Sustainability Insights Service

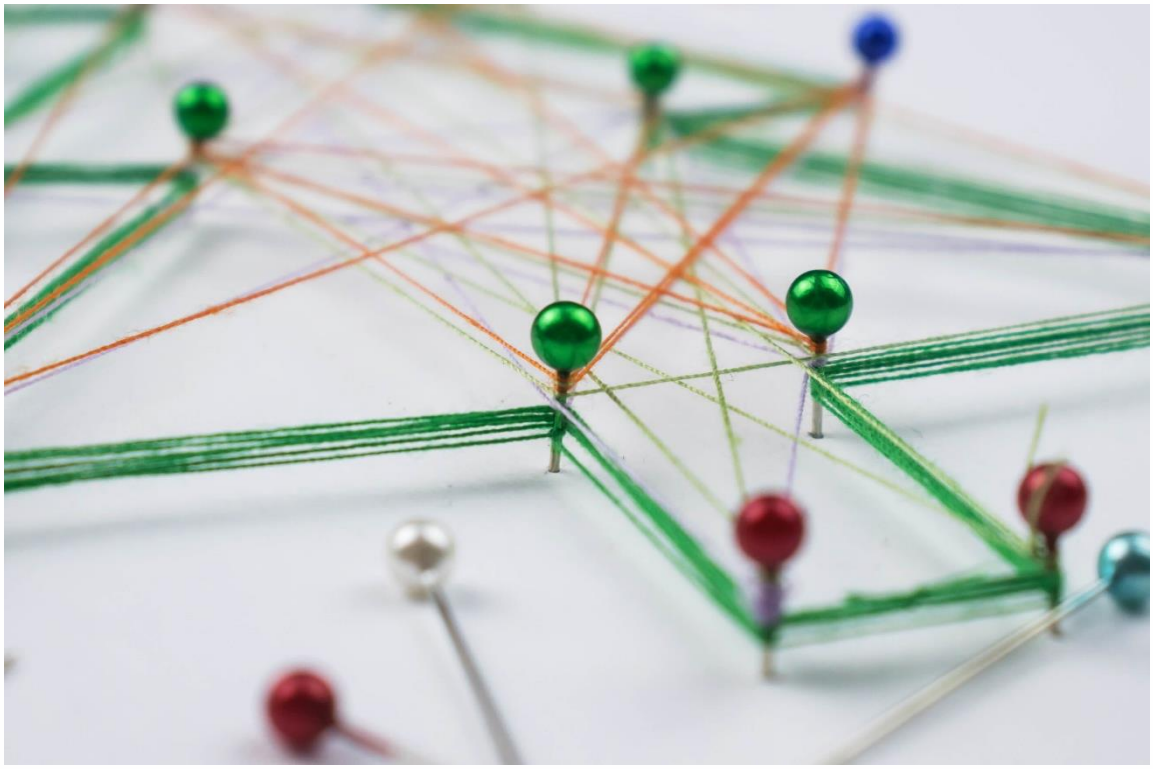
JUNIPER NETWORKS

STL PARTNERS

Executive Briefing

DRIVING SUSTAINABILITY IN METRO NETWORKS

How can operators apply best practice principles from the cloud and leading operators as they plan their metro network for growth?



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Executive Summary

Telecoms operators are having to support ever-increasing levels of traffic while reducing their environmental impact. Given the recent energy crisis, this issue has become a cost imperative, as well as 'the right thing to do' by customers, investors and employees. Keeping costs and emissions to a minimum becomes increasingly challenging in the face of user demand that is not only growing in terms of volumes but also more diverse and demanding in terms of application requirements (for example, latency for some applications). Traffic patterns are also evolving. STL Partners estimates that metro network traffic will grow by at least threefold by 2030.

To understand how operators are addressing these challenges, STL Partners conducted an interview programme with telcos in North America and Europe. Our research sought to address the following question:

How should operators better incorporate energy and sustainability goals into their metro networks and apply cloud principles and lessons from leading operators?

The findings from the interview programme revealed that operators tend to fall into two main stages in the sustainability journeys: those focusing solely on the low hanging fruit, adopting 'common practice' sustainability initiatives, and those focusing on the next tranche of sustainability initiatives, or what we have termed 'best practice'. But even today's best practice is still far from enough to achieve net-zero ambitions. Therefore, we also identified a number of next practice initiatives that operators should consider in their journey towards greater sustainability. Some of these common, best and next practice initiatives are informed by what other industries and technologies, notably cloud and datacentres have been doing. Below is a summary of our findings:

Common practice: Where have/should metro network operators initiate their sustainability efforts?

- Decommissioning legacy equipment, networks and services
- Upgrading copper to fibre

Best practice: Applying cloud principles to metro networks

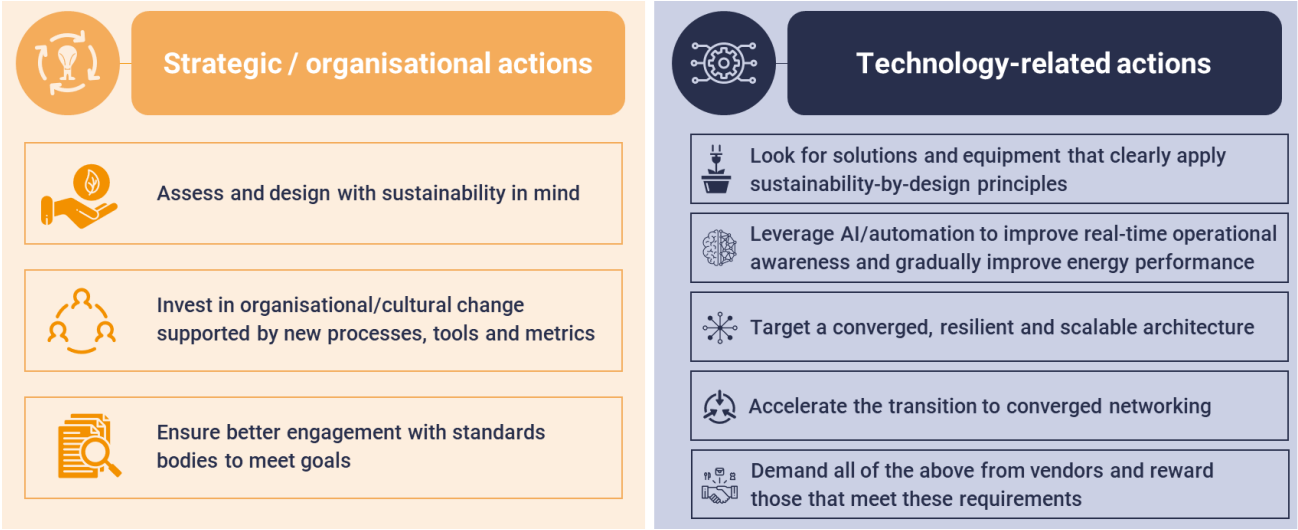
- Resource sharing (doing more with less), including network convergence and reducing the physical footprint of equipment
- Extending the life of infrastructure through more modular design
- Reducing the energy intensity of facilities/support infrastructure (e.g. heating, ventilation, and air conditioning [HVAC] systems)
- Continuous monitoring, feedback and assessment of infrastructure. Holding suppliers accountable and incorporating results into future decision making.
- Introducing more automation and enhancing sleep modes

