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Low-carbon fuels: can new tech deliver on old promises?

Drop-in synthetic eFuels could make dirty ICE a thing of the past



ALSO: Nissan Ariya makes EV trek from pole to pole

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eFuels are fighting to be the alternative to the alternative of electric propulsion in the carbon-free future. (Image: eFuels Alliance)



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The future is back

As I was working on this issue's cover story — a look at the current state of low- and no-carbon fuels and the potential they hold — the cyclical nature of life made itself readily apparent (once again). I will warn those of you who were involved in the automotive industry a decade or two ago that you might experience similar flashbacks when you read about how eFuels could, if everything works the way it's supposed to, provide a way for much of today's internal combustion engines to power legitimately zero-new-emission vehicles, especially in regions of the world where EVs don't yet make sense.



That's great. Well, it sounds great, at least. The many promises made by producers and researchers of synthetic fuels sound strikingly similar to what the companies supporting biofuels were saying back when George W. Bush was still president. The fuel is cleaner, they said. We can keep (some of) the same infrastructure, or just modify it slightly, they said. This will work with EVs to make the whole future brighter. That was the message.

Obviously, ethanol and biodiesel have not taken over the world's gas stations. Just ask the Coskatas, BioWillies and Solazymes of the era. There are, of course, notable technical differences between those biofuels and the nextgen eFuels that some automakers and oil companies are researching today. I'm not trying to compare them directly to find out which is better. The point is, things often move in cycles. As different as the auto industry is from where it was in decades past, certain ideas just cycle their way in and then back out before returning.

Design touches offer a few easy-tospot examples. Take the PT Cruiser's retro look at the turn of the century or the way the just-revealed Rivian R3's silhouette could be mistaken for an Audi Quattro coupe from the 1980s at a distance. But I'm most interested here in the cycle where we repeatedly search for workable alternatives to petroleumbased fuels. It's not just the next generation of synthetic fuels where one can spot the repetition. Engineers worked on building a modern electric vehicle decades ago, and then they stopped. And then they started again. At this point in the story one has to, of course, mention the great success EVs had in the early days of the automotive industry. Same with hydrogen. When GM talks about its latest hydrogen advancements, it often includes a mention of its first H2 vehicle, the 1966 Electrovan.

We're not going in circles. We are on the precipice - and stop me if you've heard this before, but doesn't it feel real this time? - of actually shifting our transportation options away from fossil fuels. When I look back on the path we've taken, it reminds me not of a straight line where we made all the perfect executive decisions and product plans and engineering efforts the first time. Instead, it's an odd spiral that reveals all the times we've circled back to something we tried before, but that now thanks to some new technology or a changed regulatory reality, it's time to try again. It's herd behavior. We can't yet quit fossil fuels, in part because our system was designed with their energy density as the standard, but if history tells us anything, it's that we will keep trying.

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AUTOMOTIVE ENGINEERING

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SUPPLIER EYE

New Keys to Success

uch has been written about the extraordinary vehicle production and market environment of the past four years in North America and beyond. The plethora of negative impacts from COVID, chip availability, scarcity of labor, inflation, shipping disruptions and union/OEM disputes can all be boiled down to what's best described as an "operational hell." Everyone is happy to put this all behind us.

The dawn of 2024, at least for North America, has enabled some stability from a volume perspective as the industry slowly rebuilds inventory and adjustments are made to the pace of BEV volume buildout over the next couple of years. This should offer some familiarity and a welcome breather from the highly unpredictable environments we've seen since late 2019. That being noted, there's a question in the air about the new, inexperienced challenges that might lurk around the corner.

As one carefully peers ahead, what are the levers of success for the supply base? Are they the same as in the past or have recent events, the addition of several new OEM (and supplier) players and the secular shifts towards new propulsion forms changed the playing field? Let's outline a handful of core considerations that apply to virtually every supplier as they build strategy.

The Crossover – New vs. Old

The industry has or will be launching several new BEV-only or "multi-energy" platforms through this decade. At issue will be the underlying volumes OEMs need to drive improved economies of scale (and therefore lower costs) versus the ability to sell these profitably given consumer acceptance.

As outlined a couple of columns back, this ongoing balancing act of required production volumes (necessary for OEMs to drive scale) and forecasted production volumes (consideration of real-world market dynamics) drives suppliers to renew their focus on program-level profitability and capital efficiency. If a BEV program is



Michael Robinet Executive Director, Consulting, S&P Global Mobility

SAE Foundation Trustee michael.robinet

If a BEV program is delayed or reduced, you can bet that in most cases an ICE-focused entry will be filling the gap. delayed or reduced, you can bet that, in most cases, an ICE-focused entry will fill the gap. Mastering BEV delays vs. ICE extensions will be key for suppliers this decade.

Operational Efficiency

To achieve economies of scale as we transition to new BEV-format platforms and eke out more volume from existing ICE structures, suppliers must be flexible and operationally efficient. Using a "less is more" philosophy is key. Where in the past an organization may have been somewhat looser with capital and resource allocation, strong volumes can hide inefficiencies. One should not count on this past luxury. Hard choices may increasingly be required in an environment of accelerated volume instability and the relatively high cost of capital our industry faces.

Trade, Tariffs and Labor Costs

Building for several years, though propelled by COVID and recent inflation flareups, are rising labor costs. Before last year's UAW and Unifor agreements, suppliers were already feeling the impact of higher hourly costs, poor labor availability and the requisite cost of quality with high turnover. Virtually no company has been immune from rising costs and altered benefit structures that impact overall costs. For many, increased automation is the only answer.

New trade regulations (U.S. IRA), specific tariffs (like the 25% parts tariff on China-sourced products) and a host of other protective tariffs add to the hurdles companies must overcome going forward. Though many are well-intentioned, obstructions add to the cost of doing business with fewer options as several regions turn inward.

While many of these obstacles are re-emerging from the past, together they portend a new ecosystem that must be navigated. Smart suppliers will have Plans B and C ready if the situation demands alternatives. To paraphrase my hockey coach, suppliers should keep their heads on swivels.



Hydrogen and Alternative Fuels Summit 2024



A Two-Day Event from the Leaders in Mobility Standards

SAE International's **Hydrogen and Alternative Fuels Summit** returns this May to help companies creating the future of mobility understand the tactical decisions they can make now to advance alternative fuels initiatives.

Topics covered during the FREE event include:

- The latest updates to the hydrogen industry
- Utilizing hydrogen fuel cells to reduce energy costs and improve availability
- Hydrogen's role in sustainable aviation
- Recent research findings on hydrogen for ICE vehicles
- Affordable hydrogen fuel cell powerplant technology
- How national strategies and regulations are driving the hydrogen market forward

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Sumitomo Sensing Core: a sensor-free smart tire



Sumotomo's CES 2024 booth was designed around promoting the Sensing Core tire system.

Sumitomo Rubber Industries first announced its Sensing Core technology in 2017. But it wasn't until 2024 that the Japanese tire maker used its debut appearance at CES to promote the sensor-free signal analyzer.

Sumitomo president and CEO Satoru Yamamoto said the company exhibited at CES, "to expand our partner companies and to get more drivers and companies to know about this sensing core technology."

Sumitomo's vice president of technical, David Johansen, said 2024 could be a big year for Sensing Core. Johansen told SAE Media that the complete feature set presented at CES will be available later in 2024, and Sumitomo is looking for more partners to add to the "couple of contracts" Sumitomo has already signed.

"This is not something that we want to do stand-alone," Johansen said. "We need to partner with the vehicle manufacturers or with a fleet to be able to apply this tool. We really want to grow this over the next six years. There are definitely targets for 2030 to have this very widespread. They're looking at over 150 billion yen [\$1B] in sales by 2030, selling the software to the OEMs."

