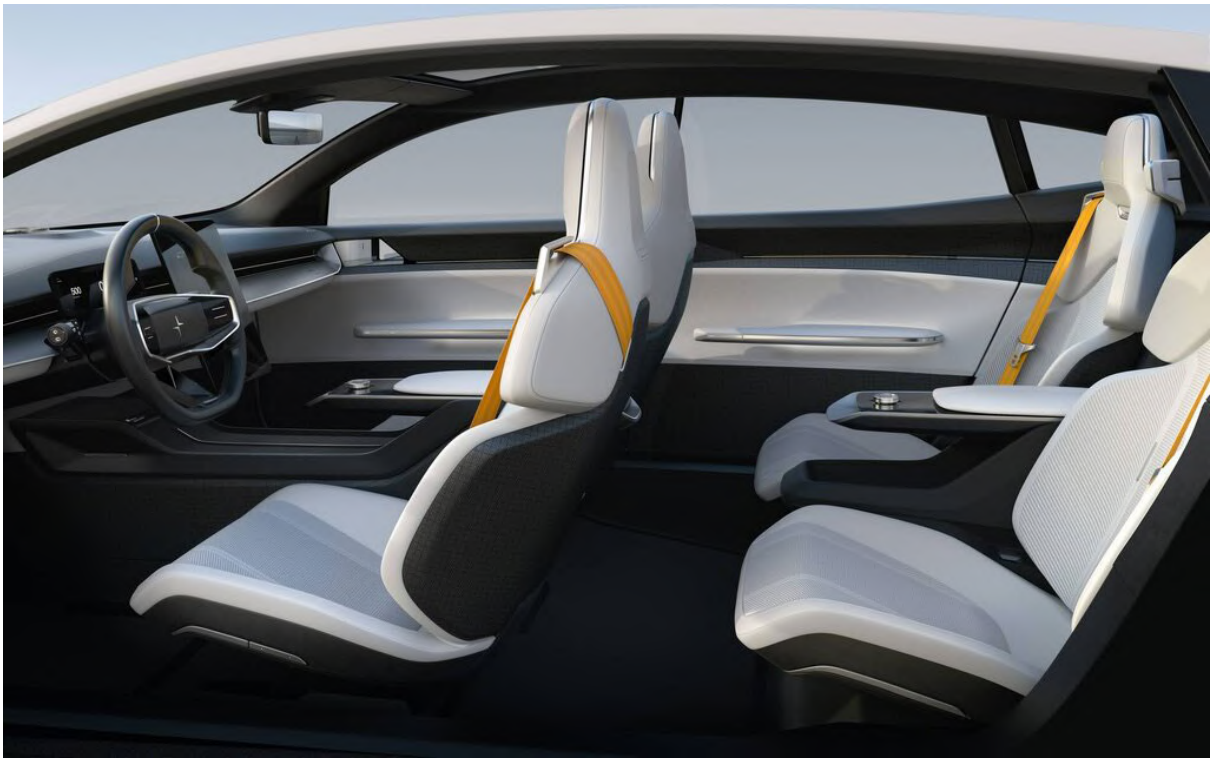
Thu, 7 April 2022
Weekly Newsletter

DVN-I
Automotive Interior

NEWSLETTER #106

Editorial

Sustainable Material Value Chain Development



POLESTAR PRECEPT CONCEPT (2020). MATERIALS MADE FROM RECYCLED BOTTLES; RECYCLED CORK, RECLAIMED FISHING NETS (POLESTAR IMAGE)

This week's in-depth article addresses the importance of plastics in the overall automotive carbon neutrality equation, with even an increasing relative importance as powertrains are getting more electrified. There's a real bonanza of new materials competing on strengths of design, sustainability, and light weight.

New materials bring with them a complex new value chain which has to be developed. Novel choices like recycled polyurethane granulate; wool; recycled polyester from PET bottles, recycled and biomass-derived polymers—each brings its innovations and challenges.

Today's simple fact is that sustainable materials are practically mandatory. Pushes and pulls at every level of the value chain call for cutting down on carbon footprint and weight. But this onslaught of different new materials, however innovative they are, tends to slow down market introduction and maintain uncompetitive costs. A coordinated, collaborative, industry consortium-led approach across the whole value chain would make it easier to bring in these materials cost-effectively. Who will step up? It could be an automaker; a major tier-1, or a major material/chemical supplier.

There's a materials session on the docket of the DVN Interior Workshop coming up in just three weeks. Stay tuned and connect with us to access the DVN-I workshop member account. If you haven't yet registered, you'll want to do so while space remains available. And of course, if you're not yet a DVN-Interior member, do come join us!

