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Recent Impacts on the Automotive Electronics Industry

Vehicle Sales Remain Fragile

Recent economic indicators show a decrease in passenger vehicle sales of nearly 7% in July compared to the previous year, despite some countries showing variable signs of recovery after the COVID-19 lockdown. Overall, global sales plunged 25% year over year in the January–July period [1]. Although most regions are certainly seeing signs of a rebound, the real market situation remains very uncertain. Pent-up demand continues to be the main driver of the recent gains, and it could mask a lower level of intrinsic market activity. Several analysts continue to maintain their outlook for a 2020 sales decline of nearly 20% compared to last year [1], with global passenger vehicle sales estimated to be approximately 71 million units. Major regions are recovering based on different economic factors, as described in [2].

ANALYSTS CONTINUE TO MAINTAIN THEIR OUTLOOK FOR A 2020 SALES DECLINE OF NEARLY 20% COMPARED TO LAST YEAR.

Sales in the United States continue to fall because of the pandemic's prolonged impact on the economy. The volume of passenger vehicle sales in July, although higher than in June, declined almost 19% compared to the year-earlier period. Fleet sales also remained weak, with July volumes tumbling nearly 30% from those reported in June [1]. As COVID-19 continues to spread in major U.S. states, including California, Texas, and Florida, people are experiencing less traffic, and passenger vehicle sales face strong headwinds. All of this is happening while the industry continues to free itself from the effects of the lockdowns that closed thousands of dealerships in March, April, and May. Following current trends, analysts suggest a 24% annual decline for U.S. vehicle sales in 2020 (estimated to constitute approximately 13.4 million units).

Despite these predictions, the recent increase in electric vehicle (EV) sales in the United States may provide a boost to the market, although not enough to offset declines in overall sales. The 2020 numbers confirm that Tesla still dominates the U.S. EV market, with its Model 3 selling almost five times more cars than the Chevy Bolt, nearly 13 times more than the Nissan LEAF, 13 times more than the Audi e-tron, and 152 times more than the BMW i3, which is suffering a lot this year, as indicated in Figure 1 [3]. The dealership availability of other electric models, including the Volkswagen (VW) e-Golf and Porsche Taycan, is uncertain. Comparing the first half of 2020 with the same period in 2019, Tesla's sales were basically divided between the Model 3 and the Model Y. Sales of the Bolt were comparable to the prior period, but sales of the LEAF dropped by half. The e-tron totaled 1,000 sales, and the Taycan joined the market for roughly 1,000 more, but the e-Golf lost roughly 1,400 sales, and i3 sales collapsed, as documented in Figure 1 [3].

In comparison with Europe, the U.S. EV market is extremely fragile. Without Tesla, it would be a disaster. Even the few competitive models face the challenge of limited availability, and traditional dealers do not want to sell them, or, at least, they do not try. Furthermore, even in the case of Tesla, with the exception of California there is a need for more recognition of EVs' essential qualities and cost competitiveness: sales are severely restricted outside California.

Passenger vehicle registrations in Europe fell 5.7% in July, as government incentives and the lifting of restrictions increased demand to levels close to those before the pandemic. However, from an annual point of view, Europe has seen vehicle sales fall 36% compared to the first six months of 2019. Some analysts have estimated that sales in Europe will drop nearly 26% this year, to 13.6 million units, with key factors such as lower government incentives and the possible resurgence of COVID-19

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likely to have an effect during the last quarter of the year [1].

In Asia, China's passenger vehicle market continues to experience a V-shaped recovery, with July volumes growing 16% compared to a year ago, presenting a fourth consecutive month of improvement. This dynamic is accelerating sales after they grew almost 7% year over year in June. While July passenger vehicle sales totaled 2.1 million in China, the cumulative sales volume fell 13% from 12.4 million in the same month of 2019 [1].

The market is being stimulated by new concepts, such as neighborhood EVs (a U.S. designation for battery EVs that are usually built to have a top speed of 40 km/h and a maximum loaded weight of 1,400 kg), battery EVs, and gasoline and hydrogen fuel cell hybrids. The July results represent an increase of 20% for this market segment, to nearly 98,000 units. This increase may demonstrate that original equipment manufacturers (OEMs) and neighborhood EV customers are on the right path, with reduced government subsidies compared to last year. Some estimates anticipate more than 1.1 million neighborhood EV sales in 2020, down 11% from the previous year [1]. In July, Tesla dominated the all-EV field, with 11,000 vehicles sold, while BYD took the lead in neighborhood EV sales, at more than 14,000 units.

