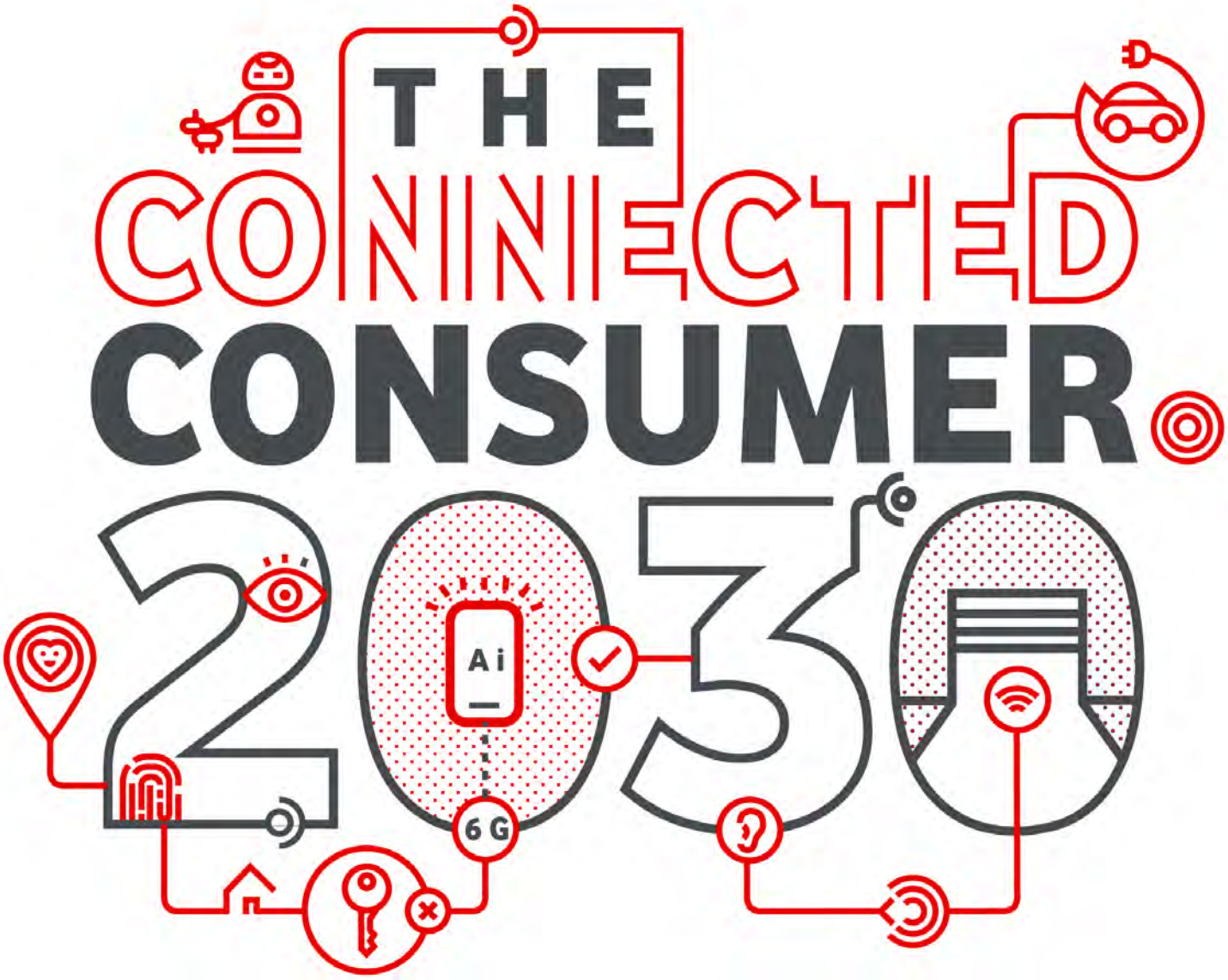
: : VODAFONE SMART TECH

THE CONNECTED CONSUMER



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‘Connectivity is the fabric that will sit underneath all of our digital infrastructure, applications and content. The next decade will see connectivity become much more visible to customers, enabling new experiences which fundamentally transform both individual lives and society’

Vinod Kumar, CEO, Vodafone Business

Executive Summary

Today, we sit on the precipice of a connectivity explosion that will transform society.

Harnessed in the right way, connectivity and smart tech can help solve a series of once-in-a-generation societal challenges, improve the lives of consumers across the globe and unlock greater human potential.

But how do we get there?

In this report, strategic foresight consultancy The Future Laboratory, in partnership with Vodafone Smart Tech, answers this question. We explore how the next decade of connectivity-powered transformation looks, including:

: The creation of circular and regenerative societies that have a holistic view on the environmental impact of every action, product and person

: The development of smart cities that respond seamlessly to the needs of citizens, and intuitive mobility systems that fundamentally change how and why we move from A to B

: An era of Connected Care that empowers and liberates people to live independently for longer and take ownership over their own health, and provides a lifeline to a healthcare industry at breaking point

: The emergence of new frameworks that embed integrity and ethical codes of conduct into new technologies, placing people in control of their data

: The rise of new, immersive technologies that, combined with human imagination, transform our experience of the world

Depending on your appetite for the future, you may want to take this report in small bites, or, if you’re hungry for transformation, innovation and inspiration, consume it all at once. Either way, read on to find out about the emerging trends that will shape the next decade of connectivity and beyond, and fundamentally transform our world in the process.

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Part One: Foresight Overview

Introduction

By 2030, a connectivity explosion will fundamentally transform our experience of the world.

The world is at a crossroads. From the complex impacts of climate change, depleting resources and ageing populations to geopolitical instability and healthcare crises, society is facing a series of once-in-a-generation challenges simultaneously. In a period where it can feel as though uncertainty is the only certainty, these longer-term challenges can at any moment be themselves disrupted too – the global pandemic transformed many societies within days.

Crucially, this disruption can drive positive transformation, as the recent Covid-19 crisis illustrates. 'Over the past 18 months, the world has experienced a dramatic shift in dynamic and demand for connectivity, as people have come to rely on technology to stay connected with the outside world,' says Alex Froment-Curtil, chief commercial officer at Vodafone Group. 'Now, consumers have a greater appreciation of connectivity and how it adds transformative value to their everyday lives.'

'Connectivity is the fabric that will sit underneath all of our digital infrastructure, applications and content. The next decade will see connectivity become much more visible to customers, enabling new experiences which fundamentally transform both individual lives and society'

Vinod Kumar, CEO, Vodafone Business

This appreciation is set to grow over the next decade, as an explosion in connectivity creates new opportunities to help the world overcome major societal challenges and improve the lives of consumers across the globe.

MarTech Advisor forecasts that by 2030 the number of connected devices globally will reach 125bn, representing around 15 devices per individual consumer. Enabling more people to tap into global flows of communication and services could add another £1.4 trillion ($2 trillion, €1.7 trillion) to GDP by 2030 and unlock greater human potential at the same time, according to McKinsey.

In this report, strategic foresight consultancy The Future Laboratory, in partnership with Vodafone Smart Tech, explores what the next decade of transformation, powered by connectivity, looks like.

We investigate:

: The rise of new mindsets among connected consumers

: How connectivity will be harnessed to create a more resilient, circular, regenerative society

: The rise of smart urban infrastructure and mobility systems

: The transformative impact of connectivity within care and the wider health eco-system

: How integrity and collective ethical codes of conduct will be embedded in new technologies

: How future interfaces and ways of engaging with technology will transform our experience of the world

Through this examination, we have identified the emerging trends that will shape the next decade of connectivity and beyond. As Vinod Kumar, CEO of Vodafone Business, states: 'Connectivity is the fabric that will sit underneath all of our digital infrastructure, applications and content. In the next decade connectivity will become much more visible to customers, enabling new experiences which will fundamentally transform individual lives and society.'

‘Society is evolving faster than we think, and it’s driving new, sustainable directions within the world of technology. We need technology to optimise daily life so we can live more sustainably’

Alex Froment-Curtil, chief commercial officer, Vodafone Group

Part Two: Connected Consumer 2030

A series of technological, economic, social and cultural shifts will drive consumer behaviour throughout the next decade, shaping how, where and why people harness connectivity and smart technology.

‘Connectivity and smart devices are already playing an influential role in people’s lives – and it’s probably a more influential role than many people may think,’ says Simon Gosling, futurist and founder of Great Intro. ‘Throughout the next decade, people will harness connectivity in new, transformative ways.’

These future use cases will be determined by shifting consumer attitudes, behaviour patterns and outlooks – tenets that tech brands should place front and centre of their products, services and strategies. As Pamela Brown, chief marketing officer at Vodafone Smart Tech, states: ‘A deep and meaningful understanding of customers’ lives has to be at the core of smart innovation, as it enables us to build solutions that address real, everyday challenges in simple, elegant ways.’

Here, we explore five consumer mindsets that will define the next decade of connectivity.

: Whole-system Thinkers

Previously focused specifically on the environment, consumers are now developing a holistic understanding of ethics and sustainability.

Ethical and conscious mindsets – from circularity to the rise of veganism – are increasingly integrated into everything, from our diets to the technology we use, with the global pandemic serving to highlight the interconnected relationship between society and our living world.

In response, consumers now expect brands to help them on a journey to live more sustainably. And they are willing to invest more with brands who enable this: the EY Future Consumer Index, for instance, reveals that 43% of global consumers want to buy more from organisations that benefit society, even if products or services cost more.

As we think holistically about our impact in terms that go beyond traditional environmentalism, we are moving towards a world in which human innovation, nature and smart tech will be integrated and hybridised.

‘Society is evolving faster than we think, and it’s driving new, sustainable directions within the world of technology,’ says Vodafone’s Froment-Curtil. ‘We need technology to optimise daily life so we can live more sustainably.’

: Rurban Mindsets

Cities, which have their own cultural and economic microclimates, were already undergoing transformation before the pandemic. Covid-19 has accelerated this process, revolutionising the way we work and placing a greater emphasis on liveability, sustainability and health.

Covid-19 has already significantly altered urban life, both physically and socially, reviving anti-urban sentiments. But the broader global trend of rapid urbanisation will continue. At the end of the current decade, three in every five humans will live in urban areas, according to the UN, with city-dwellers accounting for a staggering 80% of GDP, according to World Bank Group.

‘Mobility and transport is currently a big failure when it comes to cities – it’s not efficient at all. To solve these issues, cities need to work on connecting all vehicles and enabling them to share data in a proper way’

Elias Arnestrand, head of future mobility at Nordic Innovation House

The anti-urban sentiments that emerged during global lockdowns will see citizens demand changes to their cities, as they seek to bring the best qualities of rural areas – liveability, sustainability and health – into urban settings, for a new ‘rurban’ future. To ensure

their needs are met, consumers will demand that smart technology is harnessed so public space becomes responsive, with smart infrastructure enabling them to respond to issues in real time.

New smart mobility systems will also prove integral. 'Mobility and transport is currently a big failure when it comes to cities – it's not efficient at all,' says Elias Arnestrand, head of future mobility at Nordic Innovation House. 'To solve these issues, cities need to work on connecting all vehicles and enabling them to share data in a proper way.'