Next practice: What future measures need to be incorporated into assessment, design, planning and procurement thinking?

- Decentralising routing fabric to reduce 'tromboning'
- Rearchitecting to spine and leaf architecture
- Ensuring availability of equipment for smaller or more appropriate network footprints
- Enhancing existing metrics for measuring sustainability, particularly within the procurement process by using a more granular total cost of ownership (TCO) measurement.

Regardless of where operators are in their sustainability journeys, there are some overarching principles to consider. STL Partners recommends the following actions, summarised in the diagram below (see Figure 1):

Figure 1: Recommendations for operators



Source: STL Partners

However, operators will not be able to achieve these ambitions alone. The ecosystem also must collaborate to make these goals achievable.

STL Partners's recommendations for the wider telecoms industry:

- Adopt sustainable design principles
- Drive cross-industry collaboration on standards for reporting design metrics and requirements
- Develop more granular standards and targets for Scope 3 emission and set up APIs to reduce manual entries and/or costly integrations for this

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Introduction

Against the backdrop of the recent energy crisis, there is a new sense of urgency around energy consumption and sustainability. Enterprises are doubling down on their green targets, in many cases accelerating plans for an ambitious endgame – net-zero emissions. As we have covered extensively in previous reports, the telecommunications industry is not an exception to this.

Telecoms operators face a particular challenge in that they have experienced and anticipate future high levels of growth in traffic (20% to 40% per annum). Furthermore, consumption patterns are changing with even higher levels of traffic growth originating and terminating within the metro network. The metro network (sometimes referred to as access and aggregation) is the section of communications service providers' (CSPs) network between the last-mile access and the core backbone. STL Partners estimates that metro network traffic will increase threefold to 2030. This is driven by:

- growth in demand for increasingly immersive user services,
- proliferation in high-bandwidth connections to machines, vehicles and sensors
- the deployment of multi-edge compute (MEC) infrastructure and applications,
- the need to support next-generation services to support the above.

In light of CSPs' net-zero commitments, the significant growth in traffic across the metro network makes it imperative to drive down energy use and associated emissions (including embedded greenhouse gas emissions) to make the metro network sustainable. The challenges faced in the metro network are not dissimilar from those faced by cloud providers - massive growth in scale coupled with ambitious sustainability commitments. While cloud providers have already been addressing these challenges, operators have typically been further behind. Our research, therefore, sought to address the question:

How should operators better incorporate energy and sustainability goals into their metro networks: applying cloud principles and lessons from leading operators?

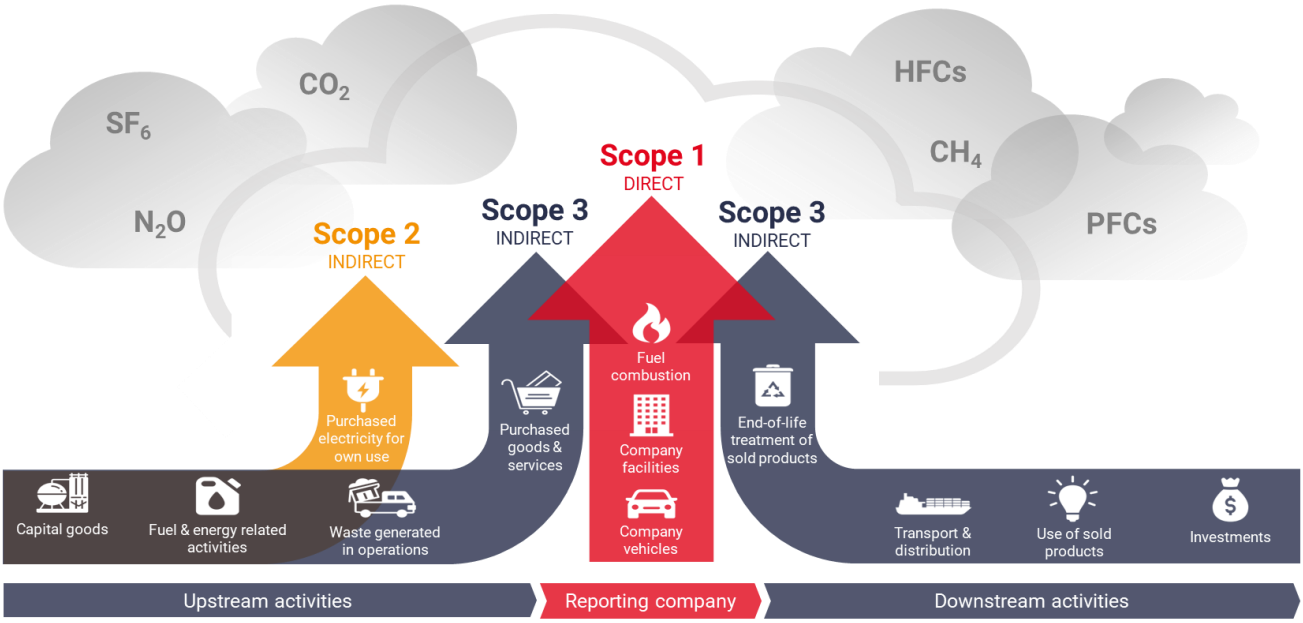
To understand telcos' sustainability efforts, we conducted an interview programme with key decision-makers at Tier-1 and Tier-2 operators across North America and Europe. We focused our conversations on telco networks and how they are designed, built and maintained to address both near and long-term sustainability challenges, with a special interest in operators' metro networks.