Although China's economy continues to recover, a second wave of COVID-19 is expected during the fall, and analysts maintain their initial forecast of roughly 22 million passenger vehicle sales for 2020, representing a drop of 15% from the previous year. In addition, India's domestic automotive industry restarted in July, but monthly downward trends persist. For the first time in several months, the country's automotive industry reported only a 1% drop in passenger vehicle sales, with 198,000 units shipped in July compared to 200,500 units in the same month a year earlier. Analysts expect that the figure represents the lowest point of a V-shaped recovery, as Indian states are increasingly easing lockdowns, and several dealerships are opening in major urban centers [1]. The sector has not yet shown a sustainable trend in demand, but, for the medium term, the indicators are encouraging. As OEMs in India continue to solve supply chain problems, they will also need to purchase intermediate hardware stocks to protect against possible future lockdown troubles.

In Japan, passenger vehicles sales continue to improve, falling 14% year-on-year in July as opposed to 45% in May. This positive indicator stems from consumers' prefering to buy smaller vehicles, such as neighborhood EVs, to avoid public transportation congestion. Low-power vehicles currently represent approximately 40% of total passenger car sales. However, with the recent sharp increase in new cases of COVID-19 and

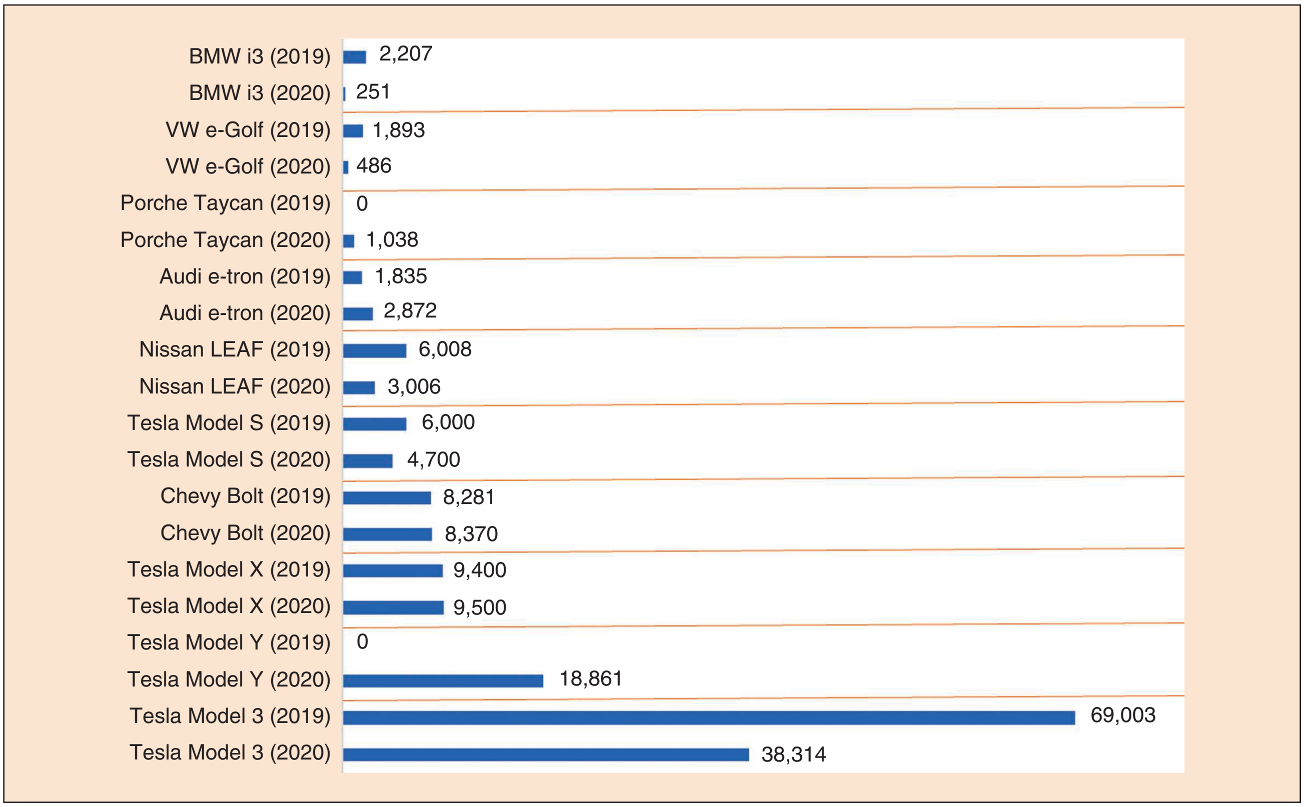

FIGURE 1 Estimated U.S. EV sales during the first half of 2020 versus the same period during 2019. The data are estimated since EV carmakers do not publish sales information. (Source: CleanTechnica [3].)

the possible application of movement restrictions, the recovery in sales is expected to slow down again.

South Korea's sales rate slowed from its June record, with the first phase of a temporary reduction in excise duties on passenger vehicles expiring at the end of July. However, the market continues to perform well, with sales growing nearly 8% this year. Sales during the second half of 2020 are expected to be sustained by the early announcement of the second phase of the excise duty reduction, which proved to be a key factor in stimulating demand recovery during the second and third quarters.

Since several signs of a fragile recovery continued to emerge in July, economic analysts remain cautious and maintain their global passenger vehicle sales forecast of roughly 72 million units for 2020, down more than 20% from 2019 [1]. All these predictions will highly depend on the fourth quarter and the so-called second wave of COVID-19.

Automotive Lighting Alliance

New additions have been made to the Intelligent Smart Embedded LED (ISELED) alliance for vehicle lighting control, and the recent extension of the ISELED protocol to an open fieldbus introduces the possibility of integrating LED headlights, sensors, and actuators into the concept, as presented in Figure 2. Now, the second-generation ISELED specification is also complete.