As urban areas tackle the issues that threaten city-dwellers' quality of life, infrastructural developments outside cities will reboot the suburbs, exurbs and rural areas too, creating new zones of innovation, opportunity and enabling Urban Mindsets to be applied to areas far beyond the city limits – the impact of which will be transformative. Unlocking the digital potential of rural areas in the UK alone could add between £12bn ($16bn, €14bn) and £26bn ($35bn, €30bn) annually to the UK economy, according to Rural England.

Vodafone's Kumar paints a picture of how future cities could look. 'The city as we know it is going to evolve,' he says. 'We'll see more population dispersion – and it'll be more like a population cluster. Everything will become much more integrated as multipurpose, hybrid spaces emerge.'

: Digital Wellness

In the aftermath of Covid-19, collective concerns about wellbeing and immunity will drive new directions in connectivity, as consumers harness smart technology for phygital rehabilitation.

'Concepts of wellness have developed rapidly in the past few years, with consumers now viewing wellness holistically and seeking to incorporate it into their lives as much as possible post-pandemic,' says Martin Raymond, co-founder of The Future Laboratory. According to McKinsey, 79% of consumers believe wellness is important, while 42% consider it a priority.

During the pandemic, however, products and experiences that previously helped people to feel well, calm and physically fulfilled became harmful and anxiety-inducing. Fear of touch and contact, and wariness about the communal surfaces and spaces intrinsic to beauty, fitness and wellness compounded matters, with global shutdowns of physical locations and experiences pushing brands into the digital realm.

'79% of consumers believe that wellness is important, while 42% consider it a top priority'

McKinsey

Technology provided solutions to the wellness conundrum, as consumers and brands alike became more comfortable with the use of tech-delivered, touch-free and hyper-personal services. In the years ahead, consumers will harness tech to amass a clear picture of their everyday habits and build up their own comprehensive health profiles, fuelling a move away from the traditional doctor-patient relationship, as wellness and digital health brands become an integral part of the conversation.

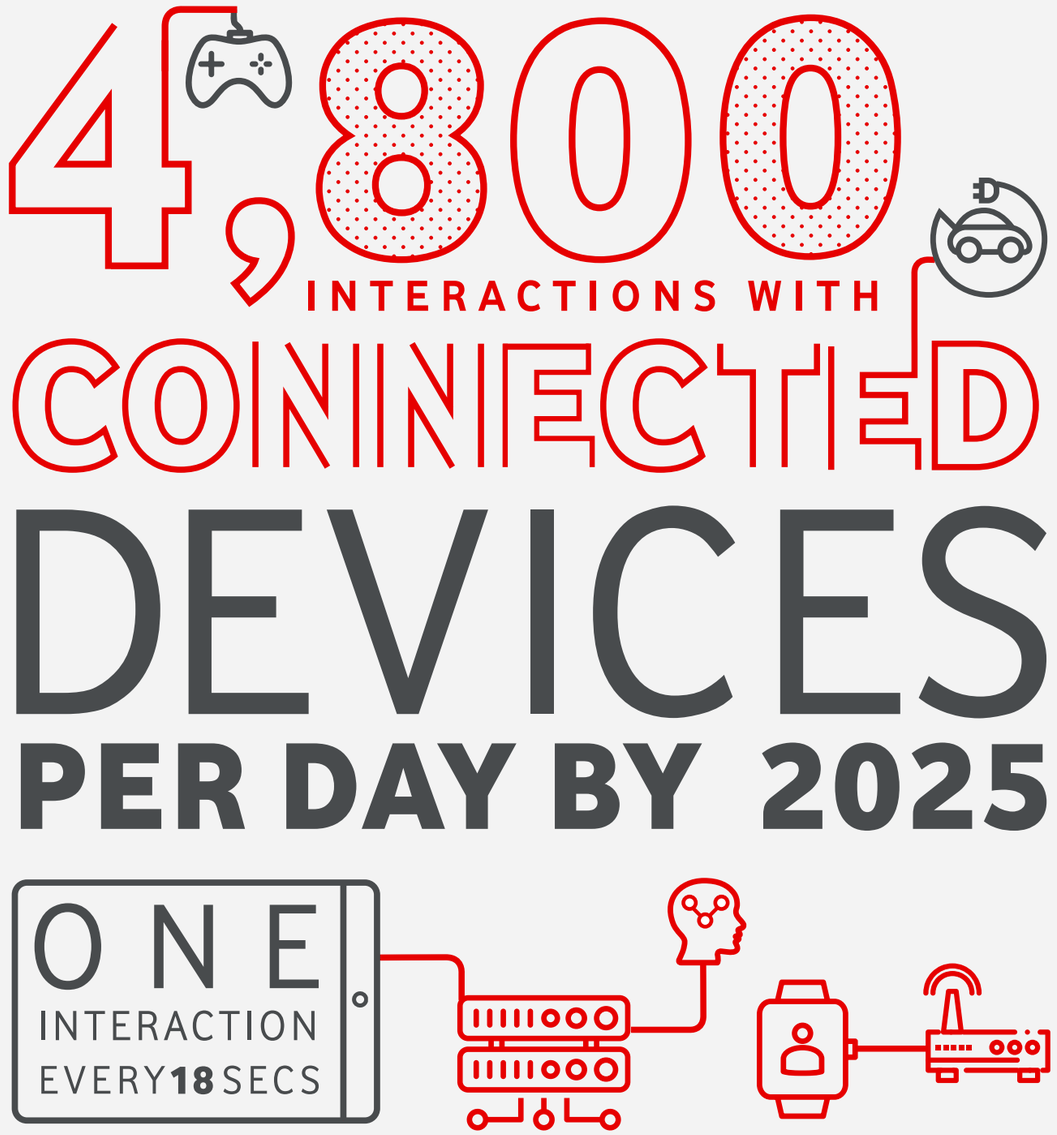
The global wellness sector was valued at £3.6 trillion ($4.5 trillion, €4 trillion) at the start of 2020. As consumers begin to seek a new framework for healthy living that prioritises convenience, accessibility and fidelity, their attitudes will drive the industry onwards.

: Data Doubles

As our lives become more digitally dependent, consumers are generating huge amounts of data that brands are using to understand their desires, at times arguably even better than consumers do themselves.

By 2025, an average connected person anywhere in the world will interact with connected devices nearly 4,800 times per day – about one interaction every 18 seconds – up from 601 in 2020, according to IDC. This wealth of information is eradicating any remaining distance between brands and consumers.

But with global cybersecurity breaches, unsolicited data-sharing and hacked accounts becoming daily news, it's no surprise that consumers are increasingly concerned about how their data is being tracked and used by faceless entities.



‘Covid-19 left people more reliant on technology than ever before. It helped people remain connected, both to other people and to key services, transforming the acceptance rates of people across an entire demographic spectrum’

Katie Hillier, chief digital anthropologist, the LiiV Center

According to research from The Conference Board, almost one-fifth (19%) of consumers have switched to a competitor that adheres to what they perceive to be better data policies. As Katie Hillier, chief digital anthropologist at the LiiV Center, states: ‘People are becoming more aware of issues around privacy as they spend more of their lives in digital spaces – it’s an exciting shift that could herald a new era for data protection.’

‘By 2025, an average connected person anywhere in the world will interact with connected devices nearly 4,800 times per day – about one interaction every 18 seconds’

Source: IDC

As a result, the next decade will see increasingly data-savvy consumers call on brands to help them regain control and offer them the option to decide when, how and where to share their data. ‘Personal data and privacy are going to become even more important in the future,’ says Kumar. ‘People don’t want to be taken advantage of, so giving people more say on what data is captured and when it can be used is integral.’

: Tech Acceleration

The global pandemic has accelerated digital adoption among consumers, transforming how people view and use technology for good.

According to McKinsey, society experienced five years of digital transformation in the first eight weeks of the pandemic alone. ‘Covid-19 left people more reliant on technology than ever before,’ says the Liiv Center’s Hillier. ‘It helped people remain connected, both to other people and to key services, transforming the acceptance rates of people across an entire demographic spectrum.’

For Great Intro’s Gosling, the shift to remote work for many was a significant factor in this transformation. ‘Suddenly, people were forced to consider the true power of connectivity, enabling a whole new working landscape to emerge,’ he says. According to consulting firm SLT, the digital health market is now four years ahead of where it was at the beginning of 2020, as consumers seamlessly take to a new digital healthscape.

This acceleration is seeing consumers increasingly open to placing connectivity at the centre of their lives, adopting everything from next-generation smart tech products to new connected services at a faster rate than was forecast before. In addition to 300 million mobile customers, 27 million fixed broadband and 22 million TV customers, Vodafone alone has already connected more than 13 million IoT devices worldwide. But the way in which connectivity will change is only just beginning to be understood.

As Dr Nadina Galle, an ecological engineer, technologist and entrepreneur, states: ‘Consumers are on the cusp of understanding what smart technology can do. On a personal scale, awareness is growing, but on a bigger, society-wide scale, the magnitude of new opportunities on offer will be truly transformational.’

Consumer Snapshots

Connected Consumers represent a global cohort of future-facing citizens that will harness connectivity to improve their lives. Their emergence will index differently in different regions. Here, we explore how Connected Consumers will be manifest in the UK, Germany, Spain and Italy.

UK

- 62% of UK consumers are more likely to purchase a product with sustainable credentials, while 50% of under-35s would pay more for sustainable products and 42% of under-35s would pay a green premium for sustainable home energy *(source: EY)*
- 93% of UK city officials think that real-time city data will feature prominently, while significant majorities think cloud-based technologies (93%), IoT sensors and wearables (86%) and mobile apps (86%) will generate this data *(source: CBRE)*
- By 2022, British consumers are forecast to spend £487 ($654, €563) per head annually on wellness *(source: GlobalData)*
- In the UK, the average person now owns 6.2 smart devices, compared to 3.8 in 2015 *(source: Deloitte)*
- Ownership of smart speakers surged to 29% in 2020, compared to five years before, when the category was nascent *(source: Deloitte)*

Germany

- 60% of German consumers say they are willing to pay more for eco-friendly products *(source: YouGov)*
- 74% of Germans live in cities and towns, with urbanisation helping fuel the country's smart city market forecast to be worth £37.8bn ($50.8bn, €43.8bn) in 2022 *(source: German Institute for Urban Studies)*
- 35% of German consumers note that health and wellness have become a higher priority in the past two to three years *(source: McKinsey)*
- The German smart healthcare market size is projected to reach £24.65bn ($33.09bn, €28.52bn) by 2027, up from £5.1bn ($6.7bn, €5.3bn) in 2019, a compound annual growth rate of 21.9% *(source: Fortune Business Insights)*
- In Germany, consumers will pay as much as £137 ($184, €158) to protect their data, but consumers in the US and China place a single-digital value on the certainty of their data being safe *(source: Harvard Business Review)*
- 41% of digital leaders in Germany say they have accelerated digital transformation plans because of the pandemic *(source: Equinix)*

Spain

- More than 90% of Spanish consumers are willing to change their regular habits in order to combat climate change *(source: ENGIE)*
- The urban population of Spain reached a record high of 80.81% in 2020 *(source: Trading Economics)*
- In light of the pandemic, 84% of Spanish consumers now feel it is more important to take their health into their own hands *(source: GSK)*
- In Spain, Covid-19 prompted consumers to reconsider data-sharing for the public good, with 47% responding they would be comfortable providing location-sharing information to trace potential contact with other citizens *(source: Oliver Wyman Forum)*
- Digital adoption in Spain jumped from 84% to 96% as a result of the Covid-19 crisis *(source: McKinsey)*