Built on DWS

Sensing Core is built upon Sumitomo's Deflation Warning System, which already has 50 million sales to 25 OEMs, including 3.6 million in 2022. The DWS software can detect various tire conditions without additional hardware – not even TPMS sensors. In August 2023, Sumitomo and Viaduct, an AI-powered connected vehicle analytics company, announced a partnership to use Sensing Core for predictive-failure services.

DWS and Sensing Core both use an indirect tire pressure monitoring system to analyze tire rotation signals and can detect changes in tire air pressure. Sumitomo works with brake manufacturers to install Sensing Core software on the brake ECU. Since Sensing Core is purely software, it can be installed in one of three ways: as a stand-alone system on the vehicle ECU, as a cloud-based system that adds shared information from other vehicles or as a cloud installation that uploads essential signals from the vehicle for analysis.

"We're actually not installing sensors, directly," Johansen said. "We're using our knowledge of tire dynamics and then taking advantage of that, using the vehicle ECUs and the CAN to actually take the data from the vehicle itself that gives us the rotational speed, mu slip and more [and filter it for] a baseline differential."

Newly installed tires need a few minutes of what Johansen called "teaching time," where the system sets the baseline rotational signal. "Then we're able to actually look for differences from that, and then translate that into a pressure differential," he said. "If you look at the tires' slip and braking force, you can do a mu slip type of curve and identify the slope in that transitionary area. And then, basically, a change in slope will identify a change of grip, so we can use that to detect road conditions or if the tire is worn."

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Software-based data analysis is the key to Sumitomo's Sensing Core technology that can detect road conditions, tire air pressure and even potential wheel detachment.

While both these problems would show up as slippage, a Sensing Core system samples conditions every 20 milliseconds and can therefore determine between poor road conditions – which show up as transient events – and tire wear, which appears as a more gradual decrease over time.

Another use case: wheel detachment warning

A Sensing Core system can detect other potential problems, Yamamoto said, including torsional force that could cause

wheel detachment, the load on the tire and the degree of tire friction occurring on a circuit.

TECHNOLOGY REPORT

"Detachment is not something that we deal with here in North America, but in left-hand drive countries, because of the crown of the road, when they're actually breaking braking, they're going in an opposite force from the direction that the lug nuts are torqued," Johansen said. "It's a serious issue in some left-hand drive countries, where the wheel lug nuts get loose, and the whole wheel comes off. So, that's one of the features that has been a key focus for us in China and in Asia, primarily."

Sumitomo is focused on different regions for different applications, Johansen said.

"There's a strong synergy between Sensing Core and electric vehicles and, in the future, towards autonomous vehicles," he said. "The U.S. is really the third-largest market for that, so right now, we've been working with China. We've [also] got relationships with car makers in Japan. The U.S. has the largest size of fleet management, and this software can also be used from a maintenance standpoint for the operator of the fleet to be able to track pressures, track wear, take a look at any other conditions that may signal that a vehicle needs to go down for service, something to take care of before it actually becomes a roadside event."

Sebastian Blanco



SIGNAL PROCESSING

Neural Propulsion Systems claims significant radar breakthrough



Behrooz Rezvani, founder and CEO of **Neural Propulsion Systems**, cuts to the chase quickly. "We can improve the performance of any radar and help it see clearer, farther and sooner," he said. Using a mathematical framework initially discussed in an MIT research paper 14 years ago, Rezvani says his company can take any manufacturer's radar unit and help it:

- Increase resolution by a factor of 10 for two-dimensional imaging
- Suppress 10 times the number of false positives
- Detect targets at twice the current distance with a lidar-like point-cloud density
- Differentiate notoriously difficult targets, such as pedestrians walking or standing next to parked vehicles

NPS Executive Consultant Lawrence Burns, the former head of GM research and development, has seen plenty of advancements during deep involvement with the development of night vision and adaptive cruise control. But he always knew existing radar systems were not yet the answer for the future needs of hands-free driving and other features.

Rezvani said that the company's al-

gorithm allows for signal parsing at very near the mathematical limits. "At MIT, there was a breakthrough that gets us to the theoretical limits of parsing," he said. That breakthrough recognized the usefulness of frameworks called atomic norms, first discussed in a 2010 paper later updated in 2012.

Ben Recht, now a professor of electrical engineering and computer science at UC Berkeley and one of the original paper's authors, wrote this as an introduction to the topic: "Many signals and systems that we commonly acquire and analyze can be expressed as linear combinations of a few basic building blocks. For example, radar signals can be decomposed into a sum of elementary propagating waves. Atomic norms provide a framework for estimating these sorts of signals with very few sensors or very fast acquisition times by solving convex optimization problems.

"In the atomic norm project, we are interested in exploring the fundamental limitations of optimization methods in data analysis and how these theoretical techniques mesh with the myriad of complex systems and signals that we encounter in practice."

NPS founder Rezvani followed by saying the company's software could optimize other sensors, including lidar. But radar tech is cheaper – and NPS software can work with fewer chips.

Babek Hassibi, the company's CTO, explained the difference in the software: "The breakthrough here is a totally new way of looking at radar signal processing. The algorithm looks at the received signal and says, 'If I wanted to describe this as a collection of reflections of point targets, where in space are they? What are the distances? What is the azimuth? What are the elevation angles? If there's motion, what are the speeds? It does it all at once.

"Lidar people like to talk about resolution. What many don't talk about is

NPS Software running on Texas Instruments (TI) Radar HW

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The results of Neural Propulsion's software running on standardized Texas Instruments radar equipment.



Pedestrian & Car Separation - (High Dynamic Range)



- NPS Software reliably resolves pedestrian from car at (70% of the time) at 0.55 degrees
- TI Reference Processing does so at 3.3 degrees
- This is 6X improvement in performance

ghosts," he added. "False positives can lead to emergency braking, which can lead to bad things (such as rear-end accidents). How do you relate measurement to what is critical to safety? With radar, the larger the aperture, the narrower the beam you can create to determine whether something is one object, two objects, et cetera.

"What you can't do is miss something. A car, pedestrian or bicyclist," he continued, making the point that one of NPS' triumphs is being able to consistently detect a pedestrian next to a vehicle.

VPS

"That's one of the instances where someone is trying to change a tire. It's an actual specification of some of the safety requirements." He says the software is six times better than a baseline system at detecting a human and also is adept at identifying two separate pedestrians instead of indicating only one target. "This is what I think is going to broak

"This is what I think is going to break the logjam of mass deployment. You can get [an angular resolution of] 0.5 degrees or less and it can be affordable. Every asset that we can check says 'yes,' this is the answer." From a business standpoint, Rezvani said that despite use of a public concept, he isn't worried about being overtaken by another company. "No other company can leapfrog our tech because there is a fundamental limit to how close you can get to those theoretical limits," he said.

The company is working with and has an investment from an OEM it can't disclose and says the U.S. Army just approved a research proposal for a defense application the company is exploring in partnership with Raytheon.

Chris Clonts



MANUFACTURING

Porsche study: Europe missing out on tooling battery gigafactories

A study examining the prospects for supplying manufacturing tooling for the scores of EV battery "gigafactories" scheduled to be built worldwide found there are opportunities for Europe-based mechanical and production-engineering firms. But it also serves as a warning that China-based engineering companies have established deep foundations in the vertical integration typical of gigafactory construction – foundations that may prove difficult to shake.

The study, "Battery Manufacturing 2030: Collaborating at Warp Speed," was conducted by Porsche Consulting in collaboration with the German Mechanical Engineering Assn. (VDMA). It determined that, worldwide, there are approximately 200 EV battery gigafactories either planned or currently under construction. "At the moment," the study blunted concluded, those battery manufacturing facilities "are mainly equipped with production technology from Asia. Chinese machine builders are currently setting the standard as fullservice providers. Only eight percent of the high-tech equipment in such factories comes from Europe."

In a release, the VDMA said it represents more than 3,600 German and



Battery developer and manufacturer Northvolt's Ett (One) battery plant in Skelleftea, Sweden, is claimed to be the European continent's first battery gigafactory.