Recently, Marquardt, Preh, and TactoTek joined the ISELED alliance, which continues to grow. Thus, as of August 2020, the technological grouping around the control bus of the same name for automotive LEDs includes the following companies: Allegro MicroSystems, Brightek, Cemm Thome, designLED, Dominant Opto Technologies, Dräxlmaier, Dr. Schneider Unternehmensgruppe, Elmos, Everlight, Hay, Grupo Antolin, Hella, Inova Semiconductors, iSYS RTS, ITSWELL, Lightworks, Lucie Labs, Magna Lighting, Marquardt, Melexis, Microchip, Novem, NXP, Osram Opto Semiconductors, Preh, Prettl, TactoTek, Techniplas, TE Connectivity, UG Systems, Pforzheim University, Valeo, and Xingyu [4].

Marquardt, a family business founded in 1925 and headquartered in Rietheim–Weilheim, Germany, manufactures mechatronic switching and control systems. The company's products are used by many customers in the automotive industry. The product list includes control components, vehicle access, and driving license and battery management systems for EVs as well as electromechanical and electronic switches and switching systems. Marquardt has approximately 10,500 employees in 20 units on four continents. In fiscal year 2019, its sales exceeded 1.3 billion euros. Each year, Marquardt invests roughly 10% of its revenue in research and development [5].

Preh is an automotive supplier that currently employs some 7,000 people and generated sales of roughly 1.5 billion euros in 2019. Since 2011, it has been part of Joyson, one of the 30 largest automotive companies in the world. Its development and manufacturing include human–machine interface systems for passenger cars and commercial vehicles as well as electric mobility control units [6].

Finland-based TactoTek focuses on the development, industrial exploration, and commercialization of injection-molded structural electronic (IMSE) technology that is changing the way electronic components are designed and manufactured. IMSE parts not only are manufactured with additive processes and less plastic but also emit less greenhouse gas. [7]

The members of the ISELED alliance are constantly developing solutions aimed at the automotive market. Their product line includes LED modules, independent drivers/controllers, special microcontrollers, and development kits. Systems combining ISELED and optics components are currently under development. Only recently did the alliance complete the specification for the second generation of ISELED: the new products will offer greater chromatic accuracy across the entire temperature range and higher-current classes. Another milestone is the extension of the original local ISELED protocol to a true vehicle-wide fieldbus. This is possible thanks to the development of the ISELED light and sensor (ILaS) network bus concept. With ILaS, not only LEDs