Italy

- In Italy, 52% of consumers are willing to pay higher prices for goods that offer a collective sustainable benefit – an increase from just 32% in 2013 *(source: Green Seed Group)*
- In 2020, the Italian government spent £186m ($249m, €215m) on subsidies for bicycles, e-bikes and electric scooters in Milan – with aims of promoting lower pollution levels and fostering a more cultural city hub *(source: Bloomberg)*
- In Italy, 65% of consumers now say they consider their health in everyday decision-making *(source: GSK)*
- 66% of Italian consumers who began using a wellness app during the Covid-19 crisis intend to continue doing so post-pandemic *(source: McKinsey)*
- In 2020, in-store payments from smartphone or wearable devices in Italy nearly doubled to £2.94bn ($3.94bn, €3.4bn), while duties and fines paid remotely via a mobile device grew 30% to £1bn ($1.39bn, €1.2bn) *(source: ThePaypers)*

THE : FUTURE : LABORATORY : VODAFONE SMART TECH : CONNECTED CONSUMER 2030

‘Technology brands need to ensure they help customers effortlessly adopt eco-friendly behaviours, while creating products and services with sustainability baked in from the start’

Alex Froment-Curtil, chief commercial officer, Vodafone Group

Part Three: Connecting Futures

Over the next decade, Connected Consumers and their shifting mindsets will radically transform expectations of connectivity and smart technology. To explore this new horizon, we have identified five pillars around which consumers will seek to harness the power of connectivity through to 2030, as smart solutions fundamentally and effortlessly transform both people’s lives and society as a whole:

1 Sustainability

Humanity continues to deplete the Earth’s natural resources 1.75 times faster than our eco-systems can regenerate, according to Global Footprint Network. But the next decade – driven by a new consumer mindset – will see connectivity harnessed to create a more resilient, circular, regenerative society.

With less than 10 years to meet the target for limiting global warming to 1.5°C, the next decade must see society reframe itself around sustainability and eco-conscious models – or face ruin. According to a special Intergovernmental Panel on Climate Change (IPCC) report, published in 2021, immediate action to reduce carbon dioxide and other greenhouse gas emissions must happen – and fast – to prevent irreversible damage to our climate.

Smart technology will prove integral to this future. An explosion in connectivity will empower individuals, businesses and governments to innovate and develop clean, green solutions to the decade’s greatest environmental challenges, triggering a transformative shift that fundamentally redefines the purpose of society and tech brands themselves.

‘Technology brands must ensure they help customers effortlessly adopt eco-friendly behaviours, while creating products and services with sustainability baked in from the start,’ says Vodafone’s Froment-Curtil. Responses will fuel new areas of innovation, with the global green technology and sustainability market forecast to be worth £36bn ($48.36bn, €41.71bn) by 2027, up from £6.54bn ($8.79bn, €7.58bn) in 2019, according to Allied Market Research.

From bringing visibility to the impact of individual consumption to facilitating circular economies and embedding connectivity within nature itself, three microtrends will see connectivity harnessed to create a more sustainable society across the next decade.

: Real-time Footprints

By 2030, connectivity will enable consumers to track the environmental impact of their actions in real time and optimise behaviour for a more sustainable future.

According to research from IDC, 90ZB of data will be created by connected devices by 2025, with each byte representing information that can be harnessed to shape consumer behaviour.

Vodafone’s Kumar believes the future will see this data used to help people live more sustainably. ‘Smart technology and sensors will collect data and then shape and optimise people’s behaviour to ensure their actions are facilitating a sustainable future,’ he says.

Consumer goods giant Unilever is hinting at how this future could look. It has built virtual versions of its factories using data streamed from sensor-equipped

machines, creating digital models that track physical conditions and test operational changes. Devices send real-time information on temperature, motor speed and other production variables into the cloud, where algorithms use advanced analytics to map the best operational conditions.

In the same way that Unilever is optimising performance against certain metrics, the next decade will see connectivity help optimise consumer actions against sustainable outcomes. 'By 2030, we will be able to see exactly which applications or innovations could drive more sustainable consumer behaviour in optimal ways, and encourage people to begin using them,' says ecological engineer Galle.

Already, brands are working to bring information to consumers that helps their understanding of their own impact. The Eco Rating initiative is an early example of this thinking, created by Europe's leading mobile phone operators to provide consistent, accurate information on the environmental impact of producing, using, transporting and disposing of smartphones and feature phones.

Elsewhere, we've seen apps like Aerial help people understand their carbon footprint from travel and offset its impact through conservation projects, while Dimpact enables users to assess the environmental impact of digital video streaming, publishing and advertising services. Swedish fintech company Doconomy has launched the world's first credit card that monitors purchases by their carbon emissions – and puts a cap on spending based on a user's impact on the climate.

'Smart technology and sensors will collect data and then shape and optimise people's behaviour to ensure their actions are facilitating a sustainable future'

Vinod Kumar, CEO, Vodafone Business

By 2030, increased levels of connectivity will enable this information to be delivered in real time, giving consumers the ability to understand the environmental impact of an action before they take it. In this future, each consumer choice could come with its own carbon label – and, according to the Carbon Trust, 67% of consumers support the idea of a recognisable carbon label to demonstrate that products have been made with a commitment to measuring and reducing their carbon footprint.

The tracking functionality embedded in the Designed & Connected by Vodafone range will prove integral to providing new services to sustainably minded consumers, like showing people the most eco-friendly way to get from A to B. Vodafone's Brown points to another use case. 'With smart home products, there's a real opportunity to harness existing data in a way that empowers users to make more conscious decisions. We can already monitor our energy usage, so it's easy to imagine a future where connectivity can also show when the energy in the home is no longer coming from renewable or green sources.'

: Smart Circularity

Across the next decade, connectivity will help the world shift away from linear consumption towards a circular economy, where resources are fed back into a closed loop of recycling, re-using and sharing.

Recognising that we have reached the limits of current linear consumption models of taking, making, using and disposing, a growing number of businesses are embedding circular principles within their operations. In doing so, they are aiming to redefine growth, encourage repurposing, squeeze maximum value from existing products and prioritise access over ownership.

The need for such a shift is clear. According to research from McKinsey, in Europe the average car remains parked 92% of the time, 31% of food is wasted along the value chain, offices are in use less than 50% of the time, while the average manufactured product lasts just nine years. Improved resource productivity, however, could deliver an annual net material cost saving of £437bn ($600bn, €518) by 2025 in Europe alone, according to the Ellen MacArthur Foundation, and cut global greenhouse gas emissions by 39%, as forecast in the 2021 Circularity Gap report.

The first step on this journey is ensuring that tech products themselves are designed for circular systems. 'In future, consumers will place much more emphasis on re-usability,' says Vodafone's Kumar. 'In response, we need to focus on recyclability, multi-purpose design, begin considering what happens to devices once no longer in use and start viewing the supply chain as a circular economy. My trash could be somebody else's treasure, so there's a huge opportunity for innovation here.'

Vodafone is already paving the way, from the inclusion of recyclable components within devices to post-use recycling services; 94% of old or broken smartphones that are returned to Vodafone annually are refurbished and resold as second-hand units, and the rest are sent to accredited specialist partners for recycling.

GUALLART ARCHITECTS HAVE ENVISAGED A SELF-SUFFICIENT FUTURE CITY THAT CAN ADAPT TO MEET THE NEEDS OF HEALTH CRISES

Kumar also suggests that, as we move through the decade, an expectation for devices to work with one or two generations of previous technology will emerge. 'Forward and backward integration needs to be baked into contracts between providers and customers,' he says. 'Devices must be made to work across different generations of technology to cut down on waste and over-consumption.'

'We need to focus on recyclability, multi-purpose design, begin considering what happens to devices once no longer in use and start viewing the supply chain as a circular economy'

Vinod Kumar, CEO, Vodafone Business

The Designed & Connected by Vodafone range is paving the way towards this future. Users can access firmware updates to upgrade the entire range of products, increasing longevity by ensuring that consumers don't have to buy a new product to access the latest features.

Looking further ahead, technology will prove integral to helping society embrace circularity en masse, transforming how we view and manage consumption. This journey is already under way, as growth in connectivity and smart devices begins to make infrastructure, materials and products fully traceable.

Labels and packaging manufacturer Avery Dennison is one company leading the charge, employing radio-frequency identification (RFID) and blockchain synchronisation to create digital 'birth certificates' for materials. Doing so means both companies and consumers can trace the movements and origins of products across the entire supply chain. Trackers such as Vodafone's Curve, which can be attached to almost anything, are enabling consumers to do the same in their own lives.

By 2030, this holistic view – powered by connectivity – could be applied to society as a whole. 'We can enable industries through our connectivity to be more sustainable,' says Lutfu Kitapci, global managing director for Vodafone Smart Tech. 'To fully realise this future, we need to develop holistic systems that enable business devices and consumer devices to speak to each other, to create more sustainable living environments.'

For The Future Laboratory's Raymond, this will result in new, circular ways to exchange value, as connectivity enables people to harness resources that may be going to waste. 'One can imagine a future where the home repurposes extra resources – whether food grown in people's hydroponic gardens, or surplus solar energy – to different apartments in a building complex, or to different homes altogether.'

It's a vision for the future that's fast emerging, with a recent development by Igloo Regeneration capable of redistributing solar power stored in a Tesla battery to different homes at times of need. As connectivity delivers a holistic view of a building's performance, use cases for these concepts could soon encompass workplaces and public transport too, with algorithmically powered smart systems seamlessly transferring excess energy to where it's most needed.

Data centres – which are often referred to as factories of the digital age – are also driving this future forward, with a number of savvy brands and local government organisations exploiting the excess energy they create, transforming it into a resource for communities to generate their own power. Now under construction near the city of Bergen, Norway, the new town of Lyseparken includes a Snøhetta-designed data centre that will redirect excess heat to warm surrounding buildings, such as schools, hospitals and homes. In Sweden, data centre operator DigiPlex has joined forces with energy supplier Stockholm Exergi to use excess heat from data servers to warm the equivalent of 10,000 households.

: Digital Biosphere

As we reach 2030, new innovations will see nature itself become connected, as smart technology empowers regeneration efforts by providing real-time information on the state of our environment.

According to a recent study by Nature4Climate, nature-based solutions can deliver one-third of the global emissions reductions required to meet 2030 targets. The next decade will see connectivity become a key partner in global attempts to restore biodiversity and our ecological systems, supercharging nature-based solutions to succeed.

'By 2030, humans and nature will need to have developed a much more symbiotic relationship – and technology will provide the tools to thread these two things together,' says the Liiv Center's Hillier. 'It's about technology for good and technology for progress.'

Vodafone's partnership with the Department for Environment, Food and Rural Affairs (Defra) and Forest Research is an early signal of the future on the horizon. Exploring how technology can be used to monitor the part trees play in tackling climate change, the project uses Narrowband-IoT (NB-IoT) sensors attached to trees in Alice Holt Forest and Harwood Forest to collect data which is then analysed to assess the impact of temperature, humidity and soil moisture on tree growth and function.

