Chasing Net Zero

Are the ICT sector plans on track?

KPMG EMA TMT Sector
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Contents

Executive Summary

The climate crisis is a global threat, so it is necessary to find global solutions soon.

Decarbonisation is essential to our global net-zero efforts as the world continues to fight headwinds in the path to emitting net-zero carbon dioxide gasses and limit global warming to 1.5˚ Celsius by 2030 (according to The Paris Agreement).

Global progress in tackling climate change is, of course, heavily dependent on countries fully delivering on stated commitments and announced policies — a big bet in an era of growing uncertainty, political instability, ongoing recession risk and black swan crises. But the climate stakes are too high, and the long-term trajectory already set. And where governments fall short, businesses, pressed by investors and regulators, have a major opportunity to pick up the slack. In many ways, this is already happening, as the private sector is gearing up.

The Information and Communication Technology (ICT) industry remains a global sector that transcends geographical boundaries and through their products and services are able to promote connectivity, productivity, trade and content while also taking the lead in the adoption of sustainable business practices for shared value.

The purpose of this report is to help ICT companies, investors and sustainability professionals gain a better understanding of the adoption and reality of net-zero emissions in EMA (Europe, the Middle East and Africa) by summarising KPMG professionals' analysis of the trends, risks and opportunities related to net-zero emissions.

Additionally, this could aid operators and investors in understanding the current landscape and potential areas for improvement. Stakeholder pressure is being applied to the Telecom industry to reduce its environmental impact and conduct business more responsibly.

The sector has a strong track record of helping developing nations make rapid advancements in the net-zero emissions context by learning from developed first world countries.

Companies in the telecom industry, particularly mobile operators, are accelerating their efforts to achieve net-zero emissions. Despite growing data traffic demand, many operators have been successfully reducing their emissions. This is primarily due to investments in low-carbon technologies such as onsite and market-based renewable electricity and energy-efficient networks like 5G. According to research by a leading European telecom major, 5G technology is up to 90% more efficient than 4G in terms of energy consumption per unit of traffic.

There have been notable advancements and commitments made by the ICT sector in certain countries within the EMA region. Regarding developing countries, the salient point is that leapfrog technologies have an enormous opportunity to flourish due to their lack of established infrastructure. These markets are also balancing socio economic needs and must balance these with net-zero emissions goals. The combination of these two can lead to tremendous benefits when implemented side by side.

In the context of decarbonisation, within ICT, the Technology sector is not under as much pressure from stakeholders as other high-emitting sectors, but it still has a significant role to play in reducing its impact on the environment. This is a result of future content and communication increases. Consequently, the industry's leading technology businesses are stepping up to create voluntary net-zero emissions goals by committing to carbon neutrality, switching to renewable energy sources and establishing aggressive climate targets.

While this sector is demonstrating slightly better performance and can be a role model for other sectors, it also has some distance to cover to meet its net-zero emissions commitments. For instance, large technology companies are actively pursuing the shared objective of reaching net-zero emissions for their entire carbon footprint well in advance of the Intergovernmental Panel on Climate Change (IPCC)'s deadlines.

Using technology and systems to understand financial and sustainability goals, as well as managing and measuring data, would be critical to the success of net-zero emissions targets. There is generally a need for more Board engagement on the topic and even remuneration targets to incentivise Executive Management members.

To promote shared value, the ICT sector should continue to improve and collaborate with NGOs, governments and other stakeholders into the future.

ICT companies need to continue mobilising investments early to meet the net-zero emissions targets. Starting now will reduce the pressure to meet the deadline.

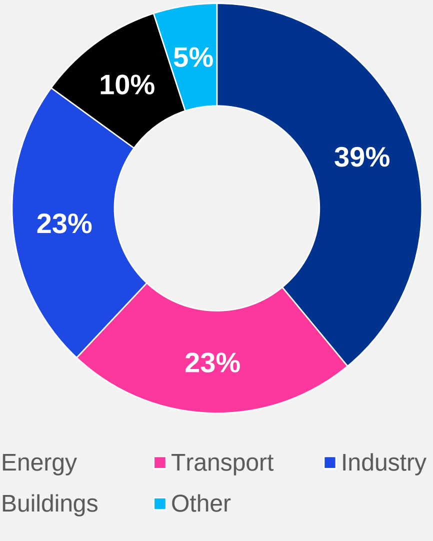
Greenhouse gas emissions in the ICT sector

Trends in the ICT sector are making it a high-impact industry, so now is the time for action.

The world is witnessing the highest-ever increase in greenhouse gas (GHG) emissions and coal-based power generation activities after the COVID-19 crisis. According to the International Energy Agency (IEA), carbon dioxide (CO_2) emissions increased by more than 2 billion tons (in absolute terms) during 2021–22, recording the largest increase in history and exceeding the pandemic-induced offset(1).

Accounting for 85% of global CO_2 emissions, the Energy, Transportation and Industrial sectors account for the largest share of emissions.

Figure 1: Global CO_2 emissions by sector (as of October 2022)(2)



Source: Global energy-related CO_2 emissions by sector, IEA

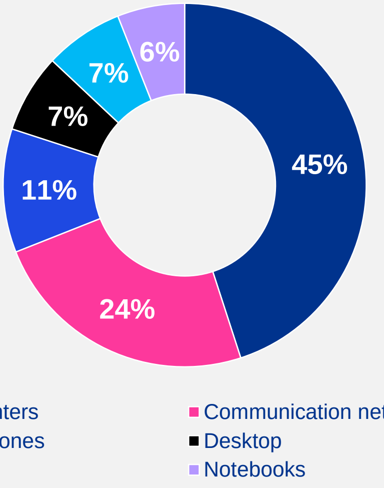
The Information and Communications Technology (ICT) sector does not have a high emission rate. However, there has been an increase in energy consumption due to the industry's exponential growth in all areas, particularly with higher creation, distribution and consumption of data(3).

According to the Mobile net-zero emissions study by a non-profit mobile network industry association, the mobile industry emits more than 220 Mt CO_2e per year, representing 0.4% of the global CO_2 emissions. This translates into the global ICT industry, accounting for about 1.4% of the global emissions (or nearly 700 Mt CO_2e) each year(4).

However, emissions from the complete lifecycle and supply chain of ICT products and infrastructure will be higher if the carbon footprint of complete upstream and downstream levels in the value chain are also considered.

As a result, the ICT sector's carbon footprint has become a topic of great interest in the current climate situation. Due to their high energy consumption, the industry’s immediate focus areas are data centres and communications networks, which account for 45% and 24% of GHG emissions, respectively(5).

Figure 2: GHG emissions by product/segment, 2020[(6)]*



**Presents relative contribution of ICT products (sourced from Belkhir and Elmeligi - 2018)*

Source: Greenhouse gas emissions in the ICT sector, UNEP

According to IEA, about 80% of the lifecycle footprint within the ICT sector is accounted for by electricity usage, and since electrification is a significant step towards decarbonisation, it makes the sector relatively easier to mitigate.

The sector does, however, face unique challenges in eliminating Scope 3 emissions, or indirect emissions, which account for most of its emissions. The absence of a well-defined reporting methodology poses a challenge for technology and telecom companies in measuring emissions within their supply chains, thereby impeding their progress towards achieving net-zero emissions.

Source(s): (1) "Global CO_2 emissions rebounded to their highest level in history in 2021", IEA; (2) "Global energy-related CO_2 emissions by sector", IEA; (3) "Emissions from computing and ICT could be worse than previously thought", ScienceDaily; (4) "The collaborative path to a Net Zero ICT sector", International Telecommunication Union; (5) "Data centers and data transmission networks", IEA; (6) "Greenhouse gas emissions in the ICT sector", UNEP

The carbon footprint within the ICT sector is growing at an unsustainable rate.

9%

annual rise in global GHG emissions from digital technologies *(as of 2021)*[7]*

1%

data centres and data transmission networks account for energy-related GHG emissions *(published in July 2023 by IEA) ***

14%

of the world's total GHG emissions from digital sector by 2040 *(as of 2021)*[8][9]

In recent years, the demand for data centres and data transmission services has grown exponentially. Emerging services and technologies such as streaming, cloud gaming, augmented and virtual reality applications are expected to boost the demand for data centres. Global AI technology supremacy race between superpowers is also likely to further increase CO_2 emissions through higher processing power requirements.

These trends can potentially turn the ICT sector into a more significant contributor to global CO_2 emissions in the future. Furthermore, unless action is taken to lessen the environmental impact of technology and telecom companies, emissions will continue to increase sharply.

The ICT industry is expanding quickly, which emphasises how critical it is to address and contain any rise in its carbon footprint.

A new standard, Recommendation L.14701, has been developed by a specialised ITC agency of the United Nations (UN) to help reduce emissions and maintain the sector in compliance with The Paris Agreement[10].

