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Orange
Energy Challenges, Drivers & Measures for Green Transformation

Telenor's Green Connection

MTN: On the Road to Net Zero by 2040

Green 5G Lights the Way to a Low-Carbon Future

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Lighting up a Green Future with Green ICT

The Glasgow Climate Pact signed at COP26 in November 2021 marked a big step forward in the drive to keep global warming below 1.5°C. I am pleased to see that so many organizations have committed to energy transformation and clean energy – it reinforces my conviction that innovations in ICT will play a pivotal role in building a green future.

To comply with the Paris Agreement, ITU's Recommendation L1470 suggests that the ICT industry reduce its greenhouse gas emissions by 45% between 2020 and 2030. Over its 30-year history, Huawei has remained resolutely customer-centric. Many carriers have already set carbon reduction targets, and we are committed to supporting their efforts through product and solution innovation in the areas of reducing emissions and boosting energy efficiency.

The ICT industry will make full use of renewable and low-carbon energy and continue to increase their own energy efficiency. It can also pass on this positive impact – the "carbon handprint" – to boost the green development of other industries, and in turn benefit from the cost savings and revenue opportunities stemming from ICT's increasing ability to boost energy efficiency.

Our integrated green site, green network, and green operation architecture enables carriers to carry out structural optimization. The green site solution is designed for scenarios such as wireless base stations, data centers, and central office (CO) equipment rooms. It features simplified sites, outdoor and high-density equipment, integrated antennas, self-sufficient renewable energy, intelligent temperature control, and engineering planning. Our green network solution deploys all-optical, simplified, and intelligent technologies that reduce power consumption, with the evolution from SDH to OXC a prime example of significantly improving network energy efficiency. Our green operations solution uses AI to adapt equipment operations to service needs and coordinate network and power equipment management. On the user side, the solution also migrates users to more power-efficient RATs.

To help carriers manage carbon emissions reduction despite rapid increases in data use, Huawei and Informa Tech have proposed the Network Carbon Intensity (NCI) index. The index measures emissions per unit of data service and is a key indicator of green infrastructure development.

Green development requires advances in digital technologies and a concerted effort across the industry value chain. We invite industry leaders to share their green practices to inspire other industry players, and we will continue to work with customers and industry partners to build a greener future that generates more bits with less watts.

By Peng Song,
President of Carrier BG Marketing & Solution Sales Dept, Huawei

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Orange: Energy Challenges, Drivers & Measures for Green Transformation

At the 2021 Better World Summit, carriers, regulators, analysts, and other industry stakeholders explored the theme "Green ICT for Green Development". Hervé Suquet, Group Energy SVP for Orange Group, described the carrier's action plan underpinning its ambitious goal of achieving net zero carbon emissions by 2040 – and the challenges it needs to overcome to reach that goal.

By Hervé Suquet, Group Energy SVP, Orange Group

Defining the challenge

Orange has two main targets defining its energy strategy: We aim to use less energy at less cost and reduce our carbon footprint. Achieving these goals is aligned with the group's broader goal of giving everyone the keys to a responsible digital world. Addressing challenges with energy efficiency, supporting the best use of energy, and minimizing our contribution to climate change are instrumental to determining how we move forward.

Taking 2015 as our baseline, Orange's Engage 2025 strategic plan commits to reducing carbon emissions by 30% by 2025 and acquiring 50% of the group's energy from renewable sources. The plan will enable us to reach our objective of being net zero by 2040 – a commitment that we are pleased to say has been approved and validated by SBTi.

In 2019, we shifted our focus to energy, underpinned by the premise that energy demand will rise by 26% from 2019 to 2023. Moreover, energy consumption tends to increase in parallel with traffic, which is forecast to rise dramatically – the impact on energy consumption will be huge if we fail to act.

Given that 80% of energy consumption is linked to networks and IT, we need identify the drivers of change. One of the primary drivers is good governance, which is central to our action plan. Governance acknowledges that energy sits at the junction of CSR, finance, technology, and sourcing – all must push in the same direction to have a meaningful impact on the energy challenge.

> Addressing challenges with energy efficiency, supporting the best use of energy, and minimizing our contribution to climate change are instrumental to determining how we move forward.
>
> —Hervé Suquet, Group Energy SVP, Orange Group

> Our energy action plan sets out how we will improve the energy efficiency of our network and IT, and it is helping us reach our first objective of stabilizing total energy consumption.

Four KPIs for energy

To reach our targets, each of the countries and business units in which we are active are tasked with implementing an effective, context-specific action plan. To drive this program, we have set up a high-level energy dashboard comprising four KPIs.

The first is the economic KPI "ENOV", which is a ratio of IT and energy OPEX in relation to revenue. A decrease of one point in this KPI results in a corresponding one-point loss in EBITDA.

The second is the technical KPI "RAN kWh/Gb", a key energy ratio for RAN efficiency that benchmarks and then charts how we evolve year-on-year, and evaluates how different countries perform. As some countries are less efficient than others, much room for progress exists.

The third – and second technical KPI – is the key metric of PUE (Power Usage Effectiveness). PUE is technical parameter central to energy efficiency and a major focus of the industry, including GAFAM. We are currently developing a dashboard to compare nations and identify ways in which they can improve.

The fourth KPI is ecological efficiency, which is measured through renewable energy ratio (RER) and is a key driver supporting Orange Group in achieving its net zero objectives.

Our energy goals can be embodied in a simple equation: reduce both CO_2 and cost.

Both elements of this equation are driven by energy consumption. Energy type directly impacts emissions, while cost is determined by overall energy procurement. In this context, our energy sourcing strategy is vital because it is the major determinant that influences energy cost and type. By buying energy-efficient equipment, we can optimize energy usage metrics.

Our energy action plan sets out how we will improve the energy efficiency of our network and IT, and it is helping us reach our first objective of stabilizing total energy consumption. In Europe, we are well on the way to achieving this. However, Africa and the Middle East present more of a challenge, because both regions are undergoing an intensive period of network development characterized by geographical coverage increases and very rapid rises in data traffic.

One of the key drivers for stabilizing total energy consumption is to consider energy in every key decision,

> Energy-saving features must be built in to network deployment at the design stage. If deployment begins without these features designed-in, as is very often the case, it is highly inefficient because they need to be added at a later stage.

including sourcing and how we technically deploy our network and IT equipment. Energy-saving features must be built in to network deployment at the design stage. If deployment begins without these features designed-in, as is very often the case, it is highly inefficient because they need to be added at a later stage. All the equipment Orange sources is assessed from the perspective of energy-efficiency, which in turn guides decision-making in investment and operations

50+ key actions

Our energy action plan is based on a full catalogue of recommended, field-proven actions designed for countries to implement. We have identified more than 50 key actions across our technical domains, with each country selecting the one that is most relevant to them. We then output a quarterly report that benchmarks every country, and work with the poorest performers to formulate and implement improvement strategies.

An additional action point is establishing energy plans with our main partners such as TowerCos, energy service companies (ESCO), and RAN-sharing JVs. Our net zero by 2040 target includes our partners. They must be aligned with our energy-efficiency strategies and support us in achieving our 2040 net zero objectives.

Today, energy costs in Europe are highly volatile, requiring a robust sourcing strategy that can help reduce carbon emissions. To support this, forecasting capabilities are required to precisely calculate energy needs, cost, and carbon impact. By running forecast, tracking, and analysis processes that compare forecast gaps against the actual situation, we can move forward with a coherent strategy.

Increases in energy costs need to be solved by embedding a strategy across organizational domains, including finance, CSR, IT, and sourcing. We can then conduct effective analysis and implement pilot programs for energy-efficient action plans that include using the right equipment, equipment swapping, and retirement.

Thus, the first focus of our action plan is to reduce the overall amount of energy spent and the second is to optimize sourcing costs. Our strategy mainly focuses on Scope 1 and Scope 2 of the carbon emissions scale set by the Greenhouse Gas Protocol. Our next challenge will be to extend this action to Scope 3, and thus drive ecosystem-wide improvements that fully support Orange Group's strategy.

Telenor's Green Connection

At the 2021 Better World Summit (BWS) hosted by Informa Tech and Huawei, Tanveer Mohammad, SVP and Head of Global Operations for Telenor, explored the operator's strategies and solutions for using technology cutting energy demand and optimizing supply.

By Tanveer Mohammad, SVP, Head of Global Operations, Telenor

> As consumers now enjoy a much better network and data experience, the increase in energy consumed by networks creates a much larger carbon footprint.

For the last three years, I've been focusing on energy efficiency and finding the right solutions for the many challenges we face.

Just as the world went through the industrial revolution, we are now going through the telecommunications revolution, from 2G, 3G, and 4G up to 5G, which we are embarking on today. However, innovation also means higher energy use. We are emitting more carbon into the environment and the temperature of mother earth is rising. If things continue as they are, it will not be long before many of us are living under sea level.

So as global citizens, this must be addressed. Telenor is ensuring its own contribution by increasing green energy use and optimizing its own demand for energy. As we cannot work alone on a global scale, we have been working with partners to take climate commitments seriously, with science-based targets leading their operations.

Three scopes of emissions

The Greenhouse Gas Protocol sets three scopes for carbon emissions. Scope 1 comprises direct emissions. We run huge networks across various geographies and, to reduce electricity usage, we are committed to modernizing our networks. We aim to use high-efficiency rectifiers and batteries to minimize system loss and deploy all available power-saving features that are available. We also plan to apply advanced AI and machine learning solutions wherever possible, remove unnecessary components such as air conditioners and cooling cabinets, and move towards outdoor sites solutions.

Scope 2 covers indirect emissions caused from purchasing electricity. If we use a grid in a country that burns coal, we in turn emit a considerable amount of carbon into nature. Our goal is to aquire energy from greener sources, preferably as part of a long-term agreement, and opt for renewable sources like solar where possible.

Scope 3 is about suppliers. Huawei is one of our biggest partners, so we have to ensure that Huawei also takes its own green operations very seriously, with clear targets and a structured approach to realizing them.

As consumers now enjoy a much better network and data experience, the increase in energy consumed by

> If you have the right kind of partnerships with key players, then the challenges are much easier to address.

networks creates a much larger carbon footprint. We need to balance technology advances with intelligent energy to flatten the curve.

For Telenor, energy-based cost is an increasing year-on-year trend owing to the increase in energy demand and the global increase in fuel prices. In Asia in particular, there is a huge dependency on fuel-based energy, requiring high diesel-generator hours and the burning of fossil fuels. However, the price of fuel is increasing exponentially in almost every market. This affects both the environment and profitability.

Knowing the problem

We launched project Thunderbolt in 2019 and started by delineating energy use based on regions. In Asia, energy usage accounts for 20% to 24% of total technology operating costs compared to 10% to 11% in the Nordic region. To improve, we need to exert strong control on energy demand and supply.

If our network equipment becomes more efficient, energy demand goes down. Site modernization, including avoiding the use of air conditioners, which are crucial but do not yield any meaningful value to the network, cuts down demand. Reducing system loss and boosting efficiency optimizes demand. Data centers and the tools used in day-to-day operations for energy help to optimize demand in a good way.

Similarly, on the supply side, if we obtain energy from inefficient sources, like diesel generators, energy usage increases compared to using the grid system. Using more renewable energy like solar and wind will help optimize energy supply and reduce CO_2 emissions. Unfortunately, there are areas where we operate in parts of Asia that have no grid availability, or the grids are very unstable and can provide only around four to seven hours of electricity a day. If we can work towards addressing these issues, we can optimize our energy usage further.

Under project Thunderbolt, we have sought to address energy-related challenges. 2020 was the first year where we were able to reduce network-based energy consumption by 1.54%, representing a year-on-year increase of 7% to 8% despite a 30% to 40% growth in data traffic.

> With Huawei, we have been working in Finland to roll out 5G. Using AI- and machine learning-based features, we can limit the energy demand to low levels.

If you have the right kind of partnerships with key players, then the challenges are much easier to address. With the introduction of 5G technology, we're adding enormous capacity to networks – between three and four times as much. This impacts our demand for energy. The initial forecast has been a 9% to 10% increase in energy consumption, but what we are seeing is that if we work together, it is possible to limit the increase in demand by a considerable amount.

With Huawei, we have been working in Finland to roll out 5G. Using AI- and machine learning-based features, we can limit the energy demand to low levels, around 3% to 4%.

In 2022, with network investment and forecasted data growth, energy demand is expected to grow, which implies that we must collaborate across the industry and learn from each other. Network modernization and phasing out legacy networks needs to be carried out to balance energy demand. Cloud-based capabilities and advanced RAN-based features will provide further efficiency in networks with the help of partners.

So far, we have installed more than 3,000 solar-powered base stations across our operations, and we are working to deploy more solar and wind solutions coupled with power purchase agreements with green suppliers. The renewables ecosystem is not quite mature in the Nordic area, and even less so in Asia. But by 2025, we should start seeing renewable technologies mature in Asia.

From partners like Huawei, we have many expectations. We have seen that the major source of demand across any network is the RAN, which means our distributed base stations. So, we need innovative RAN solutions with high energy efficiency from our partners. We also need advanced AI and machine learning capabilities to deliver advanced network features that can maximize efficiency. And we need innovations in energy supply and management, including high-efficiency rectifiers, batteries, and environmental control systems.

We expect our partners to embark on this journey with us, set scientific targets for their own operations, and address the increase in energy consumption from the demand and supply sides. While this is very challenging, we must work together for a green world.

MTN: On the Road to Net Zero by 2040

At the summit 2021 Better World Summit (BWS) hosted by Informa Tech and Huawei, Dirk Karl, Chief Procurement Officer for MTN, explained the African operator's commitment to net zero and how supply-side collaboration can help achieve this.

Dirk Karl, Chief Procurement Officer, MTN

With 277 million mobile subscribers, MTN is the seventh largest global carrier in terms of mobile network subscriptions. We are active in 21 markets, mainly covering Africa's emerging markets and the Middle East.

We still need to connect those who are unconnected in emerging markets. To achieve this, we plan to deploy new infrastructure and densify our existing networks. However, MTN's strategy is not just about flourishing in business: We also have a clear purpose, one that was proven under COVID. We aim to translate our work into a system that is relevant to both economic growth and to connecting society. To flourish in business, we also need to prioritize the well-being of communities and the industry ecosystem, including connecting the unconnected and fighting poverty.

We believe that everyone deserves the benefits of a digital life and being connected.

Environmental, Social, and Governance (ESG) is central to our corporate strategy, Ambition 2025. ESG also incorporates green ICT. When we look at environmental protection, we also need to look at sustainability and governance. We have positioned ESG at the core of our strategy as a strategic framework from the telco perspective. About a third of telcos have developed scientific targets relating to ESG, with one third of those stating their intention to be net zero by 2050.

We are more ambitious: We want to be net zero by 2040.

Cutting Emissions: Scopes 1-3

Technology companies such as Huawei have developed

> The PowerStar management system can shut down idle sites when there is little or no traffic, bringing down OPEX as well as saving energy.

solutions like PowerStar, intelligent batteries, and passive cabinets that do not require air conditioning. This is part of the equation, because it can deliver incremental improvements in reducing emissions over time and is in line with the three scopes defined by the Greenhouse Gas Protocol. If we are not prioritizing renewable energies to make our planet sustainable, then climate change will remain a threat, especially to emerging markets. In Africa, agriculture, mining, and other emerging industries will be affected by climate change, which will in turn affect Africa's development trajectory and its ability to fight poverty.