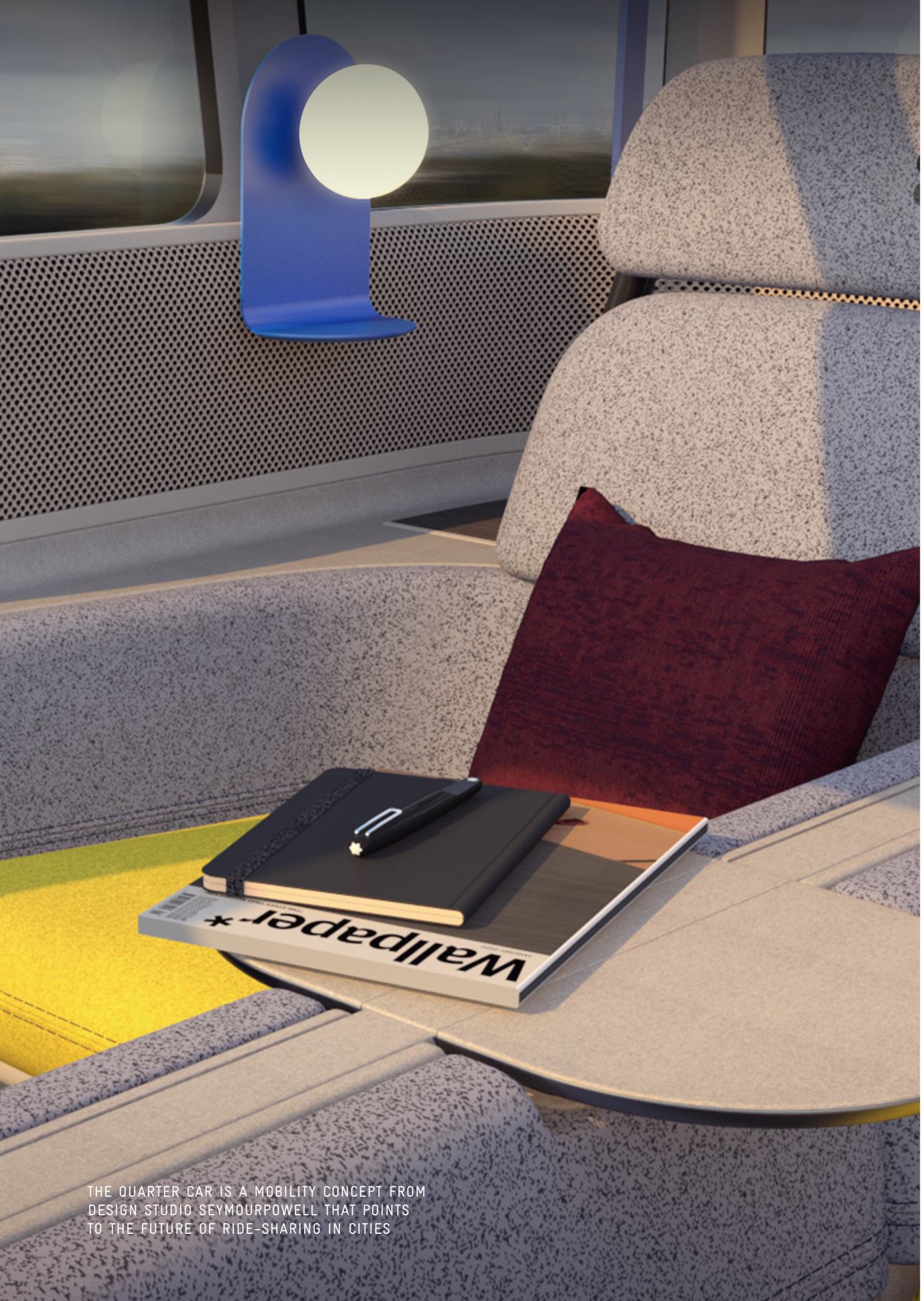
'Nature-based solutions can deliver one-third of the global emissions reductions required to meet 2030 targets'

Source: Nature4Climate

Towards the end of the decade, connectivity will be brought to other eco-systems too, from oceans to deserts to tundra. This will enable the performance of the entire natural world to be monitored and the impact of regeneration schemes quantified and optimised for ultimate efficacy.

Importantly, connectivity will also help nature thrive in spaces like cities too. Ecological engineer Galle imagines an Internet of Nature that applies emerging technologies – such as hi-res satellite imagery, IoT sensors, machine learning algorithms and more – to monitor and reconnect people to urban nature, tracking everything from soil quality to air pollution levels.

'The vast majority of cities have lost trees over the last decade, due to new developments and structural under-watering,' says ecological engineer Galle. 'But technological solutions can help overcome these issues, from soil moisture sensors to analysis of weather patterns, or even semi-automated watering systems. The ramifications of this are huge. A tree that grows three times as fast is also a tree that becomes self-sufficient three times faster – helping to promote resilience across cities.'



THE QUARTER CAR IS A MOBILITY CONCEPT FROM DESIGN STUDIO SEYMOURPOWELL THAT POINTS TO THE FUTURE OF RIDE-SHARING IN CITIES

Over the next decade, a connectivity explosion will drive high performance across the entirety of urban infrastructure, as local governments and mobility companies harness smart technology to transform transport for good.

The global market for autonomous vehicles (AVs) is forecast to reach almost £1.5 trillion ($2 trillion, (€1.7 trillion) by 2030, up from £40bn ($54bn, €46bn, in 2019, according to Research And Markets, while McKinsey estimates the GDP impact of connectivity in mobility could reach £208bn ($280bn, €241bn) by 2030. For AVs to thrive and transformative mobility systems to be fully realised, however, cities themselves must first become smart too.

Promisingly, smart city initiatives are attracting huge amounts of investment. IDC estimates the value of spending on such schemes will reach £118bn ($158bn, €136bn) in 2022, as cities harness connectivity to improve living conditions, traffic flow and pollution levels. By 2030, biometric and blockchain-based solutions are also predicted to fuel high performance in cities, driven initially by cloud-based technologies, smart sensors and wearables.

Vodafone's Brown comments on the concomitant growth in these two areas. 'With the rise of 5G and connectivity becoming faster than ever, we'll see the talk about smart cities and transport turn into a reality in the next decade, opening up a whole host of opportunities for tech companies to help improve everyday life and transform how we move around.'

From the rise of seamless, shared self-driving vehicle fleets and autonomous last-mile delivery to cities becoming sentient, three microtrends will see connectivity harnessed to transform how we move, live and play in urban environments.

'With the rise of 5G and connectivity becoming faster than ever, we'll see the talk about smart cities and transport turn into a reality in the next decade, opening up a whole host of opportunities for tech companies to help improve everyday life and transform how we move around'

Pamela Brown, chief marketing officer, Vodafone Smart Tech

: The AV Age

By 2030, connectivity will enable the creation of fully autonomous mobility systems that redefine how urban citizens get from A to B.

Smart mobility systems sit at the heart of future cities. Once connected, vehicles become part of an eco-system able to provide vehicles and their users with critical data on road conditions and traffic, optimising journeys and paving the way for autonomous driving.

Research from McKinsey predicts that by 2025, cities that deploy smart mobility applications could cut commuting times by 15–20% on average. But the benefits go beyond convenience. 'Cities that embrace smart, autonomous mobility systems will be greener, quieter, more sustainable and more liveable,' says Porsche Engineering's Contini. 'Quality of life will be enhanced for all citizens.'

For Nordic Innovation House's Arnestrand, connectivity is the key component to making this future a reality. 'Connectivity is the foundation to realising this future,' he says. 'It's essential to develop a holistic view of transport infrastructure, and ensure data and information are seamlessly shared between vehicles and transport systems.'

Before connectivity is integrated directly into vehicles, smart devices will prove integral to developing this holistic view of mobility within a city. 'We've recently launched the Curve Bike Light & GPS tracker, which turns every normal bike into a smart bike,' says Vodafone's Kitapci. 'Imagine if this functionality is applied to every car, motorbike, scooter or bike in a city. Once all of these vehicles are speaking to each other – and infrastructure – through connectivity technologies, then transformative mobility innovation will be made possible.'

A number of emerging concepts show how future mobility systems will harness this connectivity. Design studio PriestmanGoode imagines the future of urban mobility with multipurpose autonomous vehicles. Catering for myriad urban use cases – public transport or inner-city – the studio is working with autonomous network transit (ANT) company Dromos Technologies to develop a future-facing electric vehicle network. This would offer 'accessible minimalism' and run on demand, as requested by citizens.

'This type of mass transit has become even more relevant now. Not only does it answer the first- and last-mile problem, which is one of the key issues we're always trying to solve in public transport, but it's also particularly suitable for a post-pandemic world where passengers are more concerned about hygiene and safety,' explains Paul Priestman, designer and chairman at PriestmanGoode.

The Quarter Car is a mobility concept from design studio Seymourpowell that points to the future of ride-sharing in cities. With interior space defined by retractable partitions, the car can be segmented into four individual and sellable seats, allowing riders to enjoy a private journey or book multiple seats for a more convivial ride.

In a bid to offset 'the Uber Pool problem', in which people choose not to ride with strangers, the Quarter Car integrates in-car technology such as transparent glazing, gestural interaction and AI to personalise each passenger's ride. 'With the onset of autonomous, connected, electric and shared mobility, it's time to start defining the first generation of vehicles designed specifically for mobility services,' says Jonny Culkin, designer at Seymourpowell.

'Cities that embrace smart, autonomous mobility systems will be greener, quieter, more sustainable and more liveable. Quality of life will be enhanced for all citizens'

Valentina Contini, founder of the Innovation Lab at Porsche Engineering

For Nordic Innovation House's Arnestrand, ride-hailing services represent the gateway for the AV revolution. 'Before we own self-driving cars individually, we'll see ride-hailing services lead the way,' he says. 'This will be the starting point when it comes to consumer exposure to AVs. When we see these services in urban environments, the levels of efficiency and ease will be transformative.'

To enable smart mobility systems to thrive, mobility players, tech businesses and governments must now work together to define how data is shared with cities. As our urban transport systems continue to incorporate more digitally enabled ways of moving around – from ride-sharing to shared scooters and bikes to autonomous vehicles and drones – cities need new ways to ensure everyone's transport needs are met in a safe, equitable, efficient and environmentally sustainable way.

'Attitudes to sharing data are very subjective and vary from region to region,' says Porsche Engineering's Contini. 'But making people aware of the benefits on offer can help overcome this barrier across geographies and demographics.'

The Open Mobility Foundation supports the development of open-source standards and tools that provide scalable mobility solutions for cities. As Nordic Innovation House's Arnestrand explains: 'The Open Mobility Foundation has a vision of how to standardise data from private mobility actors and create data platforms that cities, businesses and regulators can harness for mobility innovation, ensuring that smart, autonomous mobility systems can flourish in the future.'

: Mobility Merchandising

By the end of the decade, new mobility systems will see vehicles become hubs of experience and enable the creation of new consumer touchpoints, from self-driving retail concepts to drone delivery services.

Once autonomous mobility concepts liberate citizens from having to drive and offer greater privacy than traditional public transport, vehicles will become hubs of experience where passengers can consume media, shop or even meditate. As Vodafone's Kumar states: 'Tech companies need to understand that the car is going to be a highly connected space, offering incredible opportunities for entertainment, for commerce, or even as a place to switch off and slow down.'

PriestmanGoode's recent New Car for London concept hints at how a vehicle's interior will change depending on the passenger's desired experience, such as travelling for work or taking a leisure trip.