In the interviews, we asked operators about their strategies to reduce Scope 1 to 3 emissions, which are defined as:

- **Scope 1 emissions:** Direct emissions from day-to-day operations, e.g. fuel combustion, coolant leakages

- **Scope 2 emissions:** Indirect emissions from electricity suppliers, e.g. to power metro networks and facilities-supporting infrastructure (heating, aircon, uninterruptible power supply, etc.)
- **Scope 3 emissions:** Indirect (non-energy) emissions e.g., embedded carbon from suppliers of equipment and services (e.g., civil works, equipment in metro locations, trucks) (see Figure 2).

Figure 2: Classification of greenhouse gas emissions reporting



Source: STL Partners

The interviews confirmed our initial hypothesis: sustainability is a growing concern for operators and there is significant work to do.

> With the energy crisis, sustainability has now become top of the agenda. The CEO and the CFO have become routinely involved in these discussions whereas they weren't involved before.
>
> *EVP, Infrastructure, Tier-2 operator, EMEA*

- All operators in our interview programme confirmed that they are on a path towards decarbonisation, but where they are on their journeys varies significantly from operator to operator and from region to region.
- European operators tend to have more established approaches to sustainability and are particularly focused on energy use given the current energy crisis affecting the region:
  - Going green is both a cost imperative as well as 'the right thing to do' for European operators, in addition to the stringent regulatory environment in which they operate.

  - On the one hand, this is a positive change as it has raised the profile of energy efficiency which is now increasingly seen as an executive-level agenda item.

  - However, there is also a hidden impact: telcos are pushing hard on energy and Scope 2 objectives. But at the same time, this has deferred the operators' efforts to reduce their embedded (Scope 3) emissions which is the biggest contributor to their overall carbon footprint (Scope 3 accounts for 80% to 95% of most operators' total emissions).

- The North American operators were less focused on the cost of energy, and therefore in reducing it through greater efficiencies, but nonetheless were aware of the need to meet the ambitious net-zero targets that they have set.

In this report, we will discuss our learnings from closely watching the industry and speaking to the leaders driving operators' efforts. The four main sections of this report discuss what we are referring to as common practice, best practice, and next practice strategies and actions that operators are pursuing to meet their sustainability goals, with a particular emphasis on their activities within the metro network (see Figure 3). For operators to meet their targets, they will need to go beyond the low-hanging fruit of common practice and focus on the additional initiatives they will need to start adopting. Operators already undertaking best practice initiatives should focus on next practice. Less mature operators should take lessons from those further ahead in their net-zero strategies and aim to cover the best practice initiatives of their peers. All operators can also borrow concepts from other industries, notably cloud providers. Ultimately, without taking on the tougher challenges in their access and metro networks, operators will miss their net-zero goals.

Figure 3: Three types of operator strategies for sustainability

Source: STL Partners

In this report, we illustrate a number of best practice initiatives that more mature operators have pursued while upgrading their metro architectures, many of which borrow from cloud principles. Building on this, we highlight some of the next practice actions that telcos can take to tackle the tougher sustainability challenges they will need to address to meet their sustainability goals. The report then provides a selection of recommendations for operators and the wider industry, to accelerate the transition to net zero.

Common practice: Where are metro network operators focusing their sustainability efforts?

Most operators have now set net-zero targets and are in the process of creating more practical plans to achieve these goals. From our conversations with CSPs, it became clear that most of them are still focusing on what we would consider is low-hanging fruit. These initiatives will have a significant impact for operators through relatively straightforward actions, but with diminishing returns.

The first and most common initiatives are for operators to decommission old technologies where newer, more energy efficient alternatives are already being introduced. Accelerating such decommissioning provides some quick wins (both financial and environmental). In particular, there is a big emphasis on copper to fibre-optic transition in telco networks (including, surprisingly, cabling in some metro sites) to, among other benefits, capitalise on fibre's energy-efficiency and smaller carbon footprint. One of the interviewees claimed that the transition to fibre has also helped them reduce the number of breakdowns in the network, which has, in turn, translated into fewer field visits, truck rolls, trucks themselves, and ultimately less Scope 1, 2 and 3 emissions.

> Upgrading from copper to fibre has helped reduce fuel consumption – there are fewer breakdowns and fewer truck rolls. And it is not just about fewer truck rolls, but also a fewer number of trucks required.
>
> *Corporate sustainability team, Tier-1 operator, EMEA*

Mobile operators are also focused on sunsetting 2G and 3G networks and refarming the spectrum. These networks tend to be supported by legacy equipment that is often less energy efficient than 4G/5G, so switching these off is also providing efficiency benefits.

> It is useful to reuse those specific energy metrics (watt per GB) to see the impact for those energy saving features. For example, we have been sunsetting 3G in some areas and refarming the spectrum and we can see the consequence of doing that.
>
> *SVP, Head of Network Architecture, Tier-1 operator EMEA*

Outside of active infrastructure, operators are also finding efficiencies in facilities-supporting infrastructure (the supporting equipment that supports network facilities). Many are developing greater monitoring and assessment capabilities to keep track of wasted energy such as blocked vents, or doors left open in central offices or other physical locations, unnecessarily straining HVAC systems.

Aside from the focus on active and facilities-supporting infrastructure, operators are focusing on internal initiatives dedicated to improving sustainability. Some of the more prominent examples that have come up during the interviews include:

- **Power ninjas:** One of the European operators we interviewed is deploying internal teams called "power ninjas" that are focused on finding ways to reduce power usage across the various domains of the organisation, including different network domains. One of their projects involved the demonstration of a green mobile site that is completely energy neutral. These projects are

largely experimental and are aimed at finding innovative ways to combat emissions. The same operator has also implemented dedicated initiatives to make their metro locations more sustainable, for example, by deploying rooftop solar panels for clean energy generation or by exploring green roofs as a natural way of reducing energy consumption for cooling.

- **Sustainability incentive schemes:** One of the North American operators we spoke to factors in sustainability in the senior leadership team's bonus package by giving it a 10% weighted score. These targets tend to be most helpful for organisations when they are linked to more detailed targets, e.g. reduction in emissions by a specific percentage, within a specific time frame. The same operator has an internal green team and a sustainability council where employees can get involved and initiate sustainability-related projects.