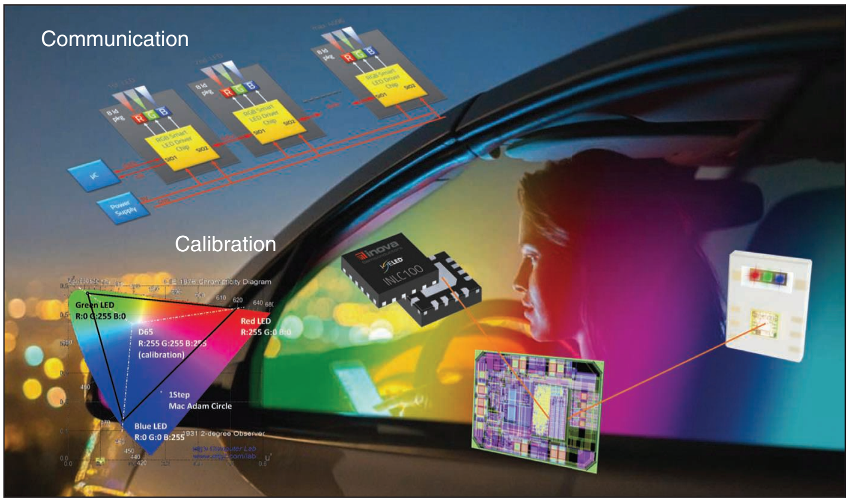

Figure 2 The ILaS light and sensor network with the ISELED concept illustration. (Source: Inova Semiconductor; used with permission.) RGB: red–green–blue; SIO: serial input/output system.

[for example, red–green–blue (RGB) and infrared] but also other components, such as matrix LED headlights, sensors, and actuators, can be controlled in large numbers via a single two-wire cable without a shield. A first ILaS test chip is now available. It fulfills all defined objectives, including the desired high robustness in terms of electromagnetic compatibility [5].

FIGURE 3 The light bar with multichannel RGB LEDs. (Source: Melexis; used with permission.)

Multichannel RGB LED Driver

Melexis, a Belgian producer of automotive integrated circuits, has launched a multichannel RGB LED driver to bring intelligent interior lighting to automotive applications [8]. The MLX81116 supports MeLiBu high-speed Internet Protocol (IP) communication to enable intelligent animated automotive lighting concepts. The technology is already being exploited to enhance the security features of several companies' latest models. More car manufacturers are looking to introduce animated lighting in the vehicle cabin to convey important driver-assistance notices and vehicle status information (see Figure 3). Current design thinking envisages the use of an RGB LED light bar to communicate with the driver through color coding, color changes, and flash sequences. The main technical challenges are maintaining a uniform color across all the LEDs in the light bar and ensuring that all LEDs change at the same time.

The MLX81116 solves this problem with its unique high-speed IP communication interface, MeLiBu, which separately controls all individual LEDs on the light bar to produce effects governed by the vehicle. The intelligent RGB-LED controller also provides real-time compensation for any color variation caused by environmental changes. The MeLiBu communication interface employs a controller area network with a flexible data rate (CAN-FD) physical layer, which guarantees robustness, reliability, and a high speed (up to 2 Mb), features that are essential requirements for today's carmakers. Support for dedicated optical configurations enables 1% ultraviolet delta color mixing accuracy to ensure that no difference can be distinguished between individual LEDs. In addition, intelligent, high-resolution temperature-related color variation helps maintain a consistent, distraction-free user experience in all operating conditions.

The MLX81116 driver integrated circuit has an extremely wide dimming range that facilitates optimal brightness regulation for day and night driving. In compliance with International Standardization Organization (ISO) standard 26262 for automotive functional requirements up to safety integrity level B, the MLX81116 also features a low electromagnetic interference emission and a high immunity through use of the CAN-FD physical layer, which facilitates compliance with applicable electromagnetic compatibility regulations. [8]