'Smart home technology means people are becoming accustomed to controlling their environment from their own devices,' says Dan Window, creative director at PriestmanGoode. 'We believe passengers will be able to pre-select from a series of settings, from work mode to leisure or even sightseeing, prior to entry.'

In this future, a passenger who wants to relax before arriving at their destination could use an app like Calm to stream its service directly to the vehicle's

'Tech companies need to understand that the car is going to be a highly connected space, offering incredible opportunities for entertainment, for commerce, or even as a place to switch off and slow down'

Vinod Kumar, CEO, Vodafone Business

DESIGN STUDIO PRIESTMANGOODE IS IMAGINING THE FUTURE OF URBAN MOBILITY WITH MULTI-PURPOSE AUTONOMOUS VEHICLES

digital screens and immersive audio. Alternatively, e-commerce brands could enable passengers to swipe through immersive holograms of their latest collections and drop customers off at retail destinations should they want to make a purchase.

As in-car connectivity becomes increasingly sought after, consumers will expect seamless transitions from their home devices to those in their vehicles. As a result, offerings such as Vodafone's OneNumber Connectivity Plan, which allows users to share their mobile plan's data, minutes and text allowance with their connected devices, will boom and begin to incorporate vehicles too.

'Tech companies need to understand that the car is going to be a highly connected space, offering incredible opportunities for entertainment, for commerce, or even as a place to switch off and slow down'

Vinod Kumar, CEO, Vodafone Business

As well as offering passengers new experiences, AVs will become retail destinations as brands send specially curated fleets to locations where there is sufficient demand for a product or service. Toyota is demonstrating how this future could work with its e-Palette concept, an autonomous moving container that can be kitted out with retail, workplace and hospitality facilities.

The car-maker envisages a future in which multiple e-Palette vehicles will come together and form spontaneous, temporary urban marketplaces, replacing traditional market stalls. To realise this vision, Toyota has announced the formation of the e-Palette Alliance, with launch partners including brands such as Pizza Hut and DiDi.

With research from the World Economic Forum revealing that demand for last-mile delivery will grow by 78% globally by 2030, an opportunity also exists to harness AVs for deliveries within cities. In collaboration with Nuro, supermarket chain Kroger is already using AVs to deliver groceries, which consumers can pick up from the kerbside.

Such concepts could even one day take to the skies. A speculative project from design agency Argodesign outlines a future where autonomous drones deliver groceries directly to an external fridge at each consumer's home. Fridges will be automatically stocked based on householders' previous shopping preferences, with the purchase point being the moment the consumer moves an item from the fridge's delivery shelf.

: Responsive Cities

Connectivity will see tomorrow's cities become intuitive entities, able to respond quickly to the evolving behavioural patterns and needs of citizens.

Cities are hubs of growth and innovation, but many are also beset with crumbling infrastructure, environmental pollution and growing social inequalities. Around the world, governments are struggling to manage the rapid pace of change – but connectivity is providing a solution.

Smart city concepts will be at the core of any major urban evolution in the next decade, with networks of embedded sensors accumulating unprecedented amounts of data on citizens' daily activities. Spotting the opportunities to facilitate this future, architects and technology companies are beginning to work closely together to create cityscapes that use smart technology to benefit residents. According to Report Banana, the global smart cities market is forecast to exceed £3 trillion ($4 trillion, €3.4 trillion) by 2030.

'The global smart cities market is forecast to exceed £3 trillion ($4 trillion, €3.4 trillion) by 2030'

Source: Report Banana

Growth in smart devices is at the heart of realising this future, as this will provide the foundational data required for smart city concepts to flourish. As we move through the decade, a new era of hyperconnectivity will also see infrastructure retrofitted to become connected.

The EU is pioneering this charge with its Humble Lamppost project, which aims to give a new lease of life to this long-neglected resource by making lampposts an integral part of smart city development. The EU wants to upgrade 10m lampposts across Europe to solar power and use them to deliver a range of smart city services.

As well as providing bases for a city-wide network of 5G-connected sensors that monitor vehicle and pedestrian traffic flows, smart lampposts could host

JAPANESE AUTOMOTIVE COMPANY TOYOTA'S WOVEN CITY IS A SMART CITY IN THE FOOTHILLS OF MOUNT FUJI AND SERVES AS A TESTBED FOR NEW TECHNOLOGIES AND INNOVATIONS

‘Once both citizens and infrastructure become connected to each other, a holistic view of cities and the people living in them is enabled. This view will create exponential opportunities for positive change’

Valentina Contini, founder, the Innovation Lab at Porsche Engineering

a free public wifi network and improve citizen safety by delivering public information through digital displays and speakers, as well as measuring air quality and monitoring streets for flooding.

As more infrastructure is similarly connected, cities will become intuitive, with integrated AI enabling seamless responses to citizens’ evolving behavioural patterns and needs. For Porsche Engineering’s Contini, this will represent a game-changing moment. ‘Once both citizens and infrastructure become connected to each other, a holistic view of cities and the people living in them is enabled,’ she says. ‘This view will create exponential opportunities for positive change.’

As smart infrastructure and smart devices proliferate throughout the decade, consistent, reliable connectivity will become the lifeblood of cities. Concepts like Connected by Vodafone – which enables manufacturers to bring cellular connectivity to their devices across multiple markets – will represent the fuel that keeps cities moving and enable them to realise their full potential.

In this future, cities will become testbeds for new technologies and innovations in the realms of autonomy, robotics, personal mobility, wayfinding, smart homes and AI, redefining the very fabric of the city experience. As ecological engineer Galle states: ‘Data from connected infrastructure can give us an understanding of how to optimise spaces, so that we can make the most of the city.’

‘Our future cities will be proactively steered by citizens who will proudly seek to uphold wellbeing, access and inclusivity – metrics they will no longer be willing to compromise. And why should they?’

Martin Raymond, co-founder, The Future Laboratory

Toyota is one brand hinting at what this future could look like. The car manufacturer recently unveiled plans for Toyota Woven City, a smart, open-source city in the foothills of Mount Fuji, designed to foster research and relationships between brands, humans, robotics and the environment. Described as a ‘living laboratory’, the Woven City will allow full-time residents and researchers to trial and develop new technologies and innovations that improve people’s lives.

Aware that future urban living cannot be dictated by one brand, Toyota plans to open up the Woven City to other commercial and academic collaborators. ‘Imagine a smart city that would allow researchers, engineers and scientists the opportunity to freely test technology such as autonomy, mobility as a service, personal mobility, robotics, smart home connected technology, AI and more, in a real-world environment,’ says Akio Toyoda, president and CEO of Toyota Motor Corporation.

The Future Laboratory’s Raymond adds that such concepts could also enable citizens to take ownership of public spaces. ‘Our future cities will be proactively steered by citizens who will proudly seek to uphold wellbeing, access and inclusivity – metrics they will no longer be willing to compromise,’ he says. ‘And why should they?’

Once optimised, smart cities will also deliver an invaluable resource: space to innovate. Researchers at the University of Toronto, for example, believe that a smart, tailor-made AV car park could hold 62% more vehicles than a conventional one.

As urban densities evolve, connectivity will enable architecture to be reworked and newly rediscovered space harnessed to produce green energy, food and community facilities. This will allow neighbourhoods to function autonomously within their own boundaries and become self-sufficient. ‘In cities like Singapore, we’re already seeing vertical and hydroponic farming on the rise, as the farm is moved into the city to increase self-sufficiency,’ says Vodafone’s Kumar.

We could even see entire neighbourhoods decentralise energy production, turning homes from inanimate buildings into community utilities. Guallart Architects’ Xiong’an ecological city takes a compact, mixed-use model to create self-sufficient areas that don’t rely on nearby Beijing. ‘With 5G technology integration, the home and the neighbourhood will become a service. The greenhouses on the roof produce food and energy, and there’s a 3D printing lab where you can print items you might need, instead of ordering them online,’ says the practice’s founder and CEO Vicente Guallart.

3 Connected Care

As people's health and wellbeing needs continue to grow in scale and complexity, care systems around the world are under increasing pressure – and connectivity will prove a lifeline to a sector facing breaking point.

Exacerbated by global demographic changes, including an ageing and expanding population, socio-economic barriers and a global pandemic, the healthcare industry is in crisis, with the World Health Organization forecasting a global shortfall of 18m health workers by 2030.

A fundamental value shift is occurring. Unprecedented access to smart technology is forging an age of digital citizenship among consumers, meaning that connectivity and devices become part of the fabric of daily life.

Instead of being seen as an enemy of health, tech is being reframed as a facilitator, and a wave of digital solutions are set to empower people to take ownership of their own health, live independently for longer and alleviate pressure on an industry at breaking point.

According to McKinsey, this evolution in connectivity could free up additional investment capacity in healthcare and generate from £186bn ($250bn, €215bn) to £312bn ($420bn, €361bn) in global GDP impact by 2030.

From empowering a generation of consumers who require care to proactively monitoring health and the rise of digital health services, three microtrends will see connectivity harnessed to create a new era of Connected Care.

: Domestic Guardians

By 2030, connectivity and smart technology will transform society by enabling a generation of consumers who need assistance to live independently at home for longer, and empowering a growing number of carers at the same time.

The population of Europe is ageing rapidly. Its median age is already the highest in the world, with the proportion of people aged 65 or over set to reach 25% by 2050, according to the World Health Organization (WHO). Ageing demographics are creating a growing demand for care due to age-related conditions.

As the old-age dependency ratio increases, the region is facing a shortage of carers, while carers themselves come under increasing pressure. In Europe, 80% of long-term care is provided by informal carers, while 50% of carers under 65 combine care with employment, according to Eurofound.