Philippe Aumont
General Editor, DVN-Interior

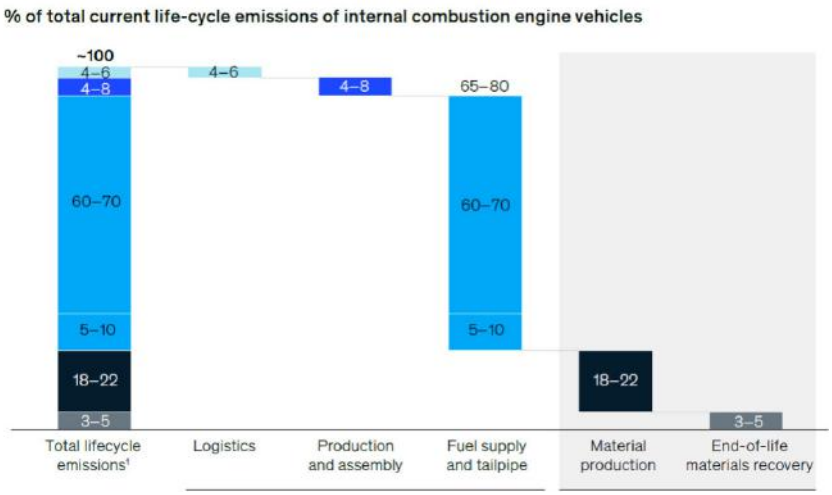
In Depth Interior Technology

As EVs Gain Traction, Plastic Carbon Balance Becomes Key

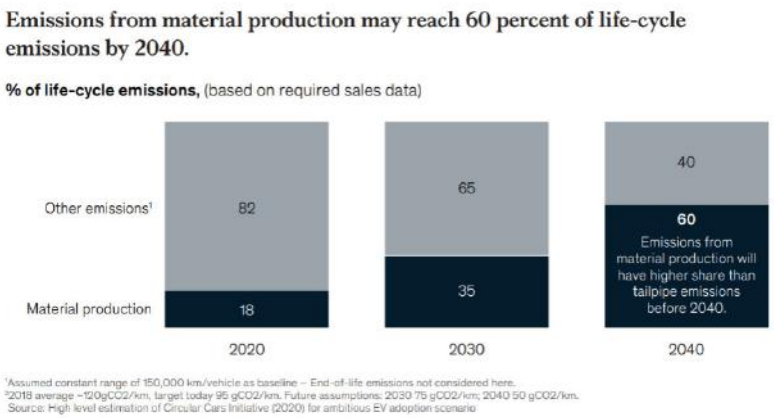
GLOBAL CLIMATE INITIATIVES IMAGE

Most automotive innovation efforts go towards electrification and transforming cars into computers on wheels. Electrification is a must on the road to carbon neutrality—65 to 80 per cent of emissions an automobile generates are from the tailpipe—but there's another major hurdle in the form of material production; especially batteries, plastics, and aluminum. We'll focus here on plastics, as most interior parts are made of it.

The automotive sector is critical to achieving net-zero global emissions by 2050, the foundation of the road map toward limiting global warming to 1.5° C above preindustrial levels. Many automakers are accordingly setting aggressive decarbonization targets to meet this challenge. As combustion engines are phased out and exhaust emissions decrease, material emission will increase both absolutely and relatively and soon become a larger share of life-cycle emissions. It is estimated that materials-related emissions, today 18 per cent of a vehicle's lifelong output, will represent more than 60 per cent by 2040! To achieve the zero-carbon car, the industry must tackle material emission as the key next step.

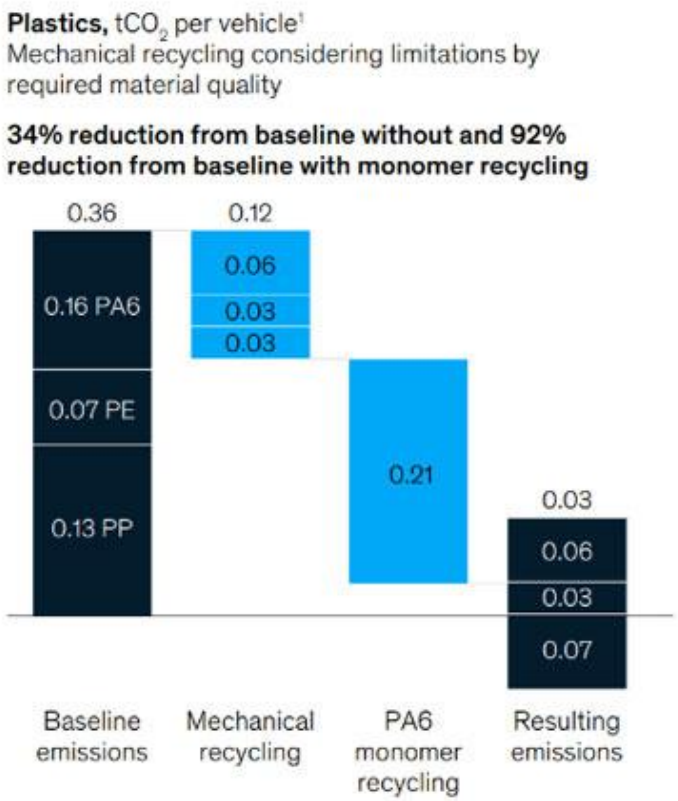


DATA SOURCE: NATURAL AND BIOGAS VEHICLE ASSOCIATION; EXPERT INTERVIEWS; MCKINSEY ANALYSIS



DATA SOURCE: NATURAL AND BIOGAS VEHICLE ASSOCIATION; EXPERT INTERVIEWS; MCKINSEY ANALYSIS

About 60 per cent of these decarbonization approaches involve aluminum and plastics. Aluminum is addressed by using recycled aluminum; new smelting technologies, and green electricity for its production.



REFERENCE: 1 TON OF CO_2 ; THIS ANALYSIS CONSIDERS A PREMIUM SUV WEIGHING 1.95 TONS: 1.04 TONS STEEL; 0.29 TON ALUMINUM; 0.10 TON RUBBE; 0.07 TON PP; 0.03 TON PE; 0.05 TON GLASS, AND 92-KWH BATTERY. (MCKINSEY ABATEMENT MODEL ANALYSIS)

For plastics, recycled materials such as polypropylene or polyethylene, especially for plastics in parts of vehicles that are not generally visible, can produce savings and cut emissions from plastic production by 34 per cent. Scaling nylon recycling technologies could further decrease total plastics emissions by up to 92 per cent.

The McKinsey reference study is showing that net result would abate 66 per cent of emissions while keeping vehicle costs the same. Despite the environmental and economic promise of decarbonizing materials in the automotive value chain, the specific path forward is challenging because a coordination problem lies at its heart. The carbon-abatement methods we describe require the work of multiple parts of the value chain. In fact, most of the material emissions identified are outside the traditional automotive value chain, including automakers' direct control.

The main thing is to close the loop by creating a robust recycling system, including logistics to get parts back. It's about renewable material sourcing and value chain; see DVN Interior 3 March 2022 ("Automotive Veganism is No Fad!"), with materials such as PVC leather; leathers made from apple and pineapple waste; materials made from paper, cotton, mushrooms, and other natural fibers, etc.

Here less is often more, as different supply chains might pursue divergent approaches and set disparate standards, which can create inefficiencies and lead to higher material costs, longer time-to-market.

Let's have a look iatn recent initiatives in these material fields:

Polyurethane

Polyurethane (PU) foam is an essential material for a modern car, used in numerous applications. There are approximately 25 kg of PU foam in every automobile, of which more than 60 per cent is used for seating.

A few methods have been tried to recycle PU waste, but these techniques result in lower-value products. Now, researchers report in ACS Central Science (April 2020) a way to recycle used PU into equivalent or even higher-value items.

