Flash forward: Life in 2030

How 5G will transform our lives over the next decade

A lasting impact

From the moment the first handprints were stencilled onto cave walls 40,000 years ago, generation after generation of humans have been leaving their mark on the world with records of their daily lives and signs to say: "I was here."

The dawn of the 5G era brings new capabilities for humanity to leave an imprint on the Earth. 5G networks will power digitized economies and societies. Ubiquitous connectivity will transform how cities, industries, healthcare, education, government and home life function and flow.

We call on companies, governments and individuals around the world to make the decisions today that will ensure the foundations of the future. Accelerating the rollout of 5G, the reach of connectivity to all and the full potential of technology will underpin a future based on the principles of equality, trust, sustainability[1] and people first.

[1] The concept of sustainability covers economic, environmental, and social aspects. It focuses on meeting the needs of the present without compromising the ability of future generations to meet their needs. Sustainability – UN Academic Impact.

The forces shaping our tomorrow

The economist-philosopher F.A. Hayek once wrote that the ability to think into the future is where "human intelligence proves itself."[2] Since some possible futures are more likely than others — and a few are truly preferable — the question is how do we, collectively, bring about the best of those potential tomorrows in light of current trends.

Here in 2020, those trends include climate change, shifting demographics and rapid advances in technology. On the climate front, the breakaway of a section of Greenland's ice cap in September 2020 was the latest proof the Arctic has moved into what scientists are calling a new "climate regime".[3] Wildfires have ravaged Australia and California, while severe weather has devastated communities from southeast Asia to South America. It's widely agreed that adapting to the new global climate reality and preventing temperatures from rising further will require radical changes to how people live and do business.

Ongoing, intensifying urbanization and the aging of many countries' populations are further factors that will influence people's lives of the future. According to the United Nations, in the next 30 years the number of people living in urban areas will grow by more than two billion, accounting for 68% of the total population.[4] Those aged 65 or older will exceed 426 million.[5]

The structure of work is shifting as well, toward self-employment and the gig economy, while the pandemic has made working from home an accepted norm. This shift requires new skills — all at least partly influenced by technological change. The world is already dependent on digital connectivity. Decisions about who controls the world's massive volumes of co-created data — and how to protect privacy and personal freedom — are crucial. So are strategies to ensure that innovations are used for the greatest good, especially the new capabilities of 5G. The key, according to Martin Mühleisen, Director of Strategy, Policy and Review for the International Monetary Fund, lies in "devising smart policies that maximize the benefits of the new technology"[6] — in other words, bringing that future view to current developments.

In the light of these trends, what do some of the best possible futures available to humanity look like — and how can 5G help to make them happen?

With its capacity to foster health and wellbeing, enhance infrastructure, promote sustainable industry, spur innovation and drive economic growth, 5G has the potential to deliver social value across all of the United Nations' Sustainable Development Goals.[7] 5G-enabled technologies can also support responsible resource consumption, enabling more sustainable cities and communities — and improve energy efficiency by enabling remote working, smart grids, Internet of Things (IoT) monitoring and more.

Seeing the future

Analytical methods developed and refined since the 1940s give researchers qualitative and quantitative tools to create narratives of future foresight.[8] These can be used by everyone from governments and policymakers to companies and social change organizations — helping point the way to action so the most preferred future can be realized. Read our five narratives for the 5G era to see how we can build a better world.

In the next 30 years the number of people living in urban areas will grow by more than **two billion**

[2] Hayek, F.A., 1960. The constitution of liberty.
[3] The Associated Press, 2020. A big chunk of Greenland's ice cap breaks off as Arctic shifts to new climate regime.
[4] United Nations, 2018. World urbanization prospects.
[5] United Nations. Ageing.
[6] Mühleisen, M., 2018. The long and short of the digital revolution.
[7] World Economic Forum, 2020. The Impact of 5G: Creating New Value across Industries and Society.
[8] Popper, R., 2008. Foresight methodology.

Welcome to 2030

Living and working in 2030

With 5G covering the densest cities and rural areas alike, everyone has equal access to opportunity

Anja and Manjeet live in a small village in southwestern Germany's idyllic Black Forest. Despite their rural location, enhanced 5G connectivity gives them access to the same economic opportunities as their friends and family in larger cities such as Stuttgart or Munich.

While there's not a large workforce to draw on in the region, 5G and the Internet of Things (IoT) are powering local manufacturing and value chains that strengthen the community. From their home in the countryside, Anja oversees production of a nearby automated solar panel factory, using 5G's ultra-low latency to check in seamlessly via virtual and augmented reality — and even advanced technologies such as holograms.

Manjeet is one of the many people who take part in the gig economy, accepting freelance graphic design projects and microtasks from any employer around the world. He can work anytime and from anywhere, connecting quickly and easily to the digital platforms he needs to do his work.

Their children, **Emma and Lukas,** are digital natives, using tablets and mobile devices more proficiently and for more activities than any generation before them. They use new virtual education platforms fluently, including virtual reality, to learn new skills. The curricula they are taught is not "one size fits all," but personalized to their individual learning preferences and strengths.