If we continue on our Net Zero 2040 journey, we have to accept another challenge. We are already analyzing and setting targets based on 2020, where we saw a reduction of 6% in greenhouse gases. By 2030, we are expecting to achieve a 47% decrease in our carbon footprint.

Most telcos are currently addressing Scope 1 of the emissions' landscape. As part of Scope 1, company vehicles alone can account for achieving 12% of the targets. We are also looking at new generators, hybrid solutions, intelligent batteries, and the deployment of sites powered by solar energy for Africa and the Middle East. We have already trialed intelligent energy management with Huawei by deploying its PowerStar solution in 5,000 radio sites – the PowerStar management system, for example, can shut down idle sites when there is little or no traffic, bringing down OPEX as well as saving energy.

Scope 2 looks at energy consumption and the indirect pollution caused by purchasing energy, which we need to trade off at the moment. We are prioritizing renewable energies so that we can reach the 2030 emissions target set by Scope 2. Renewable energies require a collaboration roadmap, and we are working with vendors not just from the perspective of a sourcing strategy, but also from a commitment perspective. This year, we have launched 150 partnerships with suppliers, such as energy service companies, to achieve gains in efficiency, energy savings, and power management.

We now collaborate with 193 suppliers and they will help us lower emissions by between 23% and 47%.

Collaboration Is the Key

To move forward and achieve our targets, we need to think in terms of a collaborative supply chain – collaboration and commitment are why we believe net zero by 2040 is an achievable target.

Innovation In Digital Technologies to Support Green Development

The challenges presented by climate change have become increasingly urgent and a global consensus on green development is rapidly taking shape. ICT enterprises need to undertake two missions to support sustainable development. First, we must make our own operations greener. Second, we must continuously innovate in digital technology to help other industries save energy and cut emissions.

By Kevin Zhang, CMO, ICT Infrastructure, Huawei

Climate change seriously threatens not only global development, but also human survival. Now more than ever, we must strive for green, low-carbon production and lifestyles, and promote sustainable development. We have seen throughout history how new technologies can drive social advancement. Already, key digital technologies, such as 5G, cloud, and AI, are playing an increasingly important role in driving us towards a green world. Many industries are using these technologies to go digital. Doctors are treating more patients remotely. More students are signing into online classes. And remote conferencing and work have become more and more efficient.

Huawei has long embraced green growth. As a leading global provider of ICT infrastructure and smart devices, Huawei's vision and mission is to bring digital to every person, home and organization for a fully connected, intelligent world. Over the past 30-plus years, Huawei has committed itself to innovating digital technologies to fulfill its vision, while staying customer-centric and meeting market demand. Together with our partners, we have strived to help various industries achieve green development.

Specifically, we have three priorities for these continued efforts.

We help build green ICT infrastructure by developing simplified architecture and innovative, energy-efficient products

For telecom carriers, saving energy and cutting emissions at sites, data centers, and network connections are the key to green development. Huawei helps carriers build green ICT infrastructure by designing simplified architecture, applying innovations in multiple aspects, and continuously improving product energy efficiency.

Green sites with simplified architecture

Widely deployed wireless sites are a primary focus in carriers' energy saving and emission reduction efforts. By simplifying the architecture of our site solutions, Huawei has managed to replace equipment rooms with cabinets and poles. This allows carriers to upgrade a site to 5G without increasing energy-related OPEX.

By using cabinets to replace indoor equipment rooms, our solution increases the energy efficiency of a traditional site, where 40% of all power is used for heat dissipation, from below 60% to 90%. Energy efficiency can even reach 97% by adopting Huawei's outdoor site solution where all equipment is installed on a pole. Solar systems can also be added to these solutions, allowing the sites to generate their own green power.

These green site solutions are the result of innovation in three areas: innovative technology and system design that make AAUs more efficient; evolution to multi-band, multi-mode, and multi-channel RRUs; and continuous improvements in solar cell efficiency.

Green data centers with multiple innovations

Data centers are the heart of a digital economy, but they also consume large amounts of energy. With the rapid growth of data centers both in terms of speed and deployment density in recent years, the shortcomings of traditional air cooling technology have become increasingly apparent.

To address the problem, Huawei has made the cooling systems of data centers significantly more energy-efficient through multiple innovations, including full liquid cooling, AI management, structural design, and cluster computing.

In a closed liquid-cooled cabinet, all heat is dissipated by liquid, reducing the power consumption of cooling systems by 96% and cutting the power usage effectiveness (PUE) from 2.2 to 1.1, compared with a conventional air cooling solution. For a 50-kW cabinet, the annual power saving amounts to about 500,000 kWh.

These reductions in the power consumption of cooling systems are key to making data centers more energy efficient. Traditional cooling systems were mostly manually adjusted. However, as data center loads and their environments constantly change, manual adjustment can no longer keep up with rapidly changing heat loads. To prevent energy from being wasted, cooling systems need smart brains that can intelligently adjust and deliver cooling as necessary. Huawei's iCooling solution, which integrates big data and AI, enables data centers to learn to save power and automatically optimize their power efficiency, making on-demand, intelligent cooling a reality. The solution reduces data centers' PUE by 8% to 15%.

> Huawei's iCooling solution, which integrates big data and AI, enables data centers to learn to save power and automatically optimize their power efficiency, making on-demand, intelligent cooling a reality.

This solution is deployed at Huawei's cloud data center in Langfang, where it delivers savings of 27.64 million kWh of electricity every year.

While greatly reducing energy consumption, the solution also uses an integrated structure and cluster-based computing architecture to maximize computing efficiency, helping carriers build green data centers.

Energy-efficient, intelligent connectivity

In addition to sites and data centers, all connections that support ICT infrastructure must also meet green and low-carbon requirements. Huawei has integrated these requirements into the entire R&D lifecycle of its products. While improvements in product and solution performance often mean higher energy consumption, we have continued to seek new and innovative ways in multiple dimensions, including raw materials, processes, algorithms, and heat dissipation technologies, to improve the energy efficiency of our products and solutions.

For energy-efficient 5G networks, Huawei has launched the innovative three-level energy saving solution, PowerStar. It uses built-in AI to analyze live network data and build traffic models to identify typical scenarios for energy saving. With these models, the AI can predict upcoming traffic changes, and deliver scenario-specific energy saving plans. This enables a targeted energy saving strategy for each network site to maximize power savings. According to China Mobile Hunan's live network tests, PowerStar lowered total network energy consumption by 10%.

Optical communications technology is widely recognized as an ideal option for providing low-carbon connectivity in the F5G era. For backbone and transmission networks, Huawei is using optical cross-connect (OXC) and passive optical LAN (POL) technologies to build green, low-carbon, and ultra-broadband networks that consume significantly less power.

For home access, Huawei has launched the Huawei OptiXstar smart optical modem series. The Advanced Power Management (APM) mechanism of these products automatically puts the device in different modes (active, dormant, and sleep) at different times of day, depending on usage patterns. This continues to deliver superior experiences to users while also maximizing green and low-carbon operations. Each Huawei OptiXstar uses only about 0.37 kWh per day and saves users 38.5 kWh every year. Broad, global adoption of these products would together bring considerable savings.

We use bits to manage watts to promote clean energy and the digitalization of traditional energy

Transforming energy systems is key to going digital, low-carbon, and green.

Huawei works to converge power electronics and digital technologies to promote clean energy and the digitalization of traditional energy. By using bits to manage watts, we are using digital technologies to control power electronics equipment. Our main focal areas span clean power generation, energy digitalization, transportation electrification, green ICT infrastructure, and integrated smart energy. We provide secure, efficient, green, and intelligent products and solutions for these areas. We also provide the energy industry with enablement platforms for embedded power, intelligent power distribution, and energy storage. Next, we will develop an open Energy Management Cloud Service platform covering various digital power scenarios for all of our customers and partners.

By providing these products and solutions, Huawei aims to support low-carbon development in a range of scenarios including homes, buildings, factories, campuses, villages, and cities. This will help transform the energy mix of enterprises and even countries, ultimately leading to a green world. As of September 30, 2021, Huawei's digital power products and solutions had helped customers generate 443.5 billion kWh of clean energy, while saving 13.6 billion kWh of electricity, equivalent to reducing 210 million tons of carbon emissions.

We bring digital technologies to all industries, enabling their green development

In addition to reducing emissions in the ICT industry, we are also paying close attention to the reductions that ICT indirectly generates by empowering other industries. According to the Global Enabling Sustainability Initiative (GeSI), ICT has the potential to enable a 20% reduction in global CO_2 emissions by 2030. The amount of carbon reduced this way far outstrips what the industry uses and emits itself.

At present, how to reduce emissions in traditional industries, especially those with typically heavier emissions, is a key issue for the transition towards a low-carbon world. It is also a key part of our innovation strategy. We remain committed to providing digital technologies to help all industries go digital and low-carbon.

We have made some exciting progress so far. For example, after Shenzhen fully electrified its bus fleet in 2017, it was plagued by short battery ranges, long charging times, and inadequate charging stations. In response, Huawei has created a smart charging solution that uses algorithms to intelligently arrange charging overnight. This peak-cut model greatly improves charging efficiency, and is expected to decrease the power expenses of Shenzhen Bus Group by 5% to 10% every year. In smart transportation, our traffic light management solution can reduce both traffic jams and emissions in cities. Our smart heating solution is already reaping benefits for Harbin, a city in northeastern China, where Harbin Taiping Heating has found that our on-demand heating solution reduces average energy use by over 10%.

Our commitment to green ICT and green development will continue long into the future. These challenges are ones that every enterprise, organization, and individual must face, and the only way to overcome them is continuous collaboration on innovation. Huawei is ready to work with everyone to achieve this goal sooner.

STL Partners: Nine Thoughts on Sustainable Telecommunications

Climate change and environmental degradation are huge challenges that must be tackled to ensure the well-being of the planet. As the ICT industry has a key role to play at the vanguard of environmental protection, telecoms consultants STL Partners shared their perspective on the strategies and approaches that the industry can employ moving forward.

By STL Partners

Underpinned by digitalization and intelligence, the digital economy is a new engine of global economic growth. At the same time, the pandemic has accelerated digital transformation, including in the fight against it, and highlighted the need for a low-carbon approach to business, work, and life. STL Partners believes that telcos have a key role to play in the global transition to net-zero and has released a series of reports on sustainability in telecommunications that explore the challenges, strategies, and best practices.

STL Partners explained the best path for the industry to follow.

How do you define sustainability?

STL Partners: We've entered a new "Coordination Age" in which technological developments will enable governments, enterprises, and consumers to coordinate their activities more effectively than ever before. The results of better and faster coordination will be game-changing for society, as resources are distributed and used more efficiently. That will in turn lead to substantial social, economic, and health benefits worldwide.

In this context, we believe that sustainability comprises three pillars: economic, environmental, and social. The United Nations defines sustainability as "meeting the needs of the present without compromising the ability of future generations to meet their own needs." The concept of sustainability assumes that resources are finite and should be used sparingly and strategically so they are available for future generations. In business, this is also known as the "triple bottom line", which hypothesizes that businesses should commit to measuring social and environmental impact as well as financial performance and profit.

Businesses should spread their focus across the "three Ps": people, profit, and planet. In essence, sustainability in business pertains to the economic, environmental, and social impact a company has on the world,

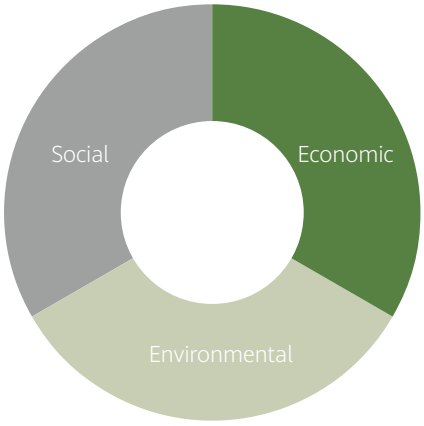


Figure 1: Sustainability

including carbon emissions, employee well-being, factory conditions, and everything in between. These concepts are not new. Many companies, including operators, have pursued strong sustainability policies and practices for years. However, we have seen a recent change in attitudes and approaches to environmental sustainability from operators, especially regarding climate change. Critically, national and enterprise commitments to net-zero greenhouse gas emissions have provided an objective and measurable framework for operators to translate aspirations into urgent action.

Companies worldwide have increasingly integrated sustainability into their business strategies, formalized their sustainable practices, started to report on sustainability initiatives, and set commitments and goals such as reducing carbon emissions.

Why is sustainability necessary?

STL Partners: Until recently, most telco CEOs were reluctant to embed sustainability into company operations and make it a top business priority. Instead, it was left to internal sustainability teams to come up with sustainability initiatives and policies and persuade colleagues to implement them. Without a strong mandate, clear targets, and incentives, these initiatives risked becoming compliance box-ticking, or worse, well-intentioned distractions from the real business of running a telco. However, companies have realized that businesses will fail or be left behind if they do not

A 2020 IBM study showed that 57% of customers are willing to change their purchasing habits to help reduce negative environmental impacts, and 77% of customers say it's important to them that brands are sustainable and environmentally responsible.

embrace sustainability.

Telcos are facing increasing pressure from customers and investors to be sustainable, with customers voting with their feet and opting for sustainable companies. Millennials and Gen Z are undeniably leading the way in sustainability awareness, but customers of all age groups are considering the sustainability of the companies they do business with. A 2020 IBM study showed that 57% of customers are willing to change their purchasing habits to help reduce negative environmental impacts, and 77% of customers say it's important to them that brands are sustainable and environmentally responsible. Nowadays investors will look at environmental, social, and governance (ESG) metrics to analyze a company's sustainability practices, for example, gender equality on boards, climate action, engagement with communities on sustainability issues, and employee relations. According to a McKinsey report, companies with high ESG ratings have a lower cost of debt and equity, and sustainability initiatives can improve financial performance. As well as being good for business, engaging with sustainability is also good for reputation, employee engagement, and attracting and retaining talent.

STL Partners also believes that a key reason for operators to accelerate transition to net zero is that doing so will enable them to capitalize on supporting their customers' net-zero transitions.

Why are telcos embracing sustainability?

STL Partners: Owing to the customer and investor pressures mentioned previously, telcos must embrace sustainability. However, it shouldn't just be perceived as a risk to be mitigated – it's also an opportunity for operators that position sustainability in their core strategy to increase their impact by supporting their customers' transitions to low-carbon businesses with new services.

Realizing this vision comes with many challenges and requires more than goodwill. It requires understanding of sustainability as a key component to the "Coordination Age", and the conviction that a telecoms operator can offer its customers more than basic communications services. This conviction is crucial to committing to developing the new practices, metrics, governance, skills, investment, and business models required to succeed.

To meet their commitments and goals, telcos are increasingly integrating sustainability into all levels of operations. Sustainability will look different to every operator with different initiatives and practices, but the overall end goals are converging.

What progress have telcos made so far?

STL Partners: To meet their commitments and goals, telcos are increasingly integrating sustainability into all levels of operations. Sustainability will look different to every operator with different initiatives and practices, but the overall end goals are converging.

Some ways in which telcos are incorporating sustainability into their businesses are:

- Aligning their initiatives with the United Nation's 17 Sustainable Development Goals.
- Implementing climate action initiatives, with a focus on reducing carbon emissions; disclosing current sustainability performance metrics; optimizing energy use through energy-efficient designs, component procurement, operations, and other practices; reducing greenhouse gas emissions across the supply chain, including e-waste management; and entering long-term agreements that underwrite additional renewable energy projects.
- Promoting diversity, inclusion, and gender equality; valuing all ages, genders, ethnicities, religions, disabilities, sexual orientations, education, and nationalities; and promoting and encouraging women in STEM and recruiting more women to board-level positions.
- Backing sustainable digital society initiatives on digital inclusion, security, child safety, personal data, and the use of AI.

What is the typical net-zero emissions journey from the telco perspective?

STL Partners: As a key component of sustainability, net zero emissions have a relationship with multiple SDGs. They should start with energy efficiency and then shift to emissions and greener energy supply. They should then expand sustainability organization-wide through incentives and reporting, and then address the supply chain.

To create major growth and advance as a telco, operators need to solve some of the world's biggest problems. Some of these are:

- A desire for greater business efficiency and productivity.

Telcos have unique assets and specific resources and capabilities such as access to data, technology, and their prevalence in the everyday lives of customers. They can contribute to tackling some of the world's problems and help make the world run better.

- The distribution and availability of human resources and services such as healthcare, education, employment, and entertainment.
- Mitigating climate change and minimizing its effects.
- Reducing the amount of waste and harmful by-products polluting the environment.
- Concerns over employment due to automation and global economic changes.

These problems are starting to be addressed through sustainability initiatives set out by companies in their agendas and policies.

Telcos have unique assets and specific resources and capabilities such as access to data, technology, and their prevalence in the everyday lives of customers. They can contribute to tackling some of the world's problems and help make the world run better.

A common problem is to help companies and people coordinate their resources near or in real-time. For example, to deliver sustainable energy means coordinating the variable demand of populations with supply. Wind turbines and solar panels cannot be relied on to produce at peak capacity in certain scenarios, like exactly half-time during a sporting event when people put the kettle on. Supply needs to be very flexibly managed in relation to demand.

This means sharing information about those resources and demands effectively, which in turn takes modern communications capabilities. Thus telcos are well-equipped to help enable sustainability.

What else should telcos be doing?

STL Partners: Incorporating the many forms of sustainability into strategy and operations can be daunting, but long-term thinking and strategic planning are critical for success with sustainability strategies. There's still a long way to go and if telcos can demonstrate that they're committed in their own businesses, there's a significant upside in helping their customers become more sustainable. Ways in which telcos can do this are:

> The cost of not being sustainable will impact enterprise value in terms of things like harm to reputation, the ability to attract and retain employees and customers, declining investor base, and the increasing price of energy.

- Formally committing to ambitious net-zero targets for their own operations and the embedded carbon in their supply chain.
- Linking executive and employee incentives like bonuses to stimulate progress.
- Adopting sustainability procedures, governance, accountabilities, reporting, and support systems.
- Putting clear commercial pressure on the vendor community and other parts of their supply chain to make their operations and products green, and stop doing business with those who don't.
- Issuing green bonds, like Telefónica did in 2019, becoming the first European telco to do so.
- Directly and indirectly supporting enterprise and public sector customers in their transition to net-zero by offering new IoT, energy, and emissions management services; product labeling; and sharing best practices.

How can telcos be sustainable and profitable at the same time?

STL Partners: One of the often-cited challenges is how to invest in sustainability without damaging profits. However, this is a false economy, because the cost of not being sustainable will impact enterprise value in terms of things like harm to reputation, the ability to attract and retain employees and customers, declining investor base, and the increasing price of energy.

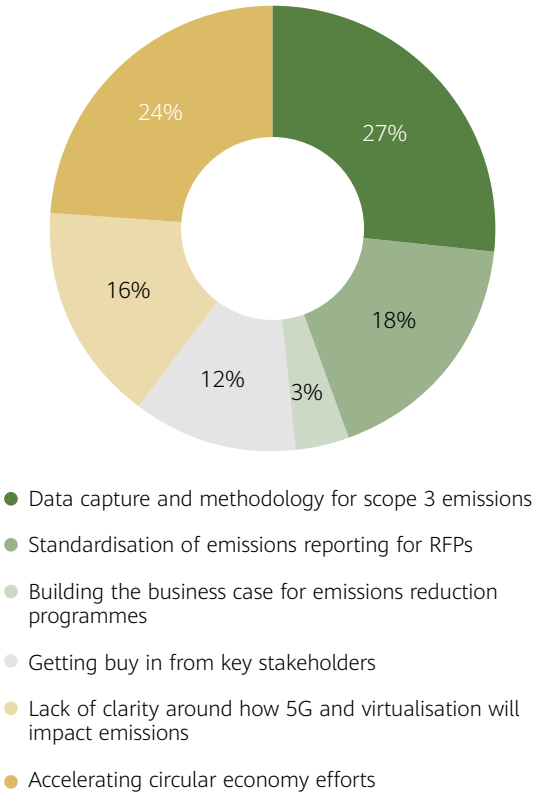
Research shows that engaging with sustainability is good for business and financial performance. A 2019 Deutsche Bank report revealed that companies that experience positive press on environmental impact saw share prices outperform the MSCI World Index by 26% year-on-year. The report also found a link between bad press regarding environmental impact and share price performance.

The telecoms industry can play a role in supporting other industries transition to net zero, with digitalization, remote automation, and employee enablement all common examples. In 2019, GSMA launched an industry-wide climate action plan to achieve net-zero greenhouse gas emissions by 2050, in line with the United Nation's Framework Convention on Climate Change 2015 Paris Agreement.

The telecoms industry can also make a difference to the social and environmental impact of its supply chain. This can be done through initiatives such as enforcing health and safety regulations in factories, managing risks associated with the types of labor used across the supply chain, and monitoring energy consumption.

Remote working is one example where telcos can play a key role in helping to reduce carbon emissions. During the COVID-19 pandemic, the robustness of telecoms networks has enabled hundreds of millions of employees to work remotely, making a strong case for reduced work-related travel in the future. Many business activities and practices that previously assumed in-person communication have gone online, with employees no longer needing to commute or travel by air for meetings.

Figure 2: What are the biggest challenges around reducing carbon emissions for telcos?



What are the biggest challenges for telcos to reduce carbon emissions?

STL Partners: Even where the most effective mechanisms have been adopted, it's doubtful whether they can claim to be 100% zero-emission. With the possible exception of a handful of countries with abundant hydro, geothermal, or nuclear power, renewable energy comes from either from biomass (burning non-fossil fuels, which creates CO_2 emissions, albeit more recently extracted from the atmosphere), or from non-emitters, but less predictable, renewable sources: solar and wind power.

The simple truth is that networks need a continuous power supply to work. Even where operators have purchased 100% renewable energy, their suppliers have usually had to "borrow" some electricity from another (typically fossil fuel-based) source when the sun isn't shining or the wind isn't blowing. This energy loan is then given back later so that the result is 100% net renewable – an elegant accounting trick that does not actually reflect the reality of what happens.

And this problem doesn't go away if we increase renewables' generation capacity because windless, dark days still mean energy has to come from somewhere else. Storage – in batteries, as hydrogen, or by pumping water back up into dams – can potentially alleviate this and get away from accounting trickery to make genuinely 100% renewable sources. But that's hypothetical.

Even if and when storage is possible, there will be some embedded carbon required to build and install the generating and storage facilities. In the worst cases, hydro-electric dams can have many years of

carbon payback embedded in civil works, concrete, and the lost carbon capture of submerged ecosystems.

Operators are right to prioritize optimization and energy efficiency and reduce the power they use to run their networks. However, the operators that are the furthest on their net zero emissions journey are now also tackling the elephant in the room: embedded carbon from their supply chain, which is far tougher to solve.

What other advice would you give to telcos?

STL Partners: Work with third-party specialists for skills and neutrality. We're already seeing many operators doing this – in particular working with third parties to create carbon reporting and disclosure policies and to evaluate products with eco-design principles. As well as bringing experience and skills, these third parties can lend confidence to reported outcomes.

Collaborate with others to drive industry level change. Operators can achieve significant sustainability improvements by themselves, but they can do more by collaborating with their suppliers. And in many cases it will be whole industry-wide initiatives (led by bodies like the GSMA and JAC) that will enable the standardization and scale that's required.

Roland Berger: Challenges & Solutions for Carbon Neutrality

When it comes to tackling climate change, the clock is ticking. Denis Depoux explains why technology solutions are crucial for cutting humanity's carbon footprint and moving towards a green and sustainable future.

By Denis Depoux, Managing Director, Roland Berger

Digitalization is critical to both climate action and climate performance

We all know that our planet is burning and that climate change is the most urgent, global issue we face today, one that will impact generations to come.

Germany, where Roland Berger is from, experienced its worst floods in 2021, with many experts pinpointing climate change in the North Atlantic as the source of these catastrophic events. Almost at the same time, China experienced torrential rains, causing the loss of life and economic havoc. It's time for action.

At the current pace of emissions, our "credit limit" of confining global warming to 1.5 degrees will take between four and eight years. For 2 degrees, it could take 20 to 25 years – if it's possible at all. Either way, the clock is ticking.

A total of 137 countries have made a pledge to achieving carbon neutrality, 90% of which have set 2045 and 2050 as targets. That may appear distant, but the lead time for transforming industry and society involves long investment cycles, particularly in the energy and mobile infrastructure sectors, which are counted in decades.

Carbon neutrality commitments put pressure on developing solutions that are up to the challenge, but it's also a matter of competitiveness. Consumers want to buy products with low- or zero-carbon content. So, while thinking of ways to penalize and tax high carbon content in their system, legislators across the planet are also looking at ways of taxing imports that have a high-carbon cost.

I'm a proud European because after pioneering the fight against climate change more than 20 years ago, the European Union is still at the forefront of change with the recently announced Fit-for-55 legislation package.

After the Kyoto Protocol was established in 1992, European commitments towards mostly renewable energy stemmed from Germany, with the economic and technological motivations for energy reduction already clear. The idea was to create a new market and a technological advantage for Europe within the

European single market. It worked: The emissions reduction roadmap saw renewable energy production rise by 2.5 times in 10 years. However, the competitive advantage of Europe is less than certain.

China benefited greatly when it joined the WTO, becoming the producer of the majority of renewable energy equipment. It now makes 70% of the world's solar PV modules and occupies a 60% share in the wind turbine market. And a lesson has been learned for the future: Climate change can stimulate progress in technology, while providing a competitive advantage to the leaders in the field.

Europe also learned that it needs to protect itself from carbon leakage, or the ability to outsource emissions globally. This resulted in the EU Green Deal and the Fit for 55 program under the Carbon Border Adjustment Mechanism, which sets targets as early as 2025 for some heavy industries.

While bringing about a competitive advantage through technology, Europe also plans to use this time to create an estimated 2 million new jobs.

Shifting to lighter carbon operations and business models will be a key driver for regional and global competition between countries, regions, and companies.

China in focus

China has a huge challenge because of the mountain of coal it starts with and because its energy consumption will continue to grow, even though the energy intensity of its economic growth has decreased by one third in the last 10 years.

However, China has a set of unique advantages, including:

- A long term perspective combined with planning and execution discipline.
- Supply chains that are gradually becoming integrated beyond China at a regional level in South East Asia, a movement that the RCEP treaty will accelerate.
- The physical space and renewable energy resources to stimulate development.
- Many potential carbon sinks such as reforestation or the restoration of wetlands.
- Strong digitalization both on the consumer and supply sides.

Abundant data can also be used to virtualize city planning and operations by enabling simulations that can improve city design, planning, and optimization, and by building in a low-carbon approach from the start.

How will China achieve carbon neutrality?

Greenhouse gas emissions are generated by every human socioeconomic activity, mostly through the combustion of fossil fuels, chemical process, and the leakage of some gases.

- Power generation, mostly by coal-fired power stations, contributes half of China's CO_2 emissions.
- Industrial production is responsible for one third.
- Transportation by road, rail, water and air, and domestic and international travel accounts for 10%.
- Up to 6% is caused by construction, construction materials, and energy efficiency in buildings.
- Waste disposal and treatment, including agriculture, generates the remainder.

Energy, mobility, and buildings are central to reducing greenhouse gas emissions and reaching carbon neutrality.

So, how can digitalization contribute?

The major factor towards carbon neutrality is reducing emissions upfront. First of all, what is not measured cannot be managed, let alone reduced. In most cases, emissions are not actually monitored, but are calculated based on data-fed algorithms that model CO_2 emissions from all types of activities. For urban activities like traffic or utilities, the data is generated from local governments' existing information systems. For industrial activities, it comes from the instrumentation and control systems of production machinery. In both cases, this data can be real-time or generated from frequent monitoring.

One district of Mannheim in Germany deployed a smart power grid system based on the data collected from smart meters, which achieved a direct reduction in carbon. A cohort of 200 residents in one phase of the project saw a reduction of daily energy consumption by 6% to 8%, with an equivalent reduction in CO_2 emissions.

Abundant data can also be used to virtualize city planning and operations by, for example, enabling simulations that can improve city design, planning, and optimization, and by building in a low-carbon approach from the start. Urban environments are the single biggest contributor to climate change, producing two thirds of emissions.

The software company Dassault Systèmes provides

Data and digitalization are key enablers of climate action and climate performance. Several key technologies can help with the modeling, visualization, monitoring, planning, and optimization processes.

multiple virtualization solutions that enable low-carbon urban planning and, in turn, new urban designs supported by environmentally optimized decisions. For example, reducing commuting time through industrial, commercial, and residential zones can optimize mobility and cut carbon footprints.

Stockholm, which plans to become carbon neutral by 2040, has implemented best practice in the field of intelligent transportation planning. The local government has reconstructed traffic routes to encourage low-carbon commuting by simulating layout, road networks, and carbon emissions. As a result, 93% of the city's residents use public transport or low-carbon ways to travel.

Energy efficiency in buildings can be increased by the continuous monitoring of key performance indicators around occupancy, heat, cold, and lighting. Doing so can achieve outcomes like minimizing heat or cold leaks and maximizing the usage of facilities. Optimized industrial processes can result in low-carbon building materials such as cement, concrete, glass, and steel.

Energy efficiency in production processes can be increased by more efficient industrial processes, for example, stopping the combustion of fossil fuel through the electrification of furnaces and tighter control of process temperature and pressure.

This is where digitalization plays a key role in saving energy by enabling instrumentation and control, real-time monitoring, and process regulation with algorithms.

Data and digitalization are key enablers of climate action and climate performance. Several key technologies can help with the modeling, visualization, monitoring, planning, and optimization processes:

- IoT and the industrial Internet can generate and collect the basic data needed through things like smart and automated meters, intelligent sensors, and smart wearables.
- 5G and cloud can meet requirements for massive, frequent, and low latency communication.
- Machine learning can process the mass of new data, enabling the understanding of greenhouse gas emissions and ways to improve it.

Corporations, as well as governments, are tackling the climate challenge out of responsibility and compliance and also to increase competitiveness. And digital technologies are the key to achieving both.

GSMA Accelerates the Mobile Industry's Race to Net Zero Carbon Emissions by 2050

John Giusti, Chief Regulatory Officer for GSMA, shared progress in reducing global carbon emissions and the ICT industry's efforts to achieve the carbon neutrality goal.

By John Giusti, Chief Regulatory Officer, GSMA

The race to net-zero carbon emissions by 2050 is speeding up. Business and world leaders met at the 26th UN Climate Change Conference of the Parties (COP26) in November 2021 to discuss how to keep the temperature of our planet under control, by aiming to keep the global temperature rise to within 1.5 degrees Celsius. Only by producing less carbon than we take out of the world's atmosphere will we have a chance of achieving this aim. This is what "net zero" means.

The mobile industry, which has been a forerunner in the campaign to fight this global crisis, has long committed to the United Nation's (UN) 17 sustainable development goals (SDGs), specifically SDG 13 – Climate Action, since 2016. And as a guardian of the mobile industry, over the years, the GSMA has relentlessly pursued its goals by advocating energy efficiency, transitioning to renewable electricity, and actively engaging with the supply chain in the mobile technology ecosystem. Moreover, the UN has recognized the GSMA as one of the first 'Race To Zero Accelerators' for its role in coordinating the industry effort in support of the organization's Race To Zero campaign.

Steady progress has been made over the last five years. However, there is more to do. The mobile industry needs to push for concerted efforts in the right direction in order to achieve the UN's 2030 Agenda for Sustainable Development target.

Energy generation is the largest contributor to climate change, accounting for 60% of global emissions. As the world's population continues to grow, the demand for cheap energy will also increase, and an economy reliant on fossil fuels is causing drastic changes to the climate, according to the UN.

As per the GSMA findings, ICT accounts for 4% of the global electricity use, with another 3% for entertainment and media from TVs and broadcasting, and so on. And, the ICT sector produces 1.4% of global carbon emissions, while the mobile sector is responsible for around 0.4%.

Research conducted by the GSMA with the Carbon Trust found that the mobile industry enables carbon reductions in other sectors that are 10 times larger, equivalent to approximately 4% of global emissions. In short, the sector

is helping other industries reduce their carbon emissions through the use of mobile and network services for their digital transformation.

As mobile operators set up 5G networks around the world – there are nearly 170 5G networks across 65 countries – it is encouraging to know that 5G mobile networks are built with network energy efficiency in mind; 5G's specification calls for a 90% reduction in the energy use to transfer each bit of data.

However, in the mobile sector, the factors for climate impact are distributed across the whole value chain with 70% of emission generated from customers, supply chain, and operations combined and 30% from running networks and data centers. The major chunk of emissions in the mobile sector is not only from electricity consumption but emissions arising from the industry's supply chain. Hence, a holistic approach to reducing carbon footprint in the supply chain is needed. Consequently, the advancements in mobile technology have positioned the industry in a leading role to help other sectors reduce their emissions through digitization.

How is GSMA helping the mobile industry on the journey to net zero?

Realizing the enormity and diversity of the mobile sector supply chain, the GSMA has set up a Climate Action Taskforce comprising 50 major global operator members. The participation has been steadily growing with 11 new members joining the task force as of 2020. Through interactive sessions and engagement programmes, the GSMA works with operators to share best practices and highlight their leadership roles. As a result of such initiatives, many operators have already implemented their carbon emissions' reduction strategies. The GSMA has also commissioned new research to understand the role of technology in helping the world meet the Paris Climate Agreement.

In 2019, the GSMA agreed to align its targets for the mobile industry to be net-zero by 2050 by initiating the following three steps:

1. Encourage more climate disclosure amongst members

> The GSMA ClimateTech Programme has created an E-Waste Legislative Framework Map to bring together summaries of e-waste policies for 76 countries.

2.Create the ICT sector pathway to net-zero emissions
3. Support members to align their science-based targets

How is the GSMA fairing on the first three steps?

Currently, 59 operators covering 69% of industry connections or 80% by revenue are now disclosing their climate impacts through the Carbon Disclosure Project (CDP). The CDP has created a global reporting system for greenhouse gas emissions and detailing climate risks and opportunities. More than 30 operators covering 50% of connections or 65% by revenue have committed to science-based targets (SBTs) to reduce emissions by 2030 and then to set targets to be reached through supplier associations such as the Joint Audit Committee (JAC), which works with around 200 Tier 1 suppliers on sustainability across the mobile industry. Around a third of the industry, covering 31% by connections and 36% by revenue are aligned to the UN's Race to Zero pledge to reach net-zero emissions by 2050.

Also, around 50 million tons of e-waste were produced in 2020 and the number is rapidly growing. Mobile phones form a small portion of overall e-waste by weight, however, the rare earth mineral and metals used in them need consideration in e-waste management. The GSMA ClimateTech Programme has created an E-Waste Legislative Framework Map to bring together summaries of e-waste policies for 76 countries, and local programmes such as the GSMA We Care initiative which helps move towards a more circular economy, thus, avoiding e-waste.

Net-zero pathways

It is heartening to see targets being set for the climate goals; however, the challenge is in achieving them. One of the effective pathways to net-zero is transitioning to renewable electricity. GSMA members were among the first companies in the world to embrace renewable electricity.

Today, nine operator groups are members of the global RE100 campaign and many operators have committed to renewable energy targets. In recent years, some favourable conditions such as investment flows and better technologies have helped the adoption of renewables. However, some countries are lagging in the energy policy frameworks that support renewable energy projects. Moreover, many fossil fuel subsidies are also distorting the energy market by keeping fossil fuel prices artificially low. A total of around $650 billion is spent every year worldwide on subsidizing energy sources. About 70% or $450 billion is spent on fossil fuels such as coal, oil and gas, while little more than a quarter (about $170 billion) goes to renewables. The rest supports nuclear energy.

The GSMA has been initiating active discussions with the governments to support decarbonisation by providing more renewable electricity.

Another area within the control of the industry is the energy efficiency of the networks. The industry spends US$17 billion per year on energy, resulting in 15-40% of operating expense (opex) and 90% of the network costs are energy (fuel and electricity). Many operators have been running energy efficiency programmes for years. For instance, Huawei promotes its PowerStar Solution to mobile operators, which won the GSMA's 2020 GLOMO for 'Best Mobile Innovation for Climate Action' award. Additionally, Huawei's 'Nature Guardian' project received the GSMA 2021 GLOMO for Outstanding Mobile Contribution to the UN SDGs for deploying cutting-edge technology solutions to protect nature, prevent deforestation, and safeguard against biodiversity loss. Moreover with the adoption of 5G technology which is designed for network energy efficiency, up to 90% reduction in energy use for data transfers can be attained. As a step in the right direction, GSMA Intelligence started the energy efficiency benchmarking pilot this year to compare operator networks around the world.

Digitization supporting decarbonization

As per the International Telecommunication Unit (ITU) recent report on climate change, the global population living in cities is expected to surge from 50% in 2021 to 70% in 2050. Cities today account for 70% of global CO_2 emissions and an average of 75% of global energy use.

A GSMA report produced in collaboration with The Carbon Trust, an independent sustainability specialist, showed that mobile technology-enabled a global reduction in Greenhouse Gas (GHG) emissions of around 2 billion tons in 2018. GHG savings are 10 times greater than the global carbon footprint of the mobile industry.

Carbon reductions are being enabled across the economy through smart technologies in various sectors, including smart cities, traveling, hospitality, healthcare, and manufacturing. These developments are also being seen as potential new markets for mobile operators for not just providing connections, but also smart technology services.

In conclusion, the adverse effects of climate change can impact the business prospect of the mobile industry as an infrastructure business. Therefore, ensuring networks that are robust enough to withstand extreme weather conditions and ones that are easy to restore is crucial. All stakeholders need to channel their energies in tackling climate change through adaptation and resilience. For instance, May 20th, 2021, Bonn, in the Capital Markets Day, Deutsche Telekom's CEO Tim Hottges issued the carbon emissions target and committed full carbon neutrality in 2040. July 15th, 2021, China Mobile released its Carbon Neutrality Action Plan. The GSMA's AI for Impact project leverages mobile operator big data to understand the internal displacement of citizens to develop insights for governments and aid agencies to prepare for disasters, monitor pollution levels and analyze country-level impacts to provide support for vulnerable communities.

Climate change is real and happening and the mobile industry has been playing its part with all seriousness and responsibility. However, the time has come to bolster efforts until the net-zero targets have been achieved. In addition, the GSMA continues to provide support on climate action to members, suppliers, and partners in the broader mobile ecosystem. Over the last two years, the GSMA has developed an extensive set of resources that are freely available on its website (https://www.gsma.com/climate).

Paving the Way to Green Development through Innovation

Informa Tech and Huawei's 2021 white paper *The Path to Net Zero for ICT Requirements Technology Innovation* proposes the Network Carbon Intensity (NCI) index to support carriers on their net-zero journeys and emphasizes the role ICT will play in achieving sustainable green development.

By Qin Fengyu,
Director of the Network Architecture Transformation Marketing Dept, Huawei Carrier BG

Zhang Zhiyong,
Network Architecture Transformation Marketing Manager, Huawei Carrier BG

Network Carbon Intensity (NCI) index: Coordinating growth and emissions

Networks have been expanding rapidly over the past decade as the world becomes increasingly digital. Carriers need to consider the impact of network scale on carbon emissions in terms of absolute carbon emissions, user requirements, and the rapid growth of data traffic.

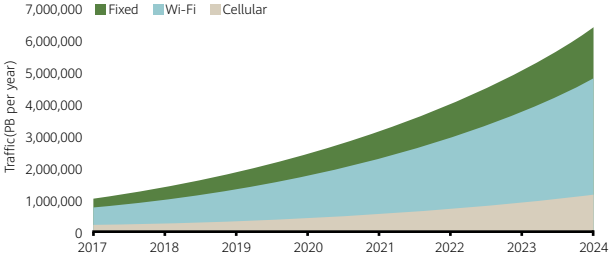


Figure 1: Global consumer data traffic

According to Informa Tech data (shown in Figure 1), global consumer data traffic on cellular and fixed broadband networks will grow by 29% annually from 2018 to 2024. That means that total data traffic will have increased from about 1.3 million PB in 2018 to 5.8 million PB in 2024 (equivalent to more than 6,700 photos uploaded per person per day worldwide). The total traffic on cellular networks is expected to grow nearly fivefold over the same period.

Based on this, Informa Tech and Huawei proposed the Network Carbon Intensity (NCI) index.

$$Network\ Carbon\ Intensity\left(\frac{kgCO2e}{TB}\right)=\frac{Total\ Carbon\ Emission}{Total\ Data\ Volume}$$

NCI indicates the ratio of total carbon emissions on the entire network against the total data volume over a certain period of time.

Given the huge variations in network facilities and

the availability of sustainable energy, it's erroneous to horizontally compare different types of network facilities and network facilities in different regions. NCI is a more accurate indicator of green networks because it measures carbon emissions per unit of data service based on a carrier's specific situation. The index can track specific carriers and thus help them manage their roadmaps for reducing the carbon emissions generated by the ICT industry.

Systematic three-layer solution: Green sites, green networks, and green operations

An industry report shows that carriers are most interested in two key emission reduction strategies: first, increasing the proportion of renewable energy used in their networks; and second, shifting focus from energy consumption to energy efficiency.

Increasing the proportion of renewable energy used: A major source of carbon emissions from carriers comes from electricity consumption. Switching from electricity generated by conventional energy sources to renewable energy, such as wind, solar, or tidal energy, can slash carbon emissions. Today, carriers care purchasing and using renewable energy to reduce their own emissions.

Conserving energy and reducing emissions: The ICT industry must focus not only on reducing energy consumption, but also on improving energy efficiency. Huawei provides carriers with comprehensive solutions that integrate green sites, green networks, and green operations to help them make structural improvements for optimal overall outcomes.

Green sites: Telecom sites account for the bulk of carriers' energy consumption. Huawei's green site solution is designed for typical scenarios such as wireless base stations, data centers, and CO equipment rooms. The solution reduces emissions and saves energy in a number of ways. These

> The index can track specific carriers and thus help them manage their roadmaps for reducing the carbon emissions generated by the ICT industry.

include equipment position (fully outdoors), equipment density (high-density and multi-band), equipment integration (integrated antennas), self-sufficient renewable energy, intelligent temperature control, and engineering planning. Simplified sites are designed to replace equipment rooms with outdoor cabinets and outdoor cabinets with poles. In an equipment room, only 60% of the power is used for the main communications equipment, with the remaining 40% used for heat dissipation. By replacing equipment rooms with cabinets, site energy efficiency can reach 90%. A zero-footprint outdoor pole site solution can realize 97% energy efficiency as well as eliminate rental costs.

Green networks: Huawei's green network solution provides an optimized network architecture that is all-optical, simplified, and intelligent, significantly increasing energy efficiency. Optical networks can provide very high data rates with lower power consumption, as optical fiber-based access networks consume much less power than conventional copper-based fixed access networks. By adopting optical equipment and negating the need for electrical signal conversion, carriers can significantly reduce the power consumed by their core networks. Moreover, all-optical equipment is smaller and requires less air conditioning than conventional photoelectric conversion solutions, further reducing power consumption. For example, China Telecom Sichuan deployed Huawei's optical cross-connect (OXC) solution, significantly reducing the power consumption of each node and saving about 250,000 kWh of power on core nodes a year.

Green operations: Huawei's green operations solution comprises network operations and user operations. In terms of network operations, the solution uses AI to intelligently adapt equipment operation to service needs. For example, when mobile traffic is low, the upper carrier frequency bands of base stations can be temporarily disabled to reduce unnecessary radio frequency and baseband power consumption. Intelligent

> Based on the index and technological innovation, the green site, green network, and green operation solutions can boost carriers' green development and empower industries to reduce emissions and achieve carbon neutrality.

network management can also dynamically adjust the network to satisfy fluctuating demands while minimizing energy consumption. This conserves energy without compromising network performance and user experience. In terms of user operations, the solution uses digital technologies to drive users to migrate to more efficient RATs, reducing energy consumption per bit. For example, it identifies 2G and 3G users and recommends that they migrate to 4G or 5G, based on parameters such as the device used, their network load, and their service package.

ICT will enable green development for industries

The white paper concludes that the ICT industry will contribute significantly to the green development of a wide range of industries, including agriculture, logistics, mining, transportation, and manufacturing. Data from the World Economic Forum shows that industries are expected to reduce their carbon emissions by 12.1 billion tons, which is 10 times as much as the ICT industry's own emissions. This empowering effect, referred to as "carbon handprint", will accelerate the application of ICT in industries for far more efficient emissions reduction.

The ICT industry's green development is one of the keys to moving towards net-zero emissions, and the NCI index is the best indicator for evaluating comprehensive development. Based on the index and technological innovation, the green site, green network, and green operation solutions can boost carriers' green development and empower industries to reduce emissions and achieve carbon neutrality.

Sustainability is a long journey, but we will keep moving toward a future that generates more bit with less watts.

Green 5G Lights the Way to a Low-Carbon Future

Huawei has identified eight technological directions that can help telecom carriers develop efficient green 5G networks and support the industry's drive to reduce carbon emissions and maximize energy conservation.

By Jiang Xudong, President of Huawei's SRAN Product Line

Although GSMA reports that telecommunications represent just 0.4% of global carbon emissions, operators have extended their green strategies from minimizing network-derived carbon emissions to boosting energy efficiency in vertical industries. Equipment vendors must therefore innovate green products and solutions to help operators build green 5G networks and achieve net zero goals while fulfilling growing demand for diverse services.

1.5°C threshold and 1:10 enablement

Climate change is one of the most pressing global challenges and one that will have a huge impact on future generations. In its latest report Climate Change 2021: The Physical Science Basis, the Intergovernmental Panel on Climate Change (IPCC) found that historically rare weather extremes have become much more common. For example, severe heat waves that happened only once every 50 years are now happening roughly once a decade.

UN Secretary-General António Guterres warns that, "We are at imminent risk of hitting 1.5 degrees in the near term. The only way to prevent exceeding this threshold, is by urgently stepping up our efforts, and pursuing the most ambitious path."

Another GSMA report, The Enablement Effect, concludes that, "With a European and North American scope, mobile technologies had a 1:5 enablement ratio compared to the footprint of the industry in 2015."

This means that one kWh of power consumed by mobile networks will lead to a 5-kWh reduction in electricity used by other industries. GSMA believes the ratio will rise to 1:10 by 2025.

As a reliable partner of operators on a global scale, Huawei will continue to develop efficient and green 5G networks to support their energy conservation and emissions reduction efforts.

Efficiency drivers

Customer-driven efficiency gains

During more than 20 years of developing wireless technologies, we have prioritized developing green products and solutions geared to boosting network energy efficiency. The best innovations are customer-driven and based on understanding customer pain points before the development process begins.

Distributed Base Stations

In 2005, Huawei launched the first-ever distributed base station. By moving RF modules from indoor equipment rooms to outdoor sites closer to antennas, distributed base stations improve signal quality while reducing air-conditioning costs. They minimize cable loss and overcome insufficient space and cooling capacity.

SingleRAN

Launched in 2007, the Huawei SingleRAN solution changed how sites are deployed and relaxed deployment requirements by enabling one RF module

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to work on multiple bands and support multiple radio access technologies. Operators could then more easily adapt to different access technologies, build converged networks, and smoothly evolve their networks. Using 50% less power than traditional solutions, SingleRAN was first deployed in Europe and is now mainstream worldwide, contributing heavily to energy savings and lower electricity bills.

PowerStar

Global operators want to deploy energy-saving software to reduce network energy consumption, but are also concerned about degraded network performance and user experience. This dilemma ended in 2018 when Huawei launched its unique energy-saving solution, PowerStar, which uses intelligence to help operators balance energy use and network performance. More than 70 operators have deployed the solution in live networks. In China, 800,000 sites are running PowerStar, saving 400 million kWh per year.

Green 5G

The ITU has set the objective of reducing ICT carbon emissions by more than 45% by 2030. Many operators have announced their own carbon neutrality targets and action plans, including for 5G.

To more effectively support operators on their energy conservation and emission reductions journeys, Huawei has introduced its integrated green site, green network, and green operations solution. We have moved to establish a green network assessment system based on energy efficiency and developed eight technological directions for building green 5G target networks. These measures will enable operators to build networks that deliver excellent performance and high energy efficiency, and thus support their carbon-neutrality strategies.

What makes a network green?

As networks develop at different stages, energy efficiency is a better measure than absolute energy use. In addition to proposing the Network Carbon Intensity (NCI) index, Huawei assesses the relationship between network demand growth and network energy consumption from the energy-efficiency perspective. The value of energy efficiency to operators is that it serves as a relatively fair and objective evaluation system that drives the industry to coordinate service traffic growth and a reduction in carbon emissions.

In theory, Huawei's MetaAAU consumes 30% less power than a typical AAU when delivering the same coverage.

Eight Directions

In addition to standards for measuring green networks, a number of technological directions are necessary for operators to develop green 5G networks.

Direction 1: Multi-antenna RF reduces per-bit energy consumption and increases transmission efficiency. 5G AAU uses a multi-antenna, multi-channel architecture alongside spatial multiplexing to significantly boost system capacity. Signal phases and amplitudes can be tweaked to concentrate radio energy in narrower beams that point to users more precisely, increasing energy transmission efficiency and ramping up per-bit energy efficiency. Our test results show that the energy efficiency per bit of 64T64R modules is 20 times higher than it is in 4T4R modules. The AAU will become an essential tool for operators to meet constantly growing traffic demand from individuals and industries.

In addition to reducing AAUs' power consumption through innovation and the comprehensive application of expertise in multiple fields, Huawei has introduced a new approach to reducing AAU power consumption: extremely-large-scale antenna arrays. Through innovations in software (e.g., baseband algorithms) and hardware (e.g., antennas), extremely-large-scale antenna arrays maximize antenna utilization, improving both energy efficiency and coverage. In theory, Huawei's MetaAAU consumes 30% less power than a typical AAU when delivering the same coverage.

Direction 2: Ultra-broadband multi-band devices reduce energy consumption. Higher integration enables a device module to expand its RF capability from single to multiple bands and provide ultra-large bandwidth. This transforms site construction from the deployment of one band on one RRU or AAU module to one integrated module that supports multiple bands. Operators can use one module to provide various services that previously required multiple modules, lowering costs and overall energy consumption.

One of our customers in the Netherlands replaced two RF modules on 800 MHz and 900 MHz with one ultra-broadband RF module that can provide services on the 700 MHz, 800 MHz, and 900 MHz bands using the same amount of power.

Direction 3: Hardware enhancement for nearly

Blade site deployment focuses on saving energy by mounting devices on poles, which maximizes the effect of natural cooling, producing a 60% to 97% increase in energy efficiency.

linear power usage changes with varying load levels to reduce low- and medium-low energy consumption. RF hardware transmits at higher efficiency as traffic loads increase. Refined, granular hardware sleeping mechanisms can shut devices down more responsively and at deeper levels when traffic loads are low, which wastes less power, increases the overall RF efficiency of hardware modules in low-traffic periods, and boosts device reliability.

Operators in China have demonstrated that deep hibernation can reduce power consumption by more than 60% in networks under a light load.

Direction 4: Simplified sites without equipment rooms and air conditioners. Air conditioning accounts for 30% to 40% of total site energy consumption. We have proposed two directions:

Centralized BBU deployment can enable one air conditioner to cool multiple sites rather than one air conditioner cooling one site. Liquid-based and natural cooling methods are a good option for equipment rooms. China Unicom has saved 17,000 kWh of electricity in each of its sites per year through centralized BBU deployment.

Outdoor equipment cabinets are the better choice. One site, one cabinet deployment and blade site deployment can replace one air conditioner at each site. With one site and one cabinet, cooling media works closely with heat-producing devices, facilitating precise and targeted cooling, which slashes energy consumption. Blade site deployment focuses on saving energy by mounting devices on poles, which maximizes the effect of natural cooling, producing a 60% to 97% increase in energy efficiency.

Direction 5: Linked site energy improves comprehensive energy efficiency. Power feeding and consumption systems, such as power supplies and transmission systems, are "dumb devices" that cannot sense each other, collaborate, or sense service load and running status, thus wasting energy and lowering efficiency.

Linking services to site power supply, storage, and use for increased efficiency is a major direction for green sites. Services and solar power, power supply, battery, the main grid, and temperatures should be linked to enable precise, real-time control on temperature and

power operations in line with service loads to ensure efficient energy usage.

Based on one of our cases in Greece, solar power can produce more than 50% of the total energy of a site linked to solar generators, substantially cutting carbon emissions.

Direction 6: Intelligence for energy-saving and network performance: Intelligent technologies can adapt spectrum and many other resources to real-time service changes and service scenarios in networks.

Launched in 2018, PowerStar was designed with intelligent technology to lower network energy consumption. This year, PowerStar2.0 adds a number of enhancements such as extending energy-saving periods from off-peak hours to all day, expanding three energy-saving dimensions to four, and narrowing KPI optimization down from days to seconds. Operators can double the energy-saving effect and deliver the same network performance.

The commercial deployment of PowerStar2.0 in China's Sichuan province has lowered energy consumption in mobile networks by more than 25%.

Direction 7: Switching services to 5G can maximize energy-efficiency advantages. 4G is 7 to 10 times more energy-efficient than 3G, and 5G is 20 times more efficient than 4G. Moreover, 5G's energy efficiency will improve exponentially as it continues to evolve.

Statistics on mobile networks in Hangzhou, China, show a 3.5-times increase in energy efficiency from 2019 to 2021, even though just 20% of network traffic is carried on 5G networks.

Direction 8: Full-lifecycle recycling reduces dependence on natural resources. Procedures like design, manufacturing, and transportation are equally important to a low-carbon future. In product packaging, for example, developed a dual-density expanded polypropylene (EPP) process. Two different-density materials can improve cushioning and recycled materials can reduce the size and volume of packaging and materials used.

These eight directions represent our E2E commitment to sustainability. We will continue to work closely with operators and partners to help operators build green 5G networks and enable vertical industries to use less energy and cut carbon emissions.

Green Networks: Optimizing Energy Efficiency for Green Development

The ICT industry can help other industries go intelligent and improve energy efficiency. At the same time, the ICT industry must also optimize its own energy usage to play a greater role in the fight against climate change.

By Zhai Haipeng, Chief Engineer,
Network Marketing & Solution Sales Dept, Huawei

ICT: The key to a green and intelligent society

Carbon neutrality attracted extensive attention in 2021 and today presents a common challenge and goal for all industries worldwide, including ICT. The ICT industry only accounts for about 2% of global carbon emissions and, in China, the three major carriers account for less than 1% of the country's total energy consumption. The ICT industry is playing a more prominent role in helping numerous industries go digital and contributing to carbon neutrality. However, the industry itself must continue to optimize the energy efficiency of telecom networks and increase the proportion of clean energy used.

Optimizing energy consumption in the ICT industry means reducing energy consumption per bit, so that the growth in carbon emissions is slower than the growth in traffic. For example, the power consumption of each fixed network terminal has increased by nearly 20 times from the PSTN era to the gigabit era. However, network bandwidth has increased tens of thousands of times, and energy efficiency has improved by dozens or hundreds of times.

Green networks: Comprehensively optimizing energy efficiency

To help carriers efficiently cut emissions, save energy, and accelerate carbon neutrality, Huawei has introduced comprehensive solutions that integrate green sites, green networks, and green operations. The green network solution targets network architecture and optimizes networking through technical means to significantly reduce power consumption.

The green network solution features networks that are all-optical, simplified, and intelligent. "All-optical" involves two aspects: first, replacing electrical switching with optical switching; second, swapping copper for fiber on the fixed access network. "Simplified" means upgrading and simplifying

networks by, for example, deploying fully converged routers, upgrading old SDH equipment with OTN, and deploying massive MIMO and fully-converged core networks. "Intelligent" means introducing intelligence to the network to reduce power consumption during off-peak hours.

1. All-optical

Optical-electrical-optical conversion and electrical signal processing are the most power-hungry processes in telecom networks. Reducing optical-electrical-optical conversions means reducing power efficiency. Replacing electrical networking with OXC-based optical networking on the transport network can slash power consumption. A core node with 96 Tbit/s capacity typically consumes about 1,000 W – less than 10,000 kWh of electricity a year – when configured with OXC. In contrast, typical power consumption with electrical forwarding configured exceeds 40,000 W, consuming more than 380,000 kWh of electricity per year, over 40 times more than the OXC solution. Adopting OXC networking across the entire network will significantly improve power

> Upgrading SDH equipment with the latest OTN simplifies the network, reduces power consumption per bit a hundredfold, and meets SLAs, greatly reducing equipment room space required.

efficiency. OXC is a highly integrated optical-layer grooming solution that consumes 40% less power and requires 90% less equipment room space than the traditional ROADM solution.

Swapping copper for fiber on the access network can save 19 kWh of electricity per household on the network and device sides combined, totaling 19 million kWh of electricity saved for every 1 million households each year – the equivalent of 9,000 tons of carbon emissions from thermal power generation based on the global average kWh-to-CO_2 score, or the same as a carbon sink of 400,000 trees. More than 400 million broadband users are connected globally by copper and coaxial cables. Migrating these users to fiber broadband would reduce carbon emissions by at least 3.6 million tons a year. Additionally, copper production consumes far more energy and water than optical fiber production, and creates waste acid, waste alkali, heavy metal, and tailings.

2. Simplified

Technologies are rapidly evolving, and the siloed sub-networks and old equipment in carriers' networks mostly only support one function and one RAT, with high power consumption per bit. Examples include old SDH equipment that carries a large number of enterprise leased lines, single-RAT 2G/3G/4G/5G voice and data core network NEs, existing 2T RF units with relatively low transmit/receive efficiency on the RAN, and traditional single-function routers such as service routers, broadband access servers (BRASs), Internet Protocol Security (IPSec), and carrier-grade NAT (CGN). Using new technologies to upgrade old equipment can replace siloed sub-networks and simplify the network as a whole, reduce power consumption per bit, and optimize network energy efficiency.

Old SDH equipment that uses power-intensive 20-year-old technology is found in many telecom networks. The addition and deletion of services over time has resulted in many zombie timeslots in equipment. Coupled with optical distribution frames (ODFs) and air conditioning, this equipment wastes equipment room space and has poor power efficiency. Upgrading SDH equipment with the latest OTN simplifies the network, reduces power consumption per bit a hundredfold, and meets SLAs, greatly reducing equipment room space required.

> Huawei's fully converged core network solution supports 2G/3G/4G/5G integration and uses technologies such as unified NFV resource pool scheduling, on-demand dynamic orchestration of microservices, elastic tidal scaling, and software performance improvement.

With home broadband, B2B services, and content delivery networks (CDNs) moving closer to the user end, convergence network COs and even access network COs require BRAS, CGN, and IPsec capabilities. Traditionally, each of these functions requires a separate router, which increases CO power consumption. The latest router models integrate segment routing (SR), BRAS, CGN, and IPsec, all of which reduce CO power consumption.

As 4G and 5G dominate the world's telecom networks, carriers are faced with the challenge of dealing with co-existing 2G, 3G, 4G, and 5G core networks. The traditional network deployment model with single-RAT overlays will increase carriers' network deployment and O&M costs and energy consumption. Huawei's fully converged core network solution supports 2G/3G/4G/5G integration and uses technologies such as unified NFV resource pool scheduling, on-demand dynamic orchestration of microservices, elastic tidal scaling, and software performance improvement. This solution consumes 30% less power per bit than traditional equipment, reducing customers' annual CAPEX on hardware and energy consumption.

In a radio access network, the power consumption per bit of a conventional 2T RF unit is about 20 times higher than that of a latest 64T64R massive MIMO RF unit. On the C-band, unlike 32T32R RF units, 64T64R RF units can be deployed fully on existing sites. This simplifies the network and eliminates the cost of building and maintaining new sites and adding to power consumption.

Most optical line terminals (OLTs) are deployed in CO equipment rooms. However, with technology advances and increasing demand for remote coverage and flexible deployment, some OLTs are now deployed outdoors using the AirPON solution, eliminating the need for air conditioning and fans, and thus reducing power consumption.

In addition, the optimal ambient temperature for lead-acid batteries found in telecom equipment rooms is 24 to 25°C, above which their lifespan greatly declines. Lithium batteries, however, still work in an optimal state at 35°C and are also 60% smaller than same-capacity lead-acid batteries. These two factors combined greatly reduce energy used by air conditioning.

3. Intelligent

During off-peak hours, the link load is much lower, but equipment still consumes a lot of power because traditional equipment lacks the ability to intelligently shutdown. Routers and microwave equipment can use traffic sensing to silence, shut down, or lower the frequency of RF components and circuits during off-peak hours to reduce power consumption. When the traffic volume increases, the RF components and circuits are automatically unsilenced, woken up, and boosted. Network intelligence is the foundation of decoupling network-wide power consumption from capacity and associating it with traffic.

Increasing the proportion of clean energy

Both carriers and equipment vendors can directly reduce carbon emissions by increasing the proportion of green energy purchases, and reducing the purchases of fossil fuels and fossil fuel-derived electricity. Data centers (DCs) account for an increasing proportion of carriers' energy consumption. Low PUE DC solutions can increase the power efficiency of power-hungry DCs. DCs should also be located near clean energy sources and where temperatures are low. Green power can replace thermal power, and natural cooling can replace air conditioning. A differentiated way of selecting DC locations is to replace power-grid-based high-loss power transmission with network-based low-energy data transmission. This is an effective measure to increase a carrier's percentage of clean energy use.

We still have a long way to go when it comes to environmental protection and reducing carbon emissions. We must take active measures to continously reduce power consumption and carbon emissions per unit of telecom service volume, and support the intelligent transformation of numerous industries so as to boost energy efficiency and reduce carbon emissions across the industry sector.

China Mobile Guangdong: Building All-optical City Clusters for Green Development

During the opening of the China Mobile Global Partners Conference, Cai Weiwen, Deputy General Manager and Director of China Mobile Group Guangdong shared his thoughts on green and low-carbon development, as well as China Mobile's practices for all-optical city clusters in the Guangdong-Hong Kong-Macao Greater Bay Area.

By Cai Weiwen, Director and Deputy General Manager,
China Mobile Guangdong

The global economy has experienced both rapid development and increasing environmental problems. Developing a green economy and realizing green growth are key to sustainable development and a low-carbon future that reduces energy consumption and emissions.

In 2007, China Mobile implemented its Green Action Plan and has since saved nearly 10 billion kWh in electricity and reduced CO_2 emissions by 6.3 million tons. By integrating IT solutions in various industries, it has helped other companies reduce emissions by more than 800 million tons.

To meet new challenges, China Mobile upgraded the Green Action Plan to the C^2 Three Energy Plan in July 2021. C^2 represents carbon peak and carbon neutrality and underpins the new green development model of "3 Energies and 6 Greens".

"3 Energies" refer to three major areas of action: energy-saving, clean energy, and empowerment. "6 Greens" refer to six paths that enable our goals: networks, energy use, supply chain, office, empowerment, and culture.

Based on this plan, China Mobile formulated its 14th Five-Year Plan targets. The company aims to increase its total telecoms business volume by 160% while reducing total energy consumption and the carbon emissions of its telecom services per kWh by at least 20%. The company is also looking to quadruple its energy conservation outcomes to above 40 billion kWh and thus surpass its 13th Five-Year Plan. China Mobile intends to reduce its carbon emissions by up to 56 million tons by 2025 and help industries double emission reductions to over 1.6 billion tons.

For the 3 Energies, China Mobile Guangdong is phasing out energy-intensive, inefficient, and outdated equipment, and is committed to building efficient, green network architecture and using high-

quality, all-optical networks to underpin the green digital economy and help industries save energy and reduce emissions.

Phasing out energy-intensive, inefficient, and outdated equipment

China Mobile has been upgrading its telecommunications equipment to improve the energy efficiency of its networks, enhance green operations, and promote the green and sustainable development of the telecommunications industry.

With the phasing out of old PSTN telephone systems and the reconstruction of 2G and 4G base stations with IP technology, traditional SDH and WDM optical transmission networks cannot cater for the rapid growth and diversification of data services. SDH equipment has a low level of integration, occupies a lot of space, and consumes much energy per bit, making it a focus of China Mobile's energy, emissions, and equipment retirement strategy.

In October 2019, China Mobile Guangdong held a conference on retiring SDH equipment. In line with the resulting plan, light-loaded SDH NEs and SDH equipment carrying wireless 2G services or group customer services were integrated and migrated to the next-generation bearer network and all services transferred from the SDN network.

At just one site where Guangdong Mobile Huizhou used GSM equipment, 55 sets of old SDH equipment and 308 DDFs had occupied 152 cabinets – each cabinet was 0.6 m long, 0.6 m wide, and 2.2 m high, and total power consumption exceeded 20,000 W. The next-generation OTN equipment used to replace the old SDH equipment offers features like hard isolation, security, and low latency, but it's also

congestion-free and saves a lot of space and power thanks to new components and processes. Moreover, 106 fewer cabinets are required, saving 7,000W in electricity and reducing electricity fees by about 64%. In addition to GSM equipment, around 3,500 sets of SDH equipment at other sites are gradually being powered off and retired. The space and power saved can be used to deploy IDCs, cloud computing, and edge cloud over the next few years to better support new services like enterprise leased lines, DC interconnection, and small and micro enterprise services.

Guangdong Mobile Shaoguan also faced a similar problem: 80% of its 1,500 sets of SDH equipment

had been running for over 10 years, taking up a lot of space and consuming high amounts of electricity and fiber core resources. An increasing number were also nearing warranty end, presenting great security risks to services. The branch proposed the bold idea of retiring all SDH backbone/aggregation equipment on the entire network.

During the 7-month project, Guangdong Mobile Shaoguan retired 924 pieces of equipment, saving about 1.47 million kWh of electricity and more than 1 million yuan (US$158,890) in annual electricity fees. A total of 130 racks were removed, freeing up 400 square meters of space and 11,600 fiber cores per kilometer. The upgraded network uses less energy and offers personalized functions, including fast service provisioning, on-demand bandwidth adjustment, efficient self-service operations, and on-demand elastic billing.

To date, about 5,000 sets of old SDH equipment have been removed from the network in Huizhou and Shaoguan, freeing up 3,000 square meters of space, saving 7.9 million kWh of electricity per year, and reducing CO_2 emissions by more than 5,000 tons – the equivalent of planting 196,000 trees.

In the future, China Mobile Guangdong will continue retiring energy-intensive, inefficient, and outdated equipment to provide a better green development

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ecosystem for the Greater Bay Area.

Establishing the world's largest green switching hub

The emergence of content such as short videos, ultra-high definition videos, live streaming, online education, VR/AR, and cloud gaming has caused China Mobile Guangdong's service traffic to increase significantly, with an average annual growth of 49%. By the end of 2022, the company's network capacity will need to double, with a node's maximum capacity reaching 268 Tbit/s. However, if China Mobile Guangdong had continued to construct networks in its usual way, huge challenges would arise at most sites with equipment room space, support power systems, and air conditioners.

In 2019, China Mobile Guangdong proposed an efficient, intensive, and cost-effective reconstruction model based on OXC equipment. OXC equipment supports Pbit-level, cross-connect capacity, and scheduling capability that’s 10 times higher than that provided by ROADM equipment. In fact, one piece of OXC equipment is equivalent to nine pieces of traditional ROADM equipment.

OXC equipment supports up to 32 dimensions of optical cross-connection scheduling, making it possible to achieve 3D, mesh-based interconnection between 21 cities. It also features simplified architecture, efficient scheduling, ultra-low latency, and flexible connections, while reducing energy consumption across the entire transport network.

China Mobile Guangdong has undertaken many successful reconstruction cases, including the network reconstruction of China-Singapore Guangzhou Knowledge City. It’s equipment room for this case features 16 optical directions, which would normally require eight racks and many complex external fiber patch cords within and between these racks. However, next-gen OXC equipment has replaced complex external fiber connections with an all-optical backplane. Integrated into one rack, this backplane saves 87% in space and reduces power consumption by 40%.

China Mobile Guangdong has deployed 110 sets of OXC switches in the Greater Bay Area, making

> China Mobile Guangdong has formulated a strategy for the Greater Bay Area of building all-optical network infrastructure to facilitate future home networks, IoT, and smart cities.

it the world's largest green OXC switching hub. With a traditional solution, a site requires five to eight cabinets compared with just one for the OXC solution, reducing equipment room space requirements by an average of 70% and power consumption by 30%. The hub saves about 2.3 million kWh of electricity and reduces CO_2 emissions by more than 1,400 tons every year, equivalent to planting 49,000 trees.

A green all-optical city cluster for a green digital bay area

China Mobile Guangdong serves more than 100 million mobile users, 16 million home users, and 1.8 million enterprise users. Optical networks are essential to maintaining growth with large-scale services while ensuring a high-quality customer service experience.

5G and gigabit optical networks are key parts of new infrastructure and crucial for the development of the digital economy. China Mobile Guangdong has formulated a strategy for the Greater Bay Area of building all-optical network infrastructure to facilitate future home networks, IoT, and smart cities.

Optical fiber has clear advantages over copper lines in terms of bandwidth, latency, anti-interference, and reliability, while also consuming 60% to 75% less power. As the greenest communications medium, the industry is honoring its low carbon commitment through the extensive deployment of optical fiber networks worldwide.

China Mobile Guangdong has deployed more than 1 million kilometers of optical cable, covering 21 cities and 130,000 villages in Guangdong, creating all-optical city clusters in the Guangdong-Hong Kong-Macao Greater Bay Area.

Building all-optical city clusters is a systematic project comprising all-optical base, all-optical network brain, and all-optical services.

All-optical base serves as the foundation of service innovation. It plays a similar role to subways or high-speed railways, featuring simplified architecture and large capacity, while saving energy. China Mobile

Guangdong has deployed more than 2,000 OTN optical nodes, including 110 sets of all-optical OXC switches, creating a 1-2-3 ms latency circle within the Greater Bay Area. "1-2-3 ms" refers to 1 ms latency within a city, 2 ms latency between cities, and 3 ms latency anywhere within the Greater Bay Area. All-optical scheduling allows one-hop direct transmission, greatly reducing the required number of relay devices, transition devices, and electrical signal switching and processing devices, realizing optimal power consumption for information transmission.

The all-optical network brain functions as the dispatch center of subways and high-speed railways. With SDN and AI, it implements intelligent management, control, and analysis on all-optical networks, providing resource visualization, automatic service provisioning, and precise troubleshooting for all-optical services. This has greatly improved operation and energy efficiency, greatly reducing emissions.

All-optical services are a range of services based on the all-optical base, including OTV 4K/8K ultra-high definition live streaming, premium OTN private networks, premium VR home broadband, and P2MP optical building. The premium OTN private network has supported the digitalization of a range of industries, including security, banking, government, and healthcare. The OTN P2MP optical building solution for commercial buildings improves the speed and quality of private lines for SMEs, providing them with premium networking and cloud-access private lines.

In Guangdong, medical care is now accessible from anywhere, financial transactions are completed within seconds, and AI is accelerating industrial transformation.

China Mobile Guangdong is using IT to save energy and reduce emissions improve resource utilization, reduce production costs, and promote the high-quality development of the green digital economy through green all-optical networks.

Towards Zero Carbon with Energy Digitalization

As carbon neutrality becomes a global mission, the world will inevitably become low-carbon, electrified, and intelligent. Integrating digital technology and power electronics technology to achieve power digitalization can help achieve carbon neutrality – a goal which Huawei is committed to supporting.

By Yan Jianfeng, Global Brand Director, Huawei Digital Power

According to a World Meteorological Organization report from December 2020, the global mean temperature from January to October 2020 was around 1.2 degrees Celsius above pre-industrial levels. This has made the need to tackle climate change more apparent than ever, with UN Secretary-General António Guterres calling for all countries to declare a "climate emergency" at the Climate Ambition Summit.

The only way to carbon neutrality

Today, humanity is experiencing three major trends:

First, the Fourth Industrial Revolution is propelling the move to an intelligent world.

Second, carbon neutrality is accelerating energy transformation. The world will witness the construction of a clean, low-carbon, safe, and efficient energy system.

Third, the integration of new power systems, energy flows, and information flows based on renewable energy is inevitable. Conventional power systems with partial sensing, one-way control, planned operation + automation, and the partial use of digital technologies will eventually be replaced by new power systems that feature full sensing, two-way interaction, intelligent and efficient operations, and pervasive digital and intelligent technologies.

In light of the carbon neutrality goal, we need to reverse the rapid growth of energy consumption and CO_2 emissions and decouple economic growth from carbon emissions. Becoming low-carbon, electrified, and intelligent is the only way to achieve carbon neutrality, and technological advances are an engine that drives the process.

First, the cost of electricity from renewable energy, such as PV power and wind power, has decreased rapidly since 2018, and is now significantly lower than the cost of fossil fuels. Renewable energy will play a key role in transforming the energy supply structure. It's estimated that by 2050, renewable energy will

> Through technological innovation, Huawei will help industries reduce energy consumption and help accelerate energy structure transformation. Our goal is to enable all industries to use stable, clean, and cost-efficient energy.

account for more than 86% of all energy supply, and installed PV capacity will increase from 750 GW in 2020 to 8,519 GW in 2050, replacing fossil fuels as the main source of electricity and helping realize low-carbon power generation.

Second, on the energy consumption side, electricity consumption will replace traditional fossil fuel consumption. It's predicted that the consumption of electricity will exceed that of oil by 2050, accounting for 49%, up from 20% in 2017. Green manufacturing, green buildings, and green travel will become major growth engines for electrification. In the industrial and construction sectors, green buildings and low-carbon campuses will become reality through power generation with renewable energy and comprehensive energy efficiency improvements.

Third, with the increasing adoption of renewable energy, the conventionally stable power grid will become unstable. The power grid system will shift from centralized to distributed power generation, and the increasing adoption of electric vehicles (EVs) will pose greater challenges to the stability of energy system architecture. Intelligent technologies will be needed for the intelligent coordinated scheduling of power generation, grids, loads, and storage, peak load shaving, making power grids more stable and reliable, improving power consumption efficiency, and reducing power costs.

Huawei will be actively involved in the process of achieving carbon neutrality and carbon peak. Through technological innovation, Huawei will help industries reduce energy consumption and help accelerate energy structure transformation. Our goal is to enable all industries to use stable, clean, and cost-efficient energy.

Accelerating power digitalization and building new power systems based on renewable energy

According to the latest forecast by Huawei Institute of Strategic Research, renewable energy will account for more than 50% of all energy by 2030, and EVs will account for more than 50% of all vehicle sales, making EVs a major means of transport. ICT has the potential to help reduce global carbon emissions by

20% by enabling other industries in the next 10 years. To make renewable energy such as PV and wind the main power sources, new power systems will integrate digital and physical systems, enabling data flows to lead and optimize energy and service flows. Data will be used as a key factor of production to streamline information about power generation, power grids, loads, and power storage. The aim is to achieve comprehensive observability, accurate measurability, and high controllability on the power generation side (power plants), form a regulation system that integrates the cloud and edge on the power grid side (power grid companies), and aggregate massive adjustable resources on the power consumption side (users) to support real-time dynamic responses to user needs.

Huawei will continue to innovate and be open to collaboration in digital power, focusing on the following methods:

First, we will continuously integrate leading digital technologies and power electronics technologies and combine energy flows with data flows to use bits to manage watts and drive the energy industry to go digital.

> We will develop a clean power system that focuses on generating electricity with alternative energy technologies such as wind, solar, and energy storage.

Second, we will develop a clean power system that focuses on generating electricity with alternative energy technologies such as wind, solar, and energy storage. We will integrate power generation, power grids, loads, and power storage with multiple complementary energy sources to transform alternative energy from a source of incremental power to a major source of grid-wide power. This is how we can move away from fossil-fuel energy to clean energy.

Third, on the energy use side, we will drive the electrification of the transportation industry, with a focus on solving problems for consumers such as slow charging, range anxiety, and safety concerns. For the consumer, Huawei will continue to develop converged, simplified, secure, and reliable smart electric solutions that deliver a superior experience. We will also develop charging and battery swap network solutions that integrate PV, power storage, and charging and bring together people, vehicles, charging infrastructure, roads, and the network.

Fourth, with the rapid development of the digital world, ICT infrastructure will face greater energy consumption challenges. It's estimated that by 2025, data centers will have consumed 950 billion kWh of power, accounting for 3% of total power consumption worldwide. Telecom sites will have consumed 660 billion kWh of power, accounting for 2% of worldwide total power consumption. Huawei will build green, efficient, and intelligent ICT infrastructure solutions based on low-carbon sites and green data centers.

Fifth, in a new power system based on alternative energy sources, power storage will be distributed in various scenarios including power generation, power grids, and loads to serve as reservoirs and power grid regulators and stabilizers. Huawei believes in the need to develop intelligent power storage systems that deliver outstanding security and are more cost-effective, plus a cloud-based battery management system (BMS) that intelligently manages batteries throughout their lifecycle.

Sixth, we will develop energy clouds to provide a comprehensive smart energy service platform that integrates power generation, power grids, loads, and power storage with multiple complementary energy sources. This will realize the intelligent management of scenarios such as wind and solar power generation, power storage, charging, industrial and building energy

> As of September 30, 2021, Huawei Digital Power products and solutions had helped customers generate 443.5 billion kWh of electricity, save 13.6 billion kWh of electricity, and reduce carbon dioxide emissions by 210 million tons, equivalent to planting 290 million trees.

conservation, site and data center energy conservation, and power distribution networks. Cloud technology can also streamline data relating to power generation, storage, distribution, and consumption to serve energy customers worldwide.

With over 30 years of expertise in digital and power technologies, Huawei can integrate energy flows with information flows through management, control, power storage, and basic power electronics technologies. This will accelerate energy conservation and emissions reduction in numerous industries. To date, Huawei's digital power solutions have been applied in more than 170 countries and regions, serving one third of the world's population.

Achieving green power generation, storage, and consumption, and enabling a zero-carbon smart world

Huawei has taken the initiative to promote intelligent transformation in the power generation industry, leveraging inverters and launching a smart PV solution based on string inverters. This solution digitalizes power plants and transforms inverters into sensors of subarrays, enabling information collection that's accurate to each string, making intelligent sensing a reality.

In 2021, Huawei enhanced the deep integration of smart PV and new technologies, introducing a fully intelligent, all-scenario solution that integrates PV and power storage. This solution significantly reduces electricity costs, and transforms PV from a backup for the grid to an enhancement of it, making PV a major power source. As of September 30, 2021, Huawei Digital Power products and solutions had helped customers generate 443.5 billion kWh of electricity, save 13.6 billion kWh of electricity, and reduce carbon dioxide emissions by 210 million tons, equivalent to planting 290 million trees. Huawei's smart PV solutions have been widely adopted in more than 70 countries and regions. In Ningxia and Shandong, China, the world's largest single-site smart PV plants for agriculture and fishery have made great contributions to local environmental protection. On September 30, 2020 and with Huawei's support, the world's largest single-site 2.2 GW PV plant was connected to the grid.

The value of green power generation is its ability to enable clean energy sites that integrate wind, solar,

> Huawei has introduced five digital power target network solutions: simplified site, simplified equipment room, simplified data center, ubiquitous green electricity, and integrated smart energy cloud.

hydro, and thermal power, and that integrate power generation, power grids, loads, and power storage. Green power also facilitates the construction of demonstration bases that drive transformation to a low-carbon energy mix. For example, green power can ensure a self-sufficient power supply for agricultural production while supplying the grid with excess electricity. This will consolidate the achievements humanity has made in eradicating poverty, boosting agriculture, and revitalizing rural areas. The use of green electricity by numerous industries will usher in a new era of electricity consumption in which the industrial sector can reduce carbon emissions, so that enterprises and environmental protection can develop in tandem. The coordinated development of PV and agriculture, fisheries, and animal husbandry can protect the environment and reverse land desertification, creating both economic and environmental benefits.

While for carriers carbon neutrality an important strategic goal, their energy infrastructure is still a great challenge that needs addressing. Conventionally, carriers' site power facilities are auxiliary products featuring high power consumption and high OPEX. To accelerate carriers' shift to carbon neutrality, Huawei has introduced five digital power target network solutions: simplified site, simplified equipment room, simplified data center, ubiquitous green electricity, and integrated smart energy cloud.

Huawei Smart Power has achieved success in a range of use cases, including zero-carbon power generation (smart PV power storage turns PV from a backup power source into a main power source, introducing green power to numerous industries), zero-carbon homes (enabling a zero-carbon lifestyle and creating a zero-carbon living environment), zero-carbon travel (delivering better user experience and accelerating the electrification of the automotive industry), zero-carbon sites (smart power target networks enabling telecom networks to conserve energy and reduce emissions), zero-carbon data centers (facilitating the sustainable development of a digital world that is green, secure, and smart), zero-carbon campuses (advancing zero-carbon smart campus innovation from green power generation to efficient power

consumption). These success stories will eventually create zero-carbon cities and contribute to a zero-carbon planet, accelerating the achievement of carbon neutrality.

Working with partners worldwide to build a robust energy ecosystem

Huawei Digital Power drives the integration of power electronics technologies with IoT, big data, and artificial intelligence, breaking limits in green technology and minimizing power generation costs. This enables each kWh of electricity to support more bits of data traffic on communications networks, and delivers stronger computing power for data centers, further expanding the reach of humanity's green efforts.

Achieving carbon peak and carbon neutrality will require the collective efforts of all industry players. Huawei will remain open and cooperative and work with partners across the industry value chain, industry organizations, and standards organizations.

Etisalat

Powering Up a Green Future

At the 2021 Better World Summit (BWS) hosted by Informa tech and Huawei in October 2021, Dr. Ahmed Bin Ali, SVP of Corporate Communications for Etisalat Group, explained the carrier's commitment to green operations, both in terms of technological innovation and business operations.

Dr. Ahmed Bin Ali, SVP, Corporate Communications, Etisalat Group

A greener tomorrow

Governments, regulators, vendors, decision makers, and suppliers play critical roles in influencing and making decisions on what can be done for a better, sustainable, and greener tomorrow in their respective sectors.

Every day, we make choices in our lives that affect the environment, the climate, and our communities. The sustainability of the new digital economy must be embedded in our business practices, requiring us to leverage technology to be agile and resilient to disruption and develop new post-COVID business models. Now is the ideal time for the ICT sector to thrive and provide solutions that bring our lives closer to nature and sustainability. The next era of digital innovations is one where 5G communications, AI, IoT, and machine learning will enable new ways of living.

At Etisalat, we believe in creative solutions and adopting technologies that ensure long-term benefits to our planet and the climate. We play a key role in realizing the national ambitions of the UAE and also in helping to achieve the United Nations' sustainable development goals. During lockdown over the past two years, telcos have been instrumental in building the bridge between digital readiness and enabling communities to thrive, despite all the challenges the world has faced. And today, we are continuing our efforts to help the planet – we remain committed to GSMA's goals of achieving net zero carbon emissions globally by 2050.

On the green journey

We have transformed our infrastructure, converting our network from traditional coverage to coverage with fiber optic cables. They are more sustainable and environmentally friendly than copper cables, something that in turn benefits society. In the UAE, we have laid down 10 million kilometers of cables – the equivalent of 28 trips to the moon or circling the earth 274 times.

However, it is not just about ICT providing solutions for customers or the industry. It is also about how to help different industries achieve their sustainability goals with digital solutions. By

> We have deployed cooling systems and hybrid solutions in more than 800 sites, achieving energy-savings of over 4 million kW and cutting diesel consumption by 14 million liters.

implementing more digital services and digital solutions, I believe that we will be able to reach sustainability goals across different sectors.

We are running various initiatives in the 16 markets in which we are active, spanning Asia, Africa, and the Middle East. In the UAE, for example, we have deployed cooling systems and hybrid solutions in more than 800 sites, achieving energy-savings of over 4 million kW and cutting diesel consumption by 14 million liters. In Pakistan, our ambitious solar power project is underway, focusing on boosting energy efficiency in 170 sites. In Afghanistan, we are applying the "super capacitor" concept to replace classical battery systems, which will cut energy consumption by an estimated 35%. Our efforts extend to mobile scenarios, with the conversion of shelter-type sites to outdoor units yielding 38% energy savings per site. In Egypt, we have continued deploying hybrid systems, which saves more than 50% in fuel. We have also implemented one of the key objectives of our digital arm, Etisalat Digital, to cultivate innovations and evolutionary services that can be implemented by our sustainable partners. Connected Mangroves, for example, is a new project that provides a solid example of how telecoms can apply connected machines, IoT, and cloud computing to boost yields by providing a full range of readings, like humidity and temperature.

In another major step in our green efforts, we're doing more business through digital channels, including digital payments and digital self-service options both online and in digital retail. For example, we have expanded the self-service touch points in our smart stores. As part of Etisalat's Go Digital drive, we're running a number of automation initiatives to go paperless, including switching from paper billing to digital billing. In 2020, we achieved a 100% e-billing rate to customers and digitized our operations and processes, reducing overall paper consumption by 99%.

Moving forward, I am confident that all of us will continue to play a major role in the new world, as we look towards providing safe, efficient, and environmentally responsible ICT services that help the planet for future generations.

Developing power technology for greater benefits and at the same time maintaining sustainability goals remains our guiding principle.

iCooling@AI

A Cool Solution for Global Warming

Huawei's iCooling@AI solution improves power usage effectiveness (PUE) in data center, cutting energy use by 8% to 15% – a significant saving that can help create a greener and smarter future.

By Data Center Energy Marketing Support Dept, Huawei

> As the world's leading provider of ICT infrastructure and smart devices, Huawei is committed to developing technologies that can help industries save energy and reduce emissions in a bid to stop global warming.

There are nearly 4.4 billion Internet users worldwide connecting to the Internet on different devices to access a variety of smart services, from online shopping to online dating. Every one of these services is built upon data centers.

At the heart of data

The rapid development of emerging technologies, such as 5G, IoT, and cloud computing, has led to demand for massive amounts of data, in turn creating a thriving data center industry for processing, storing, and managing that data.

However, data centers consume about 200 TWh of electricity each year, accounting for about 1% of the global total of energy expenditure. According to the report *Recalibrating Global Data Center Energy-use Estimates*, global data center computing instances increased by 550% in 2018 over 2010, but power consumption had increased by only 6%. Therefore, average energy consumption per computing instance has actually decreased year on year since 2010.

This uptick in energy efficiency is the result of concerted efforts by governments and enterprises around the world. As a key stakeholder, the ICT induastry is doing its best to save energy and reduce emissions. As the world's leading provider of ICT infrastructure and smart devices, Huawei is committed to developing technologies that can help industries save energy and reduce emissions in a bid to stop global warming.

Hungry for data

The demand for the massive amounts of data enabled by 5G poses greater challenges for data centers than ever before, necessitating effective environmental protection and energy conservation measures throughout the design, construction, and O&M processes.

IT equipment and services and infrastructure

8% -10%

Reduction in total power consumption of refrigeration stations, plus a 10% reduction in power consumption by end equipment and a 8-15% improvement in PUE

3.85
million kWh

will be saved, the equivalent of planting 79,500 trees

are the most power-hungry areas of the ICT ecosystem. For infrastructure, refrigeration systems consume the most power, and so reducing the energy consumption of refrigeration systems represents a first crucial step. As data center loads and their environments constantly change, cooling systems need smart brains that are capable of smart adjustments and on-demand cooling to save on energy consumed unnecessarily. Many leading operators have responded to the call for global environmental protection. China Unicom's Henan branch (China Unicom Henan) introduced Huawei's iCooling@AI solution which integrates big data and AI, enabling data centers to learn to save power and automatically optimize their power efficiency, improving data centers' PUE by 8% to 15%.

Central Plains Data Center

Located in Henan’s Zhengzhou, the Central Plains Data Center is one of China Unicom's 12

> As a data center's load increases, the cooling mode changes and the AI becomes more capable of learning. This leads to constant improvements in power saving that significantly reduce power consumption and waste.

planned, ultra-large, national data centers. It's also the only core data center in central China to be built to the T3+/T4 standard. At the start of this strategic partnership project between China Unicom and the Henan provincial government, China Unicom Henan put forward rigid energy consumption requirements for the data center. Its priority was to achieve reliability and a PUE that would be first-class both in China and globally.

In the days before the iCooling@AI solution was adopted for optimizing power efficiency, data center cooling systems were mainly configured manually. This made it difficult to achieve satisfactory results, as the load and environment were constantly changing.

In contrast, iCooling@AI can efficiently and accurately collect all data relating to a data center's power efficiency. It then uses the deep neural network for modeling and accurately compares the created models with the data center's operating status, which is optimized every hour. As a data center's load increases, the cooling mode changes and the AI becomes more capable of learning. This leads to constant improvements in power saving that significantly reduce power consumption and waste.

With the adoption of the iCooling@AI solution, components of a data center cooling system will collaborate intelligently and operate efficiently, optimizing the entire system's power efficiency. iCooling@AI acts like a data center's guardian, helping it save energy and reduce emissions, while ensuring we have greener smart living.

Innovation for green growth

In a world where all things are connected, a sustainable future is only possible when both environmental protection and growth are prioritized. Huawei will continue optimizing the iCooling@AI solution to help build more energy-efficient data centers as part of a greener intelligent world that truly achieves tech for a better planet.

Qinghai

How the Sun Revitalized a Landscape, a Community & an Economy

Qinghai has three major landmarks: Qinghai Lake, Longyangxia Hydropower Station, and the new PV power station. Powered by Huawei's digital information technologies, 5G networks, and smart handheld terminals, Huanghe Hydropower Development of State Power Investment Group successfully built China's largest centralized new energy control center. This project has boosted Qinghai's PV industry and improved the lives of people there, leading to the development and prosperity of communities in the upper Yellow River.

By Hu Xuecui, Digital Power Marketing & Solution Sales Dept, Huawei

> Gonghe PV power station is not just the world's largest PV power station – it also boasts the shortest completion time of any new energy power plant, taking just one year from bidding to connecting to the grid.

In Chinese, Qinghai means blue waters. Named after Qinghai Lake, China's largest inland salt lake, Qinghai Province attracted worldwide attention in November 2020 when two 10 million-kW renewable energy bases were completed in the Hainan and Haixi prefectures. We took a trip to the PV power station in Talatan, Gonghe County, 60 km southeast of the lake.

As you travel from the provincial capital Xining to Gonghe County, the steep mountains on both sides of the road gradually recede and the horizon gradually widens. The azure sky, fluffy clouds, verdant hills, and herds of wandering cattle and sheep evoke serenity and peace. The white caps of snow on distant mountains are the only trace of the previous night's wind and snowfall.

10 years of construction

Prior to 2011, the remote and sparsely populated Gonghe County was relatively unknown. When construction began on the world's largest renewable energy base, a monumental undertaking given how difficult it was to bring in cranes and equipment, the county bustled into its busiest time ever. The decade also saw the rapid development of auxiliary industries like catering, accommodation, auto repairs, ironware, and construction materials.

This level of activity had only been approached once before – in the 1980s, when the Longyangxia Hydropower Station was built.

September 26, 2020 was a memorable day for both Huawei and energy specialists Huanghe Hydropower Development. At 17:18, the last segment of the Qinghai Gonghe 2.2 GW PV power station was connected to the power grid, marking the rollout of a power source that would support the world's first UHVDC power transmission project to transmit 100% clean power. Gonghe PV power station is not just the world's largest PV power station – it also boasts the shortest completion time of any new energy power plant, taking just one year from bidding to connecting to the grid.

The Qingyu UHVDC power transmission line

that the plant supports stretches 1,563 km from Hainan in Qinghai Province to Zhumadian in Henan Province and is capable of lighting up the Central Plains region with 100% clean power.

Both the power station in Gonghe and the province's wind power plants connect to the power grid, providing capacities of 15.436 million kW in Hainan and 10.12 million kW in Haixi. Each of the renewable energy bases now has a capacity of 10 million-kW.

Ten years ago, China's inverter market was dominated by central inverters. In 2013, Huawei and Huanghe deployed string inverters in the Golmud PV power station in Qinghai, marking the first time string inverters were installed in a large-scale, ground-mounted PV plant. This broke the dominance of central inverters and spurred new development in the PV industry. In 2014, the two companies launched the smart PV solution based on string inverters to digitalize PV power stations. One year later, Huawei established the Smart PV Joint Innovation Center with Huanghe, which soon developed Smart I-V Curve Diagnosis technology, revolutionizing O&M and slashing LCOE (Levelized Cost of Energy).

In 2017, string inverters overtook central inverters to become the mainstream PV inverters. Smart I-V Curve Diagnosis is widely used worldwide today, replacing complex and inefficient manual O&M and inspections and accelerating the arrival of affordable PV. A little spark starts a great fire – Smart PV began by the Yellow River and now the 609- square-kilometer Gonghe PV power station is one of the world's largest PV power stations, complemented by the 100 MW Demonstration Power Station.

According to Xie Xiaoping, Chairman of Huanghe, the two companies achieved outstanding results due to aligned resources and complementary strengths. A timespan of just ten years saw the development of the world's first 100% clean energy UHV power transmission line as well as the world's largest renewable energy base, PV power operator, single PV power station, hydro-solar power plant, and demonstration base.

Powered by Huawei's digital information technologies, 5G networks, and smart handheld terminals, Huanghe had built the country's largest centralized new energy control center. With more than 20 million data measurement points, the center centrally manages 34 PV power stations, providing services like big data analysis, remote diagnosis, and real-time maintenance.

Plans are in place for a new PV park spanning 609.6 square kilometers – roughly the land area of Singapore – and a 2,400-square-kilometer wind farm.

By the end of 2020, the renewable resources in Hainan totaled an installed capacity of 18.65 million kW, including 9 million kW of PV power, 5.5 million kW of hydropower, 4.1 million kW of wind power, and 50,000 kW of solar-thermal power.

Folk songs make a return in Talatan

Located in the upper reaches of the Yellow River, Talatan was once a landscape of windswept sand, plagued by drought and overgrazing.

Since 2011, PV power has helped gradually restore the degraded vegetation and revitalize the grassland ecosystem, with solar energy increasing soil moisture and reducing evaporation from the soil's surface. Local residents herding sheep under seemingly endless rows of solar panels on the Qinghai-Tibet Plateau is a living example of how technologies can coexist harmoniously with nature. The sky is blue, the wilderness is vast, and the wind sings to cows and sheep through the grass.

In just 10 years, Talatan was restored to the way it once was – its green past has time-traveled to the present and the sound of folk songs can be heard again.

On our way to Talatan, Huan Xingsheng, the deputy director of production technology for Huanghe's PV O&M company, believes that "solar grazing" embodies the nature of this land – and the term is currently being registered as a trademark.

Fifty-year old Duogoujie lives in Tiegai Town, where he and his wife raise over 550 small-tailed Han sheep, which graze in rich fields nearby.

"Before, there was no fertile grass here. It used to grow in clumps, with sand all over it, just like the kind you see on the roadside. The sheep didn't like it," says Duogoujie with a smile.

When first planning for the PV project in Talatan, Huanghe sought ways to deploy PV power stations in a way that would benefit both the natural ecosystem and the PV industry. To absorb the impact of desert wind and sand on solar PV panels, Huanghe sowed pasture seeds around the PV park. The grass inside the park soon grew far higher than the grass outside it.

"The grass grows better because the shelter of the PV panels reduces evaporation from the soil surface, and the water used to clean the PV panels increases soil moisture," says Huan Xingsheng.

However, this creates new challenges: Grass that grows too tall stops sunlight reaching the PV panels and affects power generation. The grass

also catches fire easily when it withers in winter. In 2015, Huanghe migrated 600 sheep into the park. They kept the grass at a certain height so it power generation remained unaffected and life was made far easier for the farmers.

Also in 2015, Huanghe began researching the environmental impact of large-scale PV power stations. It found that their deployment improved soil moisture and vegetation growth, cutting average wind speeds by 41.2% and daily air temperatures by 0.5°C, while improving average daily air humidity by 2.1% and soil moisture by 32% at 20 cm deep.

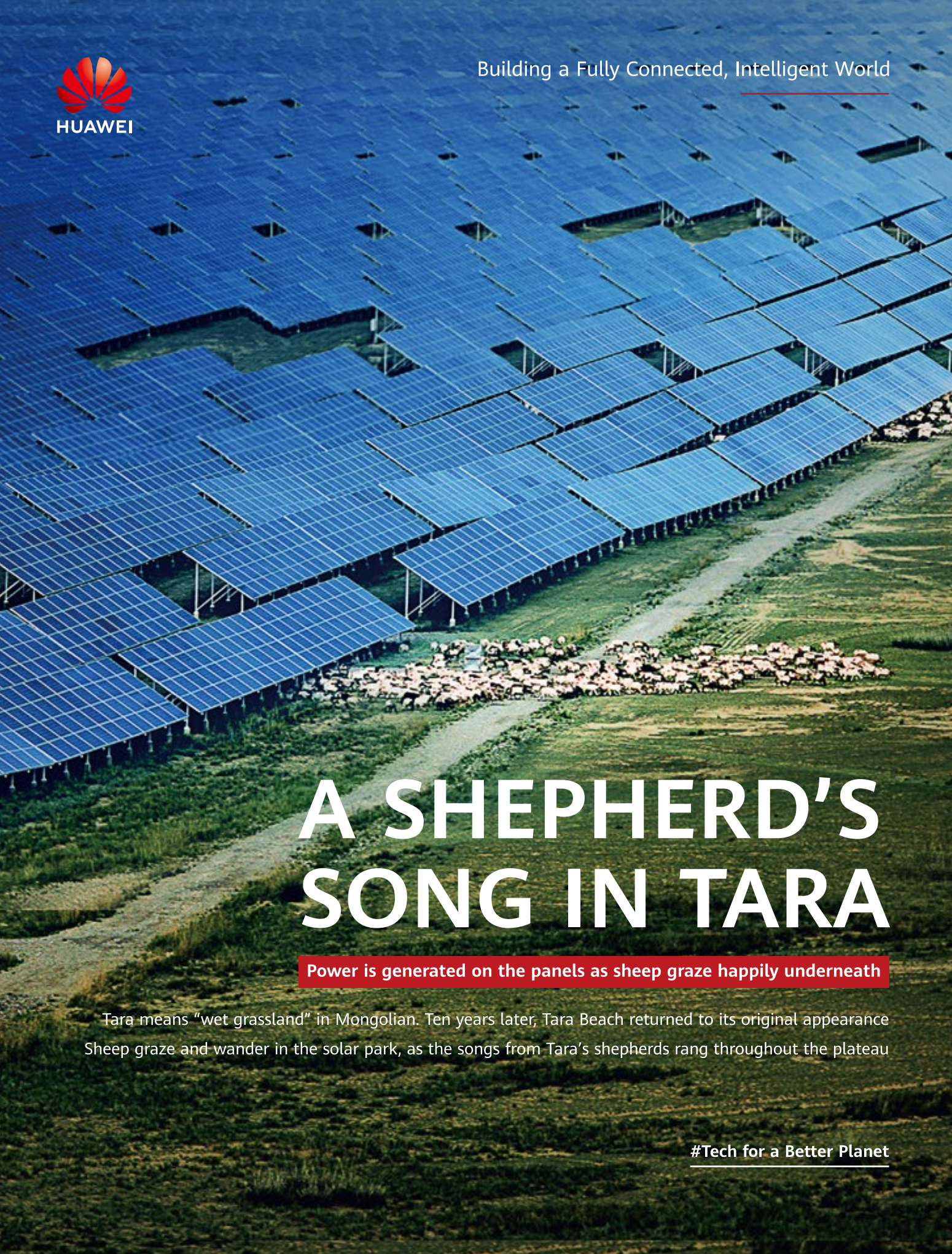
As a result, Huanghe adjusted the design of the PV supports from 50 cm to 1.2 m above ground. The increased construction costs were offset by signing grazing agreements with local farmers, employing local villagers to help construct and maintain the PV park, and growing cash crops like snow chrysanthemums and Togou grass in the park. The model of jointly benefiting the ecosystem and local people by deploying solar technology has in turn boosted the PV industry, local transportation, construction, and tourism, leading to the development and prosperity of minority groups in the upper Yellow River.

In 2018 in response to the success in Talatan, the State Key Laboratory on Ecological Water Conservation in Northwest Arid Regions set up a branch at Huanghe dedicated to researching the management of areas that, like Qinghia, are arid or have turned to desert.

Supported by the world's largest renewable energy base, Qinghai's power grid has achieved several milestones since 2017 for providing uninterrupted green power, achieving 7, 9, 15, and then 30 consecutive days.

On August 16, 2021, it achieved a record 100 days.

Looking out from a 30-meter-high inspection tower is a blue ocean of PV panels that contrasts with Qinghai Lake a short distance away. Today, this land is alive with joy, with more than 5,000 sheep grazing in the park and the sound of singing farmers floating over the grasslands.



A SHEPHERD'S SONG IN TARA

Power is generated on the panels as sheep graze happily underneath

Tara means "wet grassland" in Mongolian. Ten years later, Tara Beach returned to its original appearance
Sheep graze and wander in the solar park, as the songs from Tara's shepherds rang throughout the plateau

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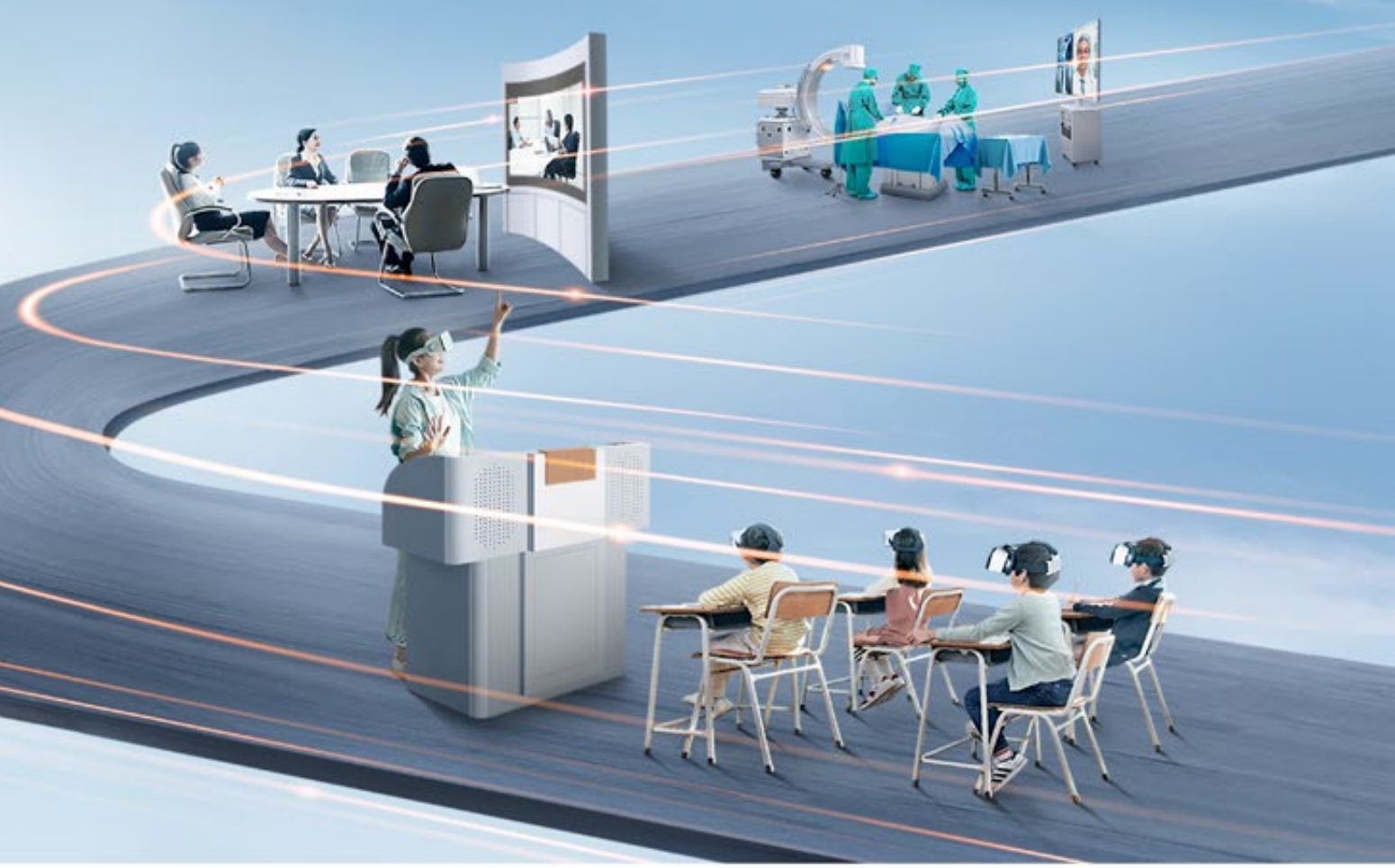

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