> We want to get ahead of this as a company - being a sustainable and green organisation is very important to us. This is, therefore, reflected in how we do things. For example, sustainability has a 10% weighted share in the senior remuneration scorecard.
>
> *Outside plant engineer, Tier-2 operator, NAM*

- **Network and service housekeeping:** Another relatively straightforward way to reduce waste is to identify, switch off and redeploy equipment that is no longer supporting live services (or paying customers). By undertaking such audits and cleaning up inventories, operators we spoke to were able to reduce energy for powered equipment that was not needed and, where possible, redeploy this elsewhere, reducing both Scope 2 and Scope 3 emissions.

Despite the significant impact that these initiatives can have on telcos' carbon emissions, they will not be enough to get operators to net zero. Ultimately, these are only a first step as there is not a single easy fix or killer solution that will solve the problem. In fact, a more comprehensive, strategic approach is needed to tackle greenhouse emissions. This includes not only getting smarter and more efficient at managing the physical infrastructure but also updating corporate culture, procurement standards and decision-making tools and processes to reflect sustainability as a new priority that the entire company has committed to get behind.

Best practice: Applying cloud principles to metro networks

In this section, we will dissect a myriad of ways in which operators showcasing best-practice in sustainability can go one step further in their green efforts. As mentioned previously, operators in this group have started to leverage cloud principles to further their sustainability goals. In many cases they can do this with the support of vendors who have built the appropriate products and services to help operators on this journey.

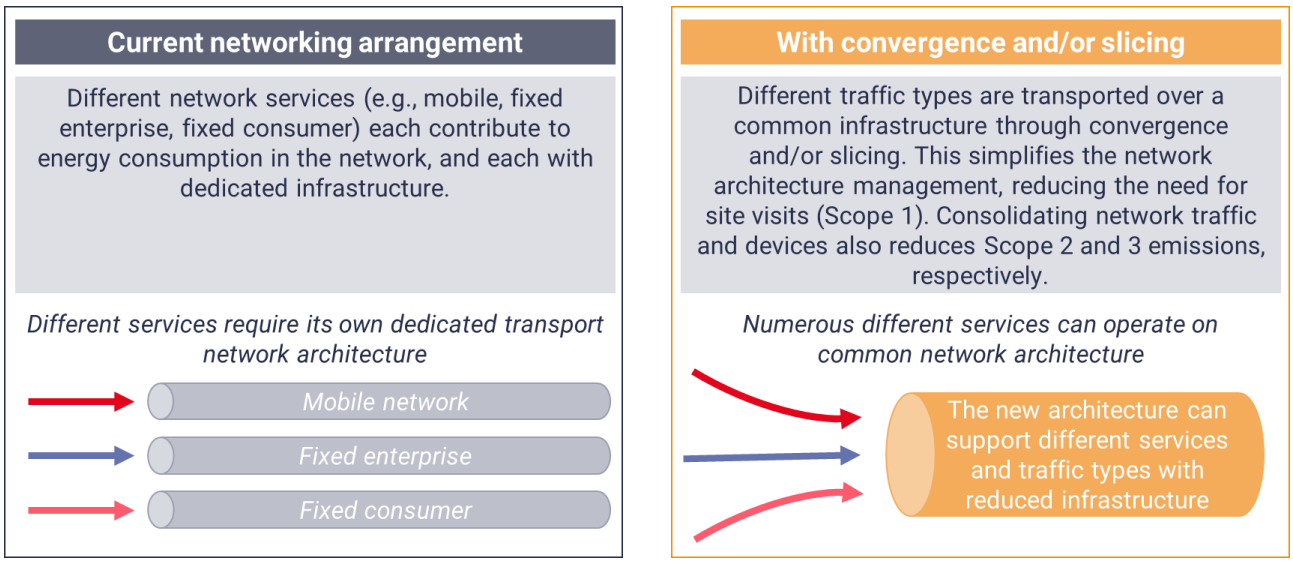
- **Doing more with less / resource sharing:** One of the key principles of cloud computing is resource sharing. Applying this principle to metro networking promotes the convergence of all metro service operations onto a single converged metro architecture – a cloud metro – eliminating the need to sustain separate networks and resource duplications that drive up cost, footprint, and carbon emissions. There are several ways in which this can be achieved:

  – **Network and service convergence with network slicing:** Convergence simplifies network architecture and reduces Scope 1, 2 and 3 emissions. Where greater convergence is achieved, the need for separate networking equipment, management systems and supporting resources, each dedicated to different services is reduced as traffic can be transported on the same architecture with the help of functionally, operationally and administratively isolated network slices (see Figure 4). This logic also applies to converging the optical and IP networks. A further benefit is that these simplified, converged networks can be more readily optimised and automated, thereby further reducing emissions.

> While network convergence was not driven by sustainability, we have seen benefits. Our preference is to continue - fewer layers, less complexity and number of devices so lower consumption and embedded carbon.
>
> *SVP, Head of Network Architecture, Tier-1 operator, EMEA*

  – **Reducing local physical footprint** is another element of doing more with less. This can be achieved by investing in equipment and devices that are smaller in size while maintaining the same, or better, levels of performance. It can also be achieved by having fewer devices to do the same job, if functions are converged on a single hardware device. A smaller (physical) footprint, in turn, means less embedded carbon and overhead energy consumption, e.g. for cooling or maintenance – meaning a reduction in both Scope 2 and 3 emissions. A smaller number of smarter devices also means fewer potential points of failure, and therefore fewer truck rolls required to resolve any issues. Applying cloud principles by abstracting control plane functions through software-defined networking supports this. As above, such networks can be more readily optimised and automated, thereby further reducing emissions.