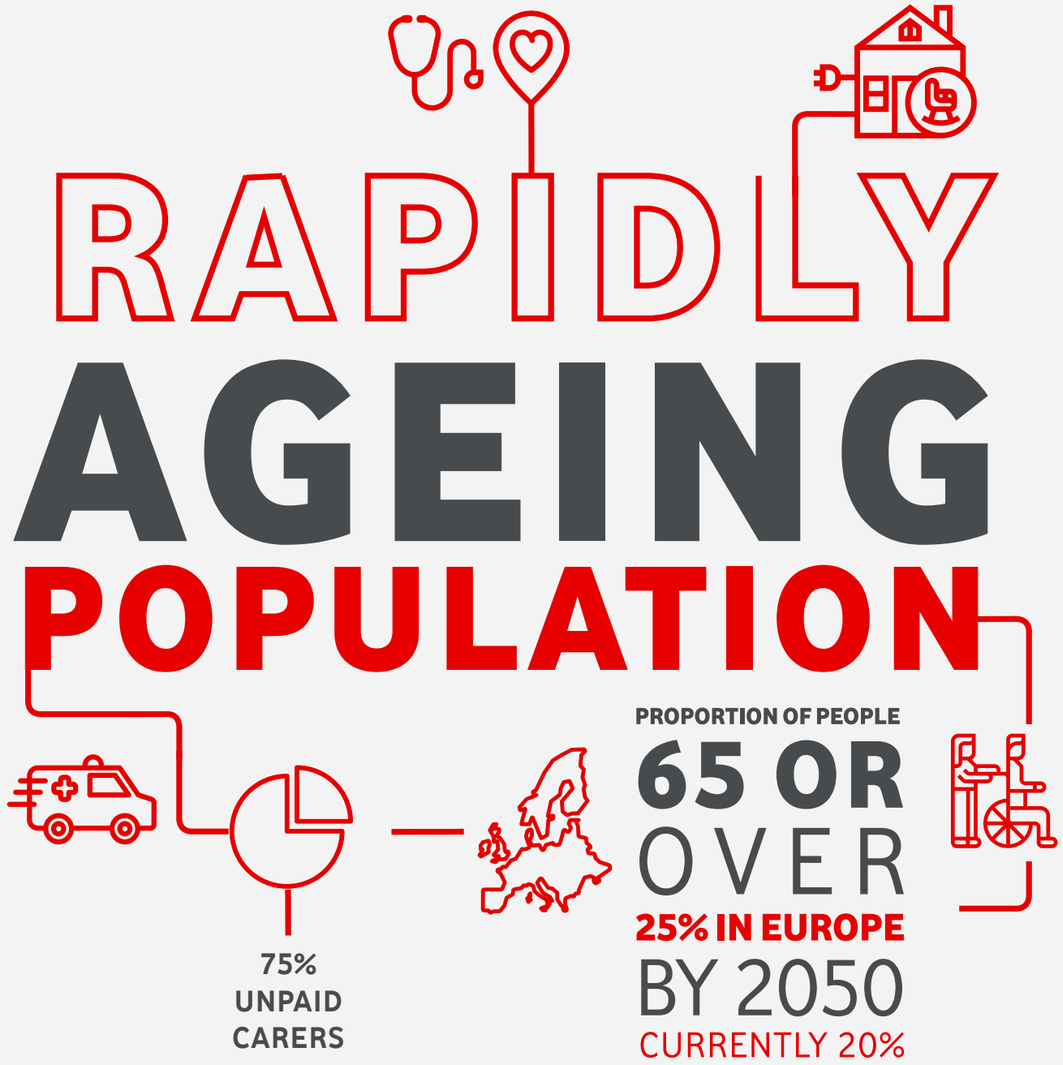
The situation is particularly precarious in countries such as Italy, where 23% of the population are already over 65 (Statista) – the highest percentage in Europe – while in the UK, the combined impact of an ageing population and severe government cuts effectively wiped out 31% of the social care budget in the five years to 2015, according to figures cited in The Guardian. The system in Germany is heavily reliant on informal carers for its sustainability. In Spain, lack of services and high demand for long-term care means as many as 33% of people with a right to receive care are still awaiting access, according to a report cited by the International Long Term Care Policy Network.

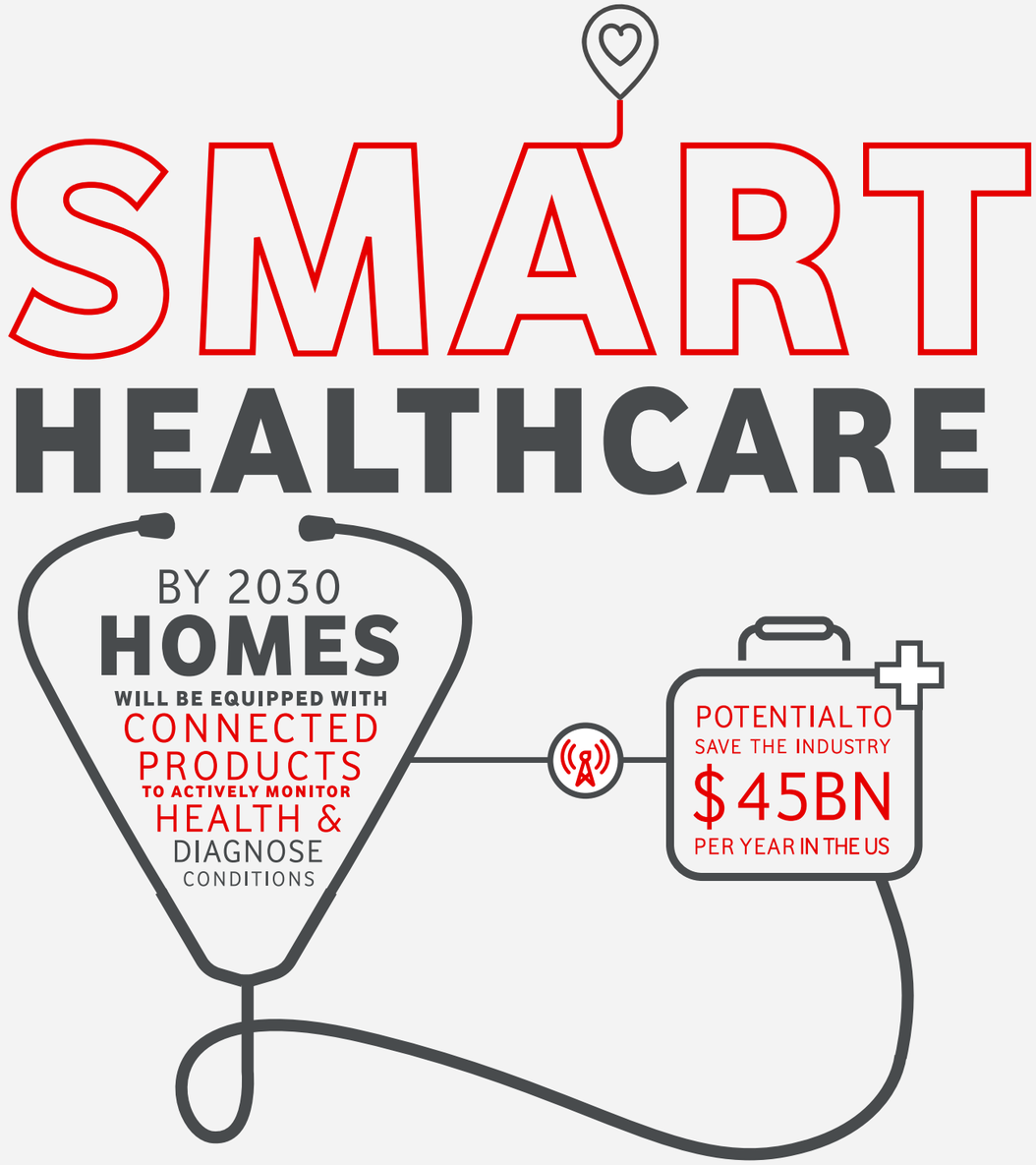
The next decade, however, will see connectivity provide an answer, empowering and liberating those who require care to live independently for longer – and making the lives of carers easier too. 'Over-65s now outnumber children under five in Europe – and a lot of people who care for this ageing demographic are unpaid carers,' says Vodafone's Kitapci. 'But connectivity can deliver a dual benefit, helping the person who needs care to live more independently and giving peace of mind to carers.'

Clara Berridge, associate professor at the University of Washington, studies healthcare technology and its implications for elder care.

'Most countries have ageing populations,' she says. 'But there is a strong desire among people to age in a familiar community. There is real hope that technology can help prolong life at home.'

Vodafone's Connected Living digital care service, developed to support individuals while connecting them to care-givers, is a case in point. Delivered via an intuitive app, Connected Living allows people to benefit from the automation of the tasks they find difficult or stressful, while easy-to-use assistive





technology supports people with age-related difficulties and learning disabilities, giving individuals and their support workers tools that provide personalised care.

'Connected care devices can remind individuals of how to complete tasks and daily activities so they can achieve these independently, while keeping them connected to their loved ones,' states Vodafone's Brown. 'Carers are alerted to any unusual activity so that they can respond as needed.'

Connected Living reminds individuals of how to complete tasks and daily activities so they can achieve these independently, while keeping care recipients connected to their loved ones. Carers are alerted to any unusual activity so that they can respond as needed.

Vodafone's Froment-Curtil believes this technological backup will prove transformative. 'The reassurance factor that connectivity can provide when it comes to care is game-changing,' he says. 'Today, to check on someone I care about, I have to proactively call them. But in future, I'll be able to check and instantly know that they are safe and well.'

On an emotional level, the impact of such functionality can be hard to quantify. But, in an assessment of a recent Connected Living pilot scheme conducted with Mencap, 72% of people with a learning disability said they had experienced improved quality of life by using the app, while 62% reported increased independence in completing tasks more comfortably, easily or quickly.

Ruth Ruppen, head of strategy at Vodafone Smart Tech, believes opportunities in this area will grow as tech-savvy consumers age. 'Today's 50-year-olds have already lived half their lives with technology,' she says. 'They won't be resigned to stop living their lives, but instead will proactively look for digital solutions that help them live the way they want.'

: Digital Diagnostics

By 2030, homes will be equipped with a suite of connected products capable of proactively monitoring health and diagnosing conditions.

Smart voice assistants are already a staple in many homes – surpassing the 450m mark in 2020, according to Smart Grid. While at present their use cases are limited to enhancing convenience, by 2030 AI home assistants will be capable of monitoring health and detecting signs of illness, or even the early stages of degenerative diseases.

In the future, AI embedded into your devices won't just work to tell you when you become unwell, but will assess vital measurements in real time – including heart and respiratory rate, hydration, blood pressure and blood sugar levels – to predict and prevent chronic health conditions even before they appear.

It's a future that's closer than many may think. Google and Amazon have already outlined plans for their smart speakers to create audio-signatures of a user in their homes, meaning the detection of sneezing, coughing or even crying could activate an AI alert that results in the delivery of the appropriate prescription.

'Preventative healthcare models could save as much as £33bn ($45bn, €39bn) per year'

Source: University of North Carolina

The Future Laboratory's Raymond believes use cases will go far beyond voice. 'Smart assistants are becoming increasingly advanced, able to detect early signs of degenerative diseases like Parkinson's from voice analysis, similar to how temperature is an indicator of fever,' he says. 'As we move through the decade, smart assistants and a network of sensors in the home will capture more information and help detect further health issues.'

Google is at the forefront of efforts that go beyond voice analysis, exploring an optical sensor that can monitor cardiovascular health. The device, which could be embedded in a bathroom mirror, works by tracking blood flow dynamics in the body. Changes in skin colour, for example, could indicate a problem that might initiate additional monitoring through other sensors or wearable devices.

Elsewhere, we've seen start-ups such as PainChek use facial analysis and AI to assess and score pain levels, helping people suffering from chronic conditions. The app's AI recognises the facial muscle movements that are associated with pain and uses this to calculate an overall pain score. According to the company, PainChek can detect pain with over 90% accuracy and more than 180,000 pain assessments have been completed worldwide on over 66,000 people.

By detecting potential health issues earlier, smart assistants can help society embrace a preventive healthcare model, rather than a curative one. According to research by Michael P Pignone of the

University of North Carolina at Chapel Hill, this could save as much as £33bn ($45bn, €39bn) per year – a significant economic benefit for a sector under immense pressure.

Applications go beyond physical health too, with connectivity able to help combat mental health conditions that currently affect up to 20% of the world's children and adolescents. Depression and anxiety cost the global economy an estimated £745bn ($1 trillion, €861bn) each year, according to the WHO.

Japanese technology start-up Neuroware represents an early iteration of this future. Neuroware has launched an intelligent lamp, Notte, which users can speak aloud to, reflecting on their day before going to sleep. Through AI and voice tone recognition, Notte can assess how the user is feeling and will soothingly change colour accordingly.

: Connected Health Eco-systems

Connectivity will join the dots between previously disparate aspects of healthcare, creating efficient digital eco-systems that alleviate pressure on health services.