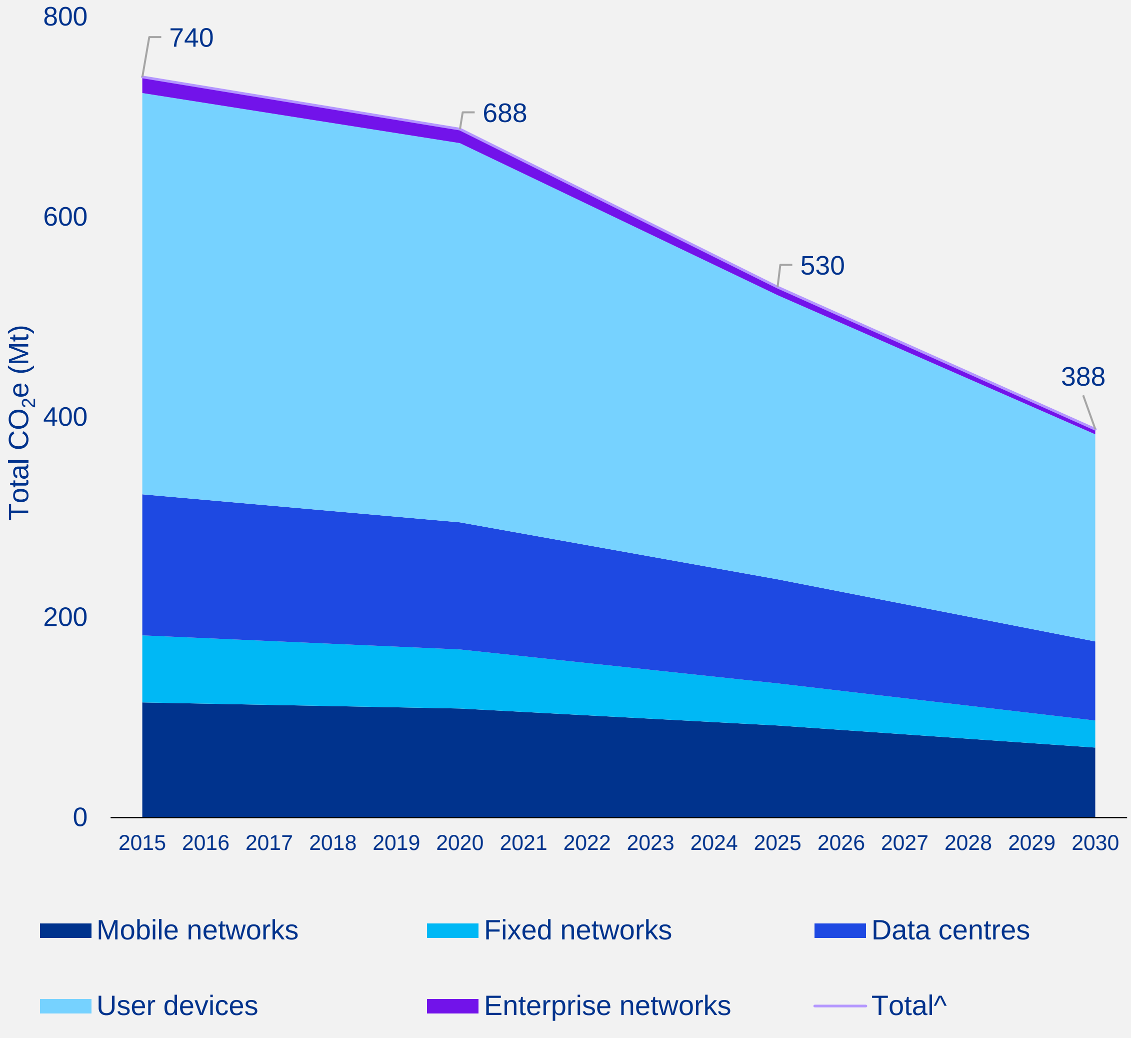
The recommendation provided detailed trajectories of GHG emissions for the global ICT sector and its sub-sectors from the year 2015 and estimated trajectories for 2025 and 2030[10].

The trajectories are in line with the average reduction of the IPCC P2 scenario, which requires the sector's emissions to be of the same proportion as the reduction required across the global level. According to a specialised ITC agency of the UN, the ICT industry will have to reduce its GHG emissions by 45% between 2020 and 2030 if it wants to comply with The Paris Agreement[10].

In accordance with the IPCC P2 scenario, Figure 3 illustrates how the ICT sector should evolve by 2030 to align with the global average (~50%)[10].

** Represents share of emissions from devices, the internet, and all supporting systems in overall global emissions*
*** Represents share of emission in overall global emissions*

Figure 3: ICT sector trajectory in line with the IPCC P2 scenario[10]



IPCC P2 scenario focuses on sustainability, low-carbon technology innovations and well-managed land systems, with limited societal acceptability for bioenergy with carbon capture and storage (BECCS). This scenario does not rely heavily on the development of GHG sinks.

^ Total includes T&D losses and fuel supply

Source: Greenhouse gas emissions trajectories for the information and communication technology sector compatible with the UNFCCC Paris Agreement", a specialized ITC agency of the United Nations

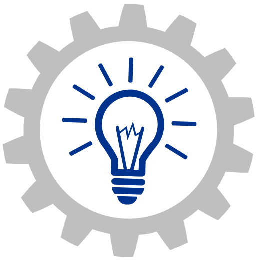
Source(s): (7) "Reduce your digital carbon footprint to shape a greener future", ESCP; (8) "Why your internet habits are not as clean as you think", BBC; (9) "A guide to your digital carbon footprint – and how to lower it", World Economic Forum; (10) "Greenhouse gas emissions trajectories for the information and communication technology sector compatible with the UNFCCC Paris Agreement"; "A greener future for digital advertising", Elespacio;

To accelerate net-zero emissions efforts, the technology and telecom sectors must address high-emitting processes and operations throughout the value chain. The section that follows will discuss how the ICT sector is approaching net-zero emissions, as well as the strategies and solutions being implemented by the sector to reduce emissions.

Emission mapping: Value chain assessment of the technology and telecom sector

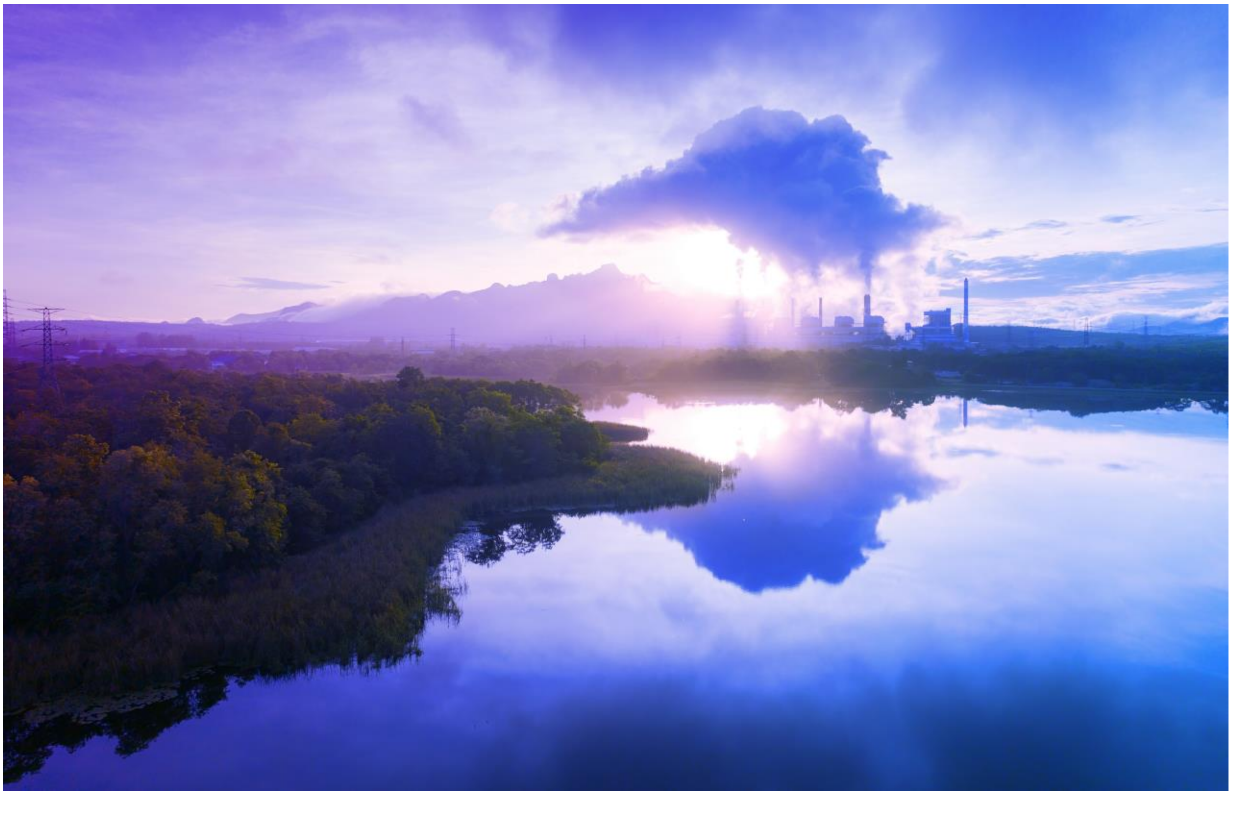
Scope 3 emissions are the highest due to raw material purchases and energy consumption by data centres

Technology sector



The main challenge, as discussed in the previous section, is tracking and reporting emissions across the value chain. To effectively measure and control emissions, businesses must identify high-emitting processes as well as the sources of emissions throughout the value chain. This allows them to trace, track and design the desired solutions.

