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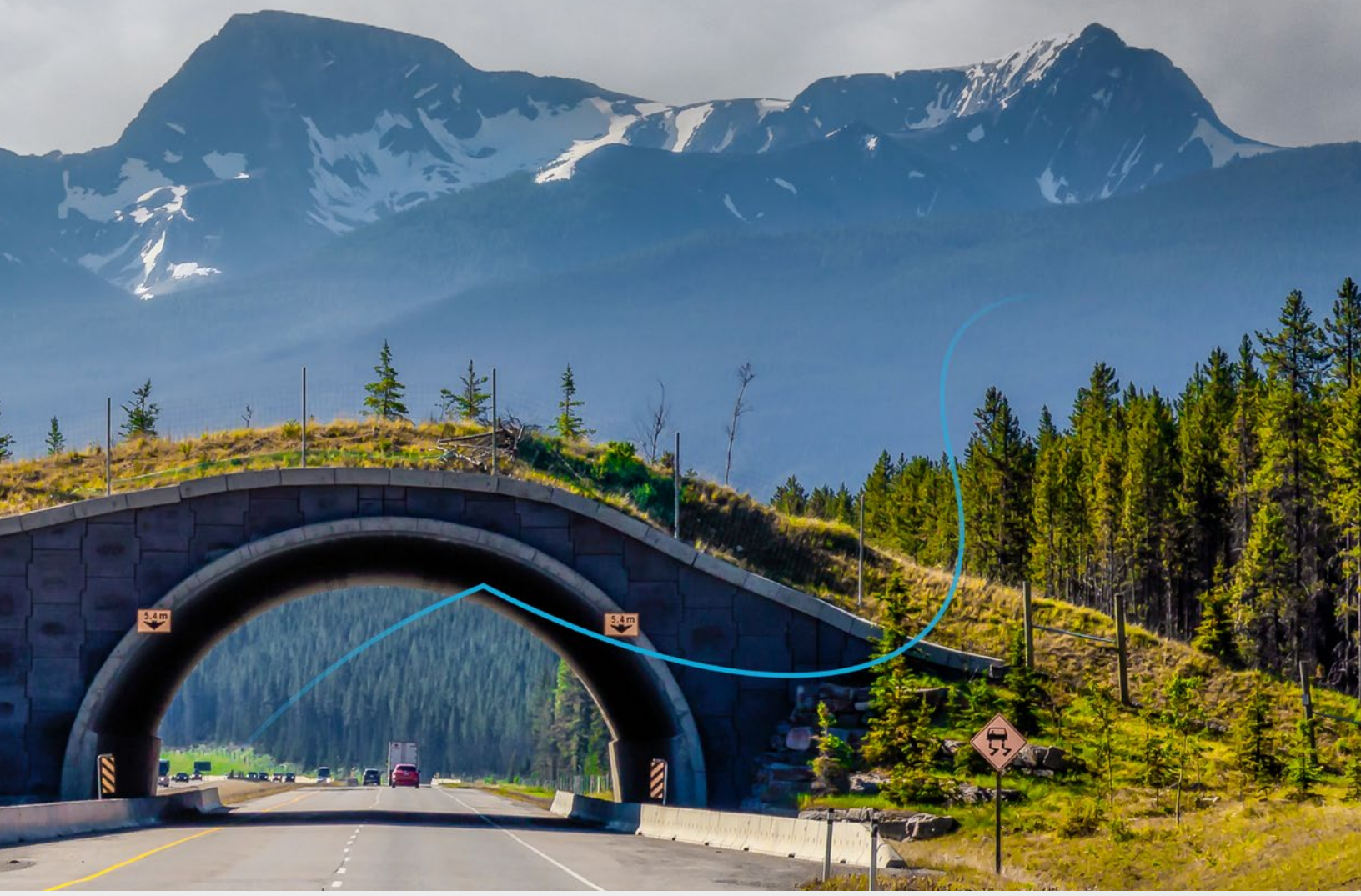
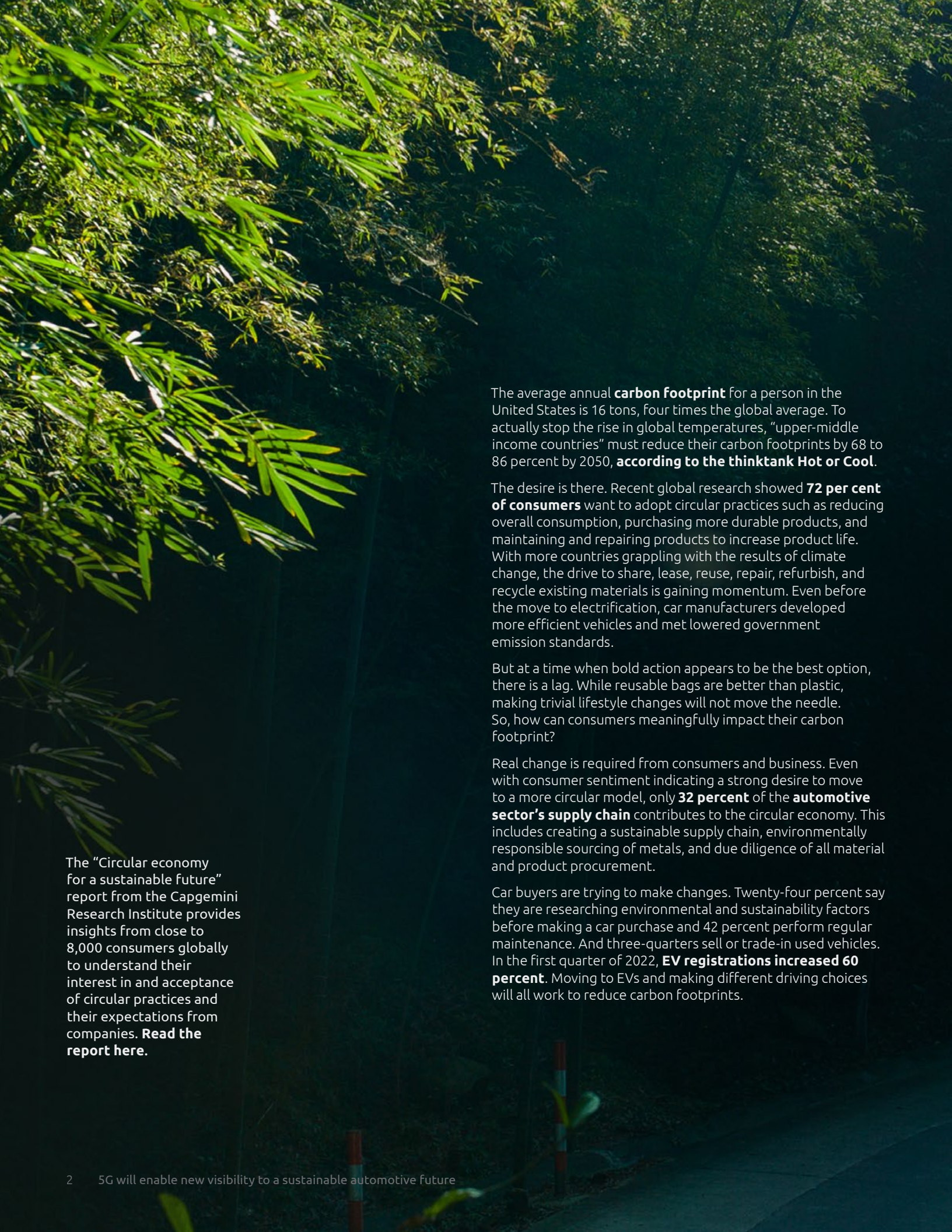