Subaru Uses Xilinx Chips in Central Driver Assistance System

In its new Levorg sport utility vehicle model, Japanese carmaker Subaru incorporates the concept of optical recognition by a stereo camera for many driver assistance functions. The central control element, called *EyeSight*, is a multiprocessor (MP) system on chip (SoC) from Xilinx, as shown in Figure 4. Xilinx's strengths are based on high-speed data processing in real time, which is particularly crucial in the automotive market [9]. The EyeSight system, produced by Veoneer, serves as the pivot for such sophisticated functions like adaptive cruise control, lane maintenance assistance, and precollision braking. It relies on a stereo camera installed near the rearview mirror. This sensor generates large amounts of data, which are preprocessed and fused in real time with a Xilinx MP SoC from the Zynq UltraScale family. A cloud based on 3D points is produced, from which a downstream computer generates driving commands. Since this

FIGURE 4 The EyeSight advanced driver assistance system based on a Xilinx chip. (Source: Xilinx; used with permission.)

process is extremely critical for security, the entire procedure of merging data should occur practically without any delay.

The EyeSight system is not just the basis for the driver assistance functions mentioned previously. It is also essential for algorithmic support in detecting critical situations, such as pedestrians on the road, the danger of collision in a curve, and unintentional vehicle movement, and to monitor a person's ability to drive (via an indoor camera with its own information processing). Subaru plans to equip the vehicle with four additional, optional short-range radars to implement other functions, including congestion assistance and curve prediction; these sensors would also interact closely with the EyeSight system.

FIGURE 5 Object recognition using the SVNet on the Socionext SoC. (Source: StradVision; used with permission.)

FIGURE 6 The KDPOF automotive multigigabit Ethernet system. (Source: KDPOF; used with permission.)

Based in its technical specifications, the Xilinx chip can process additional radar signals. Due to their architecture, which enables many hardware-programmed use, components of the Zync UltraScale family can also implement functionality for other customers' requirements, for instance, mobile industry processor interface switches and splitters for downstream data loggers and additional displays. Subaru's success proves that Xilinx is right in its strategy of serving the automotive market with heterogeneous and highly programmable MP systems. The company, based in San Jose, California, has shipped 75 million of these chips in advanced driver assistance system (ADAS) applications. Customers include OEMs, such as Subaru, Daimler, and the the not-so-familiar Chinese electric car maker Weltmeister, as well as tier 1 suppliers, including Continental, Magna, Veoneer, and ZF [9].

StradVision Builds Camera-Based ADAS With Socionext SoC

Artificial intelligence software company StradVision is collaborating with SoC provider Socionext (the successor to Fujitsu Electronics Europe) [10] to bring its SVNet deep learning-based camera perception software to the global ADAS market [11]. Through this venture, the companies intend to provide state-of-the-art object recognition technology with specialized software and hardware to allow deep learning in the ADAS market and for autonomous driving. They hope to optimize the integration of StradVision perception SVNet software in the SoC developed by Socionext, resulting in extremely stable operation inside vehicles. The SVNet running on the Socionext SoC is billed as an excellent solution for the ADAS and autonomous markets, where robust performance and security are essential.

StradVision's SVNet software enables vehicles to detect and recognize objects on the road, as presented in Figure 5. The company claims that the SVNet plus the Socionext SoC works well even in adverse weather conditions and that it can prevent road accidents by processing data collected with high speed and precision. Compared to its competitors, the SVNet is described as being compact, requiring considerably less memory capacity to operate and consuming less energy. Thanks to the company's deep neural network software, the SVNet can be easily customized for any hardware system.

The SVNet is currently being used in mass production models of ADAS and autonomous vehicles that support levels 2–4 safety functions, and it will be deployed in more than 9 million vehicles worldwide. It can also be customized for any hardware system. Software such as the SVNet associated with the Socionext SoC can detect vehicles, pedestrians, roads, and open spaces. In the automotive market, where significant growth is expected in the future, this collaboration will deliver customized SoCs that are a source of differentiation and competitiveness for OEMs and tier 1 suppliers.

Aukua Systems and KDPOF Extend ISO Standard 2111 for Automotive Ethernet

Ethernet test and monitoring company Aukua Systems [12] and KDPOF [13], a provider of gigabit transceivers over polymer optical fiber, established a technology partnership whereby Aukua provides measurement technology for an extension of ISO standard 2111 for onboard vehicle gigabit Ethernet [12]. For reliable systems that implement in-vehicle 1-Gb/s optical Ethernet as a physical layer, the ISO has added two additional sections, ISO 2111-3: 2020 and ISO 2111-5: 2020, to the international series of ISO 2111 standards. ISO 21111-3: 2020 specifies additional features for IEEE Standard 802.3bv, such as synchronized wake and sleep algorithms. ISO 21111-5: 2020 defines requirements at the system level, including a comprehensive compliance and interoperability test plan for engine control unit (ECU) suppliers that implement the 1-Gb/s optical physical layer, as specified in ISO 2111-3.