The frameworks on the next page depict the value chain for tangible and digital products, highlighting the type (Scope 1, 2 and 3), intensity (low, medium and high) and source of emissions associated with each step.



Hardware products

Hardware product lifecycles are covered by the value chain, which begins at material acquisition until end of life. Due to its lengthy supply chain and difficult-to-mitigate production methods, the sector faces difficulties in achieving net-zero emissions. The technology sector's Scope 3 emissions make up the largest portion of the global greenhouse gas emissions. This is primarily because of the emissions generated during the acquisition of raw material, the part/component production phase and the end consumer use of items sold.

Value chain elements	**Sourcing** Material acquisition and pre-processing	**Logistics** Transportation of raw materials and products	**Production** Manufacture or assembly of hardware /components	**Distribution** Distribution, warehousing and logistics	**Consumption** Use of goods by end consumer	**End of life** Recover waste, recycling and returns
GHG emissions protocol	Upstream Scope 3		Scope 1 and 2	Downstream Scope 3		
Emissions sources	Emissions from purchased goods and services; processing of sold products	Emissions generated by air, land or sea; transport of raw materials to production facility	Emissions from manufacturing of components and sub-assemblies (including product packaging and product assembly); purchased electricity	Emissions generated by air, land or sea; transport of finished products to end users	Emissions associated with the electricity consumption of the product over its lifetime	Emissions generated during the mechanical destruction, separation and transportation of end-of-life materials
Overall ratings	**Emissions: High**	**Emissions: Low-medium**	**Emissions: Medium**	**Emissions: Low-medium**	**Emissions: High**	**Emissions: Low**

Source(s): "ICT sector's role in climate change mitigation", CDP; "Assessment of lifecycle carbon footprints of products", IBM; "Chasing carbon: the elusive environmental footprint of computing", Institute of Electrical and Electronics Engineers; "Quantification of emissions in the ICT sector – a comparative analysis of the product life cycle assessment and spend-based methods", Linnaeus University; "It's time to decarbonize the technology industry", KPMG

Digital services

Emissions in digital services are caused by electricity consumption, particularly in data centres, and are directly related to a large user base using products and services.

The rapid adoption of AI/GenAI solutions and their dependence on large data models have led to an increased demand for data centres. Scaling AI sustainability is imperative to prevent a negative environmental impact, as demand for AI-backed solutions grow in the future.

Value chain elements	**Research** Defining the product vision	**Development** Engineering, software design and coding	**Testing** Integration and system testing — focus on bug fixing	**Production** Assembly, printing and packaging	**Release** Installation, configuration and launch of the product	**Usage** Use of software by customer	**Service** After-sales support
GHG emissions protocol	Scope 1 and 2						
		Scope 3				Scope 3	
Emissions sources	Power consumption from local devices and infrastructure utilising the internet such as computers, data centres, servers and networks	Power consumption by associated devices during the actual software development process; business travel emissions	Electricity consumption from hardware used for testing; infrastructure needs of finalised products in the market	Emissions from assembled software package; related documents printed on paper	Electricity consumed to power the infrastructure needed to deploy a programme, webpage or application	Usage of software from the production of energy consumed by the data centres and networks (or devices) that deploy software	Emissions from the service desk based on the tickets raised per user or tickets resolved by a service desk
Overall ratings	**Emissions: Low-medium**	**Emissions: High**	**Emissions: Low-medium**	**Emissions: High**	**Emissions: Low-medium**	**Emissions: High**	**Emissions: Medium-high**

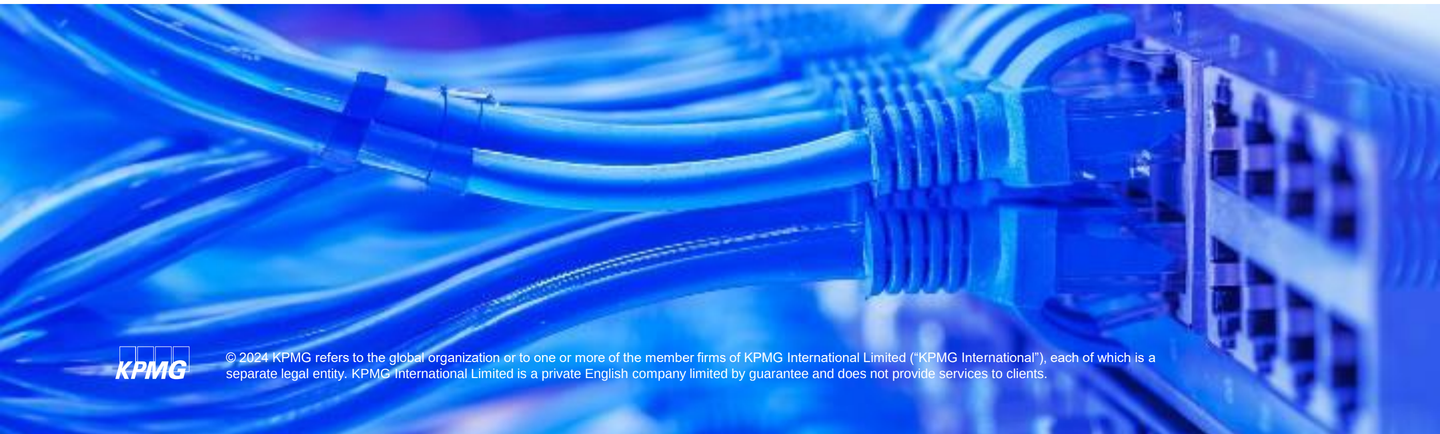
Telecom sector

Telecom companies, such as technology companies, have a complex value chain with an associated environmental impact at each stage of the lifecycle. The table below depicts the value chain's complexity, explaining how emissions at various points along the value chain are linked to suppliers, manufacturers, operators and end users. The table depicts how Scope 1 and 2 emissions differ depending on the type of stakeholder (suppliers, manufacturers, operators and end users), as well as how they contribute to Scope 3 emissions from other sectors.

Suppliers	Manufacturers	Operators	End users*
Scope 1 and 2	-	-	-
Scope 3	**Scope 1 and 2**	-	-
Scope 3	Scope 3	**Scope 1 and 2**	-
Scope 3	Scope 3	Scope 3	**Scope 1 and 2**

* Note that end user refers to consumers and organisations outside the sector. However, it may sometimes refer to end users within the sectors.

Perspective of a supplier | Perspective of a manufacturer | Perspective of an operator | Perspective of an end user



Integrated value chain

In the telecom industry, emissions occur throughout the entire equipment lifecycle, from purchase to end of life. Most of the emissions are caused by using electricity to power infrastructure (particularly data centres) and using equipment based on old and obsolete technologies that are highly inefficient in terms of energy consumption. Scope 3 emissions attributed to suppliers and partners are the major source of emissions in the telecom sector, posing a barrier to sustainability.

Value chain elements	**Equipment** Acquisition of chipsets and networking devices	**Infrastructure** Network towers, cables, data centres and spectrum	**Execution** Hardware and software integrators	**Application providers** Operations and business support systems	**Network service providers** Mobile and fixed network	**End use** Usage of service, ongoing support services	**End of life** Recover waste, recycle and return
GHG emissions protocol	Upstream Scope 3		Scope 1 and 2		Downstream Scope 3		
Emissions sources	Emissions from purchased goods and services; processing of sold products	Electricity consumed to power the infrastructure; emissions associated with the use of diesel generators as a power backup	Power consumption from local devices and infrastructure such as computers, servers and networks	Electricity consumed to power the infrastructure needed to deploy a programme or application	Energy consumed by the data centres and networks (or devices) on which voice or data traffic is carried; emissions from the operation of offices and stores; business travel emissions	Electricity consumption from end-user equipment; emissions from the service desk providing support services	Emissions generated during the mechanical destruction, separation and transportation of end-of-life materials
Overall ratings	**Emissions: High**	**Emissions: Medium-high**	**Emissions: Low-medium**	**Emissions: Low-medium**	**Emissions: High**	**Emissions: High**	**Emissions: Low-medium**

Source(s): "Greenhouse gas emissions trajectories for the information and communication technology sector compatible with the UNFCCC Paris Agreement"; "GHG emissions", Asentria; "Electricity consumption and operational carbon emissions of the European telecom network operators", MDPI

Decarbonising the sector in alignment with SBTi 1.5°C trajectory

By taking proactive measures, it is possible to eliminate the complexity associated with emission reduction across ICT.