European companies in the mechanical and plant-engineering sectors, companies that employ approximately three million people in the European union, including more than 1.2 million in Germany. The study warned that Europe's 8% share of the market for battery-factory equipment "is too low to have a significant influence on technical development and to create a second cluster for battery technology that is based in Europe. This would require a permanent market share of about 20 percent."

The study's analysis indicated that collaborations such be a focus of the European plant-tooling industries. "Only



Lithium-ion battery cell production at Volkswagen's Salzgitter, Germany, plant, which is targeted to come on stream with production-vehicle battery cells in 2025.

if European mechanical engineering firms succeed in jointly offering integrated factory solutions will they be able to hold their own against the competition from Asia," said Gregor Grandl, Senior Partner at Porsche Consulting and co-author of the study. "Technologically, European industry is on an equal footing," he continued, "but

on an equal footing," he continued, "but companies from China are already offering turnkey battery plants."

"Customers' exacting requirements for turnkey suppliers require a rethinking in the ramp-up phases for this industry," said Stephan Eirich, President of **Maschinenfabrik Gustav Eirich GmbH**. "This poses new challenges even for experienced machine and plant engineering

firms, but we're up to the task." The study said the market for machinery and plant manufacturers in the battery sector alone is 300 billion euros between now and 2030. To maintain Europe's current market share 8% during this period of rapid gigafactory construction, the study determined a growth rate of 33% per year would be necessary and to attain a 20% market share. companies would have to grow faster than the market. "Success in this competitive environment would secure Europe permanent access to the important future technology of batteries and create many jobs in the process," the report indicated.

The study can be downloaded at: www.porsche-consulting.com.

Bill Visnic

EV TESTING

All-electric Nissan Ariya handles ultra-cold temps on Pole to Pole trek

Chris and Julie Ramsey covered more than 33,000 km (20,505 miles) across three continents in an all-electric passenger vehicle from 1823's magnetic North Pole to the South Pole in a world-first expedition. The Scottish adventurers joyfully recounted their 10-month long globetrotting feat during an interview with SAE Media at the 2024 Chicago Auto Show.

The Ramseys' four-wheel transporter was a production 2022 **Nissan** Ariya e-4ORCE crossover SUV with no changes to the drivetrain, suspension system or 87-kWh lithium-ion battery system. "We wanted to keep the modifications minimal to prove the reliability of a standard EV," Julie Ramsey said.

Engineers from Reykjavik, Iceland-headquartered **Arctic Trucks** added a full underbody skid plate, installed front and rear towing points and altered the Ariya's wheel arches to accommodate 39-inch (991 mm) tires. Those colossal tires rolled at 4 psi to handle the Arctic's snow-covered boulder fields and slick ice. The coldest temperature at Earth's northernmost region hovered around -39C/-38 F degrees and plummeted to bone-numbing -53C/-63F degrees with wind chill.

"The car charged every time," Julie Ramsey said. "It might not have charged at the same rate and speed as if it were in normal temperatures, but it did charge." In the brutally frigid Arctic, the team typically charged the weather-exposed Ariya in six- to eight-hour periods.

With charging stations non-existent in the polar regions, the Ramseys' relied on prototype mobile hybrid charging systems: a 5 kW wind turbine that powered a petrol generator in the Arctic, and solar panels to supply generator power in Antarctica. "When we had good sun for the solar panels, we used about a third less of the fuel than if we were just running the generator," Chris Ramsey said.



Julie and Chris Ramsey flank the Nissan Ariya that went Pole-to-Pole over a 10-month span in 2023. The couple, who reside in Aberdeen, Scotland, also drove a modified first-generation Nissan LEAF with a 24 kWh battery system in the 10,000 mi/16,093 km transcontinental Mongol Rally in 2017.



Chris and Julie Ramsey take a self-portrait during their Pole to Pole electric vehicle expedition. "This car performed superbly," said Chris Ramsey.

During the Ariya's development, Nissan tested the EV in Japan's snow-covered northernmost main island. "The Ariya [also] underwent real-world testing in Canada in sub-zero temperatures," according to James Mastronardi, vehicle performance development manager for marketability engineering at Nissan Motor Co. The extreme cold temperatures encountered on the Pole-to-Pole EV excursion left the Ramseys with an occasional pang of range anxiety.

While Ariya's driving range can reach 304 miles (489 km) when equipped with e-40RCE all-wheel drive and the 87-kWh battery system, the driving range of the 109.3-in (2776 mm)-wheelbase utility vehicle was roughly halved (to about 150 miles, or 241 km) in the Arctic, and sometimes dropped as low as 62 miles (100 km), according to the Ramseys. "The terrain is very variable," Julie Ramsey said. "It can change from hour-to-hour, so that also has a big impact on the car's range capability."

In addition to using experimental hybrid charging systems at the Poles, the Ramseys primarily relied on public charging stations in the 14 countries the expedition passed through. The Ramseys were stymied by the unreliability of many public charging stations in the U.S. "What let us down was the infrastructure to charge the car. That part needs improvement, but the car performed amazingly." Julie Ramsey said.

For Nissan, the official car partner of the Pole-to-Pole trip, the successful expedition brings additional confidence to Ariya's capabilities and its innovative technologies, which include a dedicated battery heater to prepare the Li-ion battery system for charging. "Having an understanding of how Ariya performed in extreme cold weather conditions, like the North to South Pole expedition, is something that will help us in our future development of electric vehicles," Mastronardi said.

Kami Buchholz



Introducing new Concept CLA, Mercedes says Europe, North America charging to rapidly get better

When it displayed its Concept CLA Class for the first time in North America at CES 2024, **Mercedes-Benz** focused on the car's merging of novel user-experience, new all-encompassing operating system and a radical sound-system concept – all as examples of the company's intent to own its software-defined destiny. But the Concept CLA Class is more than a software story: it also is the showcase for the upcoming Mercedes-Benz Modular Architecture (MMA) that underpins the company's imminent new generation of compact, entry-level EVs.

In a roundtable interview with media during CES, Christoph Starzynski, vicepresident – development, Mercedes-Benz Cars, said several of the hardware innovations in the Concept CLA Class are central to improving EV performance across many segments, not just entry-level models. The concept car, he said, previews next-generation hardware that will be available when the production CLA models begin later in



Mercedes-Benz is preparing its new entry-level EV platform previewed by the CLA Class Concept revealed in fall 2023.

2024 to replace the current-generation CLA, which has been in the market for some six years.

"From the e-drive perspective, [the production CLA is] going to be a completely new e-drive," Starzynski said. The CLA Class Concept showed this new MB.EDU, or Mercedes-Benz Electric Drive Unit, driving the vehicle's rear wheels, although the current CLA models are front-wheel drive. The company has confirmed that there will be internal combustion-propelled variants of the MMA platform, however, so it may be possible IC variants will offer front-drive configurations, while EV versions offer



Battery technology developed for the EQXX hyper-efficient concept car will play a role in coming production models.



single- or dual-motor layouts.

The company said the CLA Class Concept's permanent-magnet traction motor borrows from the technology shown in the hyper-efficient Vision EQXX Concept; its motor makes virtually no use of rare-earth minerals. In the CLA Class Concept, the single rear-axle motor makes 235 hp, but also is coupled with a 2-speed gearbox, which apparently helps to achieve the 750-km (466-mi) WLTP-cycle maximum driving range the company quoted when it first revealed the CLA Class Concept in fall 2023.

"The e-drive is something which we will roll out then to our EVs, especially from the motors," Starzynski continued. "The motors and the battery are going to be completely scalable." More efficiency also is achieved with the platform's 800-volt architecture. He added that axial-flux traction motors will, at least for now, remain the exclusive province of AMG performance models, but in the future axial-flux motors may be used when a blend of performance and efficiency is appropriate.