Figure 4: Network and service convergence with network slicing

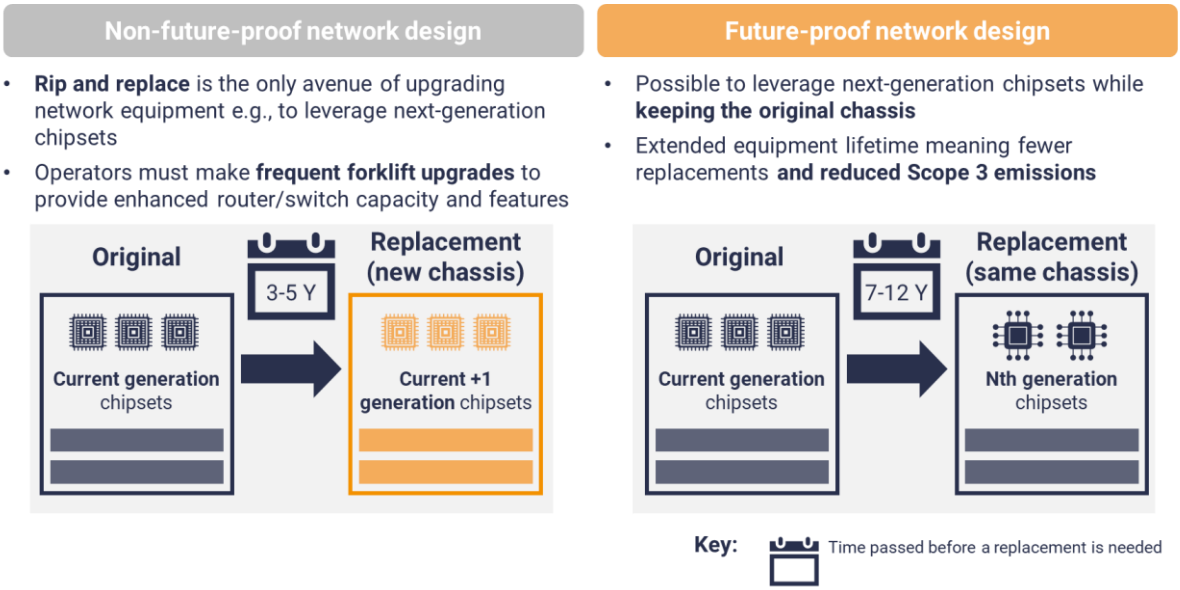


Source: STL Partners

- **Extending the life of infrastructure through more modular design:** One of the key tenets of cloud players is extending the useful life of their infrastructure. Translating this principle to telecoms, aside from the positive impact on total cost of ownership (TCO), operators can reduce their carbon footprint. Longer hardware lifecycles translate into fewer renewals and therefore less embedded carbon (as part of new equipment) and e-waste and emissions associated with disposing of old equipment.

  – One way to extend the life of the equipment is by ensuring that when upgrading metro network equipment, the operator chooses solutions that have future-proofed designs (see Figure 5).

Figure 5: Future-proof design for longer hardware cycles

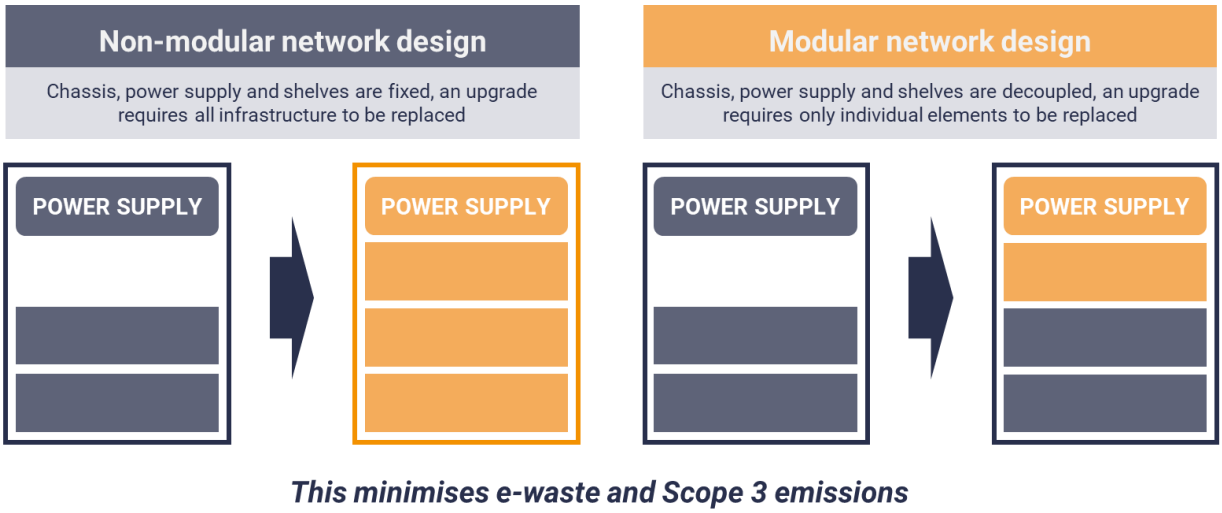


Source: STL Partners

– Another way to achieve longer hardware lifecycles is by investing in metro equipment with modular components. For example, in the case of routers with a modular design, the chassis is decoupled which means the power shelves and supply units are not fixed. If the power supply needs to be upgraded, this can be done without forklifting the entire chassis (see Figure 6).

> Modular chassis with more capacity to expand by adding individual line cards is helpful. This provides cost, space and energy efficiency.
>
> *Associate Fellow, Tier-1 operator, NAM*

Figure 6: Modular network design for longer hardware cycles



Source: STL Partners

- **Automation** is another key cloud principle that operators can borrow to enhance the performance of their metro sites and reduce their emissions (primarily Scope 1).

– AI Ops[1] can be leveraged to provide active network assurance and health monitoring to detect issues before they arise, or through regularly scheduled maintenance visits, as well as to support remote onboarding. If successful, telco engineers will have to make fewer field visits thus reducing the number of truck rolls and the associated Scope 1 emissions arising from the vehicle (see Figure 7).

> Any automation for remote troubleshooting is important for saving both costs and emissions, always trying to minimise dispatch vehicles.
>
> *Associate Fellow, Tier-1 operator, NAM*

[1] AI Ops is defined as artificial intelligence for IT operations

Figure 7: Estimated yearly reduction in CO2 emissions (for one SP) from field interventions

Estimated yearly reduction in CO2 emissions (for one SP) involved in sending a field engineer to a metro site for a field intervention:

	Onsite activities	Driving time (mins)	Average driving speed (km/h)	Km per truck roll	Average CO2/km (Kg)	Total CO2 per activity (Kg)	Number of field visits / month	Total CO2 in a month (Kg)
Manual	Site survey	40	65	43	0.12	5.2	1000	5,200
	Incident detection/ resolution	40	65	43	0.12	5.2	1000	5,200
						Average CO2 emissions (Kg/month)		10,400
Automated	Site survey	40	65	43	0.12	5.2	500	2,600
	Incident detection/ resolution	40	65	43	0.12	5.2	500	2,600
						Average CO2 emissions (Kg/month)		5,200

Yearly CO2 reduction:
62,400 Kg

Equivalent to:

- 11 homes' electricity use for one year
- 150 barrels of oil
- ~1 tanker trucks' worth of gasoline

Source: STL Partners

- **Reducing the energy intensity of facilities-supporting infrastructure (HVAC):** Cloud players have been innovating in deploying minimal facilities-supporting infrastructure. This is also a key focus area for several operators that we spoke to. Telcos reported experimenting with innovative ways to achieve this, including with immersion and liquid cooling. For example, one of the Tier-1 operators in Europe has moved to free cooling. Another North American Tier-1 operator mentioned that it is looking to use artificial intelligence (AI) to find ways to minimise HVAC and optimise cooling wherever possible. The general goal is to find ways to apply more targeted cooling directed only at specific areas rather than wasting energy cooling a wide area. Several operators we interviewed are also increasing the temperature range within which they require equipment to operate, which is reducing the burden on HVAC systems.