The impact of digital acceleration during the Covid-19 pandemic was perhaps felt most profoundly in healthcare. With people across the globe forced to retreat into their homes, scheduled doctor and hospital visits were brought to a near standstill. Healthcare providers fast-tracked digital solutions, from 24/7 digital consultations to downloadable prescriptions.

Research from global communications and research firm Mercom Capital illustrates the burgeoning nature of digital health, revealing that venture capital funding for digital health companies hit an £11bn ($15bn, €13bn) high in the first half of 2021 – up 138% compared to the first half of 2020 – as investors poured cash into the sector, convinced of digital's transformative impact on the world of health.

Vodafone is already helping this future emerge. Its technology is facilitating faster turnaround and transfer of diagnostic images and data, providing patients with informed and timely information for better healthcare experiences. Growing use of 5G, cloud, data and devices communicating with one another are connecting clinicians with clinicians, and clinicians with patients and with health services – making the everyday more efficient.

One brand quick to pivot inter-pandemic was JD Health – a subsidiary of Chinese e-commerce giant JD.com. Responding to the world's changing medical needs, it launched a family doctor service that harnesses connectivity to provide immediate responses from general practitioners alongside personalised advice.

Similarly, Philips is using data gathered by its smart products to address significant medical problems for anxious parents. The technology brand is launching a new service that integrates American Well's telemedicine offer with its range of childcare-focused Avent uGrow smart products, giving parents direct access to video consultations with paediatricians through the Avent uGrow app; the doctors have seamless access to all the information gathered by the uGrow system.

As we move through the decade, we'll also see an increasing number of treatments delivered digitally. VR, for example, offers a key means of pain treatment that has been shown to reduce activity in the five regions of the brain associated with pain.

US-based XRHealth offers pioneering virtual reality therapeutics (VRx), equipping patients with pre-installed headsets suited to their various needs. While this type of therapy is categorised as digital, it's a win for the increasingly holistic mindset of consumers and patients, as it offers an alternative to pharmaceutical options that may come with side effects and addiction-related complications.

As similar solutions proliferate, it will be integral to ensure that consumers have access to digital health wherever they are in the world. 'Remote healthcare used to be something that could never be realised in certain parts of the world,' says Vodafone's Ruppen. 'We need to ensure that digital divides are overcome, bringing connectivity and the right digital tools to those in need.'

NEO SMART KIDS WATCH BY VODAFONE GIVES KIDS A SENSE OF INDEPENDENCE AND COMES WITH A CAMERA AND ACTIVITY-TRACKER. IT ALLOWS KIDS TO STAY IN TOUCH THROUGH GPS LOCATION, CALLS AND CHAT

'As consumers continue to give away large amounts of personal data, brands must be accountable for how it is used, and guide people on how to embrace connectivity in a secure way. This will prove integral, as consumers seek out technology that is purposeful'

Ruth Ruppen, head of strategy, Vodafone Smart Tech

As people become more aware of digital threats and potential biases, the next decade will see society recalibrate its moral compass and embed integrity and collective ethical codes of conduct into new technologies.

Institutions, brands and consumers are re-evaluating the power of technological innovation and seeking to create a moral code fit for a digital era. In response, issues around privacy, personal data and the very purpose of technology will come to define the next decade of connectivity – the true potential of which will be determined by society's ability to harness data in ethical ways.

As Vodafone's Ruppen states: 'As consumers continue to give away large amounts of personal data, brands must be accountable for how it is used, and guide people on how to embrace connectivity in a secure way. This will prove integral, as consumers seek out technology that is purposeful.'

From revolutionary new ways to protect and monetise personal data to the development of technology that has a human-centric purpose, three microtrends will define the future of Ethical Connectivity.

: Data Dichotomies

Over the next decade, a data explosion will see consumers seek assurances around personal data before harnessing the true power of connectivity.

More connected than ever, humanity now creates more than 2.5 quintillion bytes of data every day, according to the Data Never Sleeps report from Domo. As people spend more time in digital spaces than ever before – sharing data, spending money, working and divulging personal details – unsurprisingly, data privacy remains a major concern.

At the start of the pandemic, rates of online fraud and hacking accelerated, according to research from Experian. An EU Fundamental Rights Survey revealed that 55% of Europeans fear criminals or fraudsters accessing their personal data, and 30% worry that advertisers, businesses and foreign governments access information without them knowing.

For the Liiv Center's Hillier, the first step in helping to allay these concerns is creating new narratives around what data is. 'When we're talking about data, we need to realise we're talking about people,' she says. 'We need to fight to protect people's privacy, grow awareness, and put pressure back on organisations so that they put the right privacy layers in their products. A new movement is required, and I think it's starting to emerge, thanks to the increasing numbers of people engaging digitally over the past year or so.'

'55% of Europeans fear criminals or fraudsters accessing their personal data, and 30% worry that advertisers, businesses and foreign governments access information without them knowing'

Source: EU Fundamental Rights Survey

Promisingly, new markers are emerging that enable tech brands to demonstrate they do have the correct privacy layers in place within smart tech products. Researchers at Carnegie Mellon University's CyLab Security and Privacy Institute, for example, are floating a working prototype of a label for connected products.

The label is designed to go on a product's packaging or on the websites where devices are sold, providing privacy information vetted by researchers and privacy experts. Products that could carry the label include any smart device that is connected to the internet – from security cameras, refrigerators, speakers and home controllers to doorbells, toothbrushes, thermostats, light switches and more.

Other solutions involve changing the information that smart technology tracks and monitors. Researchers and engineers at MIT, for example, have launched Butlr, a technology company that captures and analyses human dynamics. Butlr uses a mix of wireless sensing technology, battery-powered hardware and AI to provide real-time data on an individual's movement and motion trajectory, body temperature and behaviour, without violating privacy. By using passive infrared sensors to detect only body heat, the sensors don't know who you are – only where you are and where you're heading, with tracking stopping as soon as you leave the sensor's range.

'Significant privacy concerns exist around the monitoring of behavioural biomarkers, like diet or social media usage,' says the University of Washington's Berridge. 'But focusing on the specific medical biomarkers that the individual is concerned

about, like heart rate-monitoring, can help overcome potential privacy problems and encourage the adoption of smart technology in the home.'

Without such initiatives, consumers may well begin adopting plug-and-play hardware devices such as Winston Privacy, which can be plugged in between a user's modem and router, instantly scrambling, encrypting and anonymising the flow of data that large tech firms, hackers, data brokers and governments might be tracking.

As AI continues its transition from nascent technology to ubiquitous, new ethical concerns around bias will probably emerge. Research from Gartner predicted that, through to 2022, 85% of AI projects will provide false results caused by bias that has been built into data or algorithms.

To combat this, solutions such as Moral Machine, which was trained by more than 1,000 global experts and leaders at the World Economic Forum to evaluate various pertinent moral dilemmas, will become commonplace.

By crowdsourcing input from around the world, the machine ensures that it will generate balanced answers, with the intention of making the world a better place. As Joshua Montgomery, CEO of Mycroft AI, says: 'As these technologies become a significant part of how we interact with technology, the question becomes: "When I ask this device a question, am I getting the best answer for me, or am I getting the best answer for whatever company developed the technology?"'

: Elevated Exchange

As awareness of the value of personal data grows, future consumers will demand hyper-personalised services and experiences in exchange for it.

Consumers already feel short-changed when it comes to giving away personal data. According to research from The Conference Board, 44% of people globally say they would forego personalised content, including brand messages, offers and experiences, if it meant not having to share their personal information, while only a third claimed that sharing personal information had materially improved their life through greater personalisation or convenience.

In response, brands will have to elevate the experiences they offer in exchange for personal data – and hyper-personalised experiences represent one way of doing so. Nike's Los Angeles concept store, for instance, uses the real-time data of local shoppers to adapt its merchandise, offering a selection of styles that are determined by locals' digital commerce data for an entirely unique experience.

According to the Liiv Center's Hillier, adding an emotional element to such exchanges is another route forward. 'Using data as a social currency is a natural next step, and adding an emotional pull can help this future emerge,' she says. 'Imagine, for example, being able to share your data with an organisation working towards a cause you believe in, which could help you adapt your own behaviour to further that cause. In this future, individuals can decide on the interactions and exchanges valuable to them, and share their data if they feel it's worthwhile.'

'44% of people globally say they would forego personalised content, including brand messages, offers and experiences, if it meant not having to share their personal information'

Source: The Conference Board

Vodafone's Kitapci points to a similar future. 'Trackers are another example, providing value and solving a significant consumer problem by delivering peace of mind,' he says. 'A smart watch like Neo, designed to help parents stay connected to their kids, effortlessly brings people closer together – something for which people will happily exchange personal data.'

In future, personal data may even become a new form of currency. CoverUS's blockchain-based data marketplace, for example, allows consumers to generate a biometric revenue stream by populating their digital wallet with information from an electronic health record (EHR). The brand pays for the data collected through the fixed-price cryptocurrency CoverCoin, which the company hopes users will be able to spend on services such as gym membership in the future.

Looking even further ahead, 2030 could see consumers compile personal data to create data-rich digital twins of themselves, with their digital doppelgangers able to understand their needs better than they can themselves. Designer and researcher Camilo Oliveira explores the idea of a knowing digital self in his project An I, envisaging a future where people hold meetings and conversations with their digital selves. By harvesting their online data, the AI double can help people better understand their own feelings, acting as a bespoke digital therapist.

DESIGN STUDIO LAYER HAS CREATED THE MOVE CONCEPT SEAT FOR AIRBUS THAT USES A SMART TEXTILE TO ALLOW PASSENGERS TO MONITOR AND CONTROL THEIR SEAT CONDITIONS, SUCH AS TEMPERATURE AND TENSION, USING THEIR PHONE

‘Society would be greatly improved if tech brands could focus on designing technologies that help people become a better version of themselves – in whatever guise that may be’

Katie Hillier, chief digital anthropologist, the LiiV Center

: Transformational Tech

By 2030, consumer demands for personal transformation will require smart technology to help people become better versions of themselves.

‘Across generations and across the world, people are now looking for experiences, services and products that help them to become better versions of themselves,’ says The Future Laboratory’s Raymond. ‘This mission to be healthier, wealthier and happier is leading to the rise of the Transformation Economy – and smart technology is no exception.’

In this future, it will no longer be accepted for smart tech or digital solutions to provide novel benefits. Instead, they will have to contribute to eudaimonia – a philosophical concept best translated as human flourishing and fulfilment.

‘Technology is an enabler for wellbeing, both physical and mental. It keeps the world connected – but there is, of course, a balance that needs to be struck’

Vinod Kumar, CEO, Vodafone Business

‘Society would be greatly improved if tech brands could focus on designing technologies that help people become a better version of themselves – in whatever guise that may be,’ says the Liiv Center’s Hillier, who points to barriers that must be overcome to realise this future. ‘To get there, tech needs to balance individual progress with environmental impact, and create new language and narratives around a symbiotic relationship with technology that understands individuals and partners with them, rather than tells them what to do,’ she says.

For Vodafone’s Kitapci, delivering peace of mind to consumers through smart tech is one way to build symbiotic, effortlessly transformative relationships. ‘It’s almost like insurance for your wellbeing,’ he says. ‘Whether it’s delivering peace of mind around your personal safety on the road through our Curve Bike Light & GPS Tracker, on the items you love through the Curve tracker, and your children through the Neo smart watch – we’re providing a transformative solution to everyday problems.’