By providing the MGA2510 Ethernet monitoring and test platform (see Figure 6), Aukua has equipped the test setup for ISO certification. KDPOF supports the test environment to ensure that ECUs and their technology are evaluated by recognized laboratories and are in compliance with the ISO standards. Carmakers and tier 1 suppliers now have now access to a complete, compatible, and interoperable implementation based on these standards to develop their products.

Magna Expands Powertrain Business in Slovakia

Automotive engineering and manufacturing company Magna is expanding its powertrain (Figure 7) business with a new plant in Kechnec, Slovakia. The facility, Europe's first powertrain metal forming plant, is expected to enter service in August 2021 [14]. The plant, Magna's fourth in Slovakia, expands the company's presence in the region and brings additional capacity to its Kechnec campus. A neighboring transmission plant was opened 15 years ago, by Getrag, which Magna acquired in 2016, and it currently manufactures transmissions for BMW. Magna's relationship with the local community and the education system will help ensure a group of highly qualified employees for its operations.

Based in Aurora, Ontario, Magna is one of Canada's largest companies and the biggest auto parts manufacturer in North America, in terms of parts sales. It builds automotive systems, assemblies, modules, and components that are supplied to General Motors, Ford, Fiat Chrysler Automobiles, BMW, Mercedes, VW, and Tesla, among others.

FIGURE 7 A Magna powertrain assembly line. (Source: Magna; used with permission.)

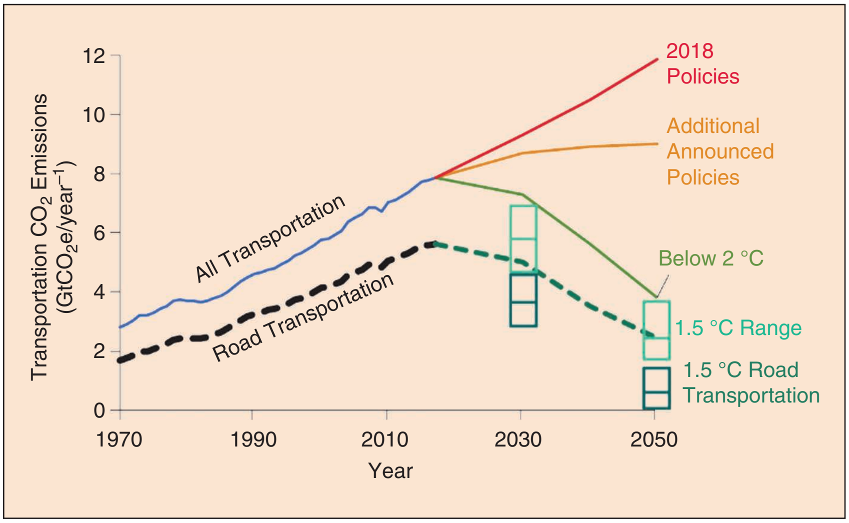

FIGURE 8 Historical and future global greenhouse gas emissions from transportation. The graph represents global emissions from all transportation modes combined (solid lines) and road transportation only (dashed line). Historical values are indicated in blue and black. The 2018 legislated policies are in red, additional announced policies appear in orange, and International Energy Agency scenarios that are well below 2 °C are given in green. Small boxes show ranges of transportation emissions that are compatible with 1.5 °C overshoot scenarios for all modes (green boxes) and road modes only (dark-green boxes). $GtCO_2e$: gigatons of equivalent CO_2. (Source: [16].)

More Measures Needed to Reduce Carbon Dioxide in Road Traffic

German and Canadian experts are calling for more stringent and integrated measures to reduce emissions [15]. For the automotive industry, this translates into an urgent need for new drive concepts. A recent study concludes that, despite new technologies and national and international targets, global carbon dioxide (CO_2) emissions from road freight transportation are increasing compared to the requirements of the Paris Climate Agreement [15].