> A large percentage of energy consumption is used to keep the site at the right temperature. Because of the cold climate of our country, we have incorporated and converted the natural airflow to cool the equipment.
> *VP, Wireless Strategy & 5G Services, Tier-1 operator, NAM*

Other beneficial principles for operators to leverage include:

- **Introducing more automation to enhance sleep modes:** Introducing greater efficiencies can be done at an overall network level and right down to the individual cores. Sleep modes can be designed so that they are very granular, shutting network resources down when they are not in use, helping to reduce the energy intensity of active infrastructure in line with demand.

- **Continuous monitoring, feedback and assessment of infrastructure to hold suppliers to account and incorporate results into future decision making:** Operators that demonstrate best practice often go the extra mile and verify that vendor-reported performance metrics meet their specifications by monitoring them in the field, reporting the actual performance (e.g., KWh/TB) and comparing to the vendors' claims. For these operators, responsibility does not end at the procurement stage but continues throughout the lifecycle of the equipment by holding vendors to account (to address any shortcomings) and incorporating findings into their future decisions (rewarding higher performance and penalising under-performance). Additionally, best practice includes setting clear procurement standards and following through with vendors to ensure sustainability targets are met.

> We know that base stations are the 'big spenders' of energy. We are measuring how much traffic is getting through the different configurations of base stations to see that comparison between different suppliers but also at different stages in the field.
>
> *SVP, Head of Network Architecture, Tier-1 operator EMEA*

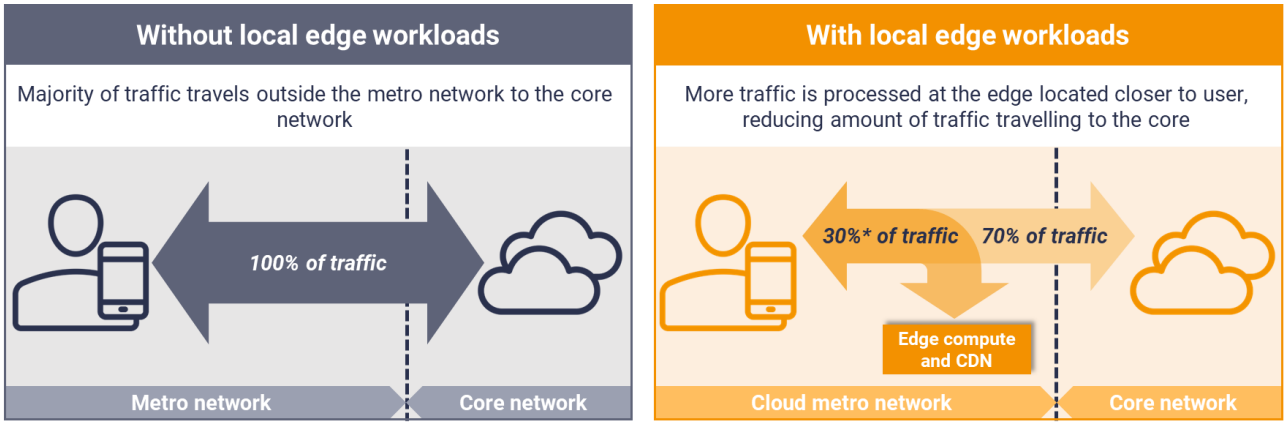
Next practice: What future measures need to be incorporated into current thinking?

Once telecoms operators have swept up the low hanging fruit and got to grips with best practice initiatives, they need to focus on next practice: initiatives that are still a few years away for most operators but will bear fruit for forward-thinking telcos. Progress towards sustainability will come from a range of measures, many of which are not possible without the help of innovative designs and architectures. This section of the report explores four future-focused sustainability initiatives that more mature telcos should start to focus on. These require operators to fundamentally revisit the underlying architectures and network operating models.

- **Decentralising routing fabric to reduce 'tromboning':** STL Partners predicts that growth in the metro network is expected to rise threefold by 2030, which represents the most significant growth area compared to other parts of the telco network. At the same time, the number of edge deployments continue to proliferate, offering the opportunity to keep more traffic local and reduce the amount sent back to the core, ultimately delaying the burden of growth on the backbone. These deployments will also be necessary for telcos to enable next-generation use cases that depend on lower latencies, data sovereignty and enhanced security. Limiting the amount of data traversing the entire network can enable operators to reduce their Scope 2 and Scope 3 emissions which will become increasingly important for meeting sustainability targets as overall data volumes continue to rise. Furthermore, by adopting innovations in edge form factors – with a focus on minimising the physical footprint – operators can reduce the embedded carbon in the hardware and the associated Scope 3 emissions (see Figure 8).

> Given the size of our country, decentralisation will have a meaningful latency impact. We will need to scale to additional network locations to make this happen but will need to have physically scaled down solutions to be able to deliver on this.
>
> *VP, Wireless Strategy & 5G Services, Tier-1 operator, NAM*