Some of their teachers aren't even located in their hometown — or Germany at all, in fact. Education is global and everybody can enjoy the best teachers across borders, with 5G's high speeds enabling real-time language translation to overcome any language barriers.

Living and working in 2030

The trends that shaped our vision

Self-employment and the gig economy are already on the rise in 2020, providing companies with low-risk staffing options.[9] The **$200 billion** global gig economy of today is expected to more than double by 2023[10] — and future social, economic and technological changes will bring about entirely new forms of employment characterized by unconventional work patterns and places of work.[11]

As the workforce changes, so will the educational system. Today, some **1.4 billion** people are using mobile devices to educate themselves or their children. Looking ahead, 5G has the potential to meet the needs of the **262 million** children[12] and youth who are not attending any kind of school.[13]

Our commitment: **People First**

5G technologies will be used to solve human problems, making life better, easier and more secure.

[9] Gupta, Aditya, 2020. Gig economy in a post-COVID era: The future of work has arrived.
[10] World Economic Forum, 2019. How is the Fourth Industrial Revolution changing our economy?
[11] Eurofound, 2020. New forms of employment.
[12] GSMA, 2019. 2019 Mobile Industry Impact Report: Sustainable Development Goals.
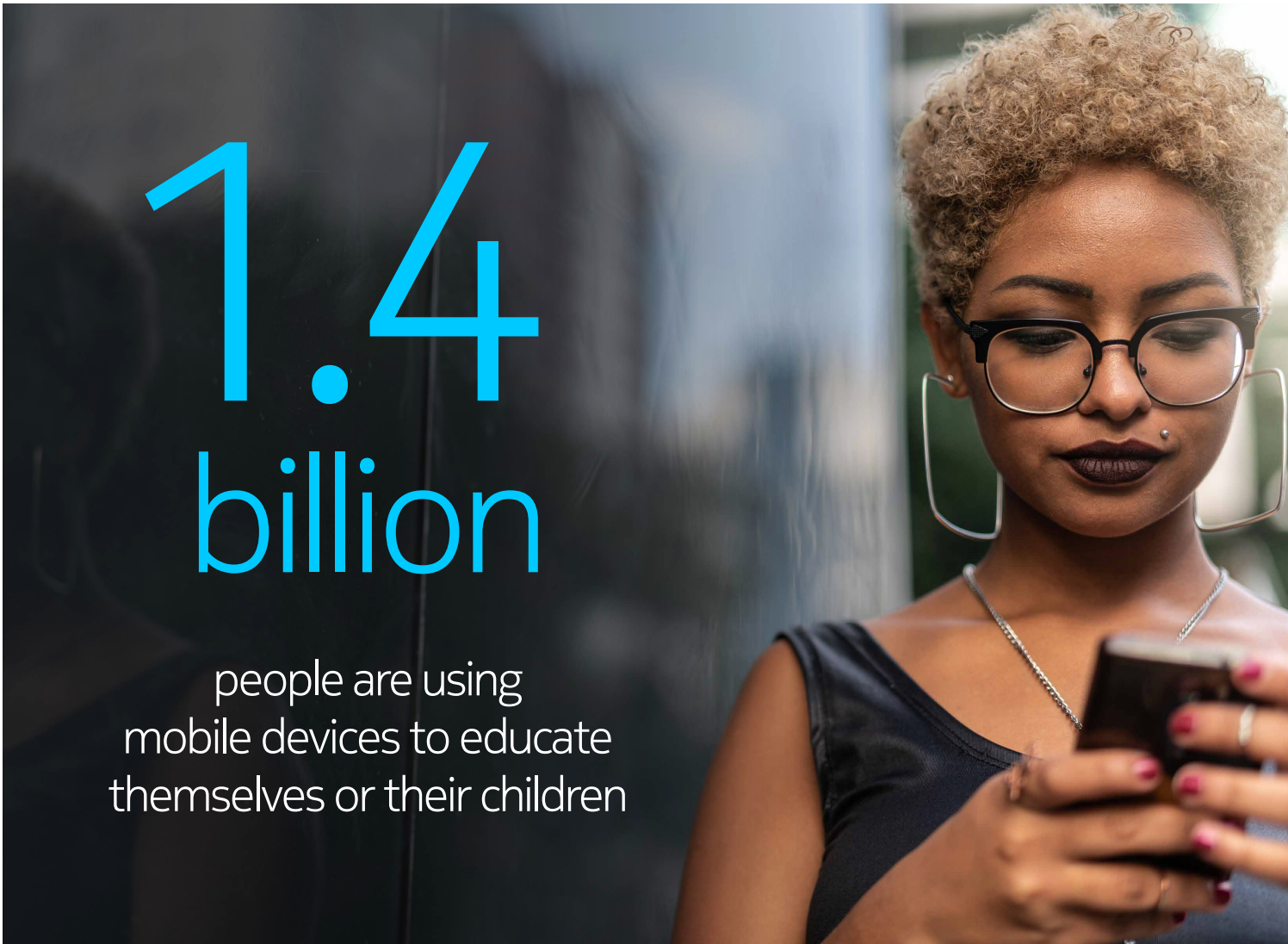[13] UNESCO, 2020. Leading SDG4 – Education 2030.