The Science Based Targets initiative (SBTi) promotes best practices for companies to achieve the net-zero emissions target in alignment with the 1.5°C goal.

The ICT sector's trajectory incorporates multiple IPCC scenarios (including the previously discussed IPCC 2) while excluding implausible outliers. Companies in developed countries are encouraged to align with 1.5°C by following the 4.2% annual linear reduction target. In comparison with 2020, the absolute contraction approach of 4.2% reduction in annual linear terms will result in a 21% reduction by 2025 and a 42% reduction by 2030. Offsets cannot be considered for SBTi-approved targets, so ICT companies are encouraged to develop long-term targets up to 2050[11].

The ever-expanding ICT sector is driving data demand, which necessitates higher transmission capacities, achieved through technological advancements and the purchase of renewable electricity. Due to the dynamic and complex nature of the ICT sector, these companies must constantly modify their commitments and targets with ambitious action plans to meet the 1.5°C target by 2030.

The action plans should emphasise the transition to low-carbon electricity supply or renewable energy, the ongoing implementation of energy-efficient plans and the promotion of carbon consciousness among end users. It is critical to continuously improve energy efficiency, which leads to lower operational costs.

Maintaining decarbonisation momentum

Achieving net-zero emissions in the ICT sector requires organisations to develop a comprehensive strategy that focuses on supply chain, circularity, energy efficiency and green infrastructure.

Supply chain
- Supplier partnerships
- Emission tracking
- Responsible sourcing

Circularity
- Refurbish/Repurpose
- e-waste treatment

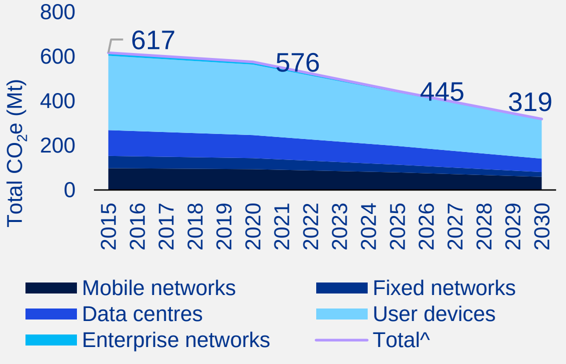
Renewables
- Renewable PPAs
- Solar and wind projects

Infrastructure
- Low-emission vehicles
- Green buildings

Supply chain

The future focus of decarbonisation plans will be supply chains, with technology and telecom companies cutting ties with high-emitting suppliers.

Figure 4: ICT sector trajectory in line with 1.5°C scenario of SBTi[11]



Offsets are not considered in meeting an SBTi-approved target and are only considered to be an option for companies wanting to go beyond their target. This approach excludes the electricity supply chain and grid losses in line with GHG emissions accounting practice.

^ Total includes T&D losses and fuel supply

Eliminating such suppliers can raise costs and destabilise existing supply chains while having little effect on decarbonisation, particularly in emerging markets such as India, Africa and parts of the Middle East.

To effectively decarbonise, organisations should begin by auditing the emissions of each component in their supply chain and identifying those that can help the most. Companies, for example, can update supplier agreements to require carbon emission disclosures. A US software company enables suppliers to manage their net-zero emissions data by calculating Scope 1, 2 and 3 emissions while streamlining data collection, organisation and storage in a single system.

Technology firms offer preferred supplier agreements that incentivise suppliers through price, volume or multi-year commitments. European firms, such as a French multinational IT services and consulting firm and a Dutch multinational corporation, are focusing on incentivising suppliers to align with their sustainability goals.

Supply chain restructuring is already occurring among geopolitical tensions and rising conflicts with countries imposing trade measures to incentivise re-shoring, on-shoring and friend-shoring of critical supply chains, including in telecommunications and related technology. This is adding extra pressure on companies to consider geopolitical trends and shifting international security alliances in addition to sustainability considerations when organising their supply chains.

To address upstream and downstream Scope 3 emissions, telecom operators in Europe are redefining their targets around supply chain emissions. A British multinational telecommunications company requires its suppliers to meet environmental and human rights procurement standards. Its suppliers must set a science-based net-zero emissions target in case the contract value exceeds GBP25 million. Controlling upstream emissions in the supply chain entails sourcing raw materials in a sustainable manner. In Africa, a South African telecom company gives environmental and social criteria a 20% weightage when evaluating suppliers during the quotation process[12].

Source(s): (11) "Guidance for ICT companies setting science-based targets", SBTi; (12) "Supply chains are European telcos' biggest climate headache", S&P Global; "Sustainability report", Vodacom; "Greening digital companies: Monitoring emissions and climate commitments", ITU

Circularity and end of use

More than 70% of what the Earth can replenish in a sustainable manner has been consumed by the global economy.

In the last five years, Circle Economy's Circularity Gap Reports have discovered that only 8.6% of what we use is recycled, resulting in a massive circularity gap of more than 90%. Additionally, while energy efficiency and switching to renewable energy could address 55% of global emissions in ICT, to reach net-zero emissions, we also need to change the way we make and use products, materials and assets. To close the gap faster, technology and telecom companies are collaborating to promote a restorative and regenerative economy[(13)].

By adopting two principles of the circular economy in the technology products, services and systems designed, ICT companies can tackle the remaining 45% of emissions associated with industry, resources and IT operations in the following way[(13)]:

- Eliminating waste and pollution to reduce greenhouse gas emissions across the value chain:
  - Eco-design principles, proper documentation and regulation such as the upcoming European Digital Passport of Products will help improve the recovery of materials.
  - By improving e-waste collection and recycling practices worldwide, a considerable amount of secondary raw materials (precious, critical and non-critical) could be made readily available to re-enter the manufacturing process while reducing the continuous extraction of new materials. This would reduce manufacturing costs, mining water usage and pollution as well as CO_2 emissions extraction. Technology and telecom companies are already collaborating with e-waste management companies to ensure end-of-life treatment, which supports a circular economy by allowing mannered treatment and disposal of obsolete, broken and surplus electronic and electrical devices.
- By circulating products and materials, we retain their embodied energy in the following way:
  - Circular economy principles, and more specifically durability, reparability and recyclability, will also help to reuse materials and prevent the need to extract new materials. For example, technology companies are offering refurbished and upgraded equipment to customers, with benefits such as updated technology, at a low cost with full warranty. Companies are also investigating product-as-a-service offerings, in which some companies let customers use their products rather than selling them. The product is still partially owned by the company, which has the option to refurbish it when it wears out or process it for a different use.
  - In another example, a Dutch multinational company has formed the Capital Equipment Coalition, bringing together a group of organisations such as a European semiconductor supplier, a US multinational digital and communications technology conglomerate, a US-based global technology company and a leading Dutch telecommunications provider to develop best practices for offering pre-owned systems and product-as-a-service options.

Sources(s): (13) "Five years of the Circularity Gap Report", Circularity gap report 2022; (14) "An African mobile network operator providing voice, data, fintech, digital, enterprise, wholesale and API services Road to Zero; "Supply chains are European telcos' biggest climate headache", S&P Global

Renewable energy

The EMA region's tech companies are concentrating on finding clean energy sources and coming up with strategies to increase energy efficiency at different high-emission points in the value chain, especially when it comes to powering data centres.

One US multinational manufacturer in the telecommunications and technology sector, for example, has been using renewable energy sources since 2018 to power all its corporate offices, retail locations and data centres across 44 countries.

Additionally, it intends to finance the development of large-scale 30 to 300 MW solar and wind projects throughout Europe. By adding significant amounts of renewable energy to the grid, these investments hope to reduce 22% of carbon dioxide emissions that come from the electricity users use to charge their devices.

The need to reduce energy consumption of the telecom industry is becoming more and more pressing, as operators are stepping up to promote sustainability, whether it be by using load optimisation techniques or utilising renewable energy sources to lessen reliance on the conventional power grid. By 2025, a telecom company based in South Africa hopes to employ only renewable energy sources by diversifying its energy mix. The acquisition of renewable power purchase agreements (PPAs) from independent power producers will be the constant focus. Using 1,183,898 kWh of clean energy, the company was able to cut its GHG emissions by 12,272 Mt CO_2e in 2021.

In June 2022, an African mobile network operator in Cameroon that provides voice, data, fintech, digital, enterprise, wholesale and API services announced plans to power its network infrastructure with solar energy. The mobile network operator has an agreement with the country's Rural Electrification Agency that will help it reduce its carbon footprint. This will also help the country meet its target for renewable energy. (By 2035, renewable energy should account for at least 25% of total supply)[(14)].