Figure 8: Local edge workloads can reduce traffic to the core



**Calculated using STL Partners' edge computing market sizing forecast*

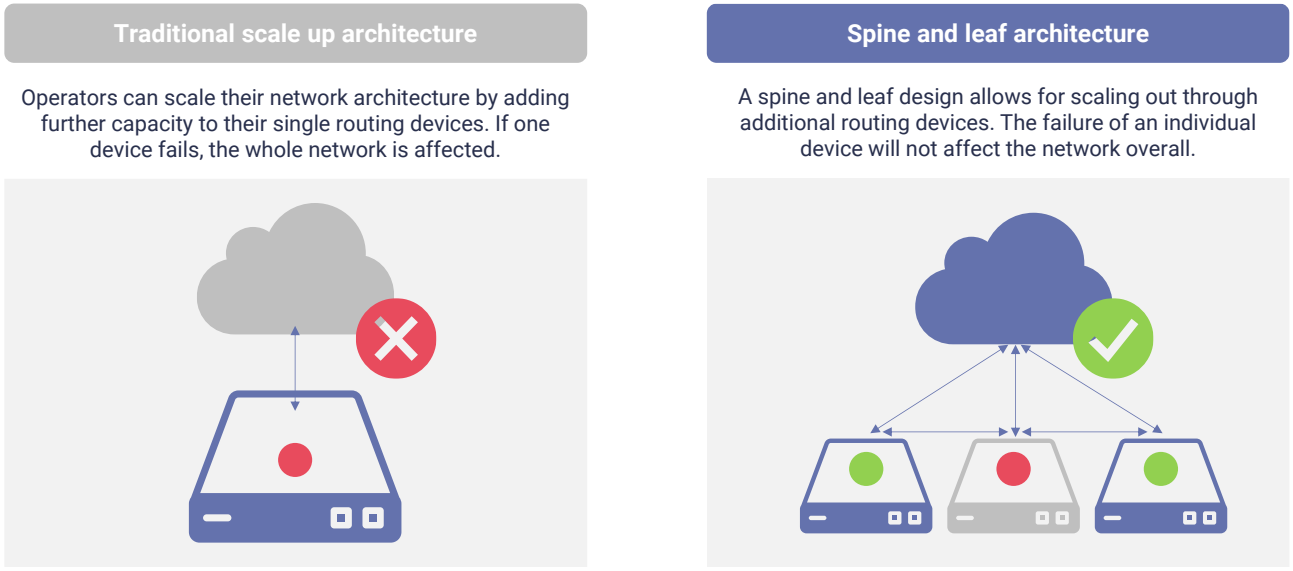
Source: STL Partners, https://stlpartners.com/research/edge-computing-market-sizing-forecast-2nd-release/

- **Rearchitecting to spine and leaf architecture:** Borrowing principles from data centre design and applying them to the metro network can also help operators to achieve sustainability benefits. Spine and leaf architecture – also called scale out architecture – provides greater network resilience thanks to a design that scales horizontally through additional routing devices and virtualised functions, allowing individual devices to fail without affecting the network overall. Other network architectures, like traditional scale up models, are more prone to failure given their need to scale vertically through adding further capacity to single routing devices, such that if one fails, then the whole network goes down.

> Spine and leaf architecture does provide direct connectivity back to every line card, connecting them in a way that allows you to easily add more line cards. This does provide a way to scale.
>
> *Network planning and technology, Tier-1 operator, NAM*

While a more resilient network is an obvious benefit for telcos, there are also sustainable aspects to this architecture. Firstly, fewer network outages mean fewer site visits (therefore saving on Scope 1 emissions). Secondly, by adding further capacity through additional energy efficient devices, energy consumption is less concentrated in fewer, larger, more power-hungry devices. Finally, deploying more virtualised functions decreases the dependence on physical hardware and the embedded carbon that this implies (see Figure 9).

Figure 9: Spine and leaf architectures can provide greater network resilience



Source: STL Partners

- **Ensuring availability of equipment for smaller or more appropriate network footprints:** Many – particularly incumbent – operators are not necessarily focused on minimising their physical footprint, given the extensive real estate to which they already have access. Furthermore, licensing practices (for example, only charging for some capacity/functionality that is used) can mean that over-sized and over-specified equipment is deployed (with excessive embedded carbon and energy use). For operators that are focusing on upgrading their brownfield sites, the key focus will be on energy efficient infrastructure that makes appropriate use of the existing

space and facilities supporting infrastructure. On the other hand, operators without extensive physical footprints deploying greenfield networks are likely to be focusing on ways to minimise their physical footprint given that real estate is an expensive resource. Brownfield operators will also need to get serious about the embedded carbon in their networking equipment and consider how a smaller, or more appropriate network footprint could help to minimise the amount of kit they are deploying across their sites.

- **Enhance existing metrics for measuring sustainability, particularly within the procurement process by using a more granular TCO measurement:** We interviewed several operators that are using traditional TCO as the basis for informing network design, planning and vendor selection. TCO is also seen as a good proxy for sustainability. Many procurement teams are already assessing the energy intensity of equipment over its total projected lifecycle, to derive a TCO that to some degree acts as a proxy for the sustainability of the design or item in question. However, this does not capture the full picture, as equipment that is more modular does not receive a better TCO score, despite it being more sustainable overall. A TCO plus model can help to account for the full impact of procured products and services. For example, we spoke to one operator that is seeking to implement a carbon cost into their assessments. This mechanism attaches an internal monetary value to greenhouse gas emissions (including refrigerant gases that are not captured from energy costs alone) that equipment is associated with over its entire useful lifecycle. This cost will be calculated using standard emissions factors (embedded and in-life use). Although the operator will not actually pay this additional cost, it nonetheless contributes to the overall TCO assessment. Other refinements to make TCO calculations more sustainable include projecting future efficiency improvements (through optimisation and SDN-enabled machine learning automation) and factoring in climate resilience through risk analysis (e.g., what if regulations change).

> When we talk about price, we are not just talking about the price of the equipment itself. Our procurement process is defined by TCO that takes into account energy and fuel consumption across the entire lifecycle. We are looking to implement this for all network and IT systems in the future.
>
> *Environmental and Climate Strategy, Tier-1 operator, EMEA*

- **Get specific to reward sustainable design and operation:** More ground-breaking operators should seek to attach the carbon cost at an equipment-specific level (rather than using factor-based estimates), including its manufacturing, distribution and incorporating re-use and recycling. Also, they should reflect any device-specific longer life-time expectations in their TCO calculations. (Operators tend not to do this but apply the same lifespan to all designs and equipment.) However, this would rely on processing detailed, granular data from suppliers, which CSPs are not yet mature enough to do.

Recommendations for operators: Identifying the right tools and methodologies

Sustainability will not be achieved in one fell swoop. This report lays out the initiatives that operators are focusing on now, as well as those they should start to consider implementing in the future. Operators should first take stock of where they are in their journeys. For those that are still focusing on common practice initiatives, it is time to start taking learnings from the cloud and other operators, by implementing best practice approaches. For operators already adopting best practice, focusing on next practice will hold the key for meeting net-zero targets. But how should operators pursue these initiatives? What is the role of the wider industry in helping telcos to achieve their goals? Below are our recommendations for operators and other industry players.