5G will enable new visibility to a sustainable automotive future

Circular mobility provides a route to more efficient car usage



The average annual **carbon footprint** for a person in the United States is 16 tons, four times the global average. To actually stop the rise in global temperatures, "upper-middle income countries" must reduce their carbon footprints by 68 to 86 percent by 2050, **according to the thinktank Hot or Cool**.

The desire is there. Recent global research showed **72 per cent of consumers** want to adopt circular practices such as reducing overall consumption, purchasing more durable products, and maintaining and repairing products to increase product life. With more countries grappling with the results of climate change, the drive to share, lease, reuse, repair, refurbish, and recycle existing materials is gaining momentum. Even before the move to electrification, car manufacturers developed more efficient vehicles and met lowered government emission standards.

But at a time when bold action appears to be the best option, there is a lag. While reusable bags are better than plastic, making trivial lifestyle changes will not move the needle. So, how can consumers meaningfully impact their carbon footprint?

Real change is required from consumers and business. Even with consumer sentiment indicating a strong desire to move to a more circular model, only **32 percent** of the **automotive sector's supply chain** contributes to the circular economy. This includes creating a sustainable supply chain, environmentally responsible sourcing of metals, and due diligence of all material and product procurement.

Car buyers are trying to make changes. Twenty-four percent say they are researching environmental and sustainability factors before making a car purchase and 42 percent perform regular maintenance. And three-quarters sell or trade-in used vehicles. In the first quarter of 2022, **EV registrations increased 60 percent**. Moving to EVs and making different driving choices will all work to reduce carbon footprints.

The "Circular economy for a sustainable future" report from the Capgemini Research Institute provides insights from close to 8,000 consumers globally to understand their interest in and acceptance of circular practices and their expectations from companies. **Read the report here.**

Enter 5G

An upcoming innovation is set to make those buyers even more proactive: the power and connectivity of 5G can enable cellular vehicle-to-everything (C-V2X) cars, and that will be game changing. The reduced latency and increased bandwidth provided by this new network technology will help drivers of 5G-enabled cars take control of their environmental impact by delivering data on actual usage and make decisions about driving times and distances, future vehicle purchases, and other consumption factors.

Not only will consumers be able to track their carbon footprint from transportation in near real time, 5G will also open the door to new safety options. Connecting vehicles via 5G is another channel to communicate and make the roads safer.

5G is expected to contribute to fostering the rapid, low-latency communications needed to enable safer driving and address immediate traffic-management demands, but the 5G-enabled car provides many other benefits within the vehicle and beyond.

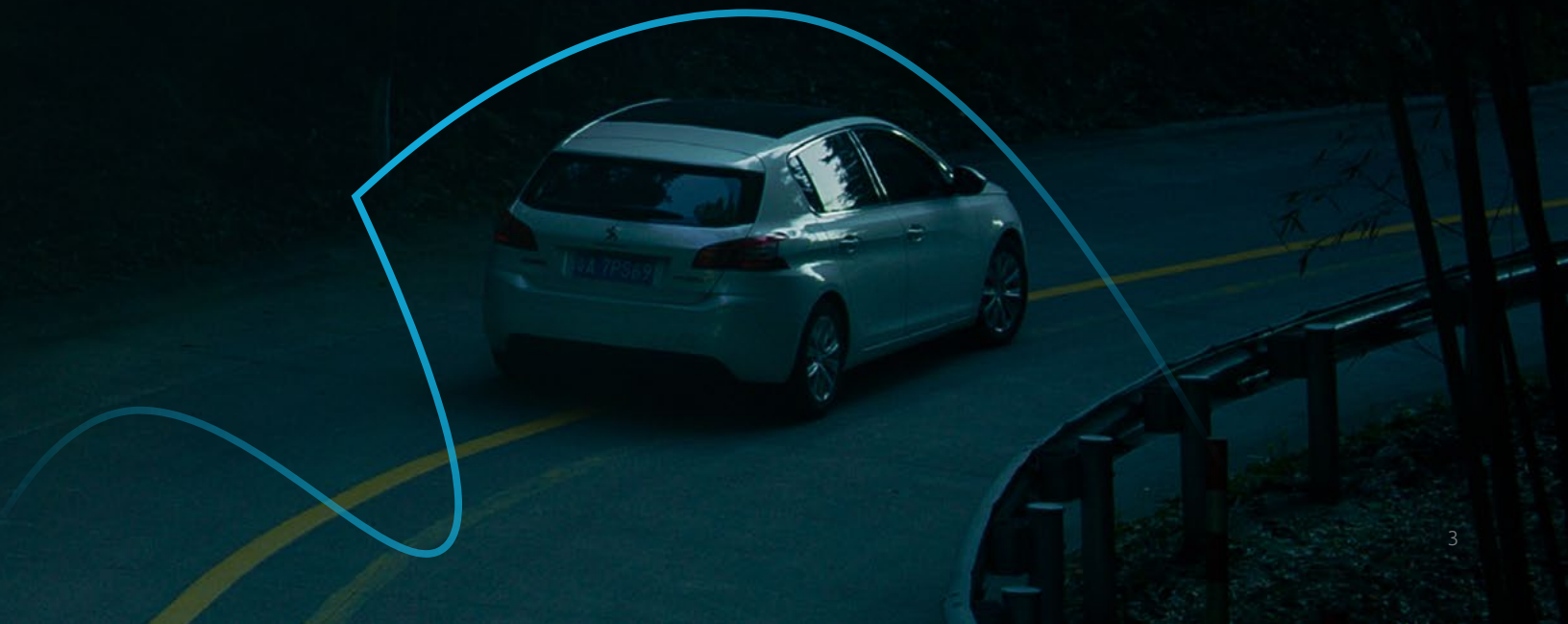
Vehicle-to-infrastructure (V2I), for example, enables communication between autonomous vehicles and infrastructure for intelligent traffic management. Verizon is working with Honda to research how new connected safety technology using 5G and mobile edge computing (MEC) could ensure fast, reliable communication between road infrastructure, vehicles, and pedestrians to reduce collisions and save lives.