Green infrastructure

Green infrastructure appears to have risen to the top of the priority list for many technology and telecom companies across the EMA region to address Scope 1 and 2 emissions. Organisations continue to prioritise green buildings and a low-emission vehicle fleet. A Germany-wide pilot gives employees a monthly mobility budget to spend on a variety of transportation options, such as trains and buses, bicycles, e-scooters and shared cars.

African telecoms have made strides in terms of sustainability, with an African mobile network operator providing voice, data, fintech, digital, enterprise, wholesale and API services in Rwanda, replacing 15% of its fleet with electric vehicles[(14)].

Green building initiatives have gained traction in other emerging markets, with Indian firms implementing refrigerants with low ozone depleting potential (ODP) and global warming potential (GWP). To avoid depletion of the atmospheric ozone layer, they use environmentally friendly cooling agents in air conditioning and refrigeration systems, in accordance with the Montreal Protocol. Telecom network advancements are further assisting decarbonisation efforts. According to a study conducted on behalf of the German environmental protection agency by a German-based non-profit environment research association and a specialised institute in applied and industrial contract research and micro integration (IZM), an hour of video streaming using 3G emits 90 grams of CO_2, while 4G and 5G emit only 13 grams and 5 grams, respectively.

Challenges with sustainable tech adoption across the value chain

Adoption of sustainable technologies to reduce emissions is accompanied by multiple risks and challenges.

Challenges in transitioning to low-emission in the ICT sector

Feasibility of renewable PPAs: Small and medium organisations face high costs associated with renewable PPAs.

Complex supply chain: A complex and varied supply chain poses a challenge to collaborate with multiple suppliers and track emissions across the supply chain.

Server cooling: An energy-intensive cooling system uses a significant amount of fresh water to reduce heat generated from data centres.

High cost of transition to greener technologies: If net-zero emissions spending is to be reached by 2050, the total amount spent worldwide must increase by US$3.5 trillion annually[15].

Need for IT hardware: Investment into new technologies (including higher risk capital into innovation) will need to accelerate by 60% from levels at the start of the decade.

Product lifecycle innovation: To transition to a low-emission circular economy, products must be updated on a regular basis to keep up with demand.

Low purchasing power: Due to low purchasing power, emerging markets such as Africa are expected to have only 10% adoption of 5G (less carbon intensive than 3G/4G) by 2027[16].

Limited technology expertise or skill: Organisations lack the technical expertise required to adopt emerging green technologies.

Job loss: The transition from fossil fuel, with respect to the shift in demand, will result in the loss of 185 million jobs.

The urgency across the globe to transition to green technologies is making it imperative for companies to identify direct and indirect risks that can impact their decision and future of achieving net-zero emissions across the value chain. The inability to address such risks on time can lead to consequences ranging from regulatory issues to losing the competitive edge and value in the market.

Source(s): (15) "What's the price of a green economy? An extra US$3.5 trillion a year", World Economic Forum; (16) "5G network roll-out in Africa continues as pricey devices impede adoption"; "An African mobile network operator providing voice, data, fintech, digital, enterprise, wholesale and API services Rwanda launches Project Zero, swaps out 15% of its fleet for electric vehicles", An African mobile network operator providing voice, data, fintech, digital, enterprise, wholesale and API services; "Data transmission technology crucial for climate footprint", Federal Environment Ministry and the German Environment Agency Report; "The net-zero transition: What it would cost, what it could bring", McKinsey

Exploring environment risk posed by increased computational power

Leveraging innovative technologies such as proof of stake (PoS) and Tensor Processing Units (TPUs) to mitigate environmental risks (H3)

AI models

Advanced AI is a barrier to a low-emission ICT sector due to the training of machine learning (ML) models and drawing inferences from them, as it increases emissions. This is especially true for ML models trained on Graphics Processing Units (GPUs) such as GPT-3, which serves as the foundation for OpenAI's **ChatGPT[17]**.

The GPT-3 ML model reportedly consumed 1,287 MWh energy, emitting about **552 tons CO_2e** during its training process[17].

Crypto assets

Crypto assets' dependency on energy supply in expanding and mining is leading to significant carbon footprint. Its computationally costly cryptographic protocol, which is based on the proof-of-work consensus mechanism, is the main cause of high energy consumption[18].

Crypto asset mining emits **140 million metric tonnes** of CO_2 annually, which translates to 0.3% of global annual GHG emissions[18].

Metaverse

High-capacity data centres and networks are required for an immersive experience with zero latency requirements. In addition, a fleet of dispersed local edge data centres will be necessary to guarantee robust global connectivity. To host all the components of a complex structure, such as a city, a central mega data centre would be required[19].

A planned data centre by a technology conglomerate in the Netherlands to host a portion of the metaverse in Europe has an expected energy consumption of **1,380 GWh per year[19].**

Due to their high power and cooling requirements, the metaverse, cryptocurrency mining and AI models eventually have high computational needs that increase the GHG emission share of cloud servers and data centres.

Source(s): (17) "The Carbon Footprint of ChatGPT", Towards data science; (18) "Fact sheet: Climate and energy Implications of Crypto-Assets in the United States", The White House News; (19) "How edge computing will power the metaverse", Forbes; "Mining the environment – is climate risk priced into crypto-assets?", European Central Bank

Recommendations

- Emissions can be decreased by utilising Tensor Processing Units (TPUs) to train the models and optimising AI algorithms for reduced energy consumption. Since TPUs are more tailored for ML calculations, they can have a longer-lasting, higher impact while using less power. One of the latest conversational AI chatbots has been trained on its in-house TPUs rather than its power-hungry substitutes.

- For specific tasks, leveraging GPUs over CPUs can deliver greater efficiency. A recent study by a North American government body showed that its computing centre, when accelerated with GPUs, showed a 5x improvement in energy efficiency. However, the use of AI and GenAI is increasing absolute energy consumption / carbon emissions globally, reinforcing the need for optimising the associated product carbon lifecycles across all value chains.

- Compared to the proof-of-work (PoW) method, mining blocks in proof-of-stake (PoS), a blockchain consensus mechanism, use less energy and does not require any specialised equipment. The Ethereum Foundation claims that switching the Ethereum blockchain from proof-of-work (PoW) to proof-of-stake (PoS) would significantly cut energy consumption by 99.9% while maintaining equivalent functionality.
- To balance the growing demand for data centres to achieve metaverse goals, ICT companies need to be extremely vigilant about managing green data centre practices. This entails looking into effective ways to recycle waste heat, convert to renewable energy sources, optimise computing operations and cool data centres.

Navigating through challenges to achieve low-emission in the ICT sector

Managing transitional issues

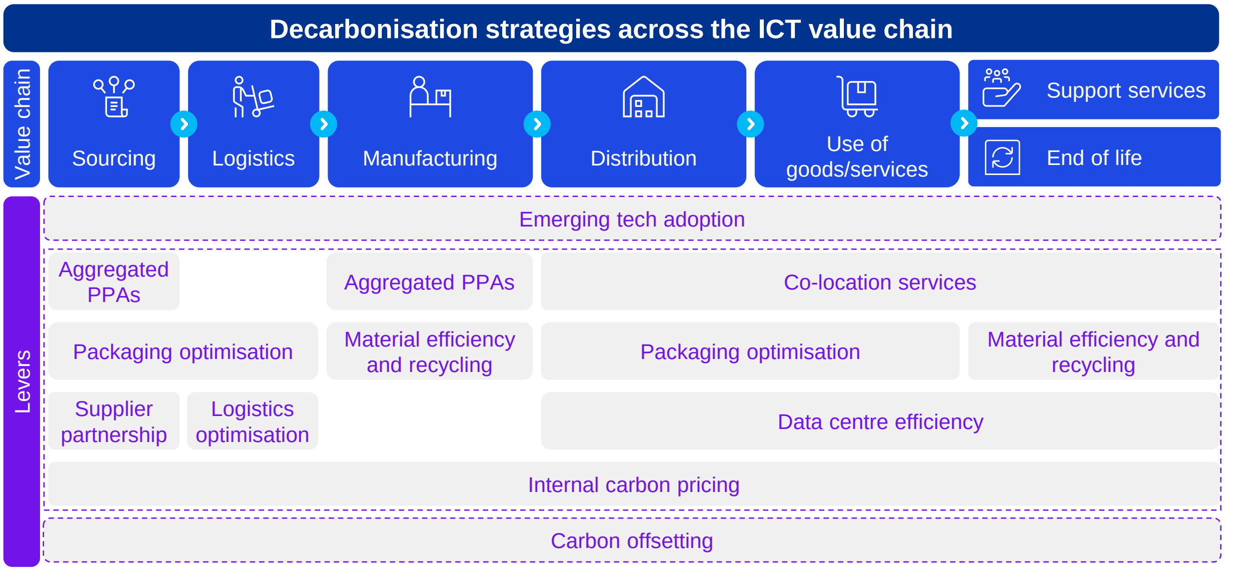
Businesses can reduce the risk of failure by taking proactive and preventive measures. Organisations must deal with the difficulties associated with the shift to low-carbon setups in a way that has the least negative effects on overall business performance. This establishes the framework for ICT businesses worldwide to investigate strategies and tactics for mitigating the risks involved in the shift to net-zero emissions.