Conventional PU can't be recycled simply by heating because it is a thermoset material. Some research groups have made new types of PU with crosslinks that can be broken and reformed in response to a stimulus, allowing it to be recycled. But this approach would require the industry to commercialize new starting materials, and it wouldn't address the issue of conventional waste lingering in landfills. Also, these methods haven't been tested on foams, the form in which most PU is used in cars. Another research group developed a way to recycle conventional polyester or modified PU by soaking it in a catalyst solution that enabled the material to be re-shaped into similar- or higher-value products.

Northwestern University; the University of Minnesota, and Cornell University have filed a patent application, based on grinding up PU foam and mixing the particles in a catalyst solution. After drying, the particles are molded to form new films. Compression molded films formed good-quality products, but foam treated in this way produced cracked and inhomogeneous materials. The researchers solved this problem by developing a twin-screw extrusion process that improved mixing and air removal in recycled foams, compared to the compression molding approach. They say this new method could be used for continuous recycling of the large amounts of PU waste currently landfilled and newly produced.

Aunde Sage Circular Economy for Škoda

ŠKODA ENYAQ IV (ŠKODA IMAGE)

Aunde Achter & Ebels and Sage Automotive Interiors Strakonice have developed seat covers that combine wool and recycled polyester from disposable PET bottles to create a material that is very durable, yet comfortable and pleasant to the touch. The first application is in the Škoda Envyaq IV, specifically the "Lodge" design selection.

BASF improves plastic recyclate materials

BASF IMAGE

BASF has launched IrgaCycle™, a new range of additives to address plastics recycling. The plastics industry is seeking ways to incorporate higher content of recycled polymeric material in all major applications to meet sustainability goals, while facing growing consumer concerns and stricter regulatory requirements to reduce plastic waste. Hereby a major challenge is to mitigate quality deficiencies of polymers arising from thermal and mechanical stress during the recycling process.

To make it global, BASF has recently announced a strategic cooperation agreement with China-based Zhejiang Reef Technology to develop advanced plastic recyclate formulations for automotive applications. BASF will provide their recently launched IrgaCycle additives along with technical consultancy and support for recycled polymer formulations conducted at BASF's test facilities.

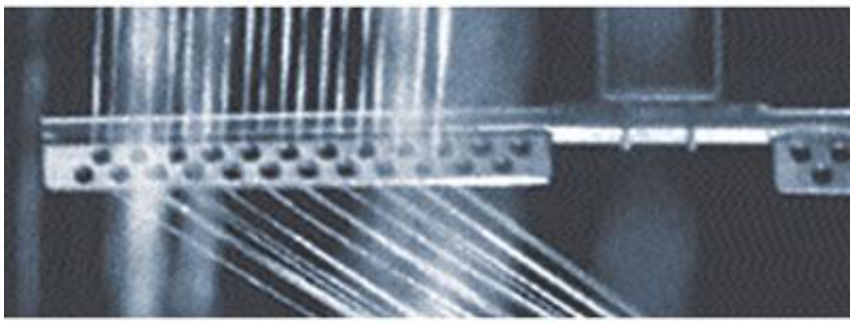
The IrgaCycle additive solutions help to increase the percentage of mechanically-recycled content in several end-use applications such as automotive and mobility. They have been developed to address specific quality issues associated with recycled resins—such as limited processability; poor long-term thermal stability, and insufficient protection from outdoor weathering.

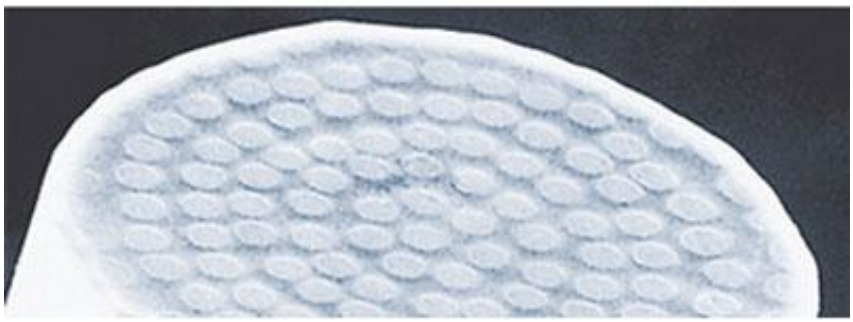
Zhejiang Reef Technology is a subsidiary of Veolia Huafei Polymer Technology, a joint venture in China with the French Veolia Group. They focus on research, development, and production of high-end engineering plastic modified materials. Reef's core products include recycled polypropylene; high-density polyethylene; ABS, and polyamide.

Toray Ultrasuede

Ultrasuede® is an ultra-microfiber material Toray classifies with their environmentally responsible line of products. It fits with any design of automobile interior application, easily adapting to seating, overhead systems, door trim, instrumental panels.

Since its debut in 1970, Ultrasuede has undergone many technological innovations, and it continues its evolution today. Ultrasuede begins with ultra-fine polyester fibers spun so light and fine that a strand more than 900 km (560 miles) long would weigh less than one gram. By combining these ultra-fine fibers, Toray has succeeded in developing a nonwoven fabric packed with unprecedented high performance and functionality.





TORAY IMAGES

Ultra-fine fiber technology has now advanced, thanks to the implementation of materials such as recycled and biomass-derived polymers.

Extruded ultra-fine fibers are bundled with polymer, creating what Toray call the “Islands in the Sea” configuration, with the filaments “afloat” in each strand.

MAZDA IMAGE

A version called Ultrasuede-nu has found its inaugural production application in the new Mazda 6 ("Atenza" in Japan). A critical part of the new interior at the premium trim levels of this model is the use of Ultrasuede-nu on the instrument panel and door panels.

Conclusion

These few examples are illustrating the complexity of the value chain which has to be developed:

- PU recycling through granulate
- Fabric made of wool and recycled polyester from disposable PET bottles
- BASF's recycling additive
- Toray's Ultra-fine fiber made from recycled and biomass-derived polymers.

Other examples would be very similar from a value chain novelty and complexity standpoint.

An industry consortium-led initiative—a coordinated, collaborative approach across the whole value chain—would optimize impact and costs. It could get started by an automaker or a major supplier; who will step up?

Interior News

Continental Collective Perception to See Around Corners

INTERIOR NEWS

CONTINENTAL IMAGE

Continental is developing an advanced new technology for allowing vehicles to use sensor and image data from nearby vehicles, effectively allowing everyone to see around corners.