As we move through the decade, trackers will begin to share data with individuals’ other connected devices, which will harness this information to further enhance the wellbeing of users.

A smart bathroom mirror created by wellness company CareOS is one example, promising to cater for families’ overall wellbeing and long-term health. The Poseidon mirror functions as a private personal care device for total wellbeing and can be customised according to individual user needs, including families with children or adults following particular care regimes. For children, Poseidon can be programmed to feature interactive games to inspire teeth-brushing and bathing, alongside individual skin analysis for teens and adults, and tutorials for everything from posture to make-up application.

By 2030, these nudges towards transformative behaviour will become commonplace, with design studio Layer’s Move concept a case in point. Designed for Airbus, the Move concept uses a smart textile that would allow passengers to monitor and control their seat conditions using their phone.

The Move app analyses the data and sends targeted messages to passengers, prompting them to move around the cabin, do in-seat stretches or stay hydrated. Users can also select different modes, such as ‘massage’, ‘meal time’ and ‘sleep’, and one can imagine similar functionality spread throughout the entirety of our future homes and workplaces.

In these cases smart tech provides a solution to support individual wellbeing and allow people to flourish; the next decade will also see tech brands help consumers achieve healthy digital usage. As Vodafone’s Kumar states: ‘Technology is an enabler for wellbeing, both physical and mental. It keeps the world connected – but there is, of course, a balance that needs to be struck.’

Research from Acxiom reveals that powerful smart technology that recognises when technology itself is not the best answer to a problem could prove popular. It found that 50% of people who have undertaken a digital detox say they would trust companies more if they were seen to be tackling the problem of over-consumption, with 25% saying they would be more likely to buy such companies’ products as a result – representing a significant opportunity for future-facing smart tech companies.

5 The Next Tech

Driven by connectivity and the power of human imagination, new tools will extend our experience of the world and facilitate an entirely new way of engaging with products – and with each other.

As more and more devices become connected, consumers are entering an era of fluid interaction that will dramatically alter every element of the human experience. 'Soon we'll have new ways of engaging with technology as it becomes more immersive,' says Vodafone's Ruppen. 'Voice activation and gestural design will become integral, while we may no longer need screens, instead finding ourselves able to project content wherever we want it.'

As the Liiv Center's Hillier states: 'People and communities are shape-shifting so quickly in digital spaces as connectivity transforms what it means to be human. We need to consider what future engagement will look like in order to develop an understanding of how human experience is set to change.'

From simple smart solutions that effortlessly blend into people's lives to the integration of digital layers into experience and next-generation responsive technology, three microtrends will define how we engage with smart technology over the next decade.

: Discreet Digital

As consumers seek a more balanced relationship with devices and technology, brands will create effortlessly simple smart tech that blends seamlessly into people's lives.

With the smart home technology market expected to be worth £39.7bn ($53.5bn, €46.1bn) by 2022, according to Statista, the notable presence of technology in our homes risks tipping the balance away from serenity and towards habitats that function solely because of – or thanks to – technology. In response, brands are prioritising functionality in smart technology, with the positive upshot of reducing the amount of visible technological clutter.

Mui Lab's minimalist wooden control pad is one such solution. Able to display weather information, control the home's interior temperature, adjust the lighting, display Spotify music playback and open smart doors, it was created as a remedy to consumer attachment to mobile devices – traditionally used to control smart appliances. Its simple design encourages people to forego their phone screens in favour of interacting with one another.

The rise of 'flexi-tech' has also led to the creation of multifunctional products that integrate seamlessly and discreetly into our home interiors. Nolii's Rise smart lamp, for instance, has integrated charging capability for mobile phones and doubles as a visual alarm clock.

Vodafone's Curve Bike Light & GPS Tracker fits seamlessly into this future, with its simple, effortless design creating an intuitive user experience. The tracker is as light as a house key and less than two inches in diameter, meaning it can be used in myriad situations. The ramifications of such innovations are particularly significant when it comes to smart tech for the home, with discreet design ensuring users won't feel they are being monitored.

As we move through the decade, we'll also begin to see smart tech designed to mimic nature, for connected experiences that feel like they're facilitated by the natural world rather than tech. HomeForest is one such digital tool, blending seamlessly into the day to day. The app creates a digital twin of the user's home and taps into connected devices to create a digital eco-system. This is then used to promote wellbeing by introducing nature's restorative properties into the user's routine, from the sound of birdsong to a projection of a forest canopy that reminds you to take a break.

: Programmable Realities

Through advances in extended reality (XR) over the next decade, digital layers will become so seamlessly integrated into our lives that reality is reconfigured and what it means to be human redefined.

The cognitive separation between the real and virtual realms is becoming far less pronounced. While a digital ball thrown across the room in augmented reality (AR) would once have fallen through the furniture, it now bounces off the material as though it possesses real weight.

VODAFONE'S CURVE BIKE LIGHT & GPS TRACKER, WITH A BUILT-IN VODAFONE SMART SIM, IS AN ALL-IN-ONE BIKE SAFETY DEVICE THAT KEEPS RIDERS SAFE, VISIBLE AND CONNECTED

Connectivity sits at the heart of this shift. Despite XR's game-changing potential, mass adoption has been a long time coming. The high price point of headsets and relatively primitive nature of smartphone-based XR apps have proved significant barriers, with almost one-fifth (19%) of industry experts citing user experience issues as the biggest obstacle blocking mass VR adoption, according to Perkins Coie.

'XR technologies will add £1.1 trillion ($1.5 trillion, €1.3 trillion) to the global economy by the end of the decade'

Source: PwC

However, where users of XR apps on 4G networks suffered from stilted experiences, the low latency, incredible speed and massive capacity of 5G (and latterly 6G) will enable new and enhanced experiences in XR, providing ubiquitous, all-pervasive connectivity. With this, the true possibilities of XR will finally be realised and new value created, with PwC forecasting that XR technologies will add £1.1 trillion ($1.5 trillion, €1.3 trillion) to the global economy by the end of the decade.

Currently facilitated through mobile and tablet apps, XR concepts will soon be delivered by increasingly discreet headsets or glasses. As Great Intro's Gosling states: 'We're not far off a future where, instead of holding tablets or phones in their hands, people will be wearing smart glasses, having offers projected to them, or seeing answers to their questions in AR.'

AR glasses are a key part of Facebook's plans to build the metaverse – a technology platform that blends virtual and physical spaces. The company's next hardware launch is set to be its long-awaited Ray-Ban smart glasses.

Such concepts are already in use within the world of industry, with Detroit-based Guardhat developing smart glasses for front-line workers that feature hands-free operation, voice commands and wireless connectivity. When wearing the device, workers are empowered with immersive, real-time situational awareness about their immediate environment.

In this future, consumers will find themselves able to project content onto any surface, not just screens, with other consumer applications for the technology set to be transformative. 'Extended reality will fundamentally change how we experience the world around us,' says Vodafone's Froment-Curtil. 'Being able to cook a meal while simultaneously and seamlessly viewing instructions in AR, for instance, enhances our experience of cooking and makes our lives richer.'

By 2030, this kind of functionality will be available to consumers across the globe. People will be able to create their own hyper-sensory versions of reality as experience becomes subjective, whether opting to see real-time information delivered in AR, or inspirational large-scale virtual artworks like those offered through Apple's collaboration with New York's New Museum.

: Interfaceless Futures

Once consumers can curate their own realities, new ways of engaging with technology – from gesture control to biometric responsiveness – could render the age of the interface over.

Consumers are becoming increasingly accustomed to seamless interactions with smart technology. Speech and voice recognition offer convenience, speed, accuracy and ease, and the market is forecast to reach £19.89bn ($26.79bn, €23.14bn) by 2025, according to Meticulous Research.

But by the end of the decade voice itself will be usurped by even more intuitive ways of engaging with tech.

Gestural design is one such solution, with pervasive connectivity enabling consumers to control smart technology through intuitive movements. Casper is already harnessing this way of engaging with its smart nightlight. Primarily controlled by a series of simple gestures, it emits warm light to counter the stimulating effects of blue light, which interrupts circadian rhythms.

By 2030, however, the rise of responsive smart tech able to respond to biometric markers will remove the need for active interaction entirely. In the home, audio start-ups such as Endel are creating customised sound frequencies to boost mood or productivity. Personalised audio tracks respond to user inputs such as time and location, as well as biometrics including heart rate.

'We're entering the era of adaptive, personalised digital soundscapes that will improve people's lives by working in the background,' says Oleg Stavitsky, co-founder and CEO of Endel. The company has offered free one-month subscriptions to the app to help ease anxiety caused by the spread of Covid-19.

Mediated Atmosphere is a project by the Responsive Environments group at the MIT Media Lab. It uses a modular, real-time control infrastructure with biosignal sensors, which track heart rates and facial expressions, to automatically create immersive environments through controllable lighting, projection and sound. The environments are designed to help users work comfortably, with the concept self-regulating on the basis of the user's activities and physiology.

Researchers at MIT are also defining the future of brain-computer interfaces, turning mind control into our main means of interacting with the digital world. The AlterEgo device, which looks like a jaw bone and runs from the user's ear to the chin, relies on sub-vocalisation – the signals the brain automatically sends to your mouth when you 'say' words or thoughts in your head. AlterEgo detects these signals, using a neural network to translate them into words that allow the wearer to interact without having to speak aloud.

Its use cases are numerous, with obvious applications such as taking mental notes or silently communicating with smart assistants. 'Our idea was: Could we have a computing platform that's more internal, that melds human and machine, and that feels like an internal extension of our own cognition?,' says Arnav Kapur, a graduate student at the MIT Media Lab that led the development of the new system.

VODAFONE'S CURVE TRACKER IS A VERSATILE SMART GPS TRACKER THAT CAN BE ATTACHED TO ALMOST ANYTHING

Part Four: Conclusion

Today we are on the precipice of a connectivity explosion, which will transform society.

Harnessed in the right way, connectivity can help solve a series of once-in-a-generation challenges and by 2030 create a cleaner, greener, healthier and more efficient world. But to get there, technology brands must first recognise that people sit at the heart of these challenges.

'At Vodafone Smart Tech, we connect people in and out of the home, and help to solve problems from a customer point of view,' says Vodafone's Ruppen. 'Our response – the product – is not just about a physical object, but also the emotions that object resolves or creates.'

Appealing to changing mindsets and empowering people to take ownership of the issues that matter to them can overcome barriers to adoption, and realise connectivity's true potential. In doing so, the next decade will witness:

: The creation of resilient, circular and regenerative societies that have holistic views on the environmental impact of every action, product and person

: The development of smart cities that respond seamlessly to the needs of citizens, and intuitive autonomous mobility systems that fundamentally change how and why we move from A to B

: An era of Connected Care that empowers and liberates people to live independently for longer and take ownership of their own health, and provides a lifeline to a healthcare industry at breaking point

: The emergence of new frameworks that embed integrity and collective ethical codes of conduct into new technologies, placing people in control of their data

: The rise of new, immersive technologies that, combined with human imagination, transform our experience of the world

As The Future Laboratory's Raymond states: 'A decade of exponential change awaits us. Connectivity represents the key to this transformation, helping us to disrupt differently and redefine what society is capable of.'

: : VODAFONE SMART TECH

THE CONNECTED CONSUMER