Aggregated PPAs

As multiple SMEs purchase renewable energy in bulk from clean electricity projects, aggregated PPAs can help address the high cost of traditional PPAs. Benefits of economies of scale include strong bargaining power, supplier negotiation and significantly lower costs than traditional PPAs. It also benefits large corporations that buy renewable energy on a smaller scale.

For example, a multinational technology and e-commerce company in the US signed a PPA with Iberdrola and Grenergy in Europe. Iberdrola will provide 1 TWh per year of offshore wind power in Germany to the US multinational technology and e-commerce company, while Grenergy will provide 665 GWh per year of solar power in Spain.

Another example is a group of five companies that has signed an aggregated virtual power purchase agreement (VPPA) to purchase 42.4 MW of energy from a 100 MW solar project being developed by BayWa r.e. in North Carolina. These companies include a US media company, a communications, automotive services and media company, an American worldwide clothing and accessories retailer, an American cloud-based software company and a US software company. In this unique partnership, individual companies have signed a standard VPPA contract, with a capacity ranging from 5 MW to 10 MW, enabling them to purchase smaller amounts of renewable energy. The companies' collaboration has resulted in an excellent solution for corporations seeking to procure smaller energy loads but unable to engage directly with large offsite renewable energy projects.



Source(s): "An American technology corporation finds underwater datacentres are reliable, practical and use energy sustainably", An American technology corporation; "Delivering a digital twin ecosystem for the SHAPE-UK project", TechUK; "Companies In The Green Hydrogen Market Implement Digital Twin Technology To Minimize Risk And Maximize ROI As Per The Business Research Company's Green Hydrogen Global Market Report 2022", Globe news; "How 4 leading companies are tackling supply chain emissions", WEF

Supplier partnerships

In order to manage a complex supply chain, supplier partnerships can be strengthened. This may entail providing stakeholders with tools and expertise for tracking emissions throughout the supply chain and implementing cleaner technologies. Businesses are funding renewable energy initiatives to give suppliers access to sustainable energy sources. For instance, in 2022, a US multinational manufacturer in the technology and telecommunications sector introduced the Supplier Clean Energy programme, which attracted more than 40 partners. The programme's goal is to use only renewable electricity sources to achieve carbon neutrality for company-related operations.

Data centre efficiency

With data centres consuming ~240–340 TWh of energy globally and expected to contribute ~14% of global GHG emissions by 2040, maximising operational and energy efficiency is key to lowering carbon footprint(20).

Since oil has a higher boiling point than water, oil-based cooling systems can be used in place of water-intensive cooling systems for data centres located in water-scarce regions. In addition to enabling stable temperature, noise reduction and server cleanliness, it allows organisations to lower power usage effectiveness (PUE) levels by customising less complex and expensive equipment. In keeping with this approach, a US technology company has developed a two-phase closed-loop immersion cooling system that submerges its servers in fluorocarbon-based liquids to guarantee energy efficiency and improve performance.

Shifting data centre servers from onshore to offshore locations is another method of increasing efficiency. Building underwater data centres is a great way to increase data centre security and prevent issues such as humidity, oxygen-related corrosion and temperature fluctuations.

An American technology corporation tested the feasibility of this idea in 2018 by deploying the Northern Isles data centre, which contained 864 servers and 27.6 petabytes of storage and was located 117 feet below the seafloor(21).

The company declared this experiment a success after two years of testing, concluding that an underwater data centre had one-eighth the failure rate of a land-based data centre.

With majority of data centre energy consumption attributable to servers (directly and indirectly), server optimisation leveraging data centre management and server monitoring tools ~~is~~ are of paramount importance. In addition, factors such as load balancing, database and code optimisation and leveraging the right OS are other aspects that need to be looked into for maximising server efficiency.

Emerging tech adoption

Emerging technologies such as digital twin can assist businesses in maximising their return on investment (ROI) by addressing implementation uncertainty and the cost of failure. An IoT-based solution provider built a digital twin of Portsmouth International Port as part of a US$1.7 million project to demonstrate a green hydrogen generation system that will significantly reduce carbon emissions and air pollution in and around Portsmouth and other UK ports, where key variables involved in green hydrogen production such as weather, off-takers' demand volatility, and local infrastructure can be modelled using digital twins.

Co-location services

Co-location services, which allow IT companies to rent data centre facilities, can help software companies and data centre operators reduce emissions from storage and processing hardware. Additionally, high-density servers can be utilised to reduce the number of servers needed to perform the same amount of work, reducing power usage and cooling requirements. Co-location services located close to end users or interconnection points can reduce the distance that data needs to travel, reducing emissions and latency simultaneously. For example, a multinational digital infrastructure company based in the US provides a variety of co-location services and operates more than 240 data centres in 70 major metropolitan areas around the world. It expanded to Africa in 2022 after paying US$320 million for the acquisition of a leading West African data centre and connectivity solutions provider to provide services to Ghana, Nigeria and Cote d'Ivoire(22).

Carbon offsetting

The journey to decarbonise is an extensive one, as companies must adopt new technologies, measure the range of emissions across the value chain and improve management capabilities in a short period of time. Companies can compensate for and offset their emissions by investing in environmental projects or purchasing carbon offset credits generated by projects aimed at reducing or avoiding GHG emissions. Most of these projects are concerned with forestry and conservation, renewable energy, community projects and waste management.

Since 2020, an Australian telecom company has been offsetting its operational emissions using carbon credits to advance its net-zero goals. These credits, sourced globally and domestically, support renewable energy, indigenous savannas and biodiversity projects.

The company, certified by the Climate Active programme, has already prevented more than 8 million tonnes of GHG emissions via its carbon credit purchases, which is equivalent to offsetting emissions from more than 2 million cars annually(23).

Internal carbon price (ICP)

Another important tool for dealing with transitional risks is ICP. Organisations all over the world are putting a monetary value on GHG emissions to fund the emission reduction efforts . Companies are using ICP to manage climate-related business risks and prepare for the transition to a low-carbon economy. For example, ICP is being used to reduce emissions by an Indian multinational IT services and consulting firm. It took a hybrid approach, incorporating an implicit and shadow price of US$9 per ton of CO_2e, as well as a tax on business units proportional to the resources allocated to projects. The company created an ICP tool for its facilities, finance and procurement teams to increase green investments (including renewable energy) and allocate funds to activities that increase resilience to climate change risks. In 2021, it saved more than 30,000 tCO_2e of emissions solely through renewable energy and resource efficiency(24).

Material efficiency and recycling

Material efficiency and recycling are key strategies that are helping telecom and technology companies reduce their carbon footprint while promoting sustainability. In 2024, a US-based tech company managed to achieve notable milestones, such as utilising 56% recycled cobalt content in its batteries and incorporating 50% recycled material in its products. By obtaining materials such as cobalt and lithium from post-consumer waste and using 100% recycled copper, the company has set the industry benchmark that inspires similar initiatives aimed at promoting a circular economy and mitigating environmental impact(25).

Logistics optimisation

Companies can achieve logistic optimisation by adopting various strategies such as using efficient routing, optimising delivery schedules and transitioning to low-carbon shipping modes. In 2023, a US technology corporation effectively reduced its transportation emissions by 95% by altering its shipping approach from air to ocean freight. Additionally, the company has been able to transport up to 25% more of the same products per trip due to this innovative method. The company has prioritised low-carbon shipping modes, such as ocean freight, which only emit a small fraction of carbon emissions associated with air freight. As a result, the company is making a significant contribution to decreasing transportation-related carbon emissions[(26)].

Packaging optimisation

The principles of circular economy emphasise the need to close material loops by reusing and recycling packaging materials.

By adopting principles such as 'reduce, reuse and recycle', the ICT industry can minimise the amount of packaging material it consume while still creating maximum utility from it. For instance, A US tech company, in 2024, achieved its goal of reducing plastic from packaging by launching fibre-based packaging, which resulted in only 3% of the plastic packaging. Collaborating with BioProducts Institute at the University of British Columbia and RISE Research Institutes of Sweden, the company published a research paper examining the limitations of traditional packaging methods and a fibre-based substitute for foam used in packaging[(25)].