Named Collective Perception, this system doesn't just draw on data from other vehicles but could also use images or sensors from the road and nearby traffic cameras. Continental has been working on the technology for two years but it is not yet clear when it could be implemented in the real world.

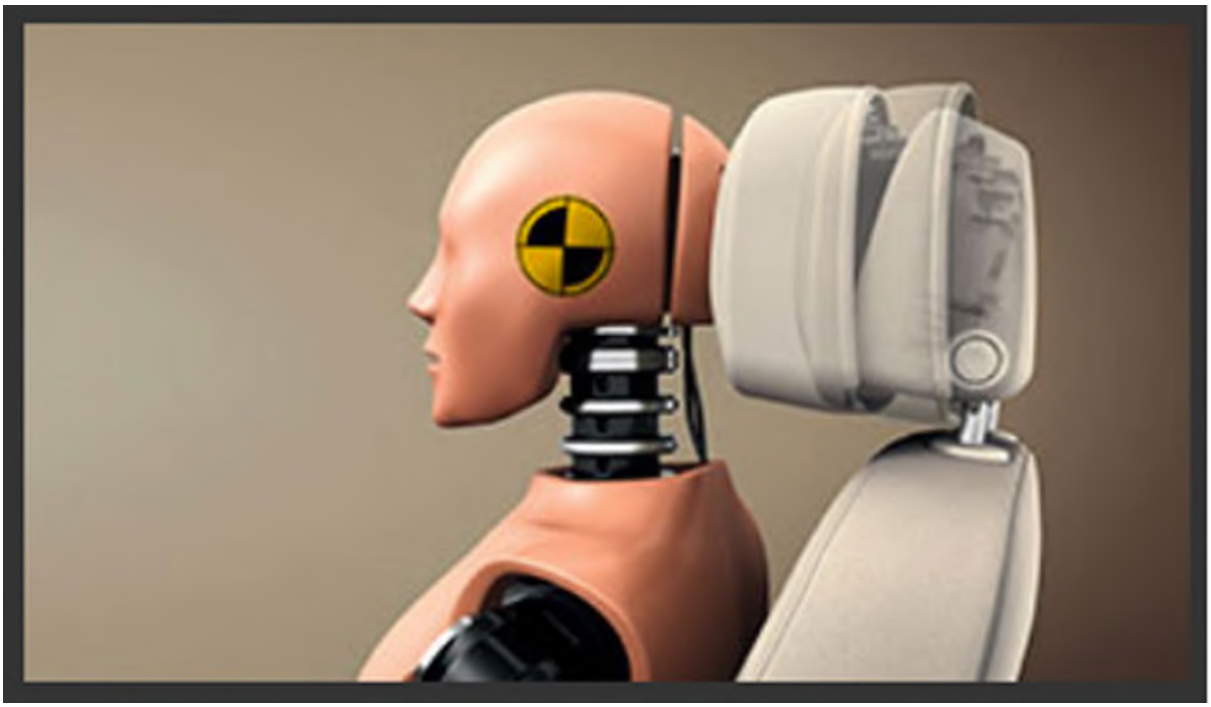
In an interview with Auto News, Continental's senior connected-vehicle and V2X portfolio development manager Robert Gee said this could help protect pedestrians; cyclists, and scooter users who are not connected. For example, the system could allow a vehicle to see around a corner that a cyclist is approaching: "It allows for one vehicle to be able to use its own sensors to detect a vulnerable road user and send that data to other vehicles and let them calculate if this is going to be in my path".

Continental believes they could launch their Collective Perception system within a year of government vehicle-to-infrastructure standards being released. Gee acknowledged that interpreting the data from cameras and radar systems used by different vehicles could be a challenge, but noted Continental's technology could translate key information between vehicles, and they are already working with five German and two American automakers to try out the system.

Gee said "We want to make sure these things are locked and loaded from a standards and cross-company agreement perspective first. Anything like this that requires communication between all different manufacturers of parts or vehicle manufacturers, you need to have one standard that you're working toward".

Occupant Safety: Effect of Stabilizing on Head Kinematics

INTERIOR NEWS



SAFETY WITH SCIENCE IMAGE

Head restraints are designed to prevent neck injuries that occur during a car crash, in which the neck is thrown backwards or forwards. Once the head is thrown one way, it is naturally also thrown the other way due to the muscles that control it moving forcefully. When the neck is thrown towards the second direction, it moves faster. This is explained through Newton's third law of motion: for every action, there is an equal and opposite reaction.

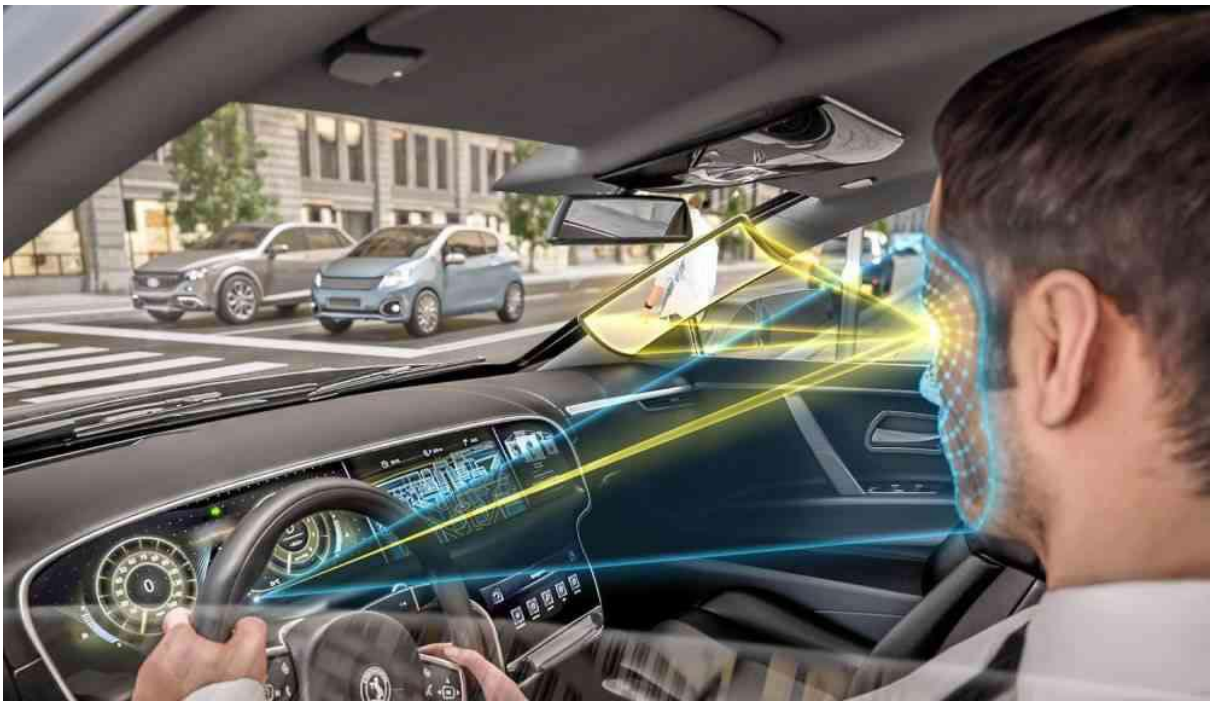
When the neck moves the first direction, there is a certain amount of impact and force put on that passenger that causes the neck to move at a certain speed towards the same direction. When the neck then moves towards the second direction, the amount of impact and force being put on that passenger is increased, which causes the neck to move at a faster speed than before along with the rest of the body and the car, as the car bounces back from impact.