Charging education

"We are doing a lot- not only in the U.S., but especially here - to educate people on the charging topic. He said the U.S. is a patchwork of charging services that invariably is confusing to a new EV customer. "It's even more complicated in Europe," Starzynski asserted.

"We made a decision, 'Okay, we have to go our own way now.' He mentioned that Mercedes-Benz recently inaugurated the \$1 billion Ionna network with six other automaker partners "and obviously we're adopting or offering the Tesla charging network. So, we're basically now using the entire infrastructure to just give every opportunity to a customer to charge the most convenient way.

"We conquested a lot of customers – which have decided to go the EV route a couple of years ago – back to the brand," Starzynski continued. "And that was the main purpose; the main purpose was not to take S-Class customers to the EQS. Basically, take and conquest other customers to Mercedes. So this is a big success, especially in the United States – we brought back a lot of customers who made already the decision to go to the EVs."

He also mentioned North America's first Mercedes-branded Charging Hub near Atlanta that became operational in

early 2024. "Now, for the new customers, especially also new EV customers, obviously what we are doing is basically helping them to understand how electric mobility works."

Bill Visnic



ROAD READY

2025 Kia Carnival MPV Hybrid brings unplugged PHEV power

The 2025 **Kia** Carnival MPV is acquiring a hybrid powertrain as part of the minivan's model year update that debuted at the Chicago Auto Show. The internal-combustion engine option remains the 3.5-L V6 GDI seen in the current Carnival and produces 287 hp and 260 lb-ft (353 Nm) that powers the front wheels through an 8-speed automatic transmission. Engine power is down slightly from the output of the V6 in the 2024 model (290 hp and 262 lb-ft [355 Nm]).

It's the addition of an electric motor to the new hybrid model where things get interesting. The hybrid Carnival uses a 1.6-L turbocharged 4-cyl. and a 54 kW motor that produce a combined 242 hp and 271 lb-ft (367 Nm). The Carnival Hybrid MPV uses a 6-speed automatic transmission. Improved fuel economy is one reason for the new hybrid option. While Kia doesn't yet have official EPA estimates, a spokesperson told SAE Media that the target is 32 mpg combined. The current ICE-only Carnival gets 22 mpg.

The revised 7- or 8-passenger Carnival receives additional benefits from the hybrid system. Using a unique 54-kW electric motor that was initially



developed for plug-in hybrid powertrains using the same platform – such as the Sorento PHEV – the motor is used not just to enhance acceleration at lower speeds but also for some of the Carnival's chassis-control functions. "E-Handling" uses the electric motor braking power to improve cornering agility and stability. E-Evasive Handling Assist helps control load movement on the front and rear wheels during emergency steering for



For 2025, the Kia Carnival gets a new hybrid powertrain using an electric motor originally designed for PHEV models.

better evasion performance. Finally, E-Ride improves ride comfort by automatically adjusting damping as the vehicle goes over bumps.

"It's all because you have an electric motor," the Kia spokesperson said. "It's able to apply the capabilities of electric motor differently. If you're going over a speed bump with the front wheels, it can use electric braking to slow the front wheels. It can also use the drive motor to accelerate when the rear wheels are going over the bump. This way, overall ride comfort is smoothed."

The new Carnival MPV will come with standard Forward Collision Avoidance (FCA) Assist as well as available options that build off of the FCA technology, such as Junction Crossing (FCA-JC), Lane-change Oncoming (FCA-LO), Lane-change Side (FCA-LS); and Evasive Steering Assist (FCA-ESA). The updated minivan will also come with Kia's Highway Driving Assist 2, a navigation-based smart cruise control and Intelligent Speed Limit Assist (ISLA).

The Carnival hybrid also gets exclusive aerodynamic 17-inch (432-mm) wheels and offers three levels of regenerative braking controlled by a paddleshift lever. The 2025 Kia Carnival is expected to go on sale in the middle of this summer.

Sebastian Blanco

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eFuels: An Alternative to the Alternative

Low-carbon fuels promise greener alternatives, but can they deliver? The 2024 Toyota Mirai requires hydrogen to refuel. In early 2024, Shell announced it would close many of its stations in California and scale back its expansion plans.

ven as electric vehicles dominate today's alternative powertrain market for passenger cars, the future of how we will all someday drive without burning petroleum is cloudier than ever. To decarbonize transportation, governments and companies around the world are promoting various future technologies, including hydrogen and synthetic fuels, as alternatives to the alternative.

In the U.S., the road to a hydrogen future recently hit a few roadblocks. In February 2024, Shell announced it would dramatically scale back its H2 refueling station plans in California and close some of its few stations. This dealt a blow to local H2-vehicle drivers as well as the state's plans for a robust hydrogen infrastructure. When Hyundai announced in October 2021 that it would support Shell's plans to add 48 additional H2 refueling stations in California, it said that "hydrogen refueling infrastructure growth is critical to rapidly increase consumer adoption of zero-emission fuel cell vehicles."

The link between stations and sales might explain why, at around the same time as the station closures were announced, some **Toyota** dealers in California started slapping \$40,000 incentives onto one of the only hydrogen-powered vehicles available in the U.S., the 2023 Toyota Mirai, which has a starting price of just over \$50,000. Toyota told SAE Media that it remains committed to hydrogen fuel cell technology "and that it can be a zero-emission solution across a broad spectrum of products and vehicle types." In private presentations, Toyota has hinted that a third-generation Mirai is on the way. The company also offers them in Japan and Europe.

So it's good news that all things H2 appear to be progressing better in Europe and Asia. **The Hydrogen Council**, a group of dozens of hydrogen industry companies and supporters, released an update to its regular Hydrogen Insights project in December 2023. The update said that there have been 1,400 hydrogen projects announced globally through 2030, with Europe the site of 540 of those. North America was second with 248. Still, the Council noted that "the clean hydrogen industry is facing headwinds" regarding the cost and expectations of producing renewable hydrogen. The rise has "caused a slower development of the global hydrogen industry than had been previously expected. Such hurdles are reflected in, for instance, a 10% drop in announced clean hydrogen supply through 2025."

Enter eFuels

This brings us to synthetically produced liquid fuels, sometimes called eFuels. Supporters say these fuels take CO2 from the atmosphere and use renewable energy to produce a climate-neutral replacement fuel, which could mimic gasoline, diesel, airplane fuel, or other liquids that currently require petroleum.

Among automakers, Porsche has been one of the most vocal proponents of synthetic fuels, spending more than \$100 million on developing and producing eFuel. Porsche partnered with Chilean company HIF Global (Highly Innovative Fuels) to build a pilot plant to produce synthetic fuels that are "potentially nearcarbon-neutral." The plant in southern Chile creates synthetic gasoline and renewable methanol, similar to how it's done at other eFuel production sites. Wind power (plentiful in Patagonia) is used to electrolyze water, which creates hydrogen, and CO2 is collected from the air using a ceramic filter (like a catalytic converter). Porsche said it takes three liters of desalinated seawater and 6,000 cubic meters of air to collect the hydrogen and CO2 to make one liter of eFuel. The idea works as long as green electricity is plentiful and there's water to be had.

Using claims that echo the U.S. biofuels boom of around 15 years ago, eFuel proponents say this process, once fully commercialized, has the potential to massively decarbonize vehicles with combustion engines, something most analysts agree we will continue to see on the roads for decades to come. Christian Schultze, deputy general manager for R&D at **Mazda Motor Europe**, told SAE Media that even countries with growing demand for EVs should consider eFuels.

"In Germany, we have a little bit more than 2.5% EVs on the market, but 97% or so are conventional vehicles," he said. "Is it okay to leave them as they are? Or shouldn't we try something to reduce their emissions as well? There's only one way to do that: by changing the fuel."

Schultze said synthetic fuels are easier to use than advanced biofuels that may be difficult to blend with standard fuels because eFuels can be made chemically identical to petroleum-based fuels. When the fuel is burned, the same CO2 that was taken from the air is released into the atmosphere again. The benefit is that this CO2 isn't newly extracted fossil-based CO2, as Shultze made clear.