Recommendations for operators evaluating the next metro upgrade

- **Look for solutions and equipment that clearly apply sustainability-by-design principles:** As discussed throughout this report, both active and facilities-supporting infrastructure plays a crucial role in efficient network design. Some vendors have designed their equipment with sustainability in mind. Telcos should seek out these vendors, particularly those that have established sustainability metrics they are able to report on to allow operators to differentiate options.

- **Leverage AI/automation to improve real-time operational awareness and improve energy efficiency over time:** This will help operators to optimise performance in a way that can maximise sustainability. For example, reducing the chance of emergency outages that require manual site visits by introducing greater levels of proactivity in network monitoring.

- **Target a converged, resilient and scalable architecture:** A converged network architecture will help minimise duplication by enabling the operator to run multiple network services over the same physical infrastructure. Additionally, moving towards a spine and leaf architecture will help drive greater resilience with a network design that scales horizontally and therefore avoids having a single point of failure. This, in turn, will translate into fewer truck rolls to fix problems and fewer emissions.

- **Explore the availability of converged networking platforms:** These platforms are designed for flexible deployment, for upgradability to extend product lifecycle, and designed to support more sustainability through density, flexibility and power efficiency by minimizing carbon footprint.

Recommendations for operators embedding sustainability internally

- **Assess and design with sustainability in mind:** During lab testing new technology or planning network evolution, sustainable and efficient architectures should be a guiding principle. If sustainability is central to these considerations, this will help to future-proof the network for years to come and ensure that both costs and carbon emissions are driven down.

- **Organisational/cultural change, through new processes, tools and metrics:** Sustainability is built into the core of how best practice telcos operate. In fact, operators should actively design and invest in training, incentives, awareness building and other 'soft' tools to drive sustainability and innovation within the organisation. Furthermore, there is an active effort to ensure that this sustainability-focused collective mindset is baked into the organisation on an ongoing basis. Sustainability should be systematic, and more telcos should focus on building up programmes that incorporate this mentality across all business.

- **Exert influence on vendors:** Operators exist in an ecosystem – the networks they build are dependent on the vendors that supply them. Although many operators have already introduced efficiency measurements into their procurement decisions, several operators noted that vendors often do not meet these standards. If operators collectively raise their minimum standards, this will leave vendors with no choice but to meet these, driving improvement across the entire industry.

- **Ensure better engagement with standards bodies:** It will be difficult for operators to drive positive change across the ecosystem without organised, concerted efforts to raise industry standards. Collective agreements across operators are more likely to be made if they are part of cross-industry organisations, standards bodies and working groups that can systematically implement efficiency measures.

Recommendations for the wider industry

- **Adopt sustainable design principles:** Designing with sustainability in mind will help vendors to build robust, future-proofed portfolios that can help operators to deliver on the sustainability targets. Vendors should design to specific metrics that are quantifiable and measurable, such that operators can systematically compare vendors on an level playing field and be able to monitor and assess the claims on an ongoing basis.

- **Drive cross-industry collaboration:** For both operators and vendors alike, better alignment on sustainability metrics and standards will help to accelerate sustainability efforts. Increasing minimum standards will help the vendor community to be more innovative. Aim to develop common language and methods for the assessment of targets, metrics and requirements. There are several examples of metrics that should become more standardised, for example:

  – How to measure the life expectancy of kit

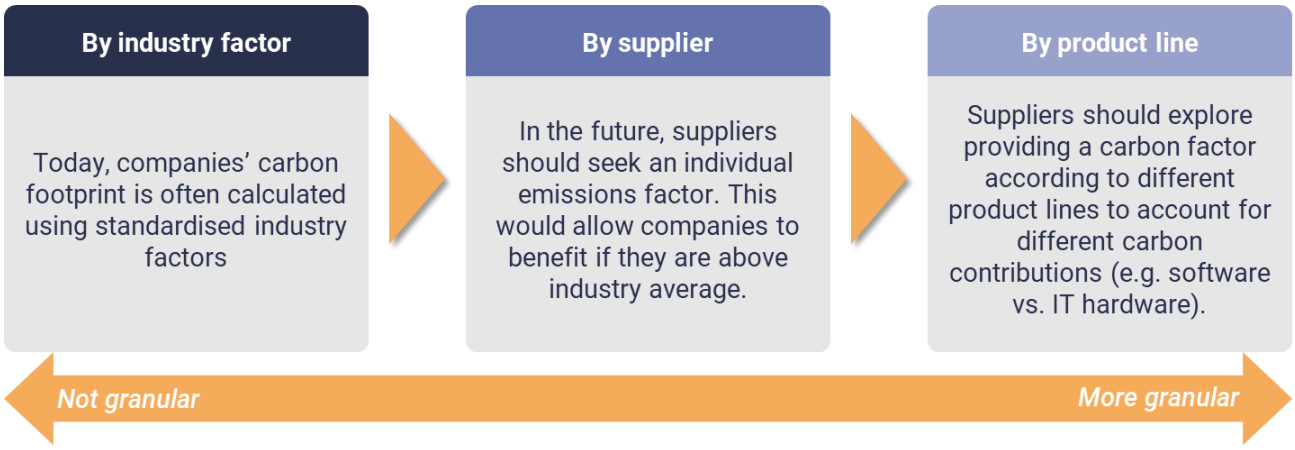
  – How to standardise procedures for decommissioning old kit

  – What unit of measurement should be deployed as a standard for measuring the power efficiency of kit

- **Develop more granular standards and targets for Scope 3 emissions:** The question (and challenge) of Scope 3 will become increasingly prevalent as operators become increasingly adept at reducing Scope 1 and 2 emissions. The difficulty of tackling Scope 3 is a result of minimal transparency from the supply chain. If vendors can provide more granular and

transparent reporting on the embedded carbon in their equipment, e.g. moving away from generic factor analysis, down to more detailed reporting on the different levels of embedded carbon across different product lines within their portfolio, this would be hugely attractive to telcos that are looking to get a better handle on their Scope 3. See Figure 11.

Figure 10: Scope 3 emissions need to become more granular



Source: STL Partners

- **For Scope 3 reporting, develop open APIs to reduce manual entries and/or costly integrations:** Achieving a better grasp on Scope 3 emissions is hugely complex. Ecosystem players looking to provide better granularity to their customers should look at trusted ways to measure the carbon emissions of their manufacturing, distribution and general operations, and then make it simple and reliable for customers to use these in their own reporting. These may be achieved by using APIs and automation to avoid manual calculations, helping to embed monitoring and measurements as standard.

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