A research team in Korea and Japan, a cooperation between Hongik University in Seoul and the Human-Centered Mobility Research Center in Japan—recently published on the effect of stabilizing strategy on head kinematics of occupants.

96 tests were conducted using a driving simulator with six male volunteers. The driving simulator produced a series of 4.8-second cycle motions combining roll (R_x) and sway (D_y). The cycle motions were produced at four levels of intensity by linearly adjusting the amplitude of roll and sway from 0.15 to 0.40 g. Meanwhile, the subjects remained either reactive or proactive. An IMU sensor was attached to the forehead of the subjects and measured head kinematics at 256 Hz. The roll, yaw, and sway motions of the head were obtained in 10 cycles of the steady-state section. All motions showed longer delay with respect to the simulator under the stronger floor intensity. In the reactive strategy, normalized values tended to be smaller as the intensity of the floor increased. In the proactive strategy, the values stayed constant regardless of the intensity. The correlation and analysis (CORA) score showed a lower inter-subject variation and higher repeatability in higher intensity. Depending on the two strategies and movement of the head, comparison of inter-subject variation and repeatability showed statistically significant differences.

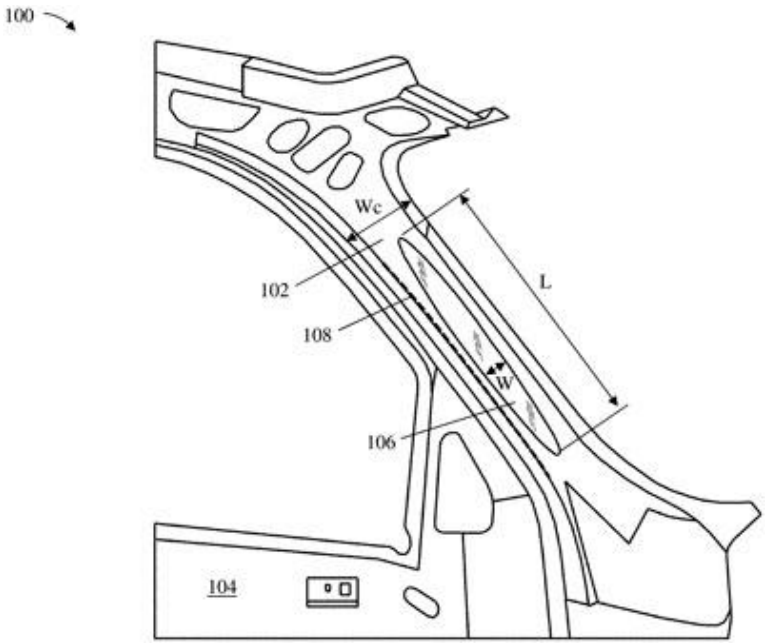
GM Patent: See-Thru Pillars for Better Visibility

INTERIOR NEWS



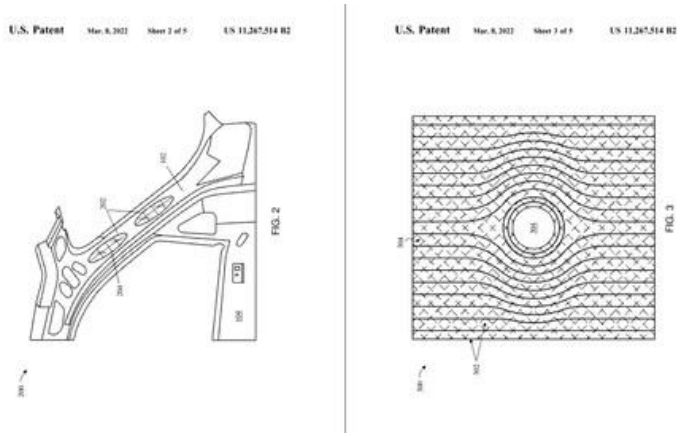
CONTINENTAL IMAGE

A new patent filing shows General Motors developing a new cabin design with see-thru A-pillars. GM's filing claims the design is intended mostly to improve driver awareness during left-hand turns (in right-traffic countries) without weakening the vehicle's crash structure.



The patent filing describes a "novel fiber-reinforced composite A-pillar that includes one or more designed openings impregnated with a transparent resin or composite," with a transparent material "disposed within the opening in the pillar body," featuring material qualities for filtering ultraviolet (UV) and infrared (IR) wavelengths, likely to protect occupants and cabin materials from sun damage.

The filing mentions the pillar support will be strengthened with an internal fiber structure, like carbon fiber, to maintain its strength. The filing also specifies that the transparent material is selected for a transmissivity of at least 50 per cent for light in the infrared (IR), visible, and ultraviolet (UV) wavelengths and a refractive index between 1 and 2 for visible light, such as polymethylmethacrylate (PMMA) or an optically transparent polycarbonate.



Transparency is not the only option to solve this issue. Continental, for example, developed a camera-and-screen setup—depicted in the image at the top of this article—that projectes an exterior image onto a screen attached to the A-pillar. Jaguar Land Rover had a transparent pillar patent in 2014; Toyota had a similar concept in 2017 that involved trick mirrors, and an American high school student **invented** a projector-based system herself—and won a prize for it.