"If I can replace 20% fossil fuels in the existing fleet, that may not sound like much, but this will be ten times more than all our electric vehicles are now achieving, which we have brought to the market with a lot of money, high investments, subsidies, incentives and more," he said. "What does it say to us? That we should better have a multi-solution approach, that is what Mazda is saying."

A world with plentiful synthetic fuels also helps car buyers keep the residual values of their current ICE vehicles high, Schultze said. More eFuels would also help countries without substantial EV fleets because the "nearly" carbon-neutral drop-in synthetic fuels could replace traditional fossil fuels without significant infrastructure changes.

Japan, Europe getting on board

In mid-2022, six Japanese companies — **Eneos**, **Suzuki, Subaru, Daihatsu**, Toyota Motor Corporation, and **Toyota Tsusho Corporation** — joined to form the Research Association of Biomass Innovation for Next Generation Automobile Fuels to "study ways to optimize the process of producing fuel." In March 2023, Mazda joined the group, also known as RABIT.

Other supporters of synthetic fuels have banded together in the eFuel Alliance, which counts Mazda, **ZF**, **Bosch**, and Porsche as members, along with oil companies like **ExxonMobil** and **Repsol**. Sal Ahmed, the head of Transformation, Strategy and Digitalization for ZF's E-Mobility Division, told SAE Media that the ZF Group supports a technology-open approach for policies affecting its products, including new transmissions that use alternative fuels.

"Synthetic fuels or e-fuels represent one of several options to decarbonize vehicle fleets for both LDV as



Porsche's eFuel project in Chile filters carbon dioxide (CO2) directly out of the ambient air to later be combined with hydrogen to make liquid fuels.



Porsche's Haru Oni production facility in Punta Arenas, Chile, is producing around 130,000 liters of eFuel annually during its test period.

well as HDV," Ahmed said, adding that ZF appreciates the fact the European Parliament and Council of the European Union have tasked the European Commission to examine a methodology of registering both LDVs and HDVs that run on synthetic fuels.

"In the US, legislative and regulatory action on this topic has been less acute, but we support a broad approach to responsibly reducing transportation-related emissions in all vehicle segments, including eFuels," he said.

Synthetic fuels appear to be on a better path in Europe, driven in part by upcoming changes to European CO2 standards expected in 2026, according to Mazda's Schultze. These regulations, which first went into force in January 2020, updated older European vehicle CO2 regulations from 2009 (for cars) and 2011 (for vans) and were themselves updated in April 2023. The upcoming changes have been in the works for more than two years, Schultze said, and are part of a broadening look at how best to reduce CO2 in the atmosphere.

"[Electricity remains] one of the possible opportunities, but what we see is simply that the uptake of electric vehicles across Europe is not as big as maybe it was expected to be, and we need to question if they

eFuels: An Alternative to the Alternative



ZF's 8-Speed HP Gen4 Transmission can be used with conventional, mild hybrid and plug-in hybrid powertrains.



Despite its H2 station closures in the U.S., Shell continues efforts to use hydrogen for transportation, especially for larger vehicles.

are enough," Schultze told SAE Media. "Frankly speaking, if you do a one-dimensional solution, then you have to live with all the difficulties."

Beyond problems with EV charging infrastructure and cost, Scultze pointed out that even if all the cars in Europe were switched to EVs tomorrow, many old vehicles would simply be sold and used elsewhere. eFuels provide a low-carbon solution for all of them, he said, despite Europe's political hesitancy to embrace petroleum alternatives other than EVs after Dieselgate.

"Even though manufacturers like Mazda were not involved in this scandal, it means there's some kind of reservation on the political side," he said. "We have been trying to make clear that an engine is nothing bad. The big problem only comes when we put fossil fuels in it because then we bring fossil CO2 into the atmosphere, and that's what we want to avoid."

Suppliers keep a foot in ICE-land

New vehicles that burn low- or no-carbon fuels still need new components, and ZF is one supplier keeping its ICE facilities running, or even expanding. In February 2024, ZF announced it would invest \$500 million in its Gray Court, South Carolina, flex manufacturing facility, where it builds parts for traditional ICE and e-mobility technologies used in passenger cars and commercial vehicles.

ZF builds 8- and 9-speed transitions at Gray Court, which opened in 2010. ZF's new investment includes \$200 million for a production line that will supply three major U.S. commercial vehicle manufacturers with new transmissions for mild hybrid and plug-in hybrid vehicles. Gray Court produced the first of these PowerLine 8-speed automatic transmissions in late 2023, and ZF expects to produce 200,000 of these transmissions a year by 2025. As Grey Court's expansion continues, the site will produce propulsion systems for traditional ICE, PHEV and EVs in both passenger and commercial segments. As ZF board member Stephan von Schuckmann said in a statement at the investment announcement, "[Gray Court] is our first ever to mirror the transition that the industry and the world is now navigating."

ZF will also build transmissions for passenger cars at Gray Court, including its 8HP Gen4 PHEV transmission (already found on the BMW 7 Series and X5) starting in 2025 as part of ZF's "local-for-local" strategy. The 8-speed plug-in hybrid transmission can produce up to 160 kW and 332 lb-ft (450 Nm).

The 30,000-foot view of low- and no-carbon fuels in the automotive industry reveals plenty of potential wins, along with even more potential problems. Previous liquid fuel alternatives like corn-based ethanol and algae fuels were promoted with big promises but have not yet replaced petroleum products. Mazda's Schultze said we're still in the promising stage of eFuels, including the possibility that they could be used as sustainable aviation fuel (SAF). He's transparent about the challenges ahead.

"At this point in time, there are no mass-production facilities [for eFuels]," he said. "There are only a few research production facilities and they are producing hundreds or 1000s of liters."

Right now, with these low volumes, eFuel prices remain high, he said, but airlines could help make synthetic fuels happen.

"Aviation fuel and car fuels, they are not competitors," he said. "eFuels will be there, at least for SAF, but we hope and we believe it makes absolute sense to have eFuels there also for cars and vans and trucks. Frankly speaking, CO2 is CO2."

WCX 2024: Come for the AI, stay for the optimism



Al top of mind at SAE's annual technical mobility conference.

by Sebastian Blanco

he never-ending task of wrapping one's head around the auto industry continues at SAE's annual WCX technical mobility event in Detroit in April. A series of keynotes will discuss the growing impact of generative AI on the auto industry, why automotive workers have reason to see the upside of working alongside AI and how drivers will interact with AI in their nextgen vehicles.

Jeremiah Golston, senior vice president and head of Automotive Engineering at **Qualcomm**, said he foresees heavy interest in generative artificial intelligence at WCX 2024.

"The new era of AI is here, and edge-based generative AI will play a critical role in transforming the cabin to deliver powerful, efficient, private, safer and more personalized experiences to drivers and passengers," Golston told SAE Media. "Specific challenges I expect to be discussed include scaling and extending GenAI across the cloud, edge and device."

Golston said his keynote presentation will address the rapid expansion of both the amount of data a car collects and the compute power required to process all that information in the car. Qualcomm's solution, he said, is to embrace the AI era and collaboration opportunities with OEMs and other "ecosystem partners" to get generative AI applications into production vehicles using the Snapdragon Digital Chassis.

"Vehicles are now computing platforms powered by scalable and upgradeable cloud-connected hardware and software platforms, with generative artificial intelligence being one of the most exciting innovations we're seeing come to life in the car today," he said. "I hope attendees leave my keynote with a better understanding of the critical role of central compute architectures, cloudnative development, and GenAI, along with a vision for how these elements will continue to come to life in the future vehicle cockpit."

Toyota Research Institute's positive outlook

The senior director of the Human Interactive Driving division at the **Toyota Research Institute** (TRI), Avinash Balachandran, will give another of the main keynotes at WCX this year. The TRI's HID division works on creating AI-driven capabilities and tools that will let people interact "more effectively and naturally" with their increasingly automated vehicles.

Balachandran identified two main challenges with AI that he plans to address in his presentation, one focused on the workforce interactions with AI and the other on the IP, ethical, and regulatory concerns that come about when working with AI.

"TRI believes that AI has the power to amplify rather than replace people," Balachandran told SAE Media. "This is rooted in the core Toyota philosophy of 'Jidoka' or human-centered automation. The research examples I will present from TRI are focused on amplifying human capabilities and allowing people to focus on high-value-added work that they can do for themselves and for society.

WCX 2024: Come for the AI, stay for the optimism



Toyota released this vehicle design sketch that incorporates results from TRI's new generative AI + optimization technique.

"TRI believes that AI has the power to amplify rather than replace people."

"In particular, the audience will learn about how core Toyota philosophies like jidoka and the concept of muda continue to be relevant as we think about how best to incorporate AI into our work." Muda, which means "waste" or "uselessness" in Japanese, is a keyword Toyota uses to remind workers to minimize things like excess production and inefficient transportation methods.

"Muda is what we call non-value-added work, work that doesn't move the needle," Balachandran said. "I think AI is going to be a tool that's going to help us focus on value-added work and reduce muda over time, on having tools that help people really focus on the things in their life that add value, things that can add value in society. And I think AI could help us focus on those things and create this happier environment for everyone."

Balachandran said he can fit AI opportunities into four "big buckets" where AI will disrupt how the industry builds and sells cars. AI will impact the design and engineering of vehicles, manufacturing those vehicles, the vehicle experience itself and, finally, the bringing those vehicles to market, including sales and marketing policy.

"Al is going to be hugely disruptive in all these areas," he said. "In my talk, I'll actually give specific examples of how we can think about using Al for the designing and engineering of cars to make that process a lot smoother and also, how we can use Al to help in manufacturing to help workers focus on the



Qualcomm's efforts with AI starts with the reality that vehicles are now computing platforms.

parts of their job that they enjoy while reducing muda. Even in the vehicle experience, [we have to] rethink the way that people and vehicles work together in order to help you achieve your goals."

Doug Field, **Ford's** chief EV, digital and design officer, will give a third keynote that will also address these and related topics. Field was not able to preview his presentation in time for publication, but it will look at similar topics. Field worked as a development engineer at Ford from 1987 to 1993 and then left to work at **Apple**, **Segway** and **Tesla**, where he was involved in launching the Model 3. Field returned to Ford in 2021 and heads a team that works on "scalable technology platforms to be deployed across Ford global products" including electric vehicles, digital platforms and software "at startup speed" inside of Ford.

WCX runs from April 16 through 18 at the Huntington Place in downtown Detroit. A connected event, the GAMIC Innovation Finals Competition, will take place on the 15th. **General Motors** will host a Hydrotec fuel cell event at WCX on the 17th. Technical session topics SDVs, low-carbon solutions, and safety and UX technologies.



Twenty DC fast chargers and amenities are available, but the most important detail is that everything works.

The exterior of Electrify America's new flagship charging station in San Fransisco at night.

he move to electrification has hit a snag. The charging infrastructure hasn't quite lived up to the needs of those with EVs. The Inflation Reduction Act requires that charging stations have a 97% uptime to qualify for government funds. According to a plethora of studies, approximately 20% (or more) of stations encountered by EV drivers have some sort of issue that results in a failed session.

Of those charging companies, **Electrify America** has become a bit of a punching bag. Its relatively large footprint in the DC fast-charging sector means that its stations are visited more often than others and its issues become far more visible.

Moving forward though, companies like Electrify America are listening to customers and there's no larger evidence of this than the company's new flagship location at 928 Harrison St., San Francisco.

In late February, the company opened the indoor facility with 20 DC-fast charging stations each capable of delivering electricity at up to 350 kW. There's also a CHAdeMo charger for owners of the Nissan Leaf. It's a facility with a station number on par with what we've seen from Tesla. But more importantly, during a recent visit, everything worked.

During SAE Media's 45-minute visit to charge an EV, none of those that pulled up for electricity encountered some of the reliability issues that have plagued EV drivers for years. Stations connected to vehicles and delivered electricity at a reasonable rate.

The quick delivery of power and large amount of stations meant that there was a constant flow of new EVs at the stations. The 800-volt vehicles that can support electricity delivered above 200kW left the quickest, but even those individuals took a few minutes to leave their vehicles and enjoy the amenities offered by Electrify America.





A view of multiple EVs charging simultaneously at Electrify America's new flagship space.

A Peek at Electrify America's Charging Station Future

The location has two lounges with free Wi-Fi, two restrooms, two vending machines, and even a small conference room. The entire facility was well lit and the furniture was comfortable. The only thing seemingly missing was a coffee bar.

Another important feature of the location is that it's staffed 24 hours a day, seven days a week. An employee wearing a security outfit greeted every vehicle with a smile and played traffic guide to those pulling in. The addition of onsite staff gives drivers a sense of comfort. If a charging station goes down, the staff can call in a technician.

By placing a large number of charging stations that have increased uptime and can deliver electricity at up to 350 kW, Electrify America is solving one of the main reasons why some people skip buying an EV. If the system works as reliably as a gas station, those on the fence about electric vehicles will feel more comfortable taking the plunge.

It also makes the lives of those who own an EV better.

San Francisco resident Matthew Villeneuve told SAE Media that to supplement at-home charging from a 120 V outlet, he will regularly head out to a local supermarket. "I charge at midnight, otherwise I might show up to **Safeway** and wait an hour."

At this flagship, he pulled up in his Polestar, plugged in, and had a nice snack with his daughter in the lounge in the middle of the day, on the weekend.

Expect more locations like this from other companies including from **IONNA**, the seven-automaker charging company joint-venture. As



View of the interior lounge at the Electrify America Flagship space in San Francisco.

ROBERTO BALDWIN

NACS (J3400) becomes the norm on EVs, drivers will also experience the Tesla charging locations with lounges. Getting a jump on other automakers, Ford announced that its electric vehicles (via an adaptor) are now supported by the **Tesla** Supercharger network. It's huge news for **Ford** owners and a sign of what's to come for the owners of other vehicles.

The future of charging is looking brighter all the time and that future requires the staffing of locations and a robust team of charging station technicians. A better experience means more jobs and the end result, a cleaner world.



Full speed ahead for second-generation Indy autonomous racers

TRIDESTONS

Major hardware and software upgrades underpin the Indy Autonomous Challenge racecar for 2024, proving self-driving vehicle capabilities at triple-digit speeds.

N

🕸 LUMIN

by Kami Buchholz

fter three years and more than 7,000 miles (11,265 km) of racing, the **Indy Autonomous Challenge** (IAC) enters year four with an updated platform and embedded software upgrades. Among the highlights for the second-generation open-wheel racecars are pending patents and first-time applications. "We've achieved several impressive milestones since our start in 2020," IAC President Paul Mitchell said.

The achievement list includes setting a speed record for passing in autonomous racing (170 mph [273 km/h]), netting the autonomous vehicle land speed record (192.2 mph [309.3 km/h]) and establishing the fastest lap speed for an autonomous vehicle (180 mph [289.68 km/h]). "More than anything, we consider the IAC an applied-research platform for industry and academia to work together on advancing high-speed autonomy," Mitchell said.

Eighteen universities from around the world are participating in IAC 2024 events. This year's line-up features nine teams, with each group made up of between one and four universities. Each team's IAC-supplied racecar — fitted with sensors, GPS technology and a central computer — operates on custom-designed instructions. "It's a software challenge for teams," Mitchell said. "They're competing on the development of the AI driver, also referred to as the autonomous software stack. Each team decides when to steer, when to brake and what the throttle position should be."

Each team uses the same hardware, but there is some optionality about the wing position and the amount of downforce, Mitchell said. IAC and partner companies install and service the cars' chassis and company-specific components.

New platform, newer sensors

IAC's 2024 platform (IAC AV-24) dramatically differs from the original 2021 platform (IAC AV-21) via upgraded components. "The quality of LiDAR and radar technology and onboard computing has just gotten better because the industry is moving that fast," Mitchell said. "So [IAC AV-21] components were changed out, not because the components weren't working right or weren't effective, but because something new is available." The secondgeneration IAC racecar is referred to as the IAC AV-24.

A patent-pending, custom-engineered drive-by-wire system on the IAC AV-24 replaced off-the-shelf steerby-wire and brake-by-wire systems, for example. The new steer-by-wire system in AV-24 uses a high-power motor that enables quicker steering speed, which improves vehicle handling. IAC AV-24's brake-by-wire uses linear actuators compared to the earlier system's servo motors. Independently actuated front and rear master brake cylinders are equipped with high-resolution brake-pressure sensors. The linear actuators include a position sensor capable of reading the absolute linear position with a high resolution of up to two microns. "A separate linear actuator is used for both the front and rear braking system, allowing autonomous dynamic brake bias and migration," Janam Sanghavi, head of engineering and vehicle integration for IAC, said.

Sports Tech Ho

The new actuating units for braking and steering, as well as a fully upgraded sensor kit, enable new software programming opportunities, according to Rodrigo Senofieni, control engineer with the PoliMOVE-MSU Autonomous Racing team comprised of **Politecnico di Milano** in Italy and two U.S. schools, the **University of Alabama** and **Michigan State University**. The new automated race control system, "allows us to push even more from our autonomous software stack, thanks to better sensor specs and faster actuating units," Senofieni said.

IAC AV-24 has the world's first autonomous vehicle application of 360-degree long range lidar via four Luminar Iris sensors. The IAC AV-21 used **Luminar**'s H3 sensors with a field of view up to 150 m (492 ft). "These [new Luminar Iris] sensors offer a field of view that extends up to 250 m (820 ft), allowing for early detection of vehicles," Riccardo Poli, PoliMOVE-MSU's perception engineer, said. Three long-range lidar sensors are mounted in the cockpit to provide

AC

Full speed ahead for second-generation Indy autonomous racers



In a first for high-speed autonomous racing, the KAIST (Korea Advanced Institute of Science & Technology) car and the TUM Autonomous Motorsport car raced side-by-side, two wide, and wheel-to-wheel through turns one and two, getting as close as 1500 mm (4.9 ft) from each other during the 2024 IAC event at CES.

front and side views, and a fourth faces rearward from near the rear wing.

Integration of long-range lidar on the racecar posed several engineering challenges, including the issue of reduced point density. To overcome the various challenges, a perception module was developed. "This custom module effectively harnesses and consolidates all the available information from the sensor, ensuring an optimized utilization of the long-range lidar data," Poli said, noting the tailored solution enables precise and reliable vehicle-detection capabilities that address the demands of a racing environment. In addition to the lidar, the IAC AV-24 is equipped with two radar sensors supplied by Continental – positioned front and rear – as well as multiple cameras. "The sensor suite ensures a robust and versatile perception system for the racecar," Poli said.

The racers' patent-pending modular robotics system allows for interchangeability and integration across different low-speed or high-speed vehicle platforms. "This approach — an adaptive robotics stack with agnostic design — not only facilitates extensive testing, but it also enhances software robustness and paves the way for the development of mass-market driverless products," IAC's Sanghavi said. The modularity of



The PoliMOVE-MSU racecar trackside at the Las Vegas Motor Speedway at IAC's 2024 CES event.



The TUM Autonomous Motorsports team from the Technical University of Munich (Germany) won the 2024 autonomous challenge at CES. The racecar reached a maximum speed of more than 150 mph (241 km/h).

IAC AV-24's robotics system also benefits maintenance, component/ system swapping and upgrading tasks.

Once an autonomous race starts, teams basically become spectators. "We can only send safety-related commands from the pit-lane if we see any kind of problem from the live telemetry," PoliMOVE-MSU's Senofieni said. Specific commands, to follow a certain speed or switch between multiple trajectories, for example, are sent to the vehicle during practice and test sessions, according to Senofieni.

Teams have been using team-developed or commercial partner simulation tools since 2021, but the ability to compete against other teams in a simulated environment has been limited because not all teams have been using the same tools. "Over the next few months, we're rolling out **dSPACE** software-in-the-loop simulation to teams, which will allow AI driver training as well as head-to-head racing," Mitchell said.

IAC's 2024 competition year began with an event during January's Consumer Electronics Show (CES) in Las Vegas, Nevada. Other events scheduled this year will take place in the UK – a hill climb during the Festival of Speed at Goodwood in July – in the U.S. at the Indianapolis Motor Speedway in September, and in Europe at the F1 circuit in Milan, Italy, on a yet-to-be-determined date.



SPOTLIGHT: SIMULATION AND ANALYSIS TOOLS

Driving simulation



VI-grade (Darmstadt, Germany) announced a collaboration with Varjo (Helsinki, Finland) to develop headsets aimed at enhancing the experience of VI-grade's professional driving simulators. VI-grade's driving simulators offer the ability to simulate testing of ride and handling, NVH, ADAS and HMI. Varjo states that its XR technology will enhance the user experience of VI-grade's simulators by providing improved realism, dynamic motion and lifelike visuals. By integrating Varjo's XR headsets into its simulation ecosystem, VI-grade claims that its driving simulators are significantly enhancing the user's experience with a greater sense of realism. Varjo's XR-3 and XR-4 headsets will be integrated with VI-grade's standard virtual environment, VI-WorldSim, which offers multi-agent AI traffic behavior and sensor fusion.

> https://www.vi-grade.com/ https://varjo.com/

Current sensors

Asahi Kasei Microdevices (Düsseldorf, Germany) has begun mass production of the CZ39 series of coreless current sensors. The company states that the CZ39 device family is suited for EV applications thanks to its 100-ns response time, low heat generation and noise immunity. These properties are compatible



with silicon carbide- and gallium nitride-based power devices. The CZ39 series also reportedly allows for the implementation of substantially smaller, lighter and more accurate onboard charging systems for EVs. The CZ39 series features a highsensitivity compound Hall element that enables a response time of 100 ns and can quickly signal the system to interrupt current flow during an overcurrent condition.

https://www.asahi-kasei.com/

Gate driver ICs

ROHM Semiconductor (Kyoto, Japan) introduced the BD2311NVX-LB gate driver IC that has been optimized for GaN devices. ROHM states that the new unit achieves gate drive speeds of nanoseconds, which makes them suitable



for high-speed switching with a minimum gate input pulse width of 1.25 ns. This speed reportedly contributes to smaller, more energy efficient and higher performance applications. ROHM states that it has developed a unique method to suppress the gate voltage overshoots and has implemented it into this driver. In addition, the optimum GaN device can be selected by adjusting the gate resistance based on application requirements. It also features a gate overvoltage suppression feature. https://www.rohm.com/

Light testing

Dynamic Research Inc. (Torrance, California) has developed new testing capabilities for adaptive driving beams (ADB). The company states that ADBs enable a vehicle's high beams to be used continuously as the system automatically adjusts the direction and intensity of the light beam to prevent glare for surround-



ing traffic. This reportedly improves visibility for the driver and better illuminates hazards such as pedestrians. NHTSA recently revised its FMVSS 108 headlight standard to enable vehicles in the U.S. to be equipped with ADB technology. This has been accompanied by a new test procedure to evaluate the performance of these headlights.

https://www.dynres.com/

Isolation valves

Eaton (Southfield, Michigan) launched a fuel tank isolation valve for hybrid vehicles. Eaton's FTIV reportedly is easier to mount, 27% lighter, 39% smaller and contains 24% fewer components than its predecessor. Eaton states that its engineers reduced the size of the FTIV by improving the magnetic force produced by the isola-



tion valve while at the same time reducing the amount of copper. Additionally, the new FTIV is designed to be easier to mount in a variety of challenging tank configurations within the vehicle. Eaton states that it has agreements to supply its FTIV to two global automotive customers.