According to the study, transportation is responsible for almost a quarter of all greenhouse gas emissions in the world, 72% of which is due solely to road traffic. At the same time, the transportation sector is the only area where emissions continue to increase, despite the fact that political measures have been implemented to meet the goals of the Paris accord: compared to 2019, emissions must be reduced by 30–40% by 2030 and by 60–80% by 2050 [16], as presented in Figure 8 after that, they should be close to zero, according to an analysis by scientists from the Fraunhofer Institute for Systems and Innovation Research, Simon Fraser University, and Navius Research. The study, published in *Nature Science*, lists national and regional policy measures that can reduce greenhouse gas emissions from road freight transportation over the long term.

The main conclusion of the study is that current policy instruments are not enough because they are not articulated to be more effective. Thus, an integrated combination of rigid measures is required, including limits for fleet CO_2 emissions, minimum licenses for vehicles with zero emissions, and licenses for fuels with low CO_2 discharges. These measures may be accompanied by appropriate prices and incentives to ensure the effectiveness of the proposed policies.

As examples that have already been implemented in the United States, Canada, and China, the scientists cite strict requirements for how emission values of all vehicles sold should be reduced by a specified date. They also advocate expanding the market share for zero-emission vehicles, such as electric cars. These are currently in short supply in Europe. The authors also recommend the introduction of measures from the United States, Canada, and China in other locations. However, they emphasize that adjustments to national and regional conditions are always necessary and that interactions must be considered. Possible negative interactions include, for example, the double accountability of EVs within the limits of the fleet and in zero-emission licenses for vehicles.

Despite new technologies and national and international targets, global CO_2 emissions from road freight transportation are increasing, and the experts call for more stringent and integrated measures to reverse the trend. For the automotive industry, this translates into an urgent need for new concepts, not only for private vehicles but also for trucks and buses. Regarding the impact that policies (for instance, bonuses for the purchase of electric cars) have at a national level, the study shows that incentives are successful only if they are relatively high and valid for at least 10 years. To support the claim, the study's authors point to the case in Norway, which has been promoting electric cars with incentives worth 10,000–15,000 euros for 20 years, leading EVs to a market share of more than 60% [16].

Emission standards related to vehicles with internal combustion engines can also help reduce greenhouse gas emissions during the short term. The authors cite the European Union (EU) as being particularly ambitious. The EU stipulates a maximum emission value of 59 g of CO_2/km for every vehicle by 2030. This will favor a switch to alternative drive systems, which means that emissions in 2030 are expected to be 40% lower than in 2010. However, minimum quotas for EVs in Europe are still lacking, although they would give the industry long-term planning security. Because EV growth has been driven primarily by private individuals, the study urgently recommends extending policy measures to freight transportation, for example, by setting minimum quotas for electric trucks in new manufacturer registries, as California was recently the first jurisdiction in the world to do.

Norwegian Cities Invest in the Future With Electric Volvo Buses

Norway is one of the most active nations when it comes to cutting carbon emissions. That means putting significant incentives in place for EVs, whether passenger vehicles, trucks, ferries, or buses. One of its policy initiatives calls for all urban buses in the country to be battery electric by 2025. Vy Buss is one of the largest bus operators in the country. Recently, it announced that 150 new electric buses would be in operation by next summer. The company has taken delivery of a number of electric buses from BYD, and it recently announced a new purchase from Volvo Buses for use in the cities of Drammen and Ålesund. Those buses should be delivered before the end of 2020 [17].

Six Volvo 7900 electric buses (Figure 9) began operating in the city of Drammen in February 2019, and 22 new ones joined the fleet this fall [17]. Two of them have the capacity to carry up to 120 passengers. For Ålesund, Vy Buss has ordered 10 Volvo 7900 buses, part of a larger order totaling 66 [17]. More European cities are choosing to improve their environment and create new possibilities for urban planning by

FIGURE 9 A Volvo 7900 electric bus. (Source: Volvo; used with permission.)

gradually electrifying their public transportation. The elimination of diesel buses reduces carbon emissions and cuts the levels of fine particles and nitrogen oxide emissions, both of which have a negative impact on people. To determine the true cost of electric buses, it is necessary to take into account the social benefits that come from cleaner air and better health for city dwellers.

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