(Patent Images: EPO)

Visteon True Color Image Enhancement

INTERIOR NEWS

VISTEON IMAGE

Visteon's product portfolio includes digital instrument clusters; displays; Android-based infotainment systems; domain controllers; ADAS, and battery management systems. Headquarters is in Van Buren Township, Michigan, and there are about 10,000 employees with reported sales around $2.8bn.

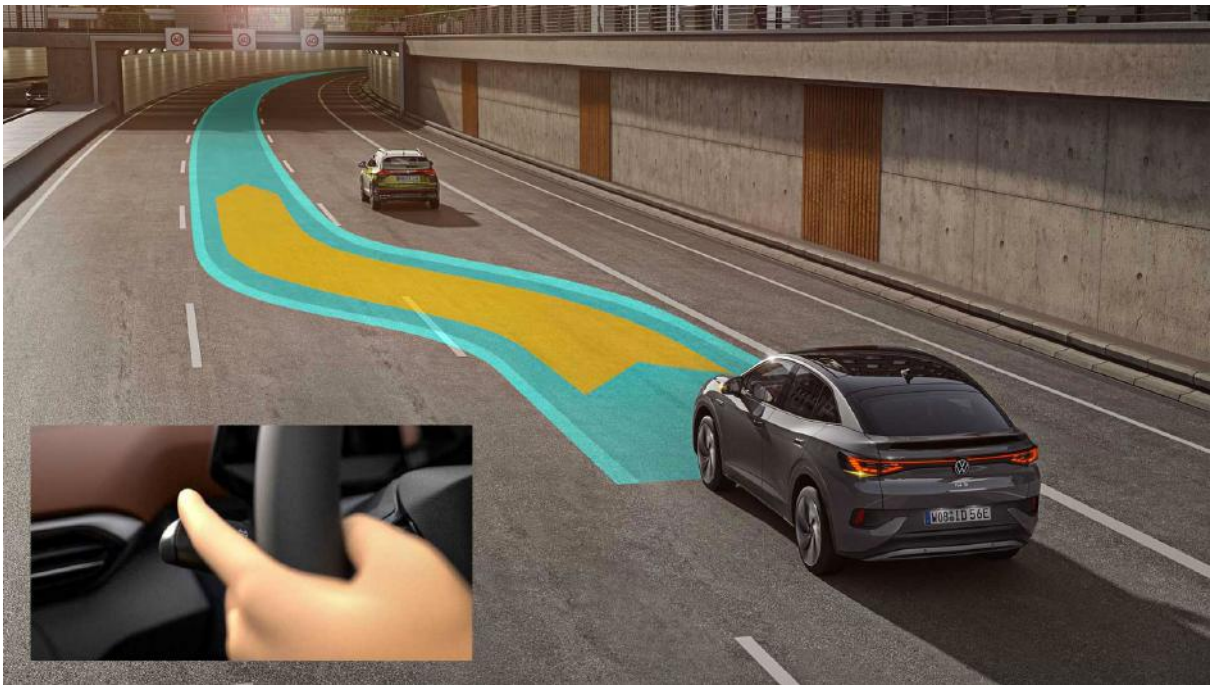
Visteon's advanced display technology brings to vehicles the same type of image quality consumers enjoy on their smartphones, televisions and other electronic devices. They've developed an in-house developed display technology they call "TrueColor image enhancement" to provide optimal visibility of HMI for all ambient light conditions.

Harsh sunlight can make it difficult for drivers and passengers to see what is being displayed in the cockpit. Visteon's TrueColor uses in-house developed technology to preserve image quality in any ambient lighting conditions a vehicle might encounter.

Visteon supports the layout and styling requirements of modern cockpit displays with unique display manufacturing capabilities featuring state-of-the-art liquid optical and structural bonding solutions. The industry's trend toward large and multi-display environments means a need for them to be curved to conform to the contours of the interior. While important for improving safety and the user experience, large, curved and multi-displays also enhance a vehicle's design aesthetic.

Volkswagen's Latest Software: Driving, Parking, Infotainment

INTERIOR NEWS



VOLKSWAGEN IMAGE

One of VW's goals is to make software more of a core competence, so they're putting a great deal of money into their own software division, Cariad. The latest major OTA update brings ID.Software 3.0 to VW's ID models, with new functions—including "Travel Assist with Swarm Data", which actively keeps the vehicle in the middle of the lane and adapts to the driving style. The assistant can maintain the distance to the vehicle in front and set a maximum speed. It also acts as a curve assistant. If a vehicle is equipped with certain radar and ultrasonic sensors, depending on the model, the assistance system can also provide active lane change assist—the vehicle steers itself into the desired lane. Drivers can take over the maneuver at any time during the process.

ID owners also benefit from the update when parking, for the new software also includes "Park Assist Plus". The system independently searches for a parking space at speeds up to 40 km/h for suitable longitudinal parking spaces and up to 20 km/h for transverse parking spaces. Then the assistance system steers the car in with the help of the environment sensors: it steers, accelerates, brakes and selects forward or reverse drive. The system can also intervene in the middle of a parking process that has begun, and it can extricate the car from longitudinal parking spaces.

As an option, the parking assistant is also available with a memory function to learn up to five parking maneuvers. It works like this: The driver parks manually, then saves the maneuver. The vehicle remembers the maneuver and can repeat it independently—handy for a tricky parking space used frequently.

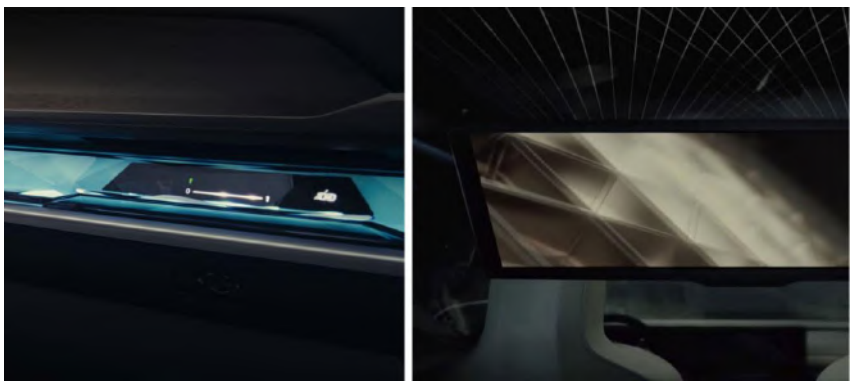
In addition to the two assistants, drivers also get new displays and innovations in the infotainment. Voice control is expected to improve significantly. The e-cars will continue to benefit from improved thermal management, more charging options, and sundry other tweaks.