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Supporting the planet in 2030

5G sensors make every sector of the economy more sustainable, optimizing energy usage and cutting emissions

Mining is an important economic industry, but ensuring that it is a sustainable industry, with a low environmental impact, is a key criteria now and in the future. The mines of Zimbabwe are a critical source of raw materials for the world's 5G devices and components. **Anodiwa** works for a large mining company in that country, where she is responsible for overseeing its environmental sustainability program. Under her watch, the company has deployed thousands of high-performance, 5G-powered IoT sensors throughout its operations to monitor resource consumption and other critical business assets.

Metal production requires the continuous adjustment of many different process parameters that affect energy, chemical and water usage. The speed and ultra-low latency of 5G make it possible for Anodiwa and her colleagues to get test and simulation results in near-real time so they can quickly optimize the mine's processes and resource consumption.

Real-time analytics enable predictive and preventative maintenance, improving process availability and uptime that ultimately decrease the risk of environmental contamination or energy leakage through a faulty system or component.

5G also helps Anodiwa reduce her personal carbon footprint. She doesn't need to travel much for work — meetings are mostly virtual — keeping her transportation-related emissions low. And the intelligent management of utility services enabled by 5G networks allows her to optimize her home energy use thanks to smart power grids, real-time environmental monitoring and highly efficient processes for agriculture, healthcare and other parts of society.

The trends that shaped our vision

If countries are to meet the targets set out in the Paris Agreement and limit global warming to just 1.5°C, a **7.6%** reduction in emissions will be needed each year until 2030.[14] In the metal and mining industry, emissions could be cut by **7%** by digitizing a single process step, such as sorting, which will optimize electricity, water and spare parts consumption.[15]

The more processes that are digitized, the greater the environmental gains will be.

Across all sectors, global emissions could be reduced by **4%** through new applications of artificial intelligence (AI), which 5G will make easier to adopt.[16]

Our commitment: **Sustainability**

5G technologies will help make human activities cleaner, more efficient and better for the planet.

[14] United Nations Environment Programme, 2019. Emissions gap report 2019: Global progress report on climate action.
[15] Nokia, 2020. Conscious industries of the future.
[16] PwC, 2019. How AI can enable a sustainable future.

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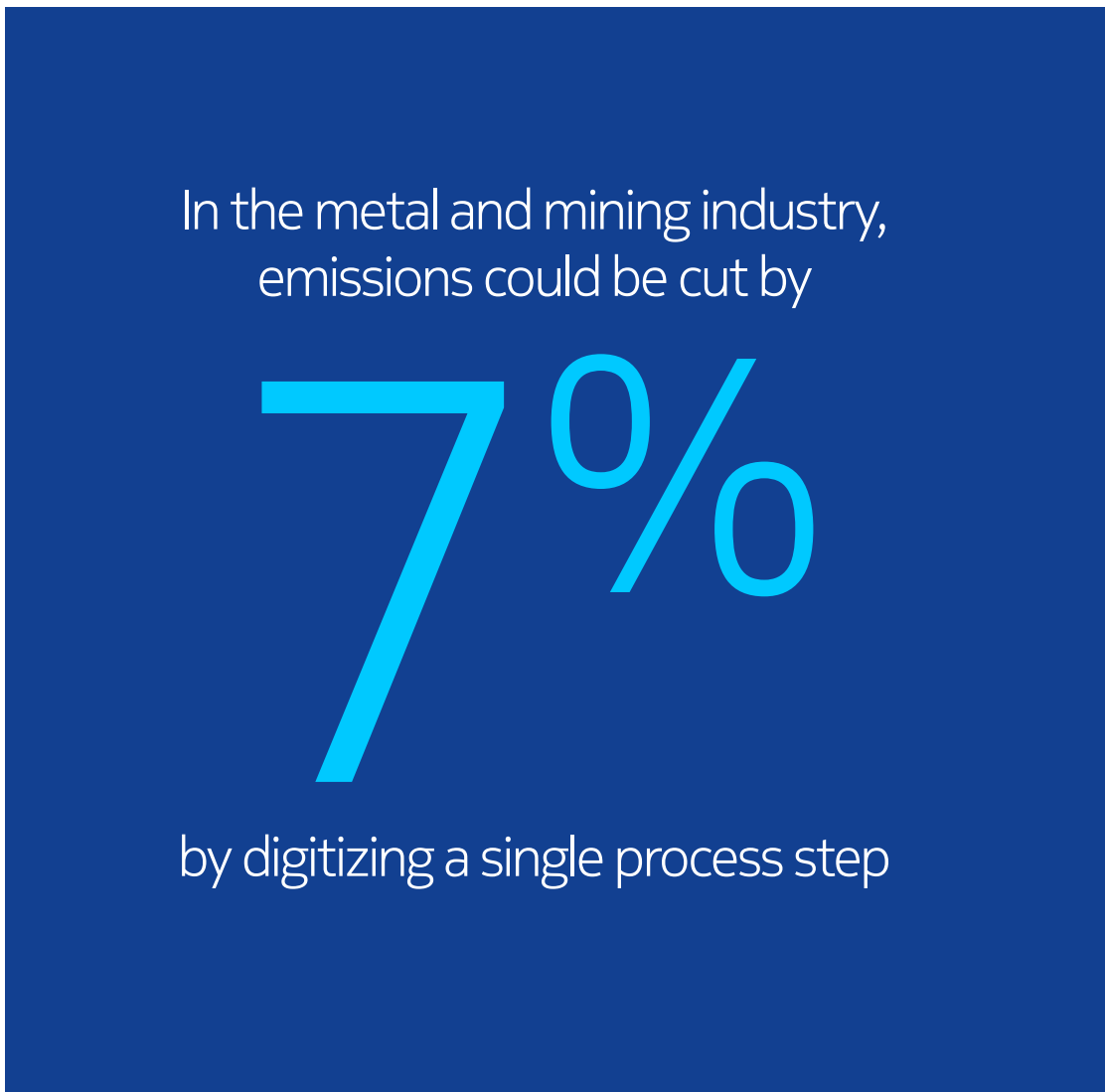
Strengthening communities
in 2030

5G makes it easy for people to stay connected, healthy and safe, no matter where they're located

While **Daisuke's** family medical practice is based in Kyoto, he treats patients all over Japan — including 80-year-old **Keiko**, a widow in the small town of Takayama in north Japan — thanks to the enhanced connectivity and huge advances in artificial intelligence supported by 5G.

A network of connected IoT sensors in Keiko's home allows Daisuke to monitor every aspect of Keiko's health remotely in near-real time. Last year, when Keiko's condition deteriorated, Daisuke coordinated a rapid emergency response with healthcare providers in Takayama. He even led the remote surgery himself, using 5G's low latency to receive haptic feedback in real time, allowing him to actually "feel" his patient.

While Daisuke's remote medicine practice handles a steady volume of confidential and sensitive information, his patients are

confident their privacy is protected thanks to the government's latest data governance laws — which align with global standards for medical data protection.

At the end of each day, Daisuke drives home from his clinic on connected roadways. His car's onboard navigation system tells him how to avoid accidents, construction and bad weather based on inputs from IoT sensors and solutions along the route.

Once a week, he makes a final "house call" at the end of the day: video conferencing with his own elderly mother, **Yumiko**, who lives 40 kilometers away in Osaka. Smart building technology and IoT-connected care robots have allowed her to live in her own home much longer than previous generations of seniors — and video and virtual reality helps both of them stay connected over any distance.

The trends that shaped our vision

Universal internet access is key to realizing the full potential of 5G — but as of 2019, **half of the world's population** was unconnected and unable to benefit from the opportunities of the digital world.[17]

Ubiquitous connectivity will support IoT-based enhancements to community services, public safety, healthcare and more.

It will play an important role in helping monitor, care for and connect the world's aging population. As the need for data increases, some **25 billion** IoT connections are expected globally by 2025,[18] with **50%** of all the data in the world being generated by IoT devices.[19]

Our commitment: **Trust**

People will have more ownership and control over their personal data in the 5G era.

[17] Broadband Commission for Sustainable Development, 2018. 2025 targets: Connecting the other half.
[18] GSMA, 2019. IoT connections forecast: The rise of enterprise.
[19] IDC, 2019. The growth in connected IoT devices is expected to generate 79.4 ZB of data in 2025, according to a new IDC forecast.

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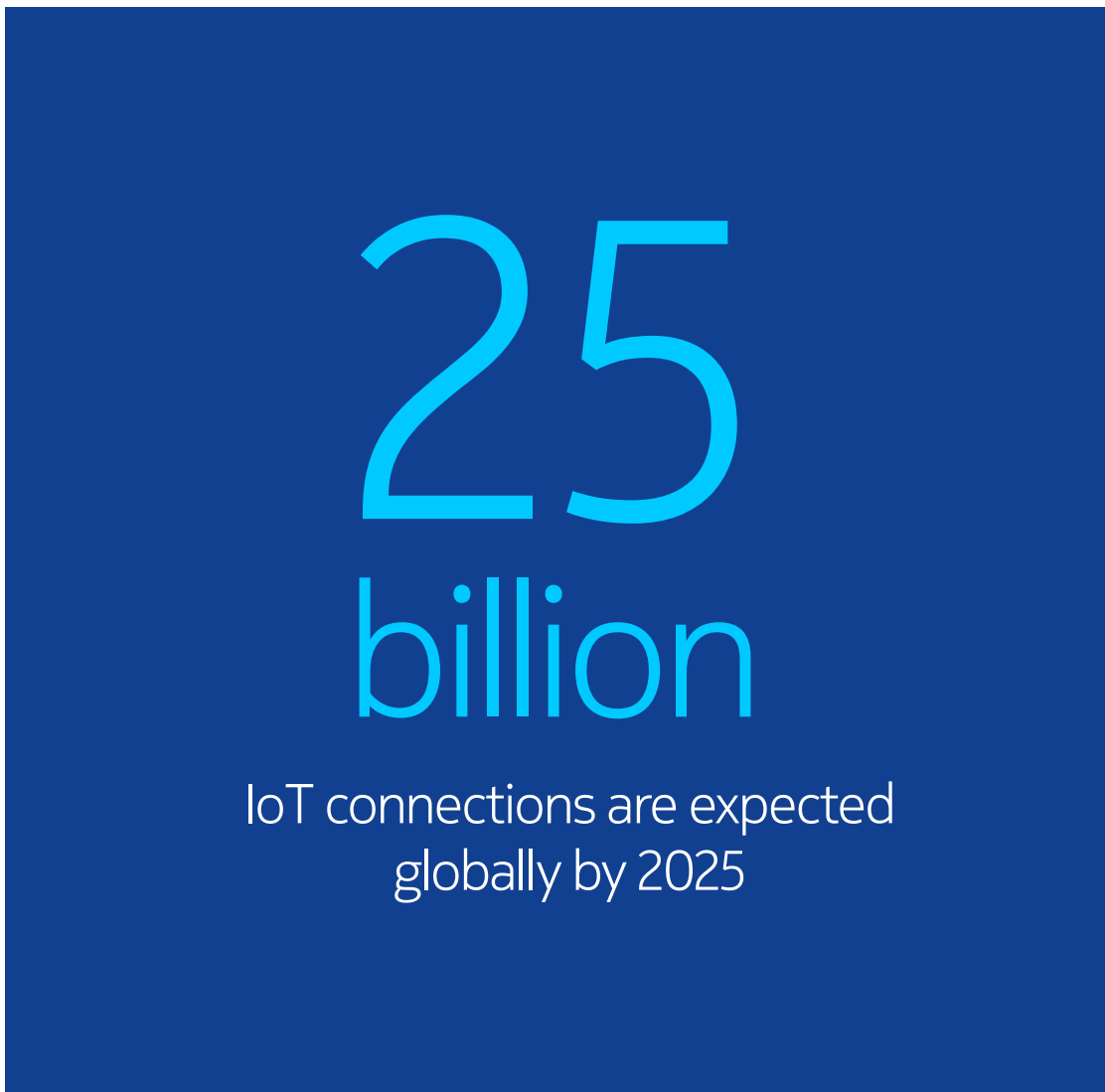
Sustaining the economy in 2030

5G enables new kinds of businesses and drives innovation in all sectors of the economy

In Rio de Janeiro, Brazil, cousins **Dani and Edson**, both in their 20s, are part of the new entrepreneurial generation that places sustainability at the top of their agenda. Using 5G connectivity, digitalization and data analytics, they operate a fleet of autonomous, self-driving vehicles that collect food waste from local restaurants and shops. The waste is transferred to a large facility operated by a multinational corporation to develop biofuels and other renewable sources of energy.

Dani, Edson and others like them are working to eliminate waste and pollution from their business processes, reusing more components and materials, keeping products in active use for longer and making better use of renewable resources.

The vehicles they own can operate practically anywhere — even in the oldest part of the city with its narrow roads, which have been seamlessly retrofitted with 5G technology to suit contemporary life without having to demolish or remodel any buildings.

5G connectivity is a crucial part of the technology stack that allows both big "platform" companies and smaller innovators such as Dani and Edson to implement smart city and climate-focused solutions rapidly. Large corporations have a strong interest in building 5G infrastructure because it allows for full vertical integration of everything from infrastructure to the individual user experience. For sustainability-oriented entrepreneurs, 5G is a major enabler of the "circular" economy that minimizes every form of waste and is the de facto standard in 2030.

The trends that shaped our vision

By 2035, some **22.3 million** jobs will be supported by the 5G value chain in countries that are likely to be 5G leaders: China, France, Germany, Japan, South Korea, the United Kingdom and the United States. At the same time, 5G will enable an anticipated **$13.2 trillion** in global economic output.[20]

Digital platforms can help private companies grow exponentially without requiring additional assets through "network effects". **Seven of the world's 10 most valuable companies** had platform business models in 2019 — with digital communities and marketplaces that allow different groups to interact and transact.[21] Emerging digital ecosystems could generate **more than $60 trillion** in revenue by 2025.[22]

Our commitment: **Equality**

5G connectivity will be accessible and available to all.

[20] IHS Markit, 2019. The 5G economy: How 5G will contribute to the global economy.
[21] The Innovator, 2019. The platform economy.
[22] World Economic Forum, 2019. Platforms and ecosystems: Enabling the digital economy.

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Feeding the world in 2030

5G makes "smart" agriculture possible, boosting yields while conserving water

Cody grew up on his family's farm in upper New York state. After studying network engineering at college, he returned home and helped his parents deploy IoT sensor arrays to monitor soil quality, air quality and moisture levels throughout their corn fields. The data they collect allows them to fine-tune their use of fertilizer, pesticides and water for irrigation — saving tens of thousands of dollars per year, protecting the land and conserving thousands of gallons of precious freshwater.

Cody even worked with a few neighbors to extend the 5G IoT network across their farms as well, expanding the data pool for better resource optimization across the region. Every farm on the network has increased its overall crop yields while using less land and water than ever before.

Now Cody is taking on a different challenge. A big agriculture company is building one of the world's first true "vertical farms" in

Queens: a high-rise greenhouse that will grow food closer to where it will be consumed, including peas and soy for enormously popular plant-based meat substitutes. Cody's network background and IoT-enabled farming experience has made him ideal for configuring the vertical farm's sensor network. When fully operational, the vertical farm will be a fully closed-loop, carbon-neutral food production operation at the edge of New York City.

Cody's girlfriend, **Naomie,** is a nutritionist. She's helping pioneer another new avenue in the future of food. The firm she's with has outfitted a pilot study group with wearable devices that assess their individual nutritional needs, hormone levels and other bio-physical factors. Based on the data Naomie and her colleagues collect, they can fine-tune the study group's individual diets for optimum health and wellbeing.

The trends that shaped our vision

A secure and plentiful food supply is vital to any sustainable future. Yet agricultural operations can't expand infinitely to keep up with global population growth. In fact, based on 2018 estimates, agricultural production is expected to decrease by **18%** by 2050.[23]

One of the key constraints on agricultural expansion is the need to conserve freshwater supplies for other human needs. While **70%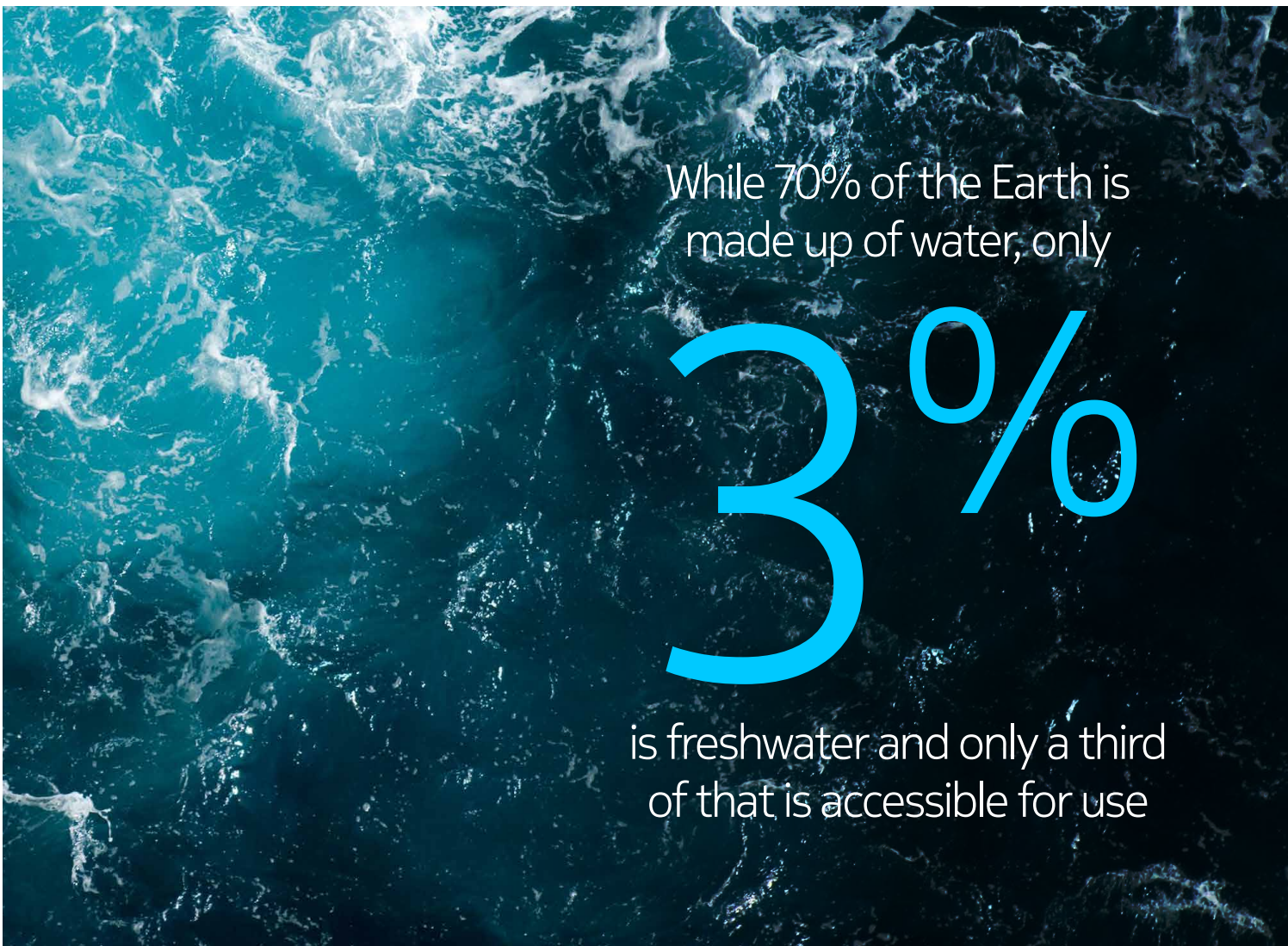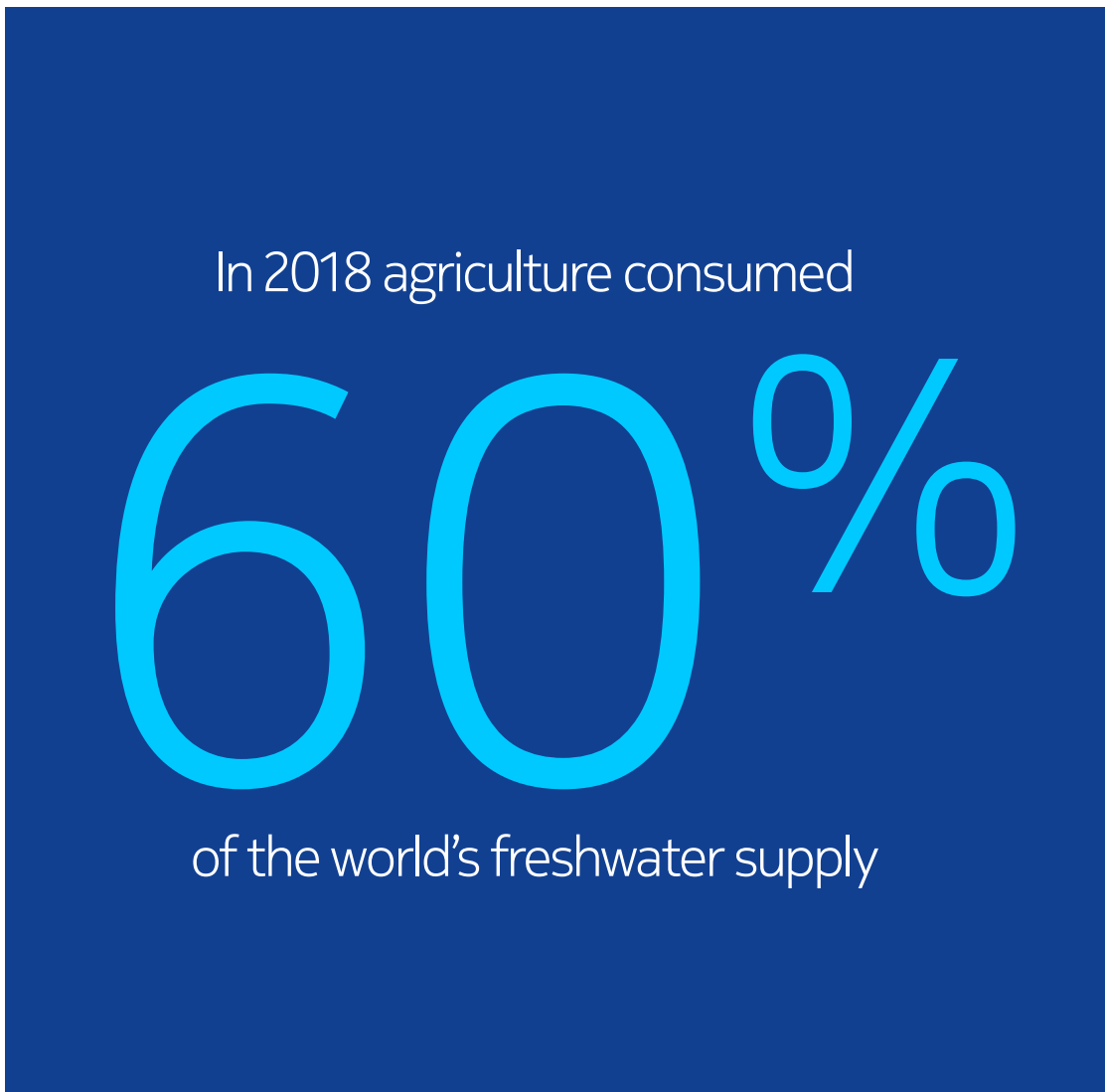** of Earth is water, only **3%** is freshwater — and only a third of that is accessible for use.[24] In 2018, agriculture consumed **60%** of the world's freshwater supply.[25]

Using connected technologies, data analytics, smart sensors and more can help maximize agricultural outputs while minimizing the amount of land and water needed to produce food for the planet.

Our commitment: **Sustainability**

5G technologies will help make human activities cleaner, more efficient and better for the planet.

[23] Figures collected from various studies done by the United Nations Food and Agriculture Organization and other NGOs.
[24] World Wildlife Fund, 2020. Water scarcity.
[25] Figures collected from various studies done by the United Nations Food and Agriculture Organization and other NGOs.

14

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While 70% of the Earth is made up of water, only

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Call to action

How to realize the 5G-enabled future

Technology is poised to dramatically change the way people live and work: digitalization, automation, robotics, wearables, the Internet of Things, artificial intelligence, machine learning and much more, with 5G connectivity powering it all.

Looking ahead to 2030, we at Nokia will redouble our efforts to act responsibly, ethically and sustainably, ensuring our choices promote **equality,** put **people first,** preserve and strengthen digital **trust** and ensure **sustainability.**

Equality

5G connectivity will be accessible and available to all.

People first

5G technologies will be used to solve human problems, making life better, easier and more secure.

Trust

People will have more ownership and control over their personal data in the 5G era.

Sustainability

5G technologies will help make human activities cleaner, more efficient and better for the planet.

66

The Nokia I want to be a part of is the one that enables ground breaking digital health care, automated transportation, brings learning and education to students in remote parts of the world, and helps address climate change and build a more sustainable world for our children and grandchildren."

Pekka Lundmark
President and CEO, Nokia

Our commitments

Promote **equality**

The 5G era must deliver equal opportunities for people and true digital inclusion, so that everyone everywhere can access and benefit from digital services.

Today's lack of universal internet access is a challenge for those in developing countries and for remote, rural and urban poor populations in G7 nations — including around 10% of the population of North America.[26]

Nokia supports the targets set by the Broadband Commission for Sustainable Development to make entry-level broadband services available and accessible for all by 2025.[27] Those targets require communications vendors, operators and regulators to work together on using the full suite of high-speed broadband access technologies — fiber, fixed wireless access, microwave, cellular, high-altitude platforms — to extend networks into more rural and remote areas. Services and devices must be made available to people living in low-income communities. And all schools must be connected so young global citizens have the skills to navigate a digital world.

Put **people first**

5G technology should be used to make life better for people around the world. It will be key to managing some of the world's most pressing challenges and to delivering real, tangible benefits to individuals and communities now and in the future.

At Nokia, we believe 5G will empower and emancipate online and flexible work and education. It can drive economic prosperity and enable big gains in productivity and efficiency while allowing people to lead better-balanced lives. Wearable devices powered by 5G connectivity can be monitored remotely by healthcare experts in real time, helping people lead longer, healthier lives. Immersive new experiences can be enjoyed by everyone, no matter where they live, bringing the world together like never before. And automated factories, farms and supply chains will keep nations fed and economies running.

[26] Internet World Stats, 2020. World internet users and 2020 population stats.
[27] Broadband Commission for Sustainable Development, 2018. 2025 targets: Connecting the other half.

Our commitments

Strengthen **trust**

Putting people first means respecting their rights to security and privacy in a world of unprecedented co-creation and sharing of data between individuals and companies.

Even in times of crisis (such as a pandemic) when monitoring, tracking and information-sharing are vital for the public good, people's right to maintain ownership and control of their personal data must be respected and preserved — and the organizations collecting and managing that data must be fully transparent in their policies, rules and operations.

Security and trust have to be woven into the very fabric of the 5G era. By 2024, the potential worldwide cost of data breaches will be more than US$5 trillion. To keep the digital world safe from harm, we must make a collective commitment to use the capabilities of 5G and other technologies in a way that secures data exchanges and protects individuals.

Ensure **sustainability**

As the world becomes increasingly urbanized, minimizing our environmental impact will require smarter, more strategic approaches to planning and managing the municipal infrastructure and services people rely on every day: transportation, housing, schools, hospitals, power utilities and more.

5G-enabled technologies can help make daily life and businesses greener, more efficient and better for society and the planet. Intelligent network infrastructure and sensors can help monitor and improve business processes, transportation flow and air/water quality. With 5G deployed in rural and remote areas to supply high-speed mobile broadband, the workforce can disperse from city centers, alleviating congestion and reducing harmful emissions.

5G technology has been designed to be up to 100 times more energy efficient than previous radio technologies — decoupling data demand from power consumption to help businesses to achieve their carbon emissions targets.

[28] United Nations, 2020. Report of the Secretary-General: Roadmap for digital cooperation.

Let's make our mark together

To make the best possible 5G future a reality and ensure the promise of connected technology comes true for everyone, we need to make some big decisions. Those decisions are too vast for any single company, industry or government to make or enact alone. 5G requires all of us, together, to embrace new approaches to shape the best possible future for all.

At Nokia, we are calling on our partners, customers, allies and stakeholders to join with us in adopting a proactive, responsible approach to 5G — and to help us uphold these commitments to equality, people, trust and sustainability.

We have to act now. What we do today will determine whether the 5G future fulfills its promise and leaves its own inspirational 'handprint on the wall' or whether it creates new challenges that successive generations will have to solve. Collectively, we have the insights, we know the trends today and we can see the path forward to the best possible outcome. Let's take action now and make this journey together.

To learn more about the 5G-enabled future, visit **nokia.ly/5g-future**

Advocate for the right to digital inclusion

Apply sustainable and circular design choices for new technology solutions

Promote ethical use of technology

Come together to drive innovations and new use cases

Agree frameworks for evaluation of 5G carbon footprint and handprint

Encourage open dialog on societal implications of 5G and other new technologies

Revisit regulation to drive rapid uptake of technology innovations or new technologies

Industry   Governments
Academic institutions   Multilateral organizations
Civil society   Individuals   Politicians

Form shared understanding of actions and time-frame to build better future world

NOKIA

About Nokia
We create the technology to connect the world. Powered by the research and innovation of Nokia Bell Labs, we serve communications service providers, governments, large enterprises and consumers with the industry's most complete, end-to-end portfolio of products, services and licensing. From the enabling infrastructure for 5G and the Internet of Things to emerging applications in virtual reality and digital health, we are shaping the future of technology to transform the human experience.