsche Telekom, Telefónica and Vodafone, for example, all plan to have 100% of electricity usage supplied by renewables by 2025 or earlier. SoftBank and Telefónica (for its non-European operating companies) have committed to this goal by 2030.

According to GSMA Intelligence analysis of real-world data from operators on their network energy usage (see Going Green: benchmarking the energy efficiency of mobile), renewables accounted for 46% of mobile network energy usage. The analysis was based on a sample of seven operators covering 31 countries in 2020. Although this sample was concentrated on Europe and the Middle East, and the share would be lower in Asia, the results suggest operators are ahead of national averages, in which renewables account for around 20–30% of all electricity generated (see Figure 7).

Figure 7

Europe leads in renewables but new generation capacity is coming online across the board




Note: renewables share as of 2020 for the US, China and India; 2019 for Europe
Source: Our World in Data, IEA, GSMA Intelligence

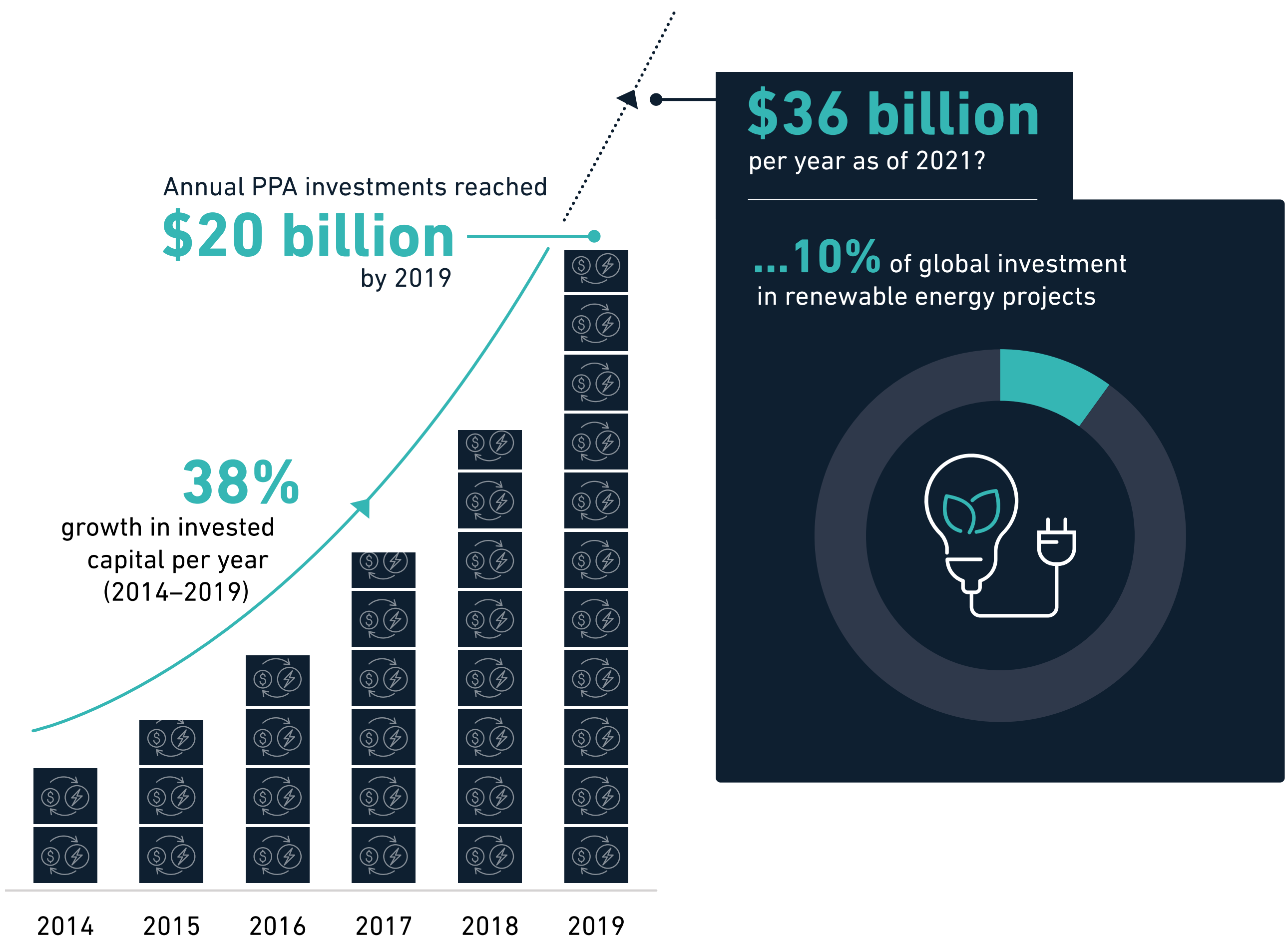
## Power purchase agreements

Power purchase agreements (PPAs) have helped advance renewable usage. PPAs are agreements in which an operator (or company from any industry) invests capital with a renewable energy provider to fund capacity at a specific generation facility, such as a solar or wind farm. The agreements typically include a dedicated supply of energy to the mobile operator (or any other investor) over a period of years. This has the benefit of securing supply and protecting against price shocks in global wholesale energy markets – something that has particular relevance of late.

While data on the total investment value of PPAs for operators is not plentiful, it likely follows a similar spend trajectory to the overall value. Data from the IEA indicates PPAs reached nearly $20 billion by 2019. If we carry forward the 40% growth rate, the figure as of 2021 would be $36 billion per year, or around 10% of global investment in renewable energy projects. T-Mobile US and Enel Green (Oklahoma), BT and Total (UK) and DoCoMo (Japan) are all recent examples of companies announcing scaled generation PPAs that will support carbon-neutral pathways.

Figure 8

Rising trend of accessing renewables through PPAs




Note: data covers all industries
Source: GSMA Intelligence analysis of IEA data for 2014–2019

## Embedding sustainability as a hygiene factor

Sustainability is now fundamental in how operators design and implement networks alongside other parts of their operations. That around 85% of operators cite energy efficiency and sustainability as a priority in their planned network transformations speaks to this change.

However, looking 5–10 years ahead, there are a number of outstanding questions and, in some cases, barriers that could hold back broader industry progress. Most pressing is the geographic imbalance in renewable energy usage and commitments to net-zero timelines by 2050 – a core part of the groundwork to justify investment in more sustainable technology. Overall, operators representing 50% of global telecoms revenue have committed to a carbon-neutral target. However, as this is heavily dominated by higher income markets in Europe and North America, the operators represent only 25% of subscribers. Many of the most populous countries in Africa and Asia (as well as parts of Latin America) have yet to commit. In Asia, excluding India, the commitment rate is only 5% of subscriber market share.

There are many reasons for this imbalance, some of which are interrelated and complex. A key outstanding question is the extent to which technology – and technology standards – can incentivise a switch to more sustainable networks. This includes the use of open RAN equipment as part of broader network virtualisation. It also includes embedding efficiency into 6G standards which will be researched and promulgated in the latter half of the 2020s. These topics are addressed in more detail in the second report of this series to be published in September 2022.

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