https://www.eaton.com

PRODUCT BRIFFS

Resins

Syensgo (Brussels, Belgium) has developed a new version of its MTM 49-3 resin that contains 30% bio-sourced monomers. The company claims this new product variant complements the portfolio of the company's MTM advanced prepregs and targets structural automotive applications, including body panels, chassis components and spoilers. MTM 49-3 has a dry glass transition temperature of 190 deg C (374 deg F)



and reportedly exhibits enhanced toughness for superior impact resistance versus competitive thermoset prepregs. Syensqo also claims that MTM 49-3 can yield component mass savings of up to 40% over metals, is compatible with autoclave and press-conversion processes and achieves curing within 60 minutes.

https://www.syensqo.com/en/

Digital mirrors

THine Solutions (Santa Clara, California) announced that Kappa optronics GmbH (Gleichen, Germany) selected THine's V-by-One HS Chipset for their digital mirror solution/system Rearview OneBox. Kappa



states that its Rearview OneBox solves many problems of conventional side/interior mirrors such as unclear vision due to weather conditions (e.g., rain, snow, fog), blind spots, design constraints and aerodynamical fuel and/or battery inefficiency. THine's V-by-One HS Chipset uses high-speed video transmission technology that enables the camera to be physically located far away from the camera monitoring processing unit that is required for camera monitoring systems.

https://www.thinesolutions.com https://www.kappa-optronics.com

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Video decoders

Renesas Electronics (Tokyo, Japan) introduced the new RAA279974 4-channel AHL video decoder. According to Renesas, the unit processes four input sources simultane-



ously, making it an economical solution for surround-view and multi-camera applications. Renesas AHL series uses a modulated analog signal to transmit video. According to Renesas. this translates to 10 times lower than digital transmission solutions (~37 MHz vs. >3 GHz). The unit is said to be robust against noise and enables longer transmission distances with unshielded twisted pair cables and standard connectors. Renesas also states that using unshielded twisted pair cables reduces cost and is easier to route through the vehicle. https://www.renesas.com

Image sensors

Omnivision (Santa Clara, California) announced a new 1.3-megapixel OX01J image sensor for automotive 360-degree surround-view systems and rear-view cameras. The OX01J is a raw image sensor with LED flicker mitigation and 140db high dynamic range (HDR). Availability of the OX01J



provides automotive OEMs with the flexibility to purchase just the image sensor if they already have their own backend image signal processor. Omnivision claims the OX01J provides a compact form factor and low power consumption. The unit also features a 3-micron (μ m) pixel in a 1/3.55-inch optical format and is built on Omnivision's PureCel Plus architecture. https://www.ovt.com/

Air purification

SKF and CabinAir (Stockholm, Sweden) announced a joint venture for a vehicle air-quality system. SKF states that their Smart Air Purification system removes more than 10 times the number of pollutants in a vehicle's interior compared with conventional solu-



tions. SKF also states that the system captures larger particles such as dust and pollen and effectively traps particles as small as 2.5 micrometers or less in diameter. Installation of the system is reportedly a one-time process, requiring only periodic filter replacements for continued effectiveness.

https://www.skf.com https://cabinair.com/

UPCOMING WEBINARS

BUILDING AN AUTOMOTIVE EMC TEST PLAN

Tuesday, April 16, 2024 at 10:30 am U.S. EDT

The vehicles we drive are getting smarter and more connected and that connectivity presents opportunities for system interference. creating potentially hazardous situations for vehicle operators and passengers. Performing electromagnetic compatibility (EMC) tests on vehicles and components can identify potential issues before they occur. This 30-minute Webinar will explain the ins and outs of automotive EMC test plan development and how to ensure a strong foundation early in the process.

Speaker:



EMC Principal Engineer, Element

Speaker:

Manager for

Testing Solutions in Automotive, Svnopsvs







For additional details and to register visit: www.sae.org/webcasts

MASTERING SOFTWARE COMPLEXITY IN AUTOMOTIVE: IS RELEASE POSSIBLE WITHIN A FEW DAYS?

Thursday, April 25, 2024 at 2:00 pm U.S. EDT

Advancements in software continue to push the automotive industry forward, but with these advancements come software complexities that can make the difference between success and failure. This 30-minute Webinar will look at the reasons for prevailing complexity in automotive software development. In addition, it will cover application software development, integration of software into an ECU, and integration of the solution into vehicles – all from an OEM's point of view.

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Owl AI making better ADAS systems with help from drones

Owl AI has steadily been improving the SWaP-C (Size, Weight, Power and Cost) of the electronics in its thermal camera sensors while also improving capability. The company's latest units have three-and-a-half times more pixel density in roughly the same size silicon area, as well as additional logic in the chip that now uses a single board versus the three-board stack used previously. We spoke with Owl AI CEO and co-founder Chuck Gershman about this improvement and how it's opening up new doors for his company. This is an edited transcript of our discussion. line from product commitment to product deployment. It's a long qualification timeline. How do you generate production revenue during the qualification timeline? We had a thesis that there were other mobility applications that could fill that revenue timeline. One of the reasons we didn't overly market into the drone space was that we might have to do additional engineering. What we're hearing from the drone guys is, "Just give us this, this and this as you have it, and we'll take care of the additional engineering. Just give us

Tell me about the improvements in your sensor since we last heard from you at AutoSens in the fall of 2023.

The whole SWaP-C concept and the whole resolution concept were designed for ADAS applications, specifically for getting us from an L2 into an L3 and anything in between. When we showed this hardware in public at CES, we got a secondary customer base that seemed to be all over us. They weren't asking us to build them something different. They were just asking us, "Could we apply this to our application," and those were mini drones. The combination of SWaP-C and the resolution really got the attention of the dual-use community."

Are you hinting at the military realm here?

It could be military. It could be surveillance. It could be border protection. It's anything associated with surveillance applications or any kind of reconnaissance, as well as search and rescue. We always knew that this technology would be applicable there, but we never actively marketed it. Once we showed the form factor, there was just this avalanche of interest. It doesn't change our basic hardware design

premises in any way, shape, or form. That automotive size, weight and power solution just happens to fit in small form factor drones.

Those benefits apply across the board. How did you react?

As a smaller company, we want to stay focused, but we were kind of inundated with requests. So we are paying attention to that.

How does that impact the automotive work?

One of the biggest negatives of trying to intersect automotive product lines [as a tier-two supplier] is simply the time-



"How do you generate production revenue during the qualification timeline?"

access to deploy cameras on this," and now you can fill your revenue gap. You can create incremental revenue while you support your longer-term qualification plans for automotive.

If you just go back and look at what happened in the lidar space, you'll see this very problem. The only real lidar companies that have survived are a handful of Chinese companies where the Chinese market bought up their stuff and those who SPACed. The reason that the ones that SPACed survived was they had ample monies to cover this valley of revenue depth between proof of concept and production.

Finally, there are new regulations on the way regarding nighttime pedestrian protection, something a thermal camera is obviously good at. The announcement describing these rules has repeatedly been delayed. What are your thoughts on the new rules, whatever they might be?

The more disruption there is in the market and the more market uncertainty that's created by that disruption, the better it is for small companies. The more that's understood and known as a given, the better it is for incumbents.

So, quite frankly, NHTSA's playing around and screwing with people's minds and being a little late is good for us. It creates more disruption, more uncertainty. We like uncertainty, as it relates to the market that relates to us. So, quite frankly, I'm not sweating at all. And whatever they come up with, whether it's more rigid or less rigid than what they have there, it's still table stakes for us. It's easy to do. We've already tested it against their original proposal, and we passed all their tests with flying colors. So we're not really sweating what the spec says.

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