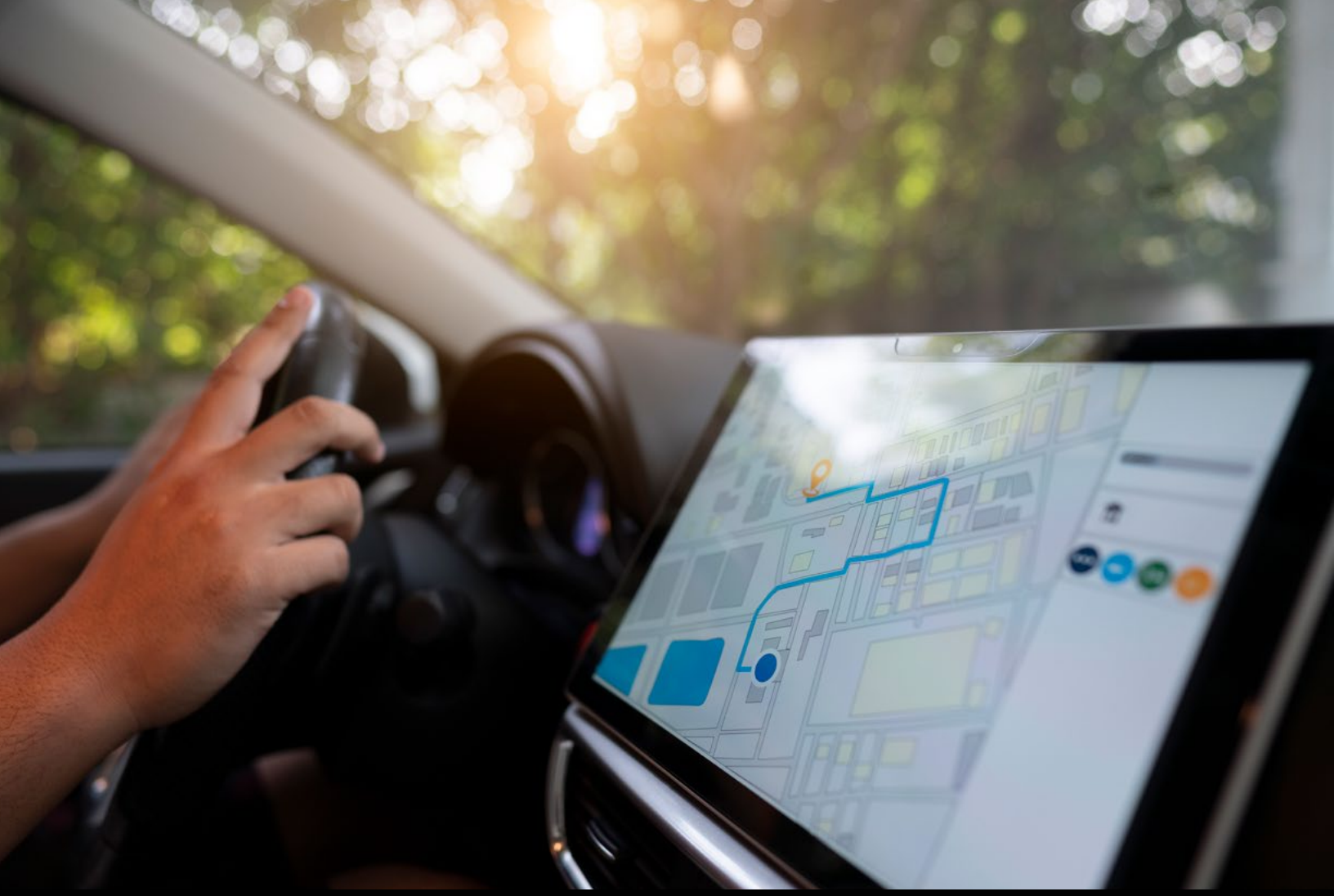
The low latency of 5G also has the potential to improve collision avoidance. Humans take approximately one second to react to a driving emergency, but a 5G-enabled autonomous vehicle can respond instantly. At typical driving speeds of 60 mph, that one second difference is the equivalent of about three feet of travel, which can have a big impact – or avoid one.

5G will operationalize sustainability

The circular economy is built on the **seven Rs**: reduce, reuse, redesign, repair, refurbish, return, and recycle. Transportation is a major component of carbon-footprint calculations and 5G could help to deliver insights about consumption and therefore the changes consumers can make.

That means drivers can determine the actual carbon footprint of their vehicle as well as the reuse of certain parts or elements. The shift to electric vehicles will only aid sustainability goals.





Innovation on top of innovation

5G-enabled cars bring together engineering, cloud services, and end-user experiences. For drivers, the connected capabilities should power a new and untapped world of potential for mobility, radically reshaping the journey of sales, lease, shared, ownership, re-ownership, and reuse. This is more than just collecting telematics on drivers. There are opportunities to digitalize the sales process and move away from the traditional dealership model.

Wireless telecommunications companies will play a vital role in circular mobility. 5G-enabled autonomous cars will need to be continuously connected to the network, so telecommunications companies will provide the backbone for 5G-enabled vehicles in autonomous mode.

In addition, multi-access edge computing (MEC) can bring technology resources closer to the vehicle. Data is processed and stored at the network's edge, not at some distant data center, significantly reducing latency. MEC provides both an IT service environment and cloud-computing capabilities from companies such as AWS and Microsoft to help enable the real-time enterprise. MEC, combined with the high bandwidth and low latency of 5G, can process road and driving information in near real time.

That means autonomous driving is more than just a system of roadways. It needs a network and cloud-based architecture that leverages the pairing of 5G and cars to meet key connectivity requirements. A 5G-enabled vehicle needs reliable networking that supports near real-time communications with a high degree of availability. When 5G connects the car to surrounding systems, all the processes can have a high-speed data backbone as a foundation.

Solving this and allowing for always-on 5G mobility could truly turn a car into an intelligent device. Similar to computers or smartphones connecting to the internet, cars could offer commerce and infotainment experiences that will alter digital lifestyles as consumers access existing subscriptions seamlessly and securely. And updates can happen securely in real time from anywhere without a trip to the dealership.

It is also a fundamental piece of a smarter, more livable city. V2X can optimize traffic flow, thereby reducing congestion and the impact of motorized transportation on the environment. Traffic analytics can help keep vehicles moving and pedestrians and cyclists safer. The data collected by autonomous vehicles can also help municipalities expand insights into traffic flow and growth to inform road and highway expansion, as well as inform transit planning.

More sustainable manufacturing

High bandwidth and low latency will also positively impact the automotive manufacturing process. With more sensors and data, companies could find new capabilities and efficiencies to streamline how a car gets made.

5G can blanket an assembly line with low-latency, high-bandwidth coverage to monitor Industrial Internet of Things (IIoT) devices, control robots and cobots (robots designed to work in concert with a human), and connect a new augmented workforce that uses AR/VR/MR technologies to supercharge the manufacturing process.

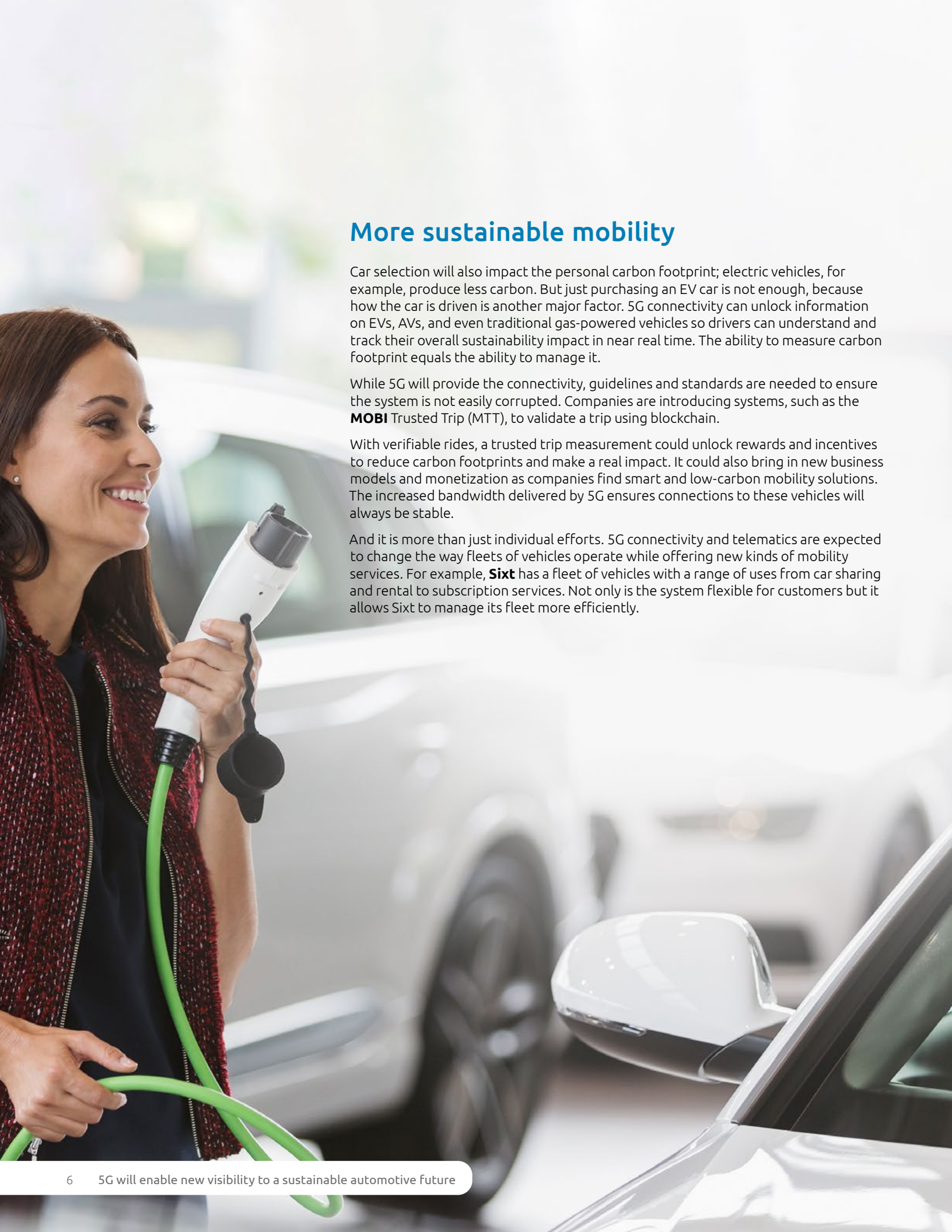
This means manufacturers are reassessing their wireless network needs. A smart factory connected by 5G requires a foundation strong enough to support this critical business function. **Nearly 50 percent** of automotive companies are progressing well on smart-factory roadmaps, compared to 18 months earlier. While a short network outage can be inconvenient in an office environment, having to shut down a manufacturing facility because of a network failure can be much more expensive.

MEC may be the answer. OEMs are exploring private 5G and MEC manufacturing solutions for their facilities. Telecommunications companies are developing private 5G networks that can be used in a manufacturing environment. These private networks open new possibilities, such as connecting to IoT solutions that may transition seamlessly between fixed positions like warehouses and mobile locations across geographies.

Building a more distributed supply chain with the ability to track and trace should work to streamline the process to be more efficient and sustainable. 5G provides a foundation for an always-on supply chain so companies can monitor their environmental impact and find new ways to reduce their footprint by studying the data from connected sensors. Companies cannot modify their behavior unless they know where they can be more sustainable.

However, private 5G and MEC manufacturing networks are complex and require multiple technologies to be successful. Manufacturers do not always have the skills and resources to build a wireless high-speed, low-latency network. For many OEMs, the answer is to look for a managed solution that brings together the telecommunications provider with the right partners, network, and support to ensure continuity.

The merging of 5G with vehicle hardware and software platforms could also unlock new capabilities for advanced driver-assistance systems and eventually autonomous driving features. Greater levels of autonomous driving require the fast access provided by 5G and MEC to connect vehicles to other vehicles, pedestrians, and infrastructure in near real time for safer, stress-free, and reliable automated mobility.



More sustainable mobility

Car selection will also impact the personal carbon footprint; electric vehicles, for example, produce less carbon. But just purchasing an EV car is not enough, because how the car is driven is another major factor. 5G connectivity can unlock information on EVs, AVs, and even traditional gas-powered vehicles so drivers can understand and track their overall sustainability impact in near real time. The ability to measure carbon footprint equals the ability to manage it.

While 5G will provide the connectivity, guidelines and standards are needed to ensure the system is not easily corrupted. Companies are introducing systems, such as the **MOBI** Trusted Trip (MTT), to validate a trip using blockchain.

With verifiable rides, a trusted trip measurement could unlock rewards and incentives to reduce carbon footprints and make a real impact. It could also bring in new business models and monetization as companies find smart and low-carbon mobility solutions. The increased bandwidth delivered by 5G ensures connections to these vehicles will always be stable.

And it is more than just individual efforts. 5G connectivity and telematics are expected to change the way fleets of vehicles operate while offering new kinds of mobility services. For example, **Sixt** has a fleet of vehicles with a range of uses from car sharing and rental to subscription services. Not only is the system flexible for customers but it allows Sixt to manage its fleet more efficiently.

Moving to circular mobility

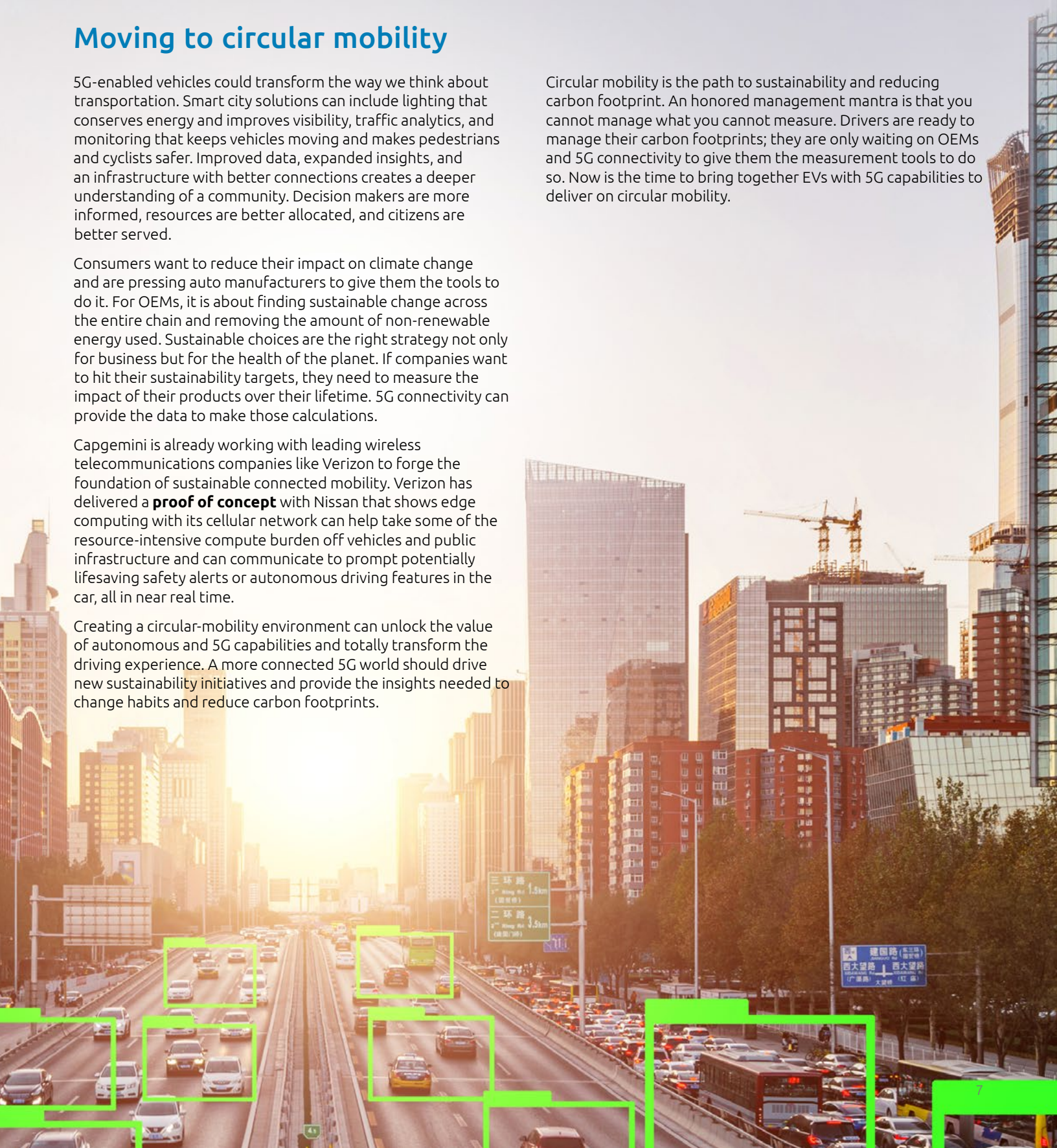
5G-enabled vehicles could transform the way we think about transportation. Smart city solutions can include lighting that conserves energy and improves visibility, traffic analytics, and monitoring that keeps vehicles moving and makes pedestrians and cyclists safer. Improved data, expanded insights, and an infrastructure with better connections creates a deeper understanding of a community. Decision makers are more informed, resources are better allocated, and citizens are better served.