Source(s): (20) Data Centres and Data Transmission Networks, IEA; (21) Turns out dumping data centres in the ocean could be a good idea", Wired; (22) "Equinix plans major investment in African data centres, Developing Telecoms; (23) "Australia's 'first carbon-neutral telco': Do environmental claims about belong stack up", The Guardian; (24) "An Indian multi-national IT services and consulting company uses ICP as a tool for rapid decarbonization", CDP; (25) "US technology corporation cuts greenhouse gas emissions in half", Company website; (26) "US technology company cuts emissions from transport by 95 percent using normal ships", The Maritime Executive

Policies play a pivotal role in driving the industry to Net Zero

Strong decarbonisation potential exists in EMA and South Asia, driven by policy directives, favourable infrastructure and a concentrated effort on renewable energy.

Well-structured policies and regulations are essential for achieving net-zero emissions globally. However, when framing policy directives, authorities face significant regional policy variations in terms of key focus areas.

Europe

The ICT sector accounts for 8 – 10% of total electricity consumption in Europe and contributes about 4% of GHG emissions[27]. The EU is actively researching and implementing regulatory frameworks to address these emissions. When framing policy directives, the EU gives significant weight to emissions from the end-of-life stage of the ICT value chain. As follows, the European Commission (EC) has laid the foundation for significant regulatory and policy developments.

1. **European Green Deal:** The European Commission adopted a circular economy action plan as part of the European Green Deal, involving initiatives spanning the entire product lifecycle. As a result, French technology manufacturers display a repairability score (the ease with which a product can be repaired) on a scale of 10, with 10 being the most repairable.

2. **EU Taxonomy Regulation:** This regulation has six objectives that are directly related to the ICT value chain. Among them are the circular economy and sustainable use of water. It is a uniform classification system for green investments.

3. **Climate Neutral Data Centre Pact:** The pact was signed by trade associations and operators as a self-regulatory measure to make power-hungry data centres climate neutral by 2030.

4. **Fit for 55 Package:** It involves European-wide directives aimed at influencing and promoting data centre heat recovery. For example, the surplus heat from the data centre of a multinational company in Denmark is fed into 7,000 households through a district heating system[28].

5. **Waste from Electrical and Electronic Equipment (WEEE):** This directive contributes to the sustainable production and consumption of EEE.

Decarbonising Europe

Enablers

- **Strong policy framework:** There are EU-level regulations in the ICT sector that are framed with a focus on high-emission points.
- **Rapid adoption of emerging technologies:** European organisations dedicated 15% of their total IT budget to emerging technologies in 2021.
- **Strong wind power:** Wind farms produced about 37% of all renewable energy produced in Europe in 2021.
- **High adoption of solar power:** Solar energy accounted for approximately 6% of the EU's gross electricity output.
- **Power grid optimisation:** The European Union's Third Energy Package* is an important step towards optimising grids alongside the ongoing annual investment of EUR40 billion for it.

Challenges

- **Coordination:** All EU-level policies and calls for initiatives may not be well received by all countries or the private sector.

In order to meet its aggressive climate targets, Europe's future policies will place a strong emphasis on net-zero emissions technologies and products. To create a climate that is conducive to the production of green technologies, the European Commission has put forth the Green Deal Industrial Plan. This seeks to create net-zero emissions industry academies for skill development and global cooperation for the green transition, as well as swiftly scale up technologies, enable raw material accessibility and accelerate financing for the production of clean technologies.

The Russian war in Ukraine is accelerating the EU's plans for net-zero emissions to eliminate its reliance on Russian gas in its energy mix. In Europe, national security necessity will accelerate the timeline of the Fit for 55 agenda, making it a 'Fit for 35, or even 25', to eliminate reliance on Russian energy imports as soon as possible. As geopolitical interests converge with climate priorities, we could see private investment becoming a primary engine for climate financing with a transformative impact.

To better align with global and regional policies, countries have started introducing and enforcing national level regulations to bridge the gap between targets set and progress made to date. For example, the Energy Efficiency Act (EnEfG) passed by Germany focuses on data centres with regard to waste heat treatment, energy efficiency standards and information obligations.

Note: The European Union's Third Energy Package is a legislative package for an internal gas and electricity market in the European Union.*

Source(s): (27) "Europe electricity consumption and GHG emission", EC; (28) "Utilization of surplus heat from data centers", C2E2; "Without grid enhancements Europe won't reach its climate goals", Wind Europe; "Regulation and supervision", EU taxonomy; "Renewable energy", European Commission; "US tech company calls on global supply chain to decarbonize by 2030", Company website

Middle East

In order to pursue the development of clean energy sources and ensure the future is energy sustainable, the Middle Eastern countries are witnessing an increase in demand for diversifying their energy strategies. While Saudi Arabia and Bahrain have declared a net-zero emissions target for 2060, the UAE and Oman have committed to achieving net-zero emissions by 2050.

The governments are implementing plans to raise the proportion of renewable energy due to factors such as an abundance of solar energy potential, relatively low-cost project financing and supportive taxation regimes. By 2025, it is anticipated that nations such as the UAE, Saudi Arabia, Qatar, Oman, Kuwait, Bahrain, Iran, Iraq, Jordan and Lebanon will have invested roughly US$182.3 billion to add nearly 57 GW of capacity. This will result in an eight-fold increase in solar and wind energy capacity.

- **Renewable energy initiatives:** Initiatives to further promote renewable energy in data centres and the telecom industry are as follows:
  - UAE's Energy Strategy 2050
  - Oman's National Energy Strategy 2030
  - Saudi Arabia's National Renewable Energy Program (NREP)
  - Saudi's Vision 2030
- **Basel Convention:** Jordan, Kuwait, Bahrain, the UAE, Lebanon, Saudi Arabia and Syria have signed the Basel Convention for the control of transboundary movements and disposal of hazardous wastes.
- **E-waste:** Laws pertaining to e-waste are specifically present in Iran (waste management regulations) and Jordan (environmental protection law); other countries categorise e-waste under hazardous wastes.

Given the current scenario of weak implementation of laws and increase in technology devices, it is imperative to have specific laws that focus on e-waste management. With respect to the current policy situation, there is a need to further implement policies and reduce emission by 16–19% to reach the nationally determined contribution (NDC) target.

Decarbonising the Middle East

Enablers

- **Abundance of natural resources:** The average solar radiation in the UAE and Saudi Arabia is 2,285 and 2,200 kWh/m2, respectively[29].
- **Presence of renewable energy projects:** The green hydrogen project, Neom, will produce 2,400 mt/year of green hydrogen by 2026.
- **Clean energy targets:** Various countries have set renewable targets for 2030 (the UAE has a target of 30% by 2030, while Saudi Arabia has a 50% ambition).

Challenges

- **Weak policy framework:** A nation-wide renewable energy policy is either absent or covered in laws for conventional electricity.
- **Subsidised conventional electricity:** The renewable energy sector is less cost-competitive due to lack of subsidies.
- **Outdated power grid and storage infrastructure:** Iraq faces intense power blackouts due to obsolete technologies.
- **Impact of geopolitical tension:** Regional conflicts risk delaying or jeopardising coordinated policy and business initiatives.

Africa[30]

Only a few African countries, including South Africa, Kenya and Nigeria, have a relatively active policy framework focused on net-zero emissions targets.

Decarbonising Africa

Enablers

- **Well-defined net-zero emissions target:** 12 African countries have committed to achieve net-zero emissions by 2050.
- **External financial support:** Germany offered EUR395 million to support Africa's 'Just Energy Transition Investment plan'.

Challenges

- **Weak policy frameworks**: The policies lack enforcement, and there is low focus on data centres.
- **Slow progress:** Long-term low GHG emission development and national adoption plans have yet to reach their full potential.
- **Inadequate infrastructure:** Obsolete technologies are posing as a threat to Africa's long-term growth and development.

Africa has the following initiatives in place in terms of renewable energy procurement:

- **South Africa's Integrated Resource Plan (IRP) 2010–30:** This plan aims to have 45% of renewable energy share by 2030 and 98% by 2050 in electricity generation, although the current rate is slow despite having ambitious 2030 targets.
- **Nigeria's Energy Transition Plan (ETP):** The similar slow pace is persistent with ETP, as it still relies on action to be taken after 2030.

South Africa will meet the 2030 upper-bound NDC target, which is in line with The Paris Agreement, if it successfully executes the planned policies of renewable electricity procurement and energy efficiency measures, as well as switches to low-carbon modes of transportation. The continent is thought to contain less than 1% of the world's data centre capacity despite housing 17% of the world's population.

Following the general guidelines on Environmental, Health, and Safety issued by the International Finance Corporation (IFC), data centre projects have started to expand in South Africa and Kenya. As this process adheres to international standards, site-specific impacts should be mitigated.

Africa generates 2.9 million tonnes of total e-waste every year, yet only 1% is formally documented to be recycled.