BMW i7's Luxury Interior with Acoustic Optimization

INTERIOR NEWS

BMW IMAGES

BMW's electric i7 gets a huge illuminated kidney that resembles the grille of the iX. Hidden behind it are radar and lidar, required—as everyone but Elon Musk agrees—for partially autonomous driving.



BMW puts a strong emphasis with interior equipment. “My Modes" in conjunction with the new generation of the I-Drive system allows the ambiance to be individualized and fine-tuned. In addition to the BMW Curved Display, a new light and function bar in the area of the instrument panel and the doors provides a modern and haptic perception. The BMW Interaction Bar is part of the ambient lighting and also features integrated control buttons. BMW also offers the newly developed "Sky Lounge" panoramic glass roof with individually adjustable LED light threads. RSE (Rear Seat Entertainment) is provided by a retractable "BMW Theatre Screen" in the roof lining, an ultra-wide screen with a diagonal of 31”, 32:9 panoramic display format and 8K streaming resolution.

BMW is currently testing the BMW i7 at the Munich Research and Innovation Centre (FIZ) for all sound emissions and immissions (sum of all pollutants). In addition to analyzing the rolling noise and drive noise, this also includes the aeroacoustics and the drive sound for the interior as well as the tuning of the acoustic pedestrian protection. BMW calls the latter "Iconic Sound Electric" developed again by Hollywood composer Hans Zimmer.

All driving situations are simulated on BMW's test stands, which use interchangeable roller surfaces to represent the different road surfaces. To ensure that the driver and passengers inside can enjoy peace and quiet, the electric motors are specially encapsulated, but there is also the option of selecting the BMW sound for the interior. In order to also optimize noise sources from the air

conditioning or ventilation, there is a climate acoustics test bench in the FIZ that can recreate different climatic conditions.

In the acoustic wind tunnel, BMW engineers analyze the drive and tire rolling noise. Here, among other things, they integrated door handles, the optimized exterior mirrors and the almost completely closed underbody not only contribute to low air resistance, but also reduce airflow noise. BMW also simulates external noise sources (construction sites or passing trucks) in order to test the i7's noise insulation here as well. Sound absorbers in the pillar trim, the seats, the headliner and the rear shelf are contributing to insulation. Fleece inserts in the doors and the sill and wheel arch linings also optimize the insulation.

The Design Lounge

Karen Hofmann Is New Chief of ArtCenter

THE DESIGN LOUNGE

ArtCenter College of Design's Board of Trustees has named educator and industrial designer Karen Hofmann as the school's next president and chief executive officer. Hofmann, an ArtCenter alumna, is the sixth president and first woman to hold the position in the 90+ year history of the College.

Following a career in product design, automotive design including Johnson Controls, and consumer and design research, Hofmann returned to the College in 2002 to assume increasing responsibilities in education, first as an instructor, then chair of the Product Design department beginning in 2010. Hofmann was named provost of ArtCenter in 2018 and, for the last four years, has helped lead the College through significant cultural and operational changes.

Founded in 1930 and located in Pasadena, California, ArtCenter is a global leader in art and design education. 11 undergraduate and 10 graduate degrees are offered in a wide variety of art and design disciplines, including transportation design.

For seven decades, ArtCenter has educated the global design leaders who have brought beauty, innovation and meaning to the way we travel. ArtCenter graduates led the teams that created the iconic cars of the '40s and '50s; the muscle cars of the '60s and '70s; supercars; family cars, and a majority of the new concept cars unveiled at major motor shows each year. They have created vehicle interiors that fuel our passion for driving, keep us safe, inform and entertain us. As dedicated problem solvers, they are addressing new challenges shaping the future.

News Mobility

California's Plan to Electrify Ride-Hails Burdens Drivers

NEWS MOBILITY

A 2030 target for electric vehicles to dominate ride-hailing is an exciting goal. But it's the drivers, not the companies, who may have to pay for the bill.

A new California rule called the Clean Miles Standard says by 2030—five years before the state hopes to stop sales of ICE vehicles—companies like Uber and Lyft must make sure at least 90 per cent of all the miles driven in the state are in electric vehicles.

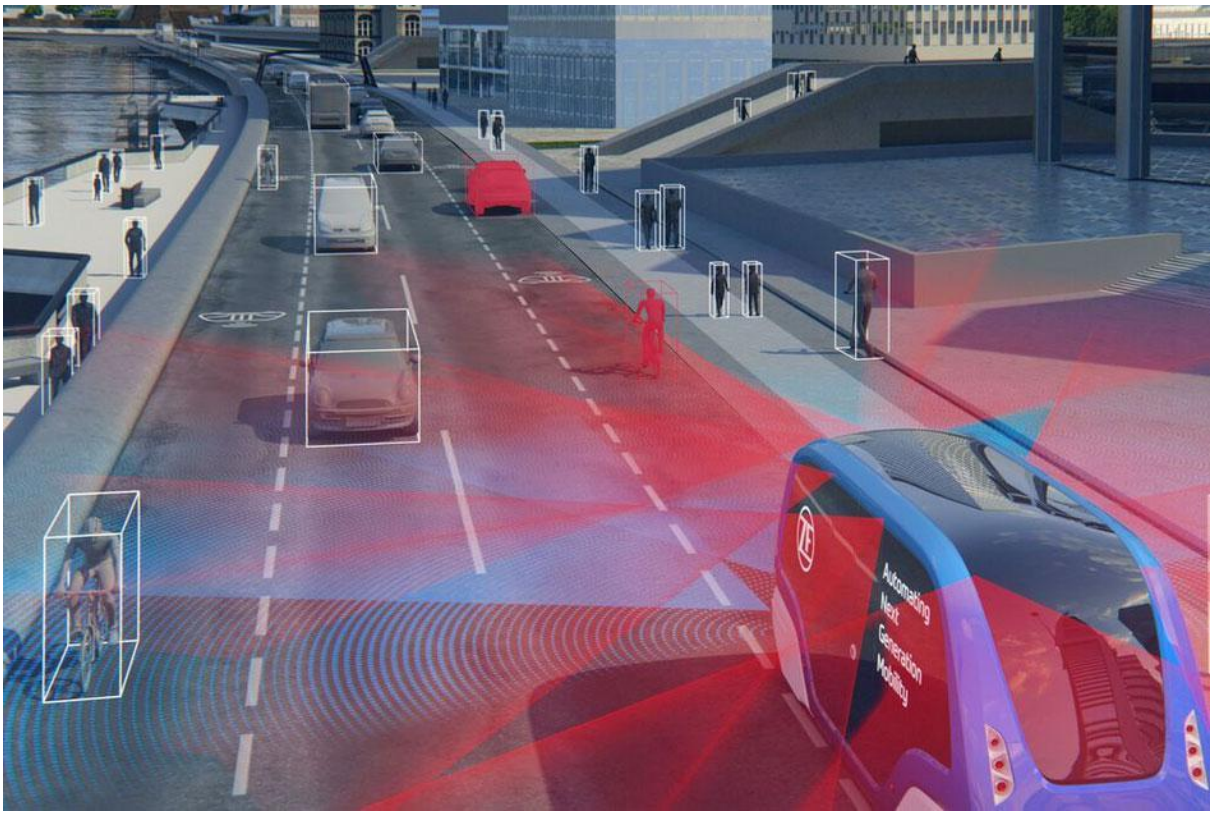
But it's not the companies who will have to pay for this change; the burden would likely fall on an already encumbered group of independent workers. In the US, and in most other countries so far, ride-hail drivers are independent contractors, responsible for financing and maintaining their own vehicles. And right now, electric vehicles are expensive, and semiconductor shortage is driving up prices even more.

Uber says they will spend $800m by 2025 to help drivers transition to EVs. One program pays drivers an extra dollar per fare they pick up in an electric vehicle. In some cities they offers another program, called Green, that allows riders to pay extra to take an electric ride. Uber says they currently have almost 15,000 drivers in zero-emission vehicles on their app worldwide, though the majority of those are in Europe.

Therefore, the overall business model to shift ride hailing fleets to electric doesn't look promising as it relies on driver individual willingness, even though helped by some government or Uber/Lyft incentives. Perhaps there's a new business model waiting to be invented!

ZF Buy Into StradVision for Mobility in Bad Weather

NEWS MOBILITY



ZF-STRADVISION IMAGE

ZF has acquired 6 per cent of the shares in StradVision, a South Korean software company specializing in image processing with artificial intelligence for automated vehicles and driver assistance systems. StradVision software enables objects such as other vehicles, lanes, pedestrians, animals, traffic signs and lights to be detected and identified even in difficult weather conditions or poor lighting.

The software relies on perception algorithms based on deep learning, which require relatively little memory and consume little energy. In addition, according to ZF, it can be adapted and optimized for a variety of different hardware platforms.

The StradVision software is already being used in large numbers in assisted or autonomous driving vehicles. ZF's head of electronics and ADAS development Marc Bolitho says "Together with our sensors, our middleware platform and our high-performance computers, StradVision software is a key component for perceiving the environment of automated vehicles such as shuttles or commercial vehicles".

General News

Lear Buys Kongsberg's Interior Comfort Systems Biz

GENERAL NEWS

Lear Corporation, a leading provider of seating and E-systems, has finished buying all of Kongsberg Automotive's Interior Comfort Systems (ICS) business unit. The acquisition will further advance Lear's seat component capabilities and expand product offerings in increasingly popular thermal and comfort seating solutions, such as seat heating and ventilation, and massage and lumbar support.

Lear was ranked № 12 in the Top 100 Automotive Supplier in 2019, with a revenue of approx. €18.5bn.

Kongsberg Automotive's product portfolio includes driver and motion control systems, fluid assemblies, and industrial driver interface products. They have about 11,000 employees in 19 countries, with 27 production facilities.

Lear acquired the ICS business unit for €175m, on a cash and debt-free basis, funded through debt financing completed in fourth quarter 2021. The ICS business unit brings operational leadership personnel and more than 3,800 employees working in four production facilities and four technical centers on three continents. It is expected to generate revenue of approximately USD $200m this year.

Lear president and CEO Ray Scott says his company is "leading an era of unprecedented evolution and growth in automotive seating innovation. As automakers look for greater product differentiation, increased efficiency and improved performance—especially in the luxury, SUV and electric vehicle segments – Lear is offering seating with more integrated thermal and premium features. We are excited to welcome the ICS team to Lear. With a well-earned reputation for talent and experience, the team is a valuable addition to the Lear family".

Washington State Sets Earliest ICE-Phaseout Target

GENERAL NEWS

TRAFFIC ON SEATTLE'S ALASKAN WAY VIADUCT - IMAGE: NPR

Washington State has set a 2030 target to end sales, purchases, and registration of new cars powered by gasoline or diesel engines. It's the earliest such target in the whole USA, five years ahead of 2035 deadlines established by other states like California; New York, and Massachusetts, and earlier than Europe or COP26 (2035-2040), and automakers' product plans

The “Clean Cars 2030” legislation also creates an interagency council given a deadline of 31 December 2023 to devise a plan for achieving the 2030 target.

The war on Ukraine and high gasoline prices "demonstrate the importance of ending our dependence on gasoline and preparing for an all-electric transportation future", says Matthew Metz, co-executive director of Coltura, a Seattle-based nonprofit that lobbied for passage of the legislation.

EPA data shows there was nearly a 23 per cent increase in transport-related emissions from 1990 to 2019, the largest documented increase of all industries tracked by the agency,

According to a report prepared for AAA Washington, reaching a goal of only zero-emission passenger vehicles in the state by 2030 would require a 40 per cent annual increase in EVs. EV registrations have increased 188 per cent since 2016. Adjusted for population, Washington’s EV registrations are 5.6 per cent, second only to California’s 8 per cent.

Legislation setting a 2030 goal for EV-only sales also has been introduced in Rhode Island and Hawaii. The federal government in Canada has said it will outlaw new gasoline and diesel vehicle

sales by 2035, while the Biden Administration has set a target of achieving 50 per cent EV market share in the U.S. overall by 2030.

These first 2030 targets shows that the automotive industry electrification will most likely to accelerate as petrol becomes scarcer and more expensive.