Consumers want to reduce their impact on climate change and are pressing auto manufacturers to give them the tools to do it. For OEMs, it is about finding sustainable change across the entire chain and removing the amount of non-renewable energy used. Sustainable choices are the right strategy not only for business but for the health of the planet. If companies want to hit their sustainability targets, they need to measure the impact of their products over their lifetime. 5G connectivity can provide the data to make those calculations.

Capgemini is already working with leading wireless telecommunications companies like Verizon to forge the foundation of sustainable connected mobility. Verizon has delivered a **proof of concept** with Nissan that shows edge computing with its cellular network can help take some of the resource-intensive compute burden off vehicles and public infrastructure and can communicate to prompt potentially lifesaving safety alerts or autonomous driving features in the car, all in near real time.

Creating a circular-mobility environment can unlock the value of autonomous and 5G capabilities and totally transform the driving experience. A more connected 5G world should drive new sustainability initiatives and provide the insights needed to change habits and reduce carbon footprints.

Circular mobility is the path to sustainability and reducing carbon footprint. An honored management mantra is that you cannot manage what you cannot measure. Drivers are ready to manage their carbon footprints; they are only waiting on OEMs and 5G connectivity to give them the measurement tools to do so. Now is the time to bring together EVs with 5G capabilities to deliver on circular mobility.



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About Verizon

Verizon Communications Inc. (NYSE, Nasdaq: VZ) was formed on June 30, 2000 and is one of the world's leading providers of technology and communications services. Headquartered in New York City and with a presence around the world, Verizon generated revenues of $133.6 billion in 2021. The company offers voice, data and video services and solutions on its award-winning networks and platforms, delivering on customers' demand for mobility, reliable network connectivity, security and control. Verizon was the first company in the world to launch commercial 5G for mobility, fixed wireless and mobile edge computing. The company's operating structure focuses on two customer-facing areas: Consumer and Business. Citizen Verizon is the company's responsible business plan for economic, environmental and social advancement.

About Capgemini

Capgemini is a global leader in partnering with companies to transform and manage their business by harnessing the power of technology. The Group is guided everyday by its purpose of unleashing human energy through technology for an inclusive and sustainable future. It is a responsible and diverse organization of over 340,000 team members in more than 50 countries. With its strong 55-year heritage and deep industry expertise, Capgemini is trusted by its clients to address the entire breadth of their business needs, from strategy and design to operations, fueled by the fast evolving and innovative world of cloud, data, AI, connectivity, software, digital engineering and platforms. The Group reported in 2021 global revenues of €18 billion (about $21 billion USD at 2021 average rate).

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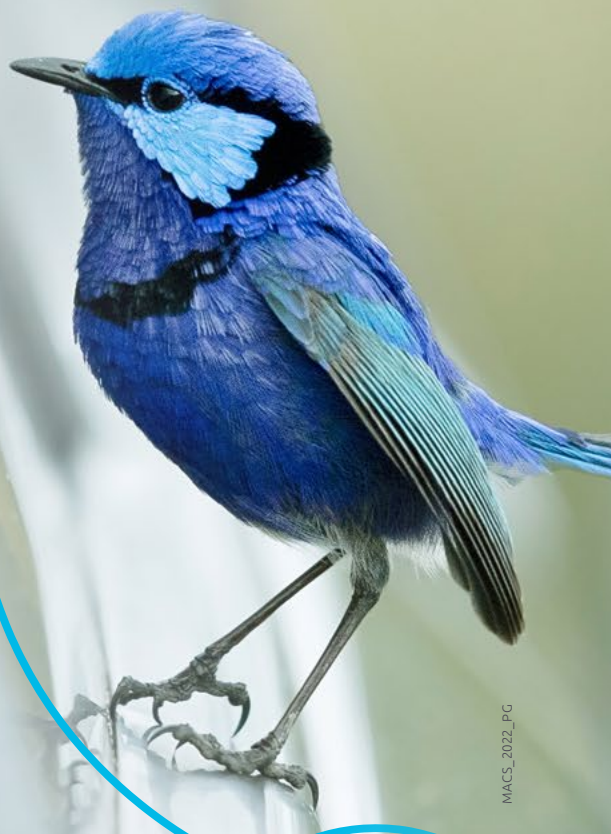

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