- **E-waste:** E-waste policies and regulations are in place in about 13 African countries to facilitate the enforcement of sustainable e-waste management and responsible importation. A few of these consist of the following:
  - The Zambia Information and Communications Technologies Authority
  - The Waste Management Law 202/2020 by Egypt
  - The Hazardous and Electronic Waste Control and Management Act by the Government of Ghana

South Asia[31]

Major economies of South Asia, including India, are formulating policies to move closer to becoming a net-zero emissions economy.

- **National data centre policy:** By working with the Ministry of Power on various green and sustainable energy initiatives, the policy promotes the use of renewable energy. It does not, however, specify any goal or course of action.

India is one of the fastest growing e-waste streams in the world, with 95% of its e-waste being recycled by the informal sector.

- **E-waste management rules:** The Central Pollution Control Board developed these to formalise circularity. They apply to every manufacturer, refurbishing business, e-waste dismantler and recycler having come into force from April 2023.
- Authorised recyclers will collect waste in bulk, recycle it and issue electronic certificates to businesses in order for them to meet their yearly target. Government agencies are leading by example, with the office of the Principal Scientific Advisor to the Government of India playing critical roles in the development of an e-waste management eco park.

Decarbonising South Asia

Enablers

Investment in alternate clean energy sources: The Government of India approved the National Green Hydrogen Mission with a total budget of INR19,744 crore.

Healthy technology adoption rate: 57% of Indian companies use AI, while 27% are exploring its use in the near future.

Solar energy potential: India's land area receives about 5,000 trillion kWh of energy annually.

Challenges

Availability of funding and access to future technologies: To achieve its 2070 target, India needs an investment of US$10.1 trillion beginning now. If the deadline is advanced to 2050, the amount ~~rises~~ increases to US$13.5 trillion[32].

Weak policy framework: India has a few non-obligatory policies, with less emphasis on the ICT sector.

Heavy dependence on fossil fuel: Coal, oil and gas make up more than 80% of the energy mix in the region.

Source(s): (29) "A review of electricity consumption and CO2 emissions in GCC region", Emerald; (30) "Africa in an evolving global context", IEA; (31) "Weekly data: South Asia suffers from climate change but sticks to fossil fuels", Energymonitor.ai; (32) "Prime Minister's concept of mass movement for 'LIFE'– 'Lifestyle for Environment' as a key to combating climate change", PIB; "IBM Global AI Adoption Index 2022", IBM AI index; "Data center Policy 2020", meity.gov; "Policy practices for e-waste management", ITU; "Public Information Summary", DFC.gov; "Solar rising: Clean power deals to expand GCC Energy mix", Technical review Middle East; "Climate Target Update Tracker", Climate action tracker; "Electronic waste considerations in the Middle East and North African (MENA) region: A review", ScienceDirect; "South Africa Just Energy Transition Investment Plan", European Commission

The road to complete decarbonisation

Through innovation, the ICT sector can leverage its transformative potential and advance its decarbonisation journey.

The ICT sector plays an important role in the global decarbonisation effort, not only by removing emissions from its own operations, but also by enabling transition of high-emitting sectors that are working to gain efficiency, embed circularity and achieve sustainability. So far, ICT has been able to control its own emissions through technological advancements and purchase of renewable electricity. Nonetheless, emerging technologies are predicted to increase energy consumption, necessitating greater efforts to keep global warming within the 1.5°C range.

ICT needs to quantify and set Scope 3 targets in order to achieve full decarbonisation. The sector can utilise the purchasing power as levers to reduce emissions and promote decarbonisation, as well as improve its calculation techniques and business models.

Nonetheless, there are a few dependencies in the telecom and technology sector that businesses need to be aware of and account for in their transition plans. These are as follows:

- **Upstream suppliers:** Many businesses, depending on their product offerings, source raw materials from high-emitting industries such as mining.
- **Product use:** Downstream Scope 3 emissions are heavily influenced by the product's end use and disposal or recycling. Companies in the sector can help promote the recycling and recovery of high-emitting raw materials.
- **Policies:** Policy decisions have high influence on the pace and timing of decarbonisation.
- **Technological advancement:** Emerging technologies (AI, 5G, etc.) will continue to drive the demand for data centres and therefore, will require timely investment in R&D of energy-efficient technologies.

Furthermore, due to these dependencies currently in different stages of adoption and development across regions, the ICT sector's short-term, mid-term and long-term roadmaps are likely to differ significantly across regions.

Key next steps			
	Short-term (2025–27)	**Mid-term (2028–35)**	**Long-term (2036–40)**
Europe	• Strengthen industry collaborations for joint decarbonisation efforts	• Embed ICT network equipment in the transition strategy • Transition to a more sustainable model	• Design for circularity at scale • Aim for carbon neutrality
Middle East	• Bolster net-zero emissions targets in alignment with The Paris Agreement • Formulate dedicated e-waste policy	• Reinforce the strategies to increase the share of renewable energy • Collaborate with suppliers to adopt sustainable supply chain practices	• Invest in energy-efficient power grids and storage infrastructure
Africa	• Enter international partnerships at government and private levels • Implement stronger national regulations to curb e-waste generation	• Strengthen the strategies to increase the share of renewable energy • Collaborate with suppliers to adopt sustainable supply chain practices	• Increase self-reliance in financing climate actions through focus on public-private partnerships
India	• Strengthen targets to align with The Paris Agreement • Focus on reducing e-waste generation • Focus on improving energy efficiency in data centres, networks and devices	• Decrease reliance on fossil fuel to accelerate inclusion of renewable energy • Invest in energy-efficient data centres with advanced cooling systems and efficient server utilisation • Leverage smart grids and IoT technologies to optimise energy consumption and reduce emissions • Promote circular economy principles by designing products for reuse, recycling and minimising resource consumption • Implement AI-driven energy management systems to optimise resource usage and reduce carbon footprint • Support R&D efforts for cleaner technologies, i.e., low-power chips and energy efficient algorithm • Increase focus on international collaboration to leverage best practices	• Adopt stronger circular economy practices • Increase focus on international collaboration to leverage best practices

Glossary

Sectors covered*

Term	Definition
Hardware	Consists of companies that design or manufacture technology hardware products, including personal computers (PCs), consumer electronics and communications equipment
Software	Comprises companies that develop and sell application and system software, delivered through cloud-based and physical platforms; includes general applications software for personal and enterprise computers and mobile devices
Technology-as-a-service	Comprises service providers delivering an information technology service to a business, allowing them to access technology on-demand such as cloud providers
Telecommunications	Comprises two primary segments — wireless (providers use wireless infrastructure to provide a range of services including wireless telephony voice, data (such as video, games and music content), text messaging, internet and satellite communications services) and wireline services (providers operate wired infrastructure to provide telephony services, video programming distribution and internet services)
Networking and internet (part of telecommunications)	Comprises companies that offer networking and internet-connected products, including wireless (Wi-Fi and long-term evolution or LTE)

** For the purpose of this study, all the above sectors are covered under information and communications technology (ICT).*

Exclusion

Term	Definition
Semiconductors	Companies designing or manufacturing semiconductor devices, integrated circuits, their raw materials and components (such as wafers, substrates and solutions) or capital equipment (such as deposition equipment, thermal processing equipment and back-end machinery used in assembly and testing); However, semiconductors have been considered in the upstream part of the value chain to provide a complete assessment.

Terminology

Term	Definition
Scope 1 emissions	Scope 1 emissions are direct emissions from owned or controlled sources, such as running machinery to make products, powering computers and driving vehicles, among others.
Scope 2 emissions	Scope 2 emissions are indirect emissions from the generation of purchased energy, such as using electricity for heating or cooling buildings.
Scope 3 emissions	Scope 3 emissions are all indirect emissions (not included in Scope 2) that occur in the value chain of the reporting company, including both upstream and downstream emissions, such as emissions produced by customers using the products or by suppliers making the products that the company uses.

Source(s): "Greenhouse Gas Protocol", GHG protocol

Abbreviations

Abbreviation	Description
AI	Artificial intelligence
EC	European Commission
EMA	Europe, Middle East and Africa
EU	European Union
GCC	Gulf Cooperation Council
GHG	Greenhouse gas
GPU	Graphics processing unit
GWP	Global warming potential
ICP	Internal carbon price
ICT	Information and communications technology
IEA	International Energy Agency
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change
IRP	Integrated resource plan
ITU	International Telecommunication Union
kWh	Kilowatt-hour
ML	Machine learning
NDC	Nationally determined contribution
NREP	National Renewable Energy Program
ODP	Ozone depleting potential
PoS	Proof-of-stake
PoW	Proof-of-work
PPA	Power purchase agreement
PUE	Power usage effectiveness
SBTi	Science Based Targets initiative
SMEs	Small and medium enterprises
TMT	Technology, Media and Telecommunications
TPU	Tensor processing unit
TWh	Terawatt-hour
UAE	United Arab Emirates
VPPA	Virtual power purchase agreement
WEEE	Waste from electrical and electronic equipment
XR	Extended reality

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