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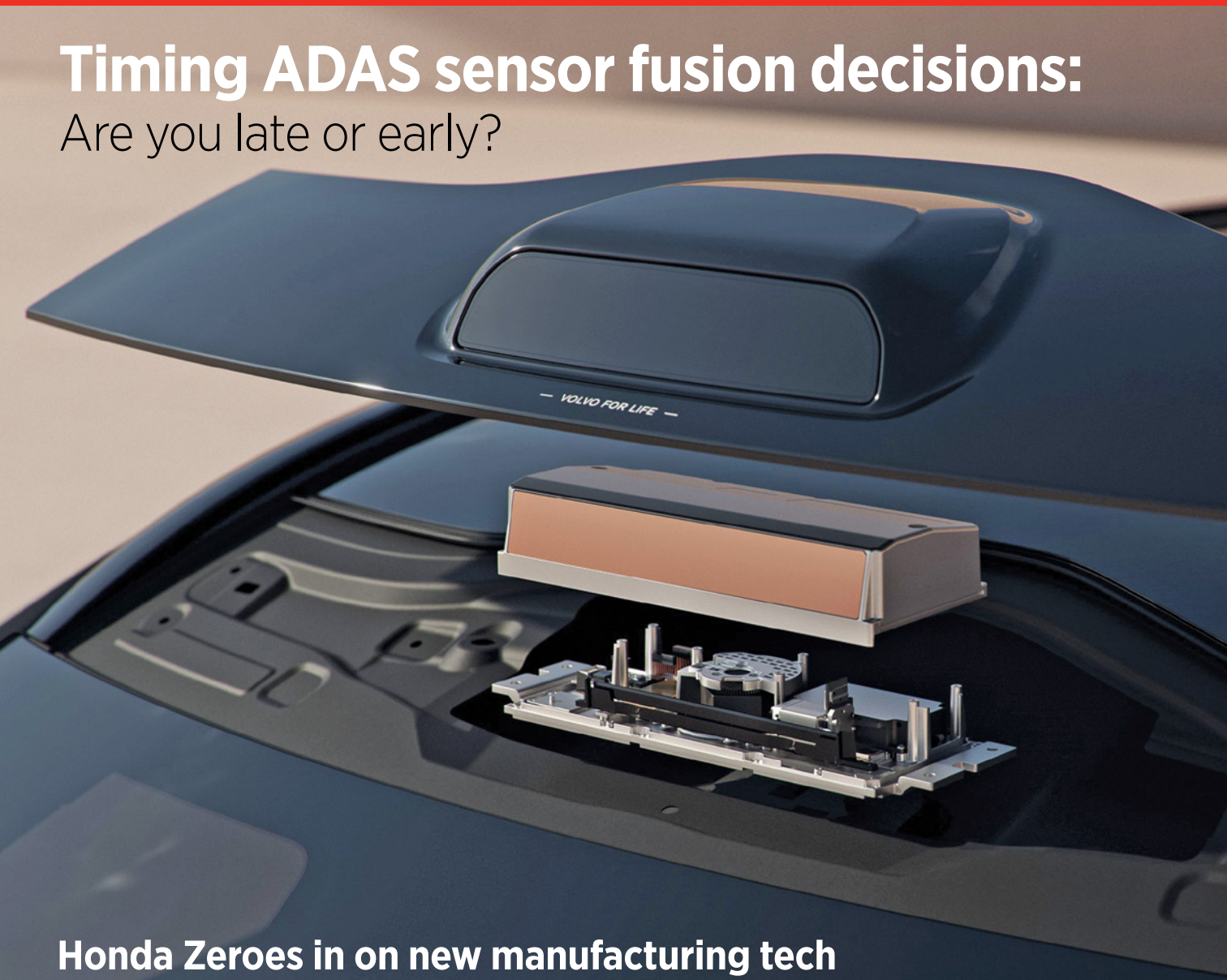

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ON THE COVER

Data from sensors such as Luminar lidar units must be merged for analysis and decision making. When to do that is a key decision in engineering ADAS systems. (Image: Volvo)

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REGULARS

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EDITORIAL

China's warning signs

Sometimes, I cringe; sometimes, I just listen and wonder. These past few months have given us all a lot to think about in the automotive space, and it's clear now that the coming years will keep the foot down on the accelerator when it comes to the dramatic changes we've experienced this past decade. One thing that stood out to me in various recent conversations is that there's a widening gulf opening between Chinese automakers and the rest of the world. This isn't exactly news, and this column isn't meant to monger any fears. It's just a bit of off-the-cuff reporting that sheds a bit of light on the level of the challenges we face.

As you can read in Chris Clonts' excellent report further in this issue about the warning that Voltaiq's CEO gave at The Battery Show this October, the U.S. is in serious danger of falling well behind Chinese competitors in the EV battery race (Michael Robinette tackles similar ground through a tariff lens in this month's Supplier Eye). But that message was obvious to anyone who meandered through the expo hall during the show. The spacious Huntington Place (neé Cobo Hall) was filled by more battery suppliers and tech companies than I could count (organizers said it was over 1,150), many with a Chinese connection. Those of us who remember the busy days when the Detroit Auto Show covered a similar footprint were astonished by the variety on display, and almost all of it was EV-focused. The Battery Show proved that there's good battery development work happening in North America and Europe, but it was hard to ignore just how present China and Chinese-related companies are in the electrification mission.

It was hard to ignore just how present Chinese-related companies are in the electrification mission.

Later in the month, at the Snapdragon Summit where Qualcomm unveiled new SoCs for automotive (full report coming in the next issue or read it now on sae.org), I spoke with a tech reporter who's gotten a taste of the Xiaomi SU7 EV. I haven't been able to visit China recently to see for myself what's happening there with EVs, but I'm sure we're all reading similar reports of the rapid electrification happening there. After hearing my friend wax poetic about the SU7 and its potential, it wasn't a surprise to hear that Ford CEO Jim Farley was also deeply in love with it. His company brought one stateside for some competitive testing and "I've been driving it for six months now, and I don't want to give it up," he said on the Everything Electric Show podcast.

I heard a similar mix of awe and worry during a visit to South Korea to see what Hyundai has been up to on EVs and hydrogen vehicles (October was a busy month). Competition from their northern almost-neighbor was unquestionably front of mind. The good news is that friendly — or even unfriendly — competition can lift many boats. These are just a few examples I've heard recently of how the automotive industry is grappling with what's coming next. More dramatic changes will be coming in the aftermath of the U.S. election (and we can't ignore the Communist political reality that helped China take the lead here), but what I'm hearing is that it might be a while until anyone catches up with what China is doing to lead the industry. If I'm hearing it, my guess is that everyone's hearing it. The question is what we're going to do about it.

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Ode to 2024

As I write this version of the Supplier Eye column, 2024 has been a critical year for our industry. No matter if you are a supplier, OEM or some other position in the ecosystem, this year has set us up for feast or famine through this decade. Let's explore why this year will go down in the record books as a pivotal one.

Editorial timing dictates that this is submitted just before the U.S. elections. While you will read this with the election in the rearview mirror, all indications are for an extremely close political outcome, though the ensuing weeks will be the final arbiter. The outcome nonetheless will impact our industry for years.

First will be the trajectory for U.S. light vehicle emissions legislation. California's famed GHG waiver (ability to set their own emissions legislation) and funding of the IRA (Inflation Reduction Act) will drive U.S. hybrid and battery electric propulsion adoption rates. How OEMs and suppliers adjust will dictate future viability.

Second, the election outcome will impact the scheduled 2026 renegotiation of the USMCA trade agreement. Suffice to note that it may not matter which U.S. party wins, the current USMCA will likely change – especially with respect to U.S. value add criteria and Mexico's future role. Look for much energy to be driven in this direction as suppliers and OEMs alike seek to optimize their footprint given possible trade-driven shifts.

Other market shifts will impact the trajectory of the global industry past 2024. Specifically, the rise of China-based OEMs and the implementation of tariffs in the U.S., Canada and EU on China-made EVs will impact competitive dynamics for several years. These tariffs will likely draw reciprocation from China with one possibility being tariffs on imports from North America or Europe. This would further burden Western OEMs should exports be stunted. China is likely to focus its attention, for now, on other export markets for their offerings and possibly seek to build vehicles within North America or the EU.

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China is likely to focus its attention, for now, on other export markets for their offerings and possibly seek to build vehicles within North America or the EU.

Conversely, there's the volume decline of Western-based OEMs in mainland China, which has not solely occurred in 2024 though the industry is finally coming to grips with the incredible share decline. According to the S&P Global Mobility Light Vehicle Production Forecast, Western OEM production share will slip from 35.9% in 2023 to less than 30% this year. That equates to a reduction of seven vehicle assembly plants with annual capacity of 250k – more than 1.7 million units shifted in one year. As recently as 2019, Western OEMs accounted for 53.5% of production. That's an incredible swing which may continue through this decade and impact global volumes and scale dynamics for Western OEMs. Without a strong mainland China market presence, Western OEMs will need to focus more effort on success in the EU, North America, Japan or South Korea. All markets which are not expected to grow that the same pace as mainland China through the decade.

Lastly, there's the pace of EV adoption and investment profiles for battery plants/critical mineral acquisition and refinement. Scores of OEMs and suppliers have delayed, rescoped or cancelled plans for EVs – instead extending ICE programs while also integrating more hybrid structures as a bridge to the future. These seismic shifts reverberate through the supply chain with footprints, investments and, in the end, profitability hanging in the balance. 2024 will leave its imprint on the industry for years to come. ■

ELECTRIFICATION

Battery analysis pioneer: North America has five years to catch China

Lithium-ion batteries on the assembly line at Mercedes-Benz's manufacturing facility in Bibb County, Alabama. Automakers and the world's largest battery makers are scrambling to scale battery production at North American gigafactories, still a subject of great concern three years after this photo was taken.

North American automakers and EV battery firms have five years to erase China's dominance in technology and manufacturing or they may face the reality of buying batteries from China for the foreseeable future. That was the message from battery-analysis company **Voltaiq** CEO Tal Sholklapper at a media briefing in Detroit.

"We're in the final innings now," Sholklapper said. "If the industry around batteries and electric vehicles and all the follow-on applications wants to make it, we're going to have to change the way we play."

That means, he said:

- Battery manufacturers need to narrow their focus on making high-quality cells, bringing in outside experts on things like analytics. They must learn and iterate faster and get to scale as fast as possible. This might seem intuitive, but many of the expensive recalls and dangers in the industry have been the result of not knowing enough about the quality of a factory's output until the batteries are already in a vehicle on the road.
- OEMs, Sholklapper said, must admit that making batteries in-house is problematic, and that electrical engineers can't just switch to making batteries. Sholklapper often refers to batteries as living, breathing beings, since they expand and contract under charge and draw conditions.

Voltaiq advocates constantly monitoring data during the manufacturing process so problems can be addressed quickly before they result in delays or monetary losses. Sholklapper said that some of today's battery factories even gather data by plugging thumb drives into machines at each step in manufacturing before collecting it in one place for analysis. Part of Voltaiq's work is helping clients gather that data in real-time.

Eli Leland, Voltaiq's CTO, said part of the problem OEMs have trying to scale directly to batteries in huge gigafactories is having the wrong experts on hand. "Did **Tesla** hire a bunch of powertrain engineers from Detroit to come and design their battery packs? We know the answer, right?" He underscored that batteries are electrochemical in nature, and it's the chemistry part that is most difficult to master.

And unlike the consumer electronics industry, which was able to perfect batteries in low volume, high value products before scaling, those products are rare in the automotive world, Leland said, pointing to examples like the **Mercedes** G-class EV.

Sholklapper also underscored the importance of OEMs and battery companies taking a collaborative approach to development. "You need to focus on your core strength. And whether it's the vehicle integration, whether it's making cells... One thing that you need to do to be successful is focus on that and then bring in best-in-class providers to help you with the rest." He also said that as long as China's subsidized industry can produce batteries for around $50 per kilowatt-

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MERCEDES-BENZ

hour, it would keep pressure on North American industry.

The briefing also served as an introduction to Voltaiq's new partnership with **Novonix**, a Canadian battery materials and testing company. The agreement calls for Voltaiq to handle Novonix's analytics and support the company's anode and cathode materials business as it nears product commercialization. Together, the companies will support customers of Novonix's ultra-high precision coulometry equipment (that tests lithium-ion battery performance) and R&D services.

Lori Mcleod, president of Novonix, said the company had experience in learning the value of outside experts. "About a year and a half ago, we went down this path of trying to do our own thing. We're going to become software makers," she said. "And after a year and a half of investment, it was hard to ask ourselves the question, should we be doing this anymore?"

Chris Clonts

CLEAN TECH

Lowering carbon emissions? What's being done for internal combustion engines

Agriculture, industrial, mining, construction, freight transport and other major global economy sectors rely on vehicle power to thrive. "Internal combustion engines – those powered by gasoline, diesel, natural gas or propane – really are key to our current economy, and we see [the ICE] as a key part of our energy future," Allen Schaeffer, executive director of the **Engine Technology Forum**, a U.S.-based educational organization, said during a September webinar.

Hosted by the Engine Technology Forum, the "Taking Internal Combustion Engines to the Next Level" session focused on current and under-development innovations aimed at increasing engine efficiency and lowering emissions.

Bio-fueling ICE

"With biodiesel, it's a very sustainable industry for food and fuel," said Steve Howell, founding partner of **Marc-IV (M4) Consulting** and chair of the **American Society of Testing** and Materials Biodiesel Task Force. Biomass-based diesel fuels can be made from animal fats or various oils, including soybean oil and distillers' corn oil.

Production of biodiesel and renewable diesel has risen dramatically over the past 15 years. In 2010, fuel production reached 200 million gallons and soared to more than 4.5 billion gallons in 2023. "We're right around 50/50 renewable diesel and biodiesel in North America today," Howell said. The long-term projection is 6 billion gallons by 2030 and 15 billion gallons by 2050.

FPT's XC13 engine, shown on display at the 2024 ACT Expo, can run on multiple fuels, including diesel (left), natural gas and hydrogen (right).

Feedstock capacity can support an additional 1.8 billion gallons of biomass-based diesel production through 2025, according to industry research.

Using low-carbon biomass diesel in internal combustion engines could reduce atmospheric carbon by 70%, according to Howell. "The industry is doing the work. So B100 [pure, unblended biodiesel], RD100 [renewable diesel] or a blend of the two will be viable options for low net-carbon combustion in 2030, 2050 and beyond," Howell said.

Diesel-fuel sulfur content in the U.S. market is 15 ppm maximum, although certain off-road applications can use a higher sulfur diesel. Mary Dery, **Innospec**'s Performance Additives technical director, pointed out that untreated diesel fuel can create engine performance issues. For example, if a fuel injector is dispensing a direct stream versus an aerosol spray, that's problematic. "It means the fuel is not going to combust properly in the combustion chamber, which leads to poor fuel economy. And it ends up making more particulates," Dery said, adding a fuel detergent can resolve the issue.

Dery cited several field-trial examples to illustrate how a diesel fuel additive can improve engine performance. In a field test involving a John Deere 5100E farm tractor with 1,800-plus hours of operation, the vehicle's untreated fuel injector was removed, revealing deep caverns of deposits.

"It looked like a volcano. But after only 100 hours of operating on a detergent additive in the fuel, the deposits around the [fuel injector] holes eroded away, and the NOx emissions were reduced by 30 percent," Dery said. She also noted that there was a 34% reduction in 2.5 PM particulate emissions and a 30% reduction in soot emissions.

Engine makeovers

FPT Industrial engineers designed a new heavy-duty engine that makes gains in performance and braking power while lowering fuel consumption and weight when compared to its predecessor. The XCursor 13 (XC13), which is FPT's first single-base multi-fuel engine, also meets 2025 European Union CO2 reduction targets for heavy-duty trucks. "It's easily the most exciting time within our industry since its inception," said Ivan Tate, technical center director for FPT Industrial, headquartered in Turin, Italy.

The new 13-L inline 6-cylinder XC13 has compacted graphite iron castings for the cylinder block and cylinder heads. "This enables us to be lighter but also more rigid," Tate said, adding that the materials change also helps with emissions and the amount of cylinder pressure that can be maintained. Friction reduction resulted from using new materials for the connecting rod pins and crankpins. Other changes include a new valve train system, using a variable oil and water pump, and employing advanced combustion control and thermal management.

In its diesel configuration, the XC13 – compared to the predecessor C13 – gains 2% more power and 12% more torque, achieves up to 7% lower fuel consumption, reduces weight by 10% and nets a 29% improvement in braking power. XC13's natural gas version gains 9% power and 10% torque, consumes up to 8% less fuel, cuts weight by 10% and improves braking power by 300%, compared to its C13 predecessor.

"One of our biggest requirements was to increase the braking power of the engine brake," Tate said. The diesel version of the XC13 engine provides up to 600 hp (442 kW) and 2,100 lb-ft (2,850 Nm), while the natural gas variant offers up to 520 hp (382 kW) and 1,840 lb-ft (2,500 Nm).

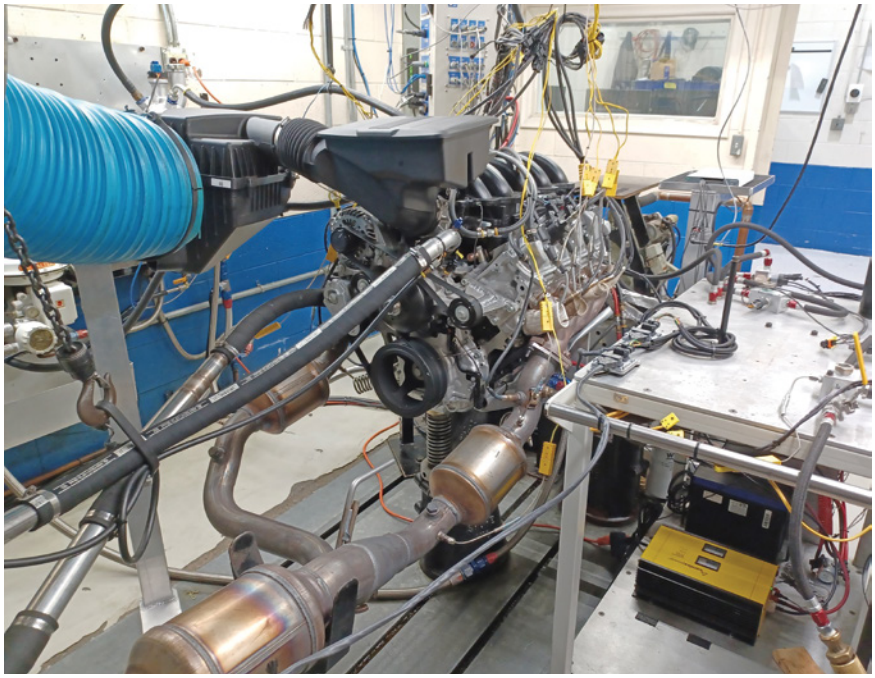
Stanadyne, Katech Engineering and the Propane Education & Research Council's (PERC) involvement in a liquid propane gas (LPG) engine project

SAE/RYAN GEHM

culminated in 2023 with testing of the novel LPG components/systems on a GM L8T engine. (Baseline engine is a direct-injection, gasoline-fueled, 6.6-L V8 designed for medium- and heavy-duty pickup trucks.)

A vapor lock inhibiting system – with hardware and software strategies designed and developed by Katech – ensures LPG delivery to a Stanadyne-developed LPG direct-injection fuel pump (which features a unique liquid flow path design) and injector system (including additional coatings on the fuel injectors for greater wear resistance). Testing confirmed that the LPG system can deliver propane fuel at a constant 350-bar pressure directly into the engine while mitigating the potential for vapor lock.

LPG typically offers an approximate 5 to 10% reduction in carbon dioxide emissions when compared to traditional diesel fuel. "There is a potential to leverage rDME (renewable dimethyl ether) blends and renewable propane with this new technology to achieve net-zero carbon emissions," said Srinu Gunturu, Stanadyne's chief engineer. Technology is ready for the commercialization of LPG direct-injection engines, according to Gunturu.



Test cell shows the GM L8T with liquid propane components.

Emission controls

Three-way catalysts have been in the marketplace since the 1970s and the technology has evolved over the decades. "We need catalysts that can work at low temperature ranges as well as be durable in high temperatures. This is really an ongoing challenge – in a good way – for us in our catalyst development," said Louise Arnold, product line manager for **Johnson Matthey**, a 207-year-old company with 50-plus years of emissions control expertise.

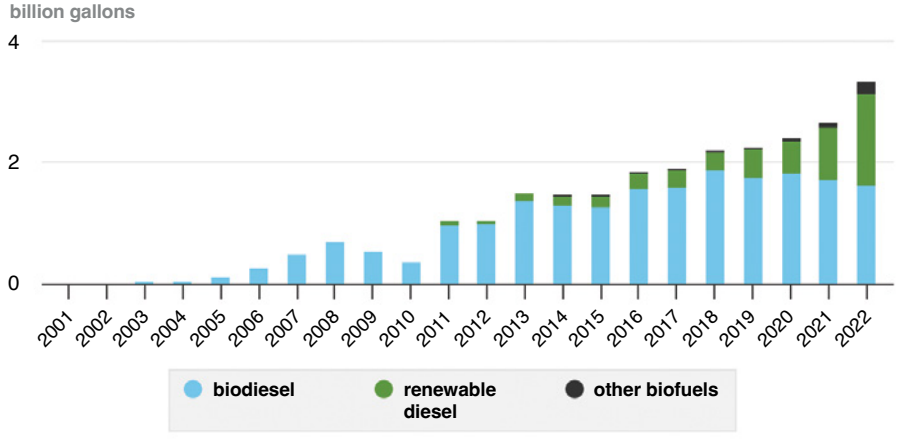
A next-generation three-way catalyst from Johnson Matthey achieves a faster light-off for improved emissions performance and a 30% cost reduction for PGM (platinum group metals). Arnold also noted that particulate filter applications for gasoline engines are revving up. "This is established technology for the European and China markets, so it's exciting for us to start seeing this application in North America," Arnold said.

Nick Morley, Tenneco's engineering director for controls and advanced technology, also mentioned three emissions-reduction technologies: a fuel burner, an electric heater, and a dual dosing and advanced mixing system.

"It does depend on the test cycle, but you can have CO2 neutrality with a nearly 90% improvement in NOx with a [fuel] burner," Morley said.

Kami Buchholz

U.S. biodiesel, renewable diesel, and other biofuels production, 2001-2022



Data source: U.S. Energy Information Administration, *Monthly Energy Review*, February 2024
Note: Other biofuels include renewable heating oil, renewable jet fuel (sustainable aviation fuel), renewable naphtha and gasoline, and other biofuels and biointermediates. Through 2020, also includes small amounts of biobutanol.

In 2022, 1.62 billion gallons of biodiesel, 1.50 billion gallons of renewable diesel, and 200 million gallons of other biofuels were produced in the U.S.

FROM TOP: STANADYNE/KATECH; U.S. EIA

TESTING

What it takes to make tire data useful to non-engineers

Putting a Tesla Model 3 through its paces on the TRC's Wet Vehicle Dynamics Area.

For all the engineering that takes place at the **Treadwell Research Park** (TRP), **Discount Tire**'s chief product and technical officer John Baldwin told SAE Media that there's actually something akin to magic in the way giga-reams of test data are converted into information non-engineers can usefully understand.

TRP is where Discount Tire generates data used by the algorithms behind its Treadwell tire shopping guide. The consumer-facing Treadwell tool, available in an app, a website and in stores, provides tire shoppers with personalized, simple-to-understand recommendations that are mostly based on a five-star scale. Discount Tire and its partners have tested over 20,000 SKUs, representing 500 to 1000 different types of tires over the years, Baldwin said, including variants and updates. Testing a tire to discover it has an 8.2 rolling resistance coefficient is one thing. The trick is finding a way to explain it to someone standing in a tire shop.

"How do I say that that's an okay tire but not a great tire? Three. Or three and a half," he said. "We just latched on to what the world's already doing. Behind the scenes, we'll have it, in that case, bucketed. X to Y is a five-star, Y to Z is four and a half, those kind of things. The algorithm actually does take the real data. The expectation is our customers are not going to become experts on tires."

To do that, Discount Tire - which does not manufacture tires, it just sells them - bought itself a tire testing facility. The 900-acre site near San Antonio, Texas, was previously owned by **Cooper Tire & Rubber Company** before it was purchased by Goodyear in 2021. Since the company already has a test track in Texas, Goodyear offered Discount Tire the opportunity to buy the TRP, Baldwin said.

Discount Tire is not involved in TRP's day-to-day operations. Instead, tire testing company **Smithers** acts as an independent third party that uses the facility around 120-150 days a year. Some tire OEMs – Discount Tire would not name them – rent permanent space at TRP in the three outbuildings. The main building houses offices and a garage with five vehicle lifts, while a nearby maintenance building holds stacks of tires and a **Matteuzzi** tire buffer, among other tools.

Test for yourself

During a recent media day, Discount Tire opened TRP to SAE Media and other outlets. We were able to participate in tests similar to what the Smithers engineers do there. That meant feeling the way **Goodyear** Assurance Max Life All-seasons pulled differently from Michelin Pilot Sport S summer tires around the curve of the 2-mile oval at 65 mph (105 km/h). We tested those same EVs and two **BMW** M5s on the 15-acre wet track with a one-degree slope and a **Lotus** Emira Turbo First Edition through some cones before running a **Jeep** Wrangler Rubicon through the off-road course. While we were stopped on the polished concrete hill, Smithers' TRP track systems manager, Taylor Floyd, told SAE Media why this is a great way to test tire compounds.

"If you're testing three different compounds, you're gonna have three different 'feels' of how easy it is," he said as we sat in the Wrangler angled at 30 degrees. "When you're doing this type of testing, you don't want the momentum because that's already a variable that is really hard to control. If you go up there as slowly and as steadily as possible, you can be the most consistent. You can take something inconsistent and try to add whatever consistency is possible."

The polished concrete hill test is where drivers evaluate how much throttle they can add before the vehicle starts up again if the vehicle loses traction at any corner, and if the driver needs to engage a differential lock or something similar to complete the climb. Floyd said the usual expectation is that 2WD will get the vehicle up the slope but will not be able to restart forward momentum once it comes to a complete stop. Restarting up the hill is the moment of truth. What the drivers are trying to feel with this test, he said,

A Hunter alignment lift in the maintenance building at the Treadwell Research Center.

BOTH IMAGES: SEBASTIAN BLANCO

Smithers' TRC track systems manager, Taylor Floyd.

The TRC features an off-road course that's over four miles (6 km) long and features hard-packed dirt, rock, sand, and gravel featuring banked curves, hill climbs, and other obstacles.

is how well the roughnesses of the rubber surface and the polished concrete surface play together at the tiniest of scales to either stick or slip.

"Each compound, each design is going to have a different way it flexes at that really small interaction face," he said. "A silica-based compound may have silica pieces at the edge of the compound face, and that helps grab onto the small roughness of the surface itself. How the compound flexes in that 10th-of-a-millimeter range at the edge of the tire, that's where the compound is having the most effect."

Subjective/objective

Baldwin, a polymer scientist who previously worked at **Ford**, said the Smithers test drivers use the SAE J1060 10-point subjective rating test to turn feelings into numbers.

"The drivers all follow the SAE rules for that," he said. "A difference of one means a professional driver may notice the difference, but your average driver wouldn't. Two is normal people, and three is a huge difference, which translates into half, one and one and a half stars. Let's say out on the wet, they might have ten categories that they're rating. There's the lap time, which I consider objective, but then there's breaking, which is subjective out there, cornering, steering, response, linearity, transition, all of those things that then they're putting ratings on. Then they add it up, and they come up with [a score] out of 10 points, and we turn that into the five stars. We might be stylizing it when we show it, but the actual number behind the scenes is whatever the driver comes up with. That's the number we use."

Baldwin said the automotive industry has been dealing with these sorts of subjective reviews for a century, and one of Treadwell's solutions is the use of control tires to help drivers find the baseline each time. These are usually represented by a standard **Michelin** tire for the application at hand, but "it doesn't mean they're the best," Baldwin said; they're just the most consistent. These control tires are usually so reliable that Smithers' drivers have been able to identify manufacturing problems that Discount Tire has then reported back to the tire OEM.

"We re-audit tires too," he said, to make sure nothing's changed. We want Treadwell to rank with what the product is today, not what it was a year ago."

Treadwell also tests worn tires, using that Matteuzzi tire buffer with diamond-encrusted blades and other surfaces to wear them down to 4/32nds before sending them on a trailer test that's similar to the European R117 wet testing protocol.

Sebastian Blanco

FROM LEFT: SEBASTIAN BLANCO; DISCOUNT TIRE

STANDARDS

Experts: J3400 isn't just a plug, but a complete system

The auto industry took the next step in the evolution of North American electric vehicle charging solutions today at The Battery Show in Detroit. That's where **SAE International** released its NACS J3400 Recommended Practice document.

Technically called the "SAE J3400TM: NACS Electric Vehicle Coupler Technical Recommended Practice," the RP can be considered a "blueprint to build" and should set off a stream of new products from suppliers that OEMs and third-party groups like **UL** will soon test, said Rodney McGee, chairman of the SAE J3400 NACS Task Force and a research engineer at the **Transportation Electrification Center** at the University of Delaware.

"There's going to be more interoperability testing, more work with the industry, as we look for opportunities for improvements in the document," he said. "When we go from a recommended practice to a standard, we really want to see more of that happen. The ideal situation is that there are very few changes between the two."

NACS is also getting an official name change with this next step. The acronym now stands for the "North American Charging System" (instead of "Standard" at the end) in order to "[reflect] that it is a system comprising a set of industry standards covering aspects beyond the vehicle coupler," SAE said in its announcement.

McGee told SAE Media that the move to J3400 gave the industry the opportunity to incorporate good ideas that have been introduced or made popular since the development of the last major North American EV standard, J1772, which kicked off in 1996 and became broadly adopted by the industry in 2009. McGee said there are two main reasons why the upcoming massive shift to NACS should finally provide better charging infrastructure in North America. First, once most new EVs can

The SAE booth at Battery Show North America 2024 in Detroit.

Rodney McGee, director of the NACS J3400 Task Force and an electrical engineering professor at the University of Delaware.

charge at the gold-standard Tesla network, other operators will need to match Tesla in ease-of-use and reliability or they'll lose the apples-to-apples comparisons that EV drivers will make in a way they couldn't before. Second, the reason Tesla's network has advantages over the OEM-and-supplier-built networks that non-Tesla drivers deal with is that Tesla engineers worked on both the vehicle and the EVSEs.

"When [Tesla] designed the basis of NACS over ten years ago, they were always focused on both sides," McGee said. "They were a company building and operating a charging network and also building cars, and when you approach a system from that development, you end up maybe in a different place than when J1772 was started, when OEMs did not have these energy units and these huge investments in infrastructure. Now, they're on both sides of the equation and so the system design of NACS really is about mass electrification: having a connector that can support more voltage types for AC charging and more connection methods. We really brought in a lot of that stuff to be THE standard to electrify transportation in North America, especially for passenger cars."

Compared to J1772, for example, J3400 will allow for digital communication between the car and the charger (J1772 uses what McGee called a "very dumb analog communication method") and the task force hopes to bring features like minimum required error codes that the **ChargeX** consortium uses with DC fast charging to the new AC J3400 standard. J3400 also adopts V2G and backup power requirements.

J3400 will also update the North American charging landscape to allow for carry-along cord sets, McGee said. Common in the rest of the world, personal cords allow for smaller, cheaper EVSEs because the stations offer a standard port instead of a cable and plug that requires more investment and maintenance. This will help bring EV charging infrastructure to lower-income drivers and people who live in apartments.

"The stuff that hangs around when there's no electric car there needs to be minimized," McGee said. "It needs to disappear into the infrastructure. And that'll really drive curbside charging."

The J3400 RP currently says the maximum amperage for the standard would be 900 amps if it's just cooling from the connector side and 1000 amps if cooling from both the vehicle inlet side and the connector side. "[That] is just theoretical," McGee said, since no automaker has announced anything that powerful. "But in theory, NACS tops off at exactly one megawatt."

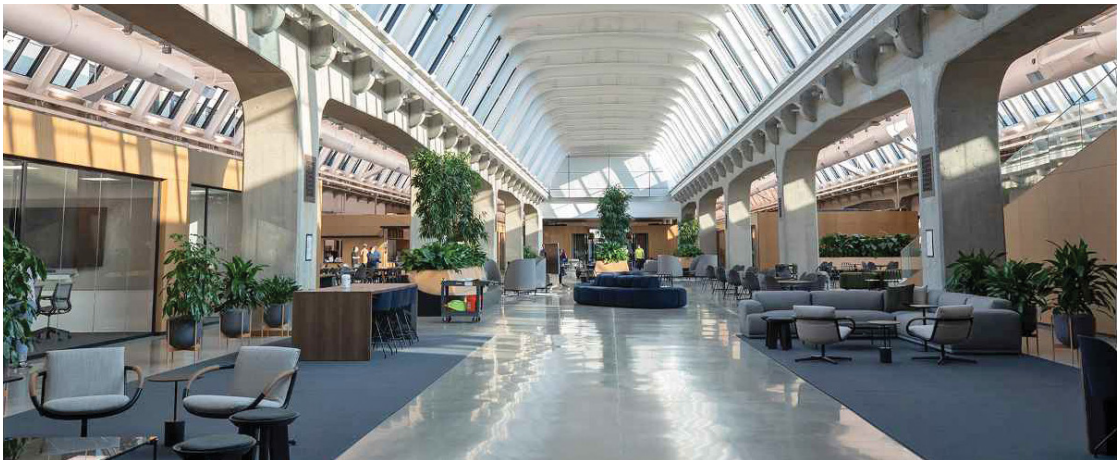
On the voltage side, the updated NACS will bring some of Tesla's farsightedness to the broader public. Tesla chargers are able to use the 480-volt, three-phase power that comes from utilities to a commercial site as single-place power at 277 volts and put that into the vehicle directly, McGee said. That will mean cheaper AC charging because you don't need to have to pay for an extra transformer right there on the curb. Using less copper and a smaller conduit are other benefits.

Sebastian Blanco

FROM TOP: CHRIS CLONTS; SEBASTIAN BLANCO

WORKPLACE

Ford Engineering Lab turns 100, hosts new team



The Ford Engineering Lab, featuring a limestone exterior facade, was designed by Detroit architect Albert Kahn with considerable input from Henry Ford. Image shows a portion of the building's first floor.

"This might be our most forward-looking team occupying the building that was the impetus for our future-looking focus in the very beginning," Jennifer Kolstad, **Ford Motor Company**'s Global Design and Brand Director, told SAE Media inside the 100-year-old Ford Engineering Lab's library.

The two-story Dearborn, Michigan building, which spans two city blocks, is now the renovated and modernized workspace for Electrified Propulsion Engineering Team innovators. "They're in-space before the research and development hub opens across the street," Kolstad said.

That two-million-square-foot (186,000 sq m) research and engineering center is slated to wrap construction in 2027, with the first phase – a showroom and studios – slated for completion in early 2026, Kolstad said. "We're currently decentralized with skilled teams scattered across our Dearborn campus. When finished, product development will be under one roof," Kolstad said about the new, four-story research and engineering center.

Historical milestones underpin the character and charm of the revamped Ford Engineering Lab's 221,000 sq ft (21,000 sq m) of workspace. A first-floor hallway leads to Henry Ford's last remaining office — replete with a majestic marble fireplace, towering grandfather clock, and an immense work desk. Adjacent to the Ford Motor Company's founder's office is his son's (Edsel Ford's) office. "A lot of important decisions have been made here," senior collections archivist Ciera Casteel said during a September 18 press tour of the building.

A second-floor hallway provides an entryway to a walk-in vault. With 8-in (203-mm) thick walls and a steel inner lining, the vault was typically stuffed with business records and substantial cash to pay employee salaries and bonuses as well as cover regular business expenses.

At the engineering lab's 1924 opening, the building featured one of the largest open office spaces anywhere. That spacious environment inspired the design and development of many vehicles, including the 1928 Model A and the 1949 Ford, which sold more than one million units in its first production year.

Decommissioned in 2007, the engineering lab was later revitalized in a multi-year renovation project that resurrected features amid modernizations to lighting (including restoring the original skylights), electrical, plumbing, air quality, and other aspects. "Ninety percent of our global facilities – excluding manufacturing – will be renovated by 2027," said Kolstad.

Kami Buchholz

Before the Ford Engineering Lab was constructed, the site was a factory for Ford tractors. Ford developed the first mass-produced, lightweight tractor under the Fordson nameplate.

FROM TOP: FORD; KAMI BUCHHOLZ

ELECTRIFICATION

Pure Lithium bets on Vanadium cathodes to save U.S. battery independence

Continuing a common theme among some presenters at The Battery Show North America, the CEO and founder of **Pure Lithium**, which is betting on lithium vanadium, framed the company's efforts as a way to end China's dominance in the battery market.

"The U.S. is facing an existential crisis, and that is the extinction of the U.S. automotive industry," Emilie Bodoin said. "But unlike the dinosaurs, we can see this comet coming. We're literally in a cold war with China over supply chain."

Pure Lithium may not be the only company pursuing lithium metal technology as an alternative to lithium ion batteries, but it is a vertically integrated one that is able to handle everything from material sourcing to manufacturing the lithium anodes and vanadium cathodes that power its products.

Bodoin, who founded the company with noted battery expert Donald Sadoway – who also started liquid battery company Ambri – said Pure Lithium has already secured enough material to power 50 million EVs.

She asserted that the battery industry is overdue for a new chemistry, as the only two that have been commercialized for gigawatt scale are lead acid and lithium ion. She said that replacing graphite — 77% of which comes from China — cuts the weight and volume of a battery by 50%. "So, we have at least twice the capacity, half of the weight, and our battery eliminates graphite, nickel, cobalt, and dependence on China."

Pure Lithium cofounder and CEO Emilie Bodoin refers to the company's lithium-vanadium technology as the "holy grail of energy storage."

The hurdle the company faced was how to manufacture lithium vanadium cells. Others have tried using molten salt electrolysis, Bodoin said, but that has drawbacks such as releasing chlorine gas and halide salts due to its pure lithium chloride feedstock. It results in an ingot, which also proved problematic because it couldn't be extruded to be thin enough to be effective.

Pure Lithium's solution? Electrodeposition, which is how copper, nickel and other metals are made. "We take a proprietary membrane that blocks water and conducts lithium, and we take lithium brine, aqueous sources of lithium, and we put it into our reactor, and we electroplate a perfect lithium metal electrode that's lithium on copper that can go directly into the battery in one step," she said.

Bodoin claims the result is drastically reduced cost, even compared to lithium-ion tech. Lithium metal from extrusion is about $3,650 per kWh. Lithium-ion batteries in America are about $100/kWh. Pure Lithium's electrodeposition process makes the batteries for $15/kWh. Bodoin also said the company cut the time from acquiring minerals to completing the battery from about 547 days to just 48 hours. She said that translates to big cost and greenhouse-gas reductions for the process.

Bodoin's most emphatic point, perhaps, was the safety advantages of Pure Lithium's technology. Compared to the NMC chemistry of most lithium-ion batteries, lithium vanadium batteries don't face the same thermal runaway problems. "Vanadium oxide itself is stable up to 1,800 degrees C," she said. "That's enough of a temperature difference that means we don't have to worry about that," even though some additive materials lower that threshold to 700 C.

Earlier this year, Yahoo! News reported that Pure Lithium entered an agreement with **E3 Lithium** out of Alberta to complete design and preproduction work to create an "economic assessment of a commercial lithium metal battery."

Chris Clonts

The lithium-vanadium battery being developed by Pure Lithium could help solve the problem of thermal runaway in EV batteries.

FROM TOP: CHRIS CLONTS; PURE LITHIUM

EXPERT Insight

Expert Insight Interview with Justin Weigold of TE Connectivity

TE Connectivity builds advanced connectors and sensors for multiple industries, including automotive, aerospace, IoT and energy. In this edition of Expert Insights, TE Connectivity's global product manager for automotive data connectivity, Justin Weigold, talks about the changes coming to electrical/electronic vehicle architectures and cameras on software-defined vehicles (SDVs).

***Expert Insight:* How does the trend toward SDVs impact the electrical/electronic vehicle architecture?**
Justin Weigold: The journey towards SDVs is driven by fulfilling our consumer's expectation of future vehicles, following the PACE trends for vehicles to become more personalized, autonomous, connected, and electrified. This results in an increase in applications and in the number of sensors per vehicle.

SDVs integrate more software-driven functionalities, requiring a new type of E/E architecture to handle software updates, data management, and integration of various systems. Traditional vehicle architectures are evolving towards zonal architectures that centralize computing, reduce wiring complexity, and provide a platform for vehicle upgrades.

***Expert Insight:* How does that transformation impact the development of vehicle cameras?**
Weigold: SDVs and zonal architectures influence it in several ways. Everything you want to do with software needs to be already available in the physical layout, which results in a strong increase in camera content per vehicle, for example. The resolution of automotive cameras is increasing quickly, with more computing power being centralized in supercomputers.

To enable this real-time, high-definition imaging, cameras need to be able to handle high data bandwidth and increased data rates. This transition introduces challenges like managing signal integrity, electromagnetic interferences, variations in temperature, and the need for miniaturization.

As cameras become more compact, connectors become a larger component on the PCB. To address this, there's a push towards high integration, such as embedding camera connectivity directly into a sensor module. This also leads to a need for cameras that support quick and easy assembly and integration. Furthermore, camera systems must be compatible with highly automated production processes.

***Expert Insight:* What do all these changes mean for camera connector designs in the future?**
Weigold: It's quite similar on the connector side. As cameras transmit higher-resolution data, connectors must support higher data transfer speeds and ensure robust signal integrity. Miniaturization is another main topic because, while the cameras become smaller, their connectors become, relatively, a larger component. This requires new, innovative designs that maintain or even increase performance. As connectors handle more data and are used in varying environments, they must be designed for greater durability and reliability, ensuring consistent performance under different conditions.

***Expert Insight:* What is TE Connectivity's solution for connecting all these cameras?**
Weigold: TE's data connectivity products can be characterized as a portfolio of robust, high-performance automotive connectors that are compatible with existing market interfaces. As architecture requirements become more sophisticated, TE's expertise and focus on creating value through highly engineered solutions supports introducing more and more of our own innovations.

Many decades ago, the coaxial system FAKRA was launched in the automotive market. It still exists today, as it offers a universal range of applications and good bandwidth, up to 6 GHz. Another development is the miniaturized coaxial MATE-AX, where we set the milestone as the first supplier to come up with market standard for mini-coax that enables bandwidth up to 9 GHz.

Now, what makes our camera solution special? We already see different coaxial connector interfaces being applied by different OEMs, creating further challenges for Tier Ones in the future to minimize variance and optimize costs. TE has developed a modular camera connector platform that enables our customers to be OEM-interface-independent. In close collaboration with our customers and suppliers, we've been working on a standardized design, minimizing complexity of connector integration and camera assembly. Our platform provides customers with several PCB sockets and different OEM interfaces. The next step will be to make the whole system even smaller, right?

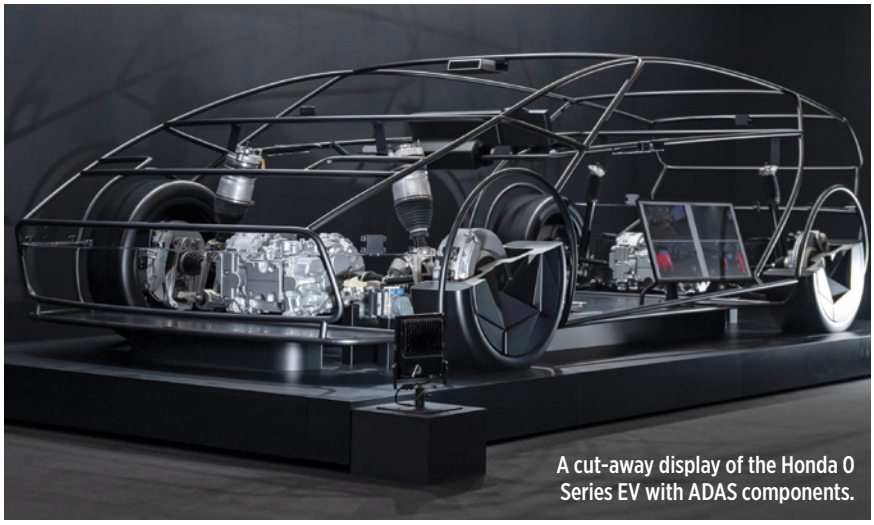
***Expert Insight:* What is the value and importance of industry collaboration when addressing the challenges posed by SDVs and vehicle architecture transformation?**
Weigold: Industry collaboration is crucial when addressing these challenges, especially when it comes to standardization and changing architectures.

It is important to understand that this need for collaboration is not limited to two-party, customer-supplier relationships, but can and actually should be expanded along the supply chain. TE works with OEMs, harness makers, chip suppliers and other partners in the supply chain to tackle these challenges of vehicle architecture transformation effectively, and to provide consumers with an SDV of the future that will have a similar, maybe even bigger, impact than the smartphone had on our lives. ■

Watch the full interview with Justin.

Honda pioneering new manufacturing tech for Zero electrified platform

Honda has long been at the cutting edge of mobility and tech, with everything from the Asimo robot of 20 years ago to plans for reusable rockets to launch lightweight satellites into orbit. During a Tech Day event in early October in Tochigi, Japan, the Japanese automaker announced further details of its upcoming Honda 0 architecture (Honda calls it "Honda Zero" but writes it with the number), its first in-house electric platform designed from the ground up. Honda also discussed some of the advanced manufacturing techniques it's pioneering to reach its core design and technology tenants.

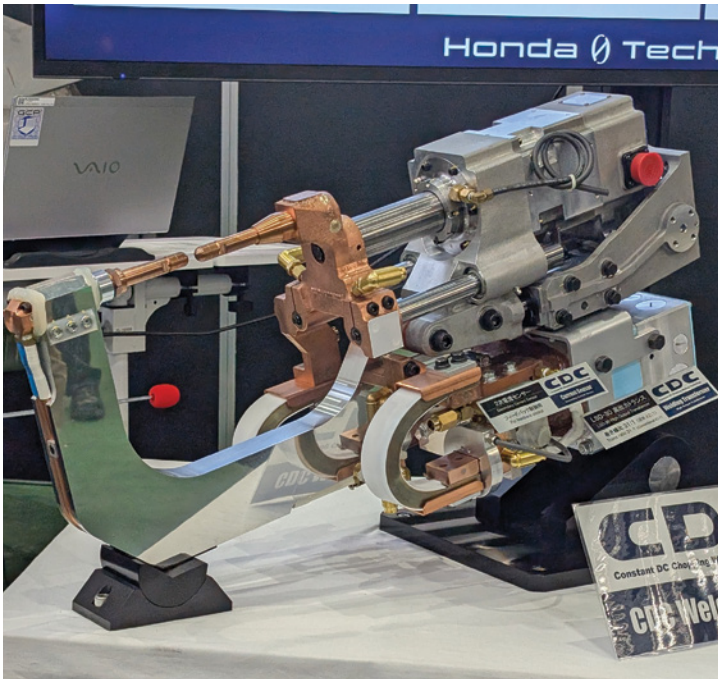


A cut-away display of the Honda 0 Series EV with ADAS components.

Smaller Axles with Plenty of Power

Honda said that the company's goal with the new 0 platform is 300 miles (483 km) of EPA range while remaining" Thin, Light and Wise." While executives declined to give specifics on the battery pack, charging architecture, or definitive power output, they did provide some details on some components.

Honda developed the new e-Axle motors in partnership with **Hitachi Astemo**, one of the company's joint venture partners. Honda says that the new motors are 40% smaller and lighter than the competitive set, with the inverter placed directly next to the motor for space savings. The 0 platform will get 50 kW and 180 kW options that can be configured for a maximum power output of 360 kW.



Honda said its new Constant DC Chopping (CDC) welding technique allows the welding of thinner and thicker pieces of high-tensile steel with less splatter and better connection.

Honda said the 0 battery will be "6% thinner... compared to the standard component/function installed in currently available production EVs," but wouldn't say which competitors it used. The company also reduced the number of parts in the battery case from over 60 to just five thanks to new modular manufacturing techniques.

Honda said the pouch-style cells will be able to charge from 15% to 80% in around 10-15 minutes, suggesting an 800-volt architecture. The batteries were developed in conjunction with the joint venture that Honda has with **LG**, and will be built in the Marysville plant.

Honda plans to release seven EVs for North America on the platform by 2030. The 0 platform is an important step toward Honda's goal of all global sales to be battery electric or fuel cell EVs by 2040. The first EV on the platform will be the upcoming Saloon, a sedan-style vehicle that was previewed at CES 2024. Honda says that the Saloon, which will likely get another name when it makes its production debut at CES 2025, will essentially be a halo vehicle for the brand and that the technology will trickle down to other lower-priced EVs as the company rolls out the rest of the lineup. Honda says the production Saloon will appear in showrooms as a 2026 model.

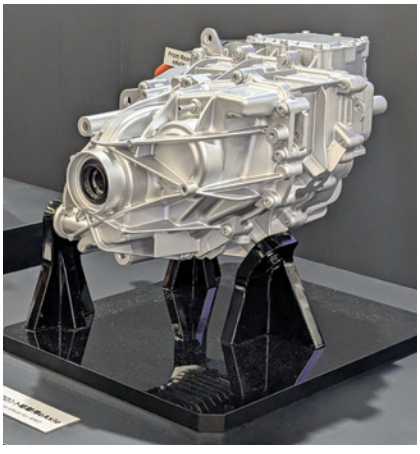
FROM TOP: HONDA; ABIGAIL BASSETT

Manufacturing updates and innovations to get to 0

To achieve its thin, light goals for the new 0 platform, Honda developed new manufacturing techniques and has made large machine investments that will arrive at the Ohio plant in the coming year.

The company has invested in six 6,000-ton mega-casting machines that will initially be used to manufacture the battery case for the 0 platform. Eventually, these machines will be expanded to manufacture body frames like the rear module. These huge machines will be able to produce modular battery cases for different-sized vehicles that Honda will build on the platform (both sedans and SUVs), and Honda will use 3D friction stir welding (FSW). The technique reduces the amount of heat put into parts, thus reducing deformation while improving the strength and air-tightness between joints. The company developed the technique on its ATV vehicles and first used it in mass production for the front body frame under the Accord starting in 2012.

Honda has also pioneered a welding technique called Constant DC Chopping (CDC), which allows the welding of thinner and thicker pieces of high-tensile steel with less splatter and better connection. Honda has leveraged what it has learned from inverter technology used in everything from their manufacturing lines to their experience in generators to manage the heat distribution in the weld and keep it constant, ensuring a better connection. Honda says it can roll out CDC welding by replacing the welding guns and simply adding software to the weld and robot controllers. The company will start by rolling the technology out to the 0 manufacturing line and then apply it to their ICE and HEV products, resulting in around 20% weight savings across the entire fleet.



Honda worked with Hitachi Astemo on the new e-Axle motors that will be used in future Honda 0 platform. The inverter is located next to the motor.

ABIGAIL BASSETT

Honda also plans to roll out machine vision and AI to digitize the quality assurance of human workers and improve

Honda 0 Series battery modules are assembled using a quality control tracking system. A green indicator on the tool confirms the correct attachment.

parts traceability. In Japan, the company showed off a camera attached to a worker's hard hat that could capture video of a weld and rate it for quality. The company also uses digital twin technology to maximize the manufacturing line and manage the complexity of different powertrain builds, as the company will build EVs alongside the ICE and hybrid vehicles it already builds on the same line.

Improved Safety and Frame Flex

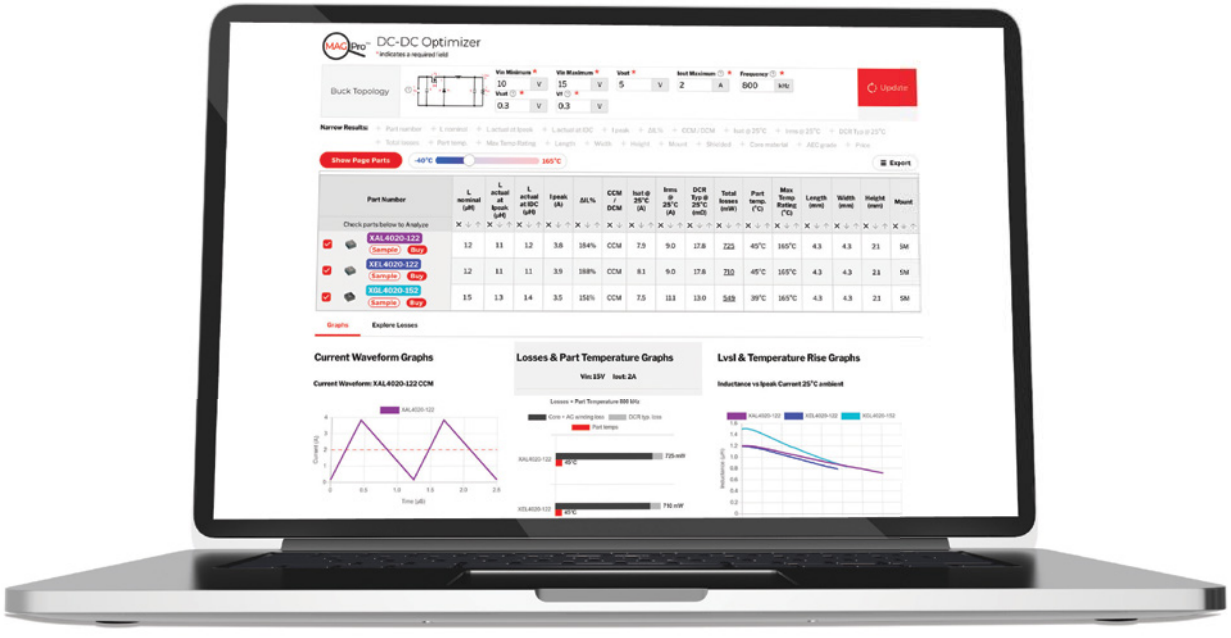
In addition to innovative manufacturing, Honda has also rethought the frame and body components of its future BEV vehicles to improve handling, create lighter vehicles, and improve performance in a crash. For one, the e-Axles are now lower in the vehicle to avoid interfering with the body in an impact. Engineers told SAE Media that they've been able to convert the collision in the small overlap crash test into a rotational force rather than a direct cabin force thanks to the new frame and body components.

Gyro attitude estimation and stabilization control lessons from the Asimo robot will also be used to improve the dynamics of future Honda vehicles. They will be integrated in a core ECU that will help control suspension, steering, brake control, and drive motor to keep cornering flat and manage body control.

Abigail Bassett

HONDA

Find the Right Part Faster



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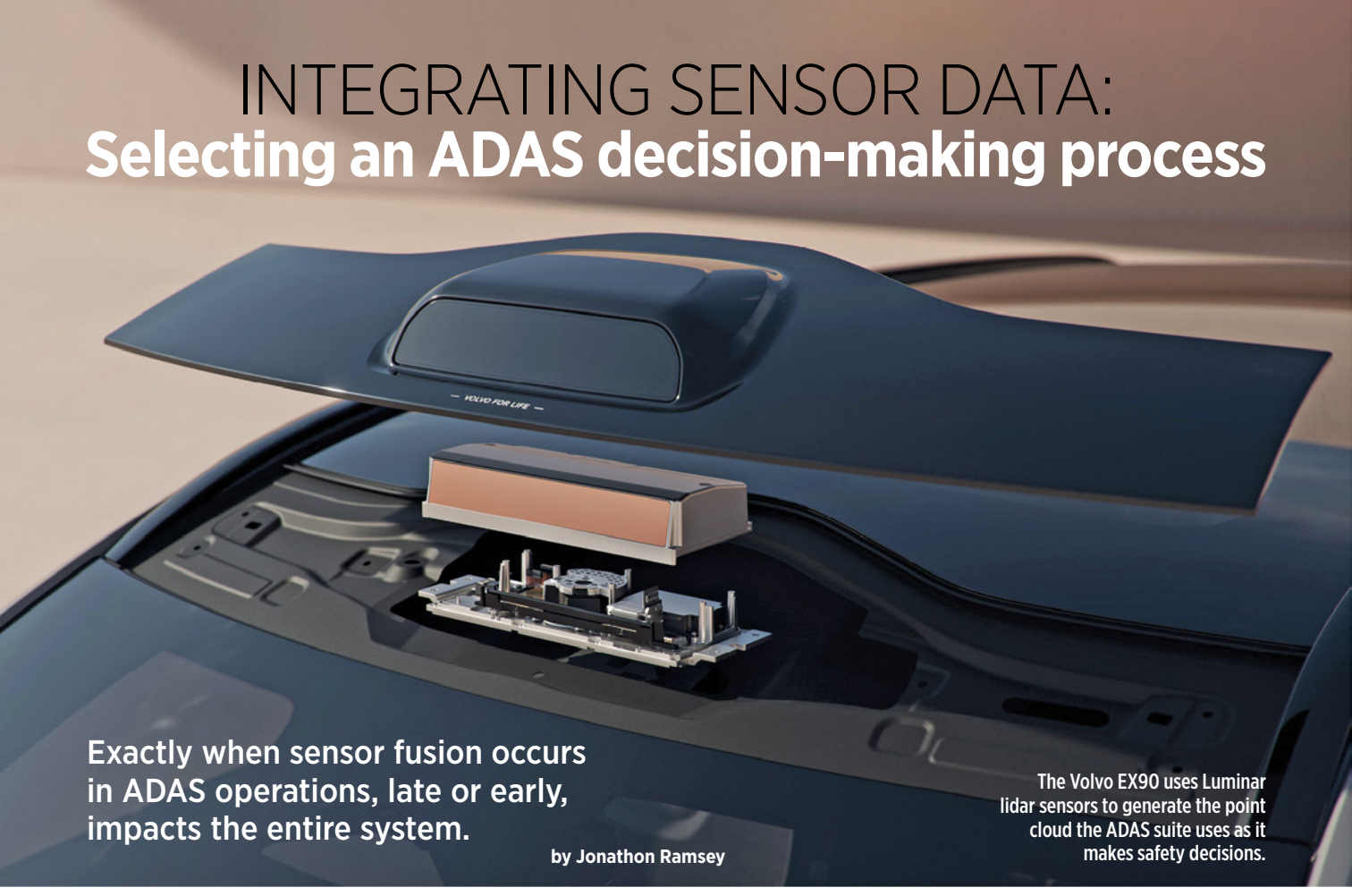
INTEGRATING SENSOR DATA:
Selecting an ADAS decision-making process



Exactly when sensor fusion occurs in ADAS operations, late or early, impacts the entire system.

by Jonathon Ramsey

The Volvo EX90 uses Luminar lidar sensors to generate the point cloud the ADAS suite uses as it makes safety decisions.

Governments have been studying Advanced Driver Assistance Systems (ADAS) since at least the late 1980s. Europe's Generic Intelligent Driver Support initiative ran from 1989 to 1992 and aimed "to determine the requirements and design standards for a class of intelligent driver support systems which will conform with the information requirements and performance capabilities of the individual drivers."

Automakers have spent the past 30 years rolling out such systems to the buying public. **Toyota** and **Mitsubishi** started offering radar-based cruise control to Japanese drivers in the mid-1990s. **Mercedes-Benz** took the technology global with its Distronic adaptive cruise control in the 1998 S-Class. **Cadillac** followed that two years later with FLIR-based night vision on the 2000 Deville DTS. And in 2003, Toyota launched an automated parallel parking technology called Intelligent Parking Assist on the Prius.

Those were à la carte options with discrete functions. That Distronic cruise control, for instance, was a radar unit in the S-Class grille plugged into an ECU in the passenger footwell, which connected to the sedan's CAN-C Bus. As an SAE Level 1 convenience system, it could only accelerate and brake within limited parameters.

Today's ADAS are networked suites of data collection devices able to control a vehicle without driver input. Mercedes' hands-free Drive Pilot system in today's S-Class counts one lidar sensor, one stereo camera, four monovision cameras, five radar units, eight ultrasonic sensors, and a road moisture sensor. On top of that, and common to all ADAS, there will be an antenna array for positioning data, a telematics module for communication with the cloud, and a processing module often called the "compute" where sensor data is turned into vehicle decisions.

The fractal complexity problem

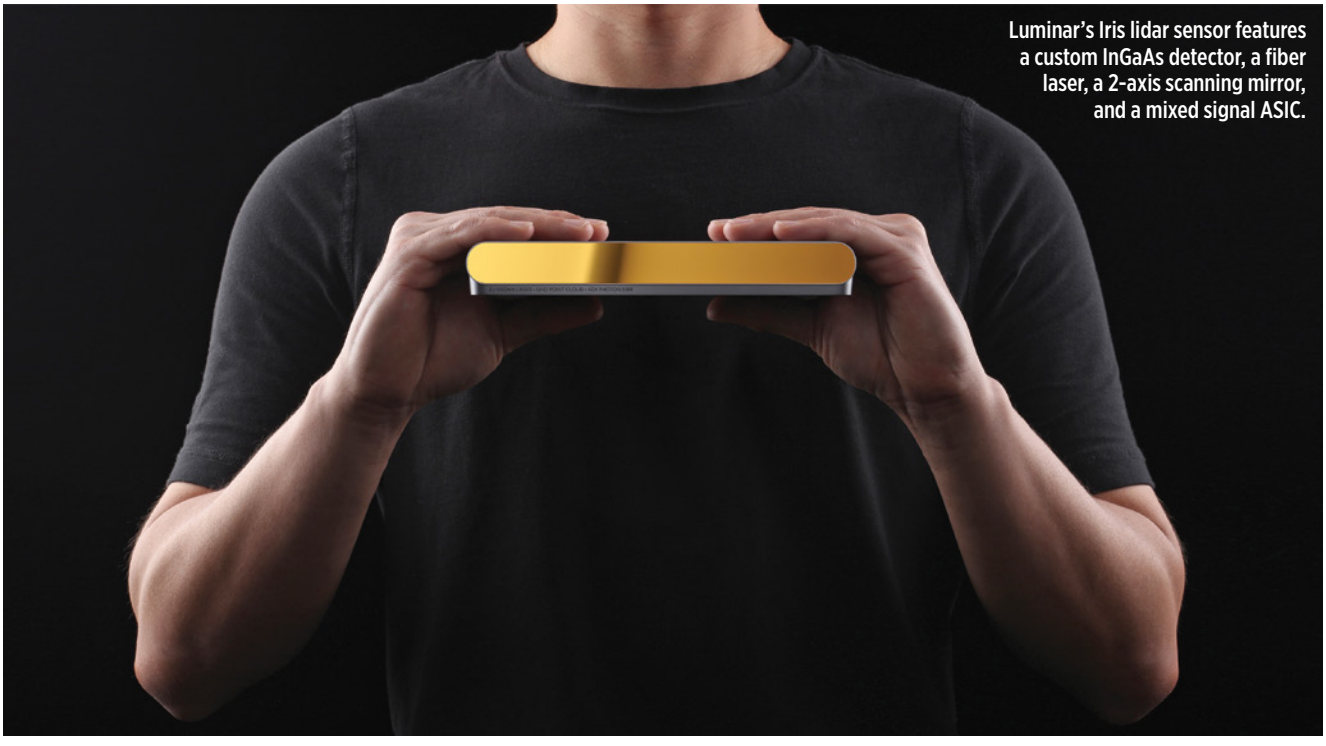
A simple flow chart for ADAS order of operations starts with sensor data acquisition, followed by an initial object detection phase called perception, enabled by AI and applied to raw sensor data. Then comes fusion of the aggregate perception data, which is run through another AI model that validates the environment and plans for vehicle action. It concludes with the execution of a vehicle command.

The vital step in that decision-making process is sensor fusion, combining perception data into an environment of accurately identified objects that the vehicle can safely navigate. ADAS is only as good as its sensor fusion performance, which boils down to the capability of the artificial intelligence models used to identify objects and deal with them. With AI still in its infancy, the science of sensor fusion is also in its early stages.

"Sketching out the pieces of an early sensor fusion model is a known process," a **Rivian** spokesperson told SAE Media. "The challenge is that each of those pieces is fractally complex and requires high reliability and scale. Continuing to chase down those subsequent nine-tenths of reliability is orders of magnitude more difficult."

A single camera offers various tunable parameters that hint as this fractal complexity: image resolution in megapixels, focal length, field-of-view, frame rate, and dynamic range. Each decision alters the cost/benefit

VOLVO



Luminar's Iris lidar sensor features a custom InGaAs detector, a fiber laser, a 2-axis scanning mirror, and a mixed signal ASIC.

LUMINAR

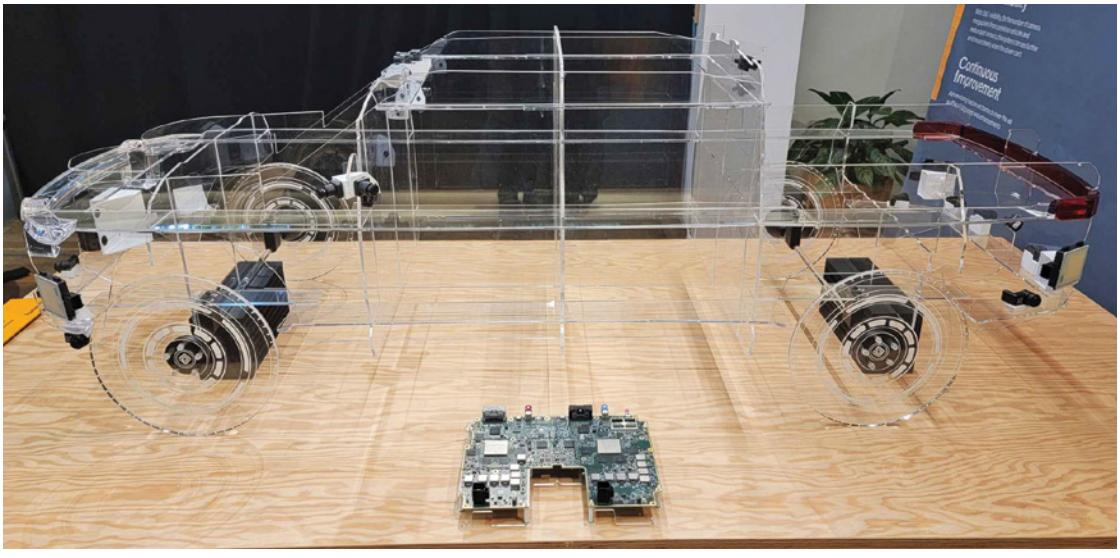
matrix of data transfer and processing requirements. And each parameter must be tuned for various cameras around the car. For example, adjusting camera height changes tuning choices. The sum of all these choices must then be tuned to work with an AI perception model—for instance, how many megapixels and how many frames per second in a forward-facing camera are ideal for a given model to accurately identify a person in an image, at what speed, and at what distance?

Or take the considerations necessary for lidar, such as the **Luminar** unit **Volvo** uses on the new EX90. Lidar output is called a point cloud, a Seurat-like picture of an environment made up of points. Matt Weed, Luminar's senior director of product strategy, told SAE Media that a sensor fusion design needs to decide on the kind of lidar output. A three-dimensional point cloud requires more compute compared to a two-dimensional array that represents three dimensions. With the latter, designers need to decide how to represent 2D as 3D. "The common one right now is a top-down projection, like a bird-eye view," Weed said. "You have things called pillars, where you have attribute height and gap and under-drivability, but not in a highly resolved way." The upside to this is "it's not blowing up your [processing] computer like crazy, like a full three-dimensional model, but it's still going to be better than what you get in a camera." These data-in-AI-identification calibrations must be done for every type of sensor on a vehicle.

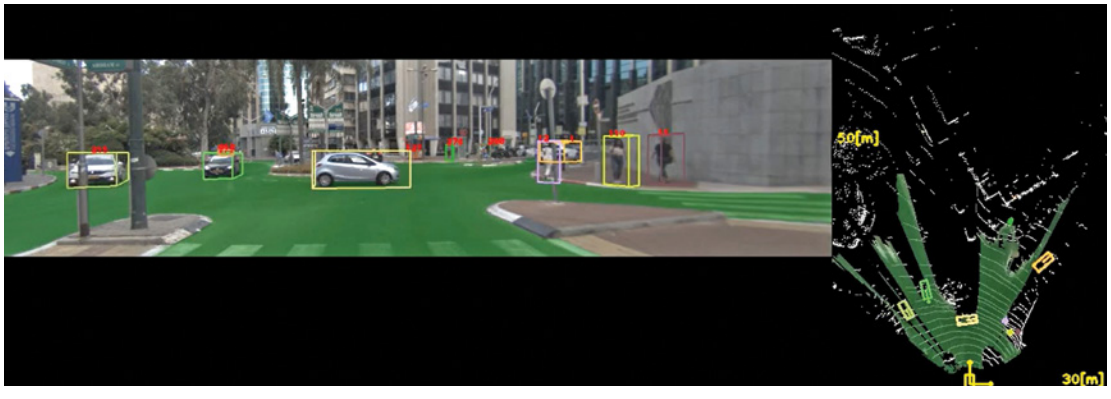
Fusion: late or early?

At the other end of fractal complexity lies the question of where sensor fusion occurs in ADAS operations. The two broad approaches are late fusion, also known as object-level fusion, and early fusion, also known as raw data fusion or low-level fusion. The flow chart described above is considered late fusion, the process automakers initially decided on. This technique puts perception work on the sensor itself, filtering raw data at the sensor to identify objects in the environment, then sending those perceptions to the compute for fusion. There, the AI model considers the fused perceptions for its world-building, validation, and vehicle reaction planning."This approach is simpler because you push much of the hard work to third-party components," Rivian said. "But [it's] limited because the outcome is mostly as good as your least-capable sensor... [and] objects must be detected by more than one sensor to be considered valid." If the camera's perception data indicates an object ahead that the radar hasn't registered, the final AI model doesn't have raw sensor data that it could use to make its own decision about the variation, with potentially deadly consequences.

Today, more companies are interested in early fusion, including Rivian, Luminar and ADAS software developer **LeddarTech**. LeddarTech chief technology officer Pierre Olivier told SAE Media that early fusion allows ADAS to use lower-cost sensors without high-performance compute power. Because "every step of processing data is a filter," Olivier said, utilizing the full spectrum of raw data maximizes output quality. Rivian said this provides, "richer and more accurate representations." Luminar's Weed said this method is standard for lidar units, because every lidar maker is "trying to keep power budget down in the sensor, which has to live at the extremity of the vehicle and deal with heat."



At the launch of the 2025 R1, Rivian displayed a model of the sensor suite and the control board.



A sample of the way LeddarTech's sensors see the world.

"The [early fusion] perception model can be jointly trained with behavioral agent prediction, where we can not only identify and classify objects but predict paths and likely actions of other vehicles and road users," Rivian said. "Modern AI is incredibly powerful, but it is a tool that requires constant early decision-making, with a view towards the future."

Raw data offers far more data to process and requires training AI perception models to filter out the kinds of noise each sensor type is prone to include. LeddarTech's open platform software toolkit for automakers can be integrated into OEM ADAS systems, and claims it offers high decision reliability on lean compute packages thanks to the quality of its perception model.

A new approach called very early fusion is now under consideration. This strategy, "incorporates tuning sensors to work together to reduce data volume almost at the sensor," Weed said. "You're actually informing the way the sensors are capturing the environment based on each other." Camera output accounts for the bulk of sensor data but much of that data is irrelevant. Lidar point cloud data could be used to strip away unnecessary image data before processing."You don't need millions of points of the sky or the road right in front of you based on the lidar data, where you see that there is free space," Weed said.

Improved compute power

The compute module is another area rife with development potential. The explosion in vehicle software has invited major chip makers into vehicle design as OEMs reduce the number of ECUs in a car in favor of powerful brains to run all vehicle functions. Rivian and Volvo use **Nvidia**'s Drive Orin chip, and Nvidia has its own autonomy solution called Hyperion that is above SAE Level 2 and uses the same Iris lidar on Volvo's EX90. **Intel**, already a force in in-car chips, bought ADAS maker **Mobileye** — which **Volkswagen** uses — in 2017. And **Qualcomm** has lately begun doing more to promote its Snapdragon Ride Platform.

Computing demands can quickly escalate when dealing with heaps of real-time raw data, predictive AI, neural networks, and large language models. Even before considering the rigors of a vehicle's duty cycle, vehicles impose constraints on space, energy draw, and heat. LeddarTech's Olivier mentioned fuel economy mandates as another hot button, noting that energy draw

FROM TOP: JONATHON RAMSEY; LEDDARTECH

Sustainability commitments that go beyond.

Current trends such as zero emission vehicles and carbon neutral manufacturing demonstrate the growing significance of sustainability in the automotive industry. To achieve industry CO^2 reduction targets, manufacturers need to focus on the production process as well as vehicle emissions.

Making production more efficient and reducing waste, water and energy consumption are key to reducing the environmental cost of manufacturing. These goals can only be achieved working in close partnership with suppliers that share the same commitment to improving sustainability.

Committed to becoming the global leader in sustainable fluid technology, Quaker Houghton has recently launched See Beyond™, a strategy which connects all of its sustainability actions and is focused on creating a safe, sustainable future for all. Sarah Briggs, Director of Corporate Sustainability at Quaker Houghton explains what it means to manufacturers, investors, and the planet.

Steady and strong progress

Across our business, we are taking positive and measurable steps to minimize our environmental impact. Recent milestones include eliminating CMR hazards[1] from 97.8% of our fluids portfolio – with a 100% target by 2030. We were also awarded the 2023 EcoVadis Silver Award and recognized as one of General Motors' (GM) Top Global Suppliers at the 2023 Supplier of the Year recognition event.

71% of our electricity is sourced renewably via grid, solar panels, and purchased contracts, strengthening our commitment to reducing our greenhouse gas emissions targets. Moreover, 7% of total mineral oils used in our products are procured from re-refined sources while over 20% of our raw materials are renewably based.

We are also working with our supply chain to promote more sustainable sourcing and best practices in their operations. Today, for example, 60% of our palm oil is fully segregated through the RSPO and we are actively leveraging the EcoVadis platform to audit the sustainability performance of our suppliers.

The bigger picture

We have recognized the need for a clear and unifying vision to focus our work. The result is 'See Beyond™', an overarching strategy which brings together all our existing sustainability initiatives and acts as a roadmap for how we will think, act, and evolve as a business.

Key to meeting our ambitious goals is supporting our customers as they tackle their own unique sustainability challenges and keep pace with the demands of a changing world. We do this is by developing innovative solutions which help customers reduce their product, water, and energy consumption, reduce their waste output and greenhouse gas emissions, as well as reduce human health hazards across value chains.

Going beyond to drive change

We continually invest in R&D to support our transition to high-performance, more sustainable solutions. We have introduced Green Chemistry guidelines and a preferred raw material list to help guide the adoption of the most favourable raw materials in terms of renewability, human and environmental safety.

Whilst many of our industrial process fluids deliver sustainable benefits to customers through the sustainable raw materials selected and by reducing the environmental footprint of our customers in application, we understand the manufacturing industry requires more than just best-in-class industrial process fluids to achieve challenging sustainability goals.

Through our QH FLUIDCARE™ business line we provide sustainable and cost-effective technical solutions that help our customers achieve waste elimination or avoidance. Measurable improvements are already being delivered at customer locations worldwide. In 2023, for example, we combined Quaker Houghton insight and technologies to save some 26,000 metric tonnes of waste at QH FLUIDCARE™ partner locations.

In addition, our QH FLUID INTELLIGENCE™ platform combines our process fluids and expertise with hardware and software to create a fully digital and automated solution to help customers optimize their fluids and processes and ultimately reduce total cost of ownership, improve sustainability and safety.

Leading the way

For years, Quaker Houghton has had a clear sustainability strategy. With See Beyond™, we now have a powerful framework which underpins all our work and demonstrates how we act tangibly and measurably to become a global leader in sustainable process fluid solutions. It positions our agenda not just as a business imperative but as a creator of social change, strong economic growth, and positive environmental benefit – for our customers, investors, communities, and, most of all, our planet.

To learn more about See Beyond™, please visit:

→ **home.quakerhoughton.com/sustainability**

[1] GHS Category 1 A/B (Not including Category 2 and Carcinogens, Mutagens, and Reproductive Health Hazards in Category 1 A/B that were tested by oral route of exposure).

See Beyond™

The Volvo EX90 is the first global consumer vehicle to standardize Lumina's laser sensors for ADAS features.

VOLVO

"in a high-power ECU or GPU, or even some of the robotaxis, could be a few kilowatts." An ADAS compute package making a constant two-kilowatt draw on the engine equals nearly three horsepower, an additional drain automakers want to avoid, especially with the resurgence of hybrid and plug-in hybrid powertrains.

Established chip makers already offer powerful hardware, but the need to extract efficiencies in every step of the ADAS chain has compelled new investments in dedicated hardware, including system-on-a-chip (SoC) and AI accelerator chips. Luminar designs the silicon and non-silicon semiconductors for its lidar units. LeddarTech counts **Texas Instruments** among its partners on chip designs tailored to LeddarTech's AI models. And Rivian developed the SoC for its newest R1 models in-house, an achievement that both shrank the vehicle's total ECU count from 17 to seven while increasing processing speed from 25 trillion operations per second (TOPS) to 250 TOPS.

"Automotive is throwing way bigger computers than I ever thought they would at consumers, but they're still struggling," Weed said.

Finally, ADAS advancements must conform to price pressures. There's a reason lidar units are limited to luxury brands like Mercedes and **Lexus**, and Volvo's flagship battery-electric SUV at the moment."Tesla's sort of shown that the upper bound for what customers are willing to pay is about $10,000," said LeddarTech's Olivier. "I think that there was a study a few years ago which said that most people were willing to pay about $3,000 for some form of autonomous functionality for privately-owned vehicle. So we're working on delivering that use case."

When it comes to SAE Level 5 fully automated vehicles, the transportation dream ADAS technology is building towards, Olivier said don't hold your breath. "[They're] probably ten to 15 years out." ■

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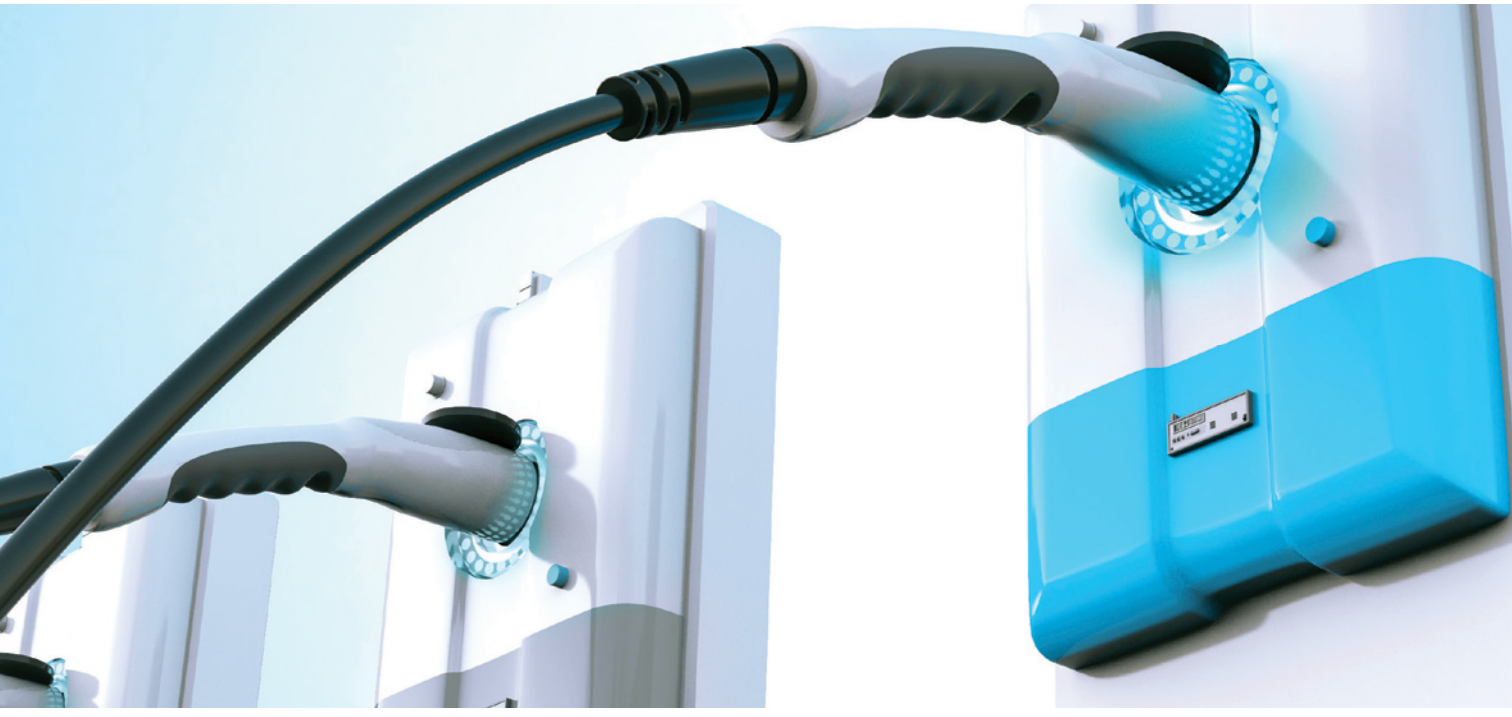

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New fluids coming for EV thermal management

Balancing low conductivity, corrosion resistance and optimum heat transfer in next-generation EV coolants while meeting new EV safety regulations.

By Lindsay Brooke

EVs with specially formulated thermal management fluids may move away from ionic corrosion inhibitors, which were developed for ICEs.

PRESTONE PRODUCTS CORP.

Managing the heating and cooling of electric vehicle propulsion systems may seem to be an easy task compared with combustion engines. After all, ICEs run much hotter—the thermal optimum for a gasoline engine is around 212 F (100 C). By comparison, EV batteries normally generate (as a function of current during charge/discharge cycles) a relatively cool 59-86 F (15-30 C). And while motors and power electronics operate hotter, typically 140-176 F (60-80 C), they still run cooler than ICEs.

But among the myriad complexities of EV thermal management are batteries' dislike for temperature extremes, new cell chemistries, heat-generating high-voltage electrical architectures and 800V fast charging. All are putting greater focus on maintaining stable EV battery thermal performance and safety. Experts note that compatibility among the cell chemistry, hardware, and coolant fluid is the key to a balanced systems solution.

"EV liquid coolant has kind of been an afterthought until recently," noted Tom Corrigan, director of EV Technology at **Prestone Products Corp**. His team of scientists and engineers is responsible for developing next-generation thermal-management fluids for OEM and, eventually, consumer customers. Corrigan said that beyond their vital role in enabling efficient heat transfer, fluid formulations must be compatible with every component and material they contact, such as polymeric seals. They also must provide internal corrosion protection (as does traditional ICE antifreeze). And perhaps fluids' most vital role is helping to prevent an extreme failure mode, i.e., thermal runaway, from spreading throughout the battery pack.

"Low electrical conductivity is a must for thermal-management fluids which could potentially come into direct contact with high voltage electronics," Corrigan asserted.

Low-conductivity coolants taking over

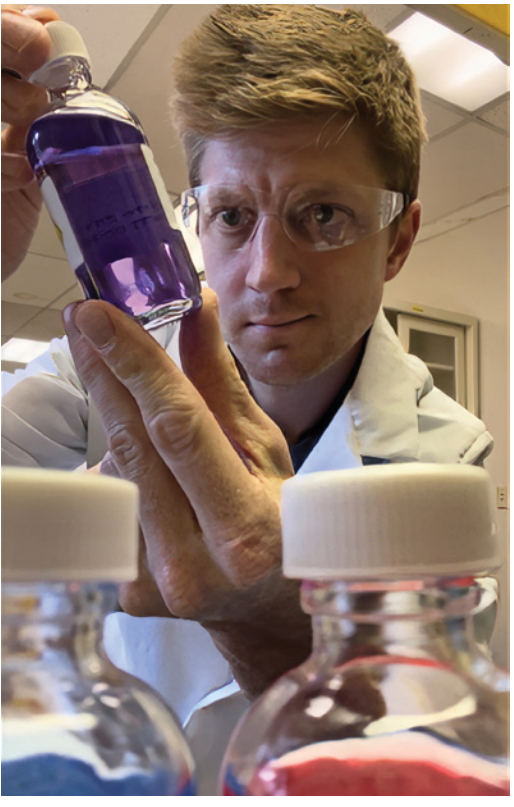
The 'first wave' of EV adoption established the electric-vehicle market before coolant suppliers had time to develop bespoke thermal-management products, Corrigan explained. "Most EVs on the road today are using the same fluids that are used in ICE vehicles, he said. "We're [Prestone] long established with many OEM customers, so when those OEMs started producing EVs, they installed the coolant fluids they trust for corrosion protection."

Corrigan sees a shift in the industry's thinking, mainly driven by EV safety concerns. For motor cooling, two main strategies are being used today: indirect and direct cooling. Indirect cooling uses the same water-glycol-based fluid, with corrosion inhibitors, that is used for the battery pack. The motor housing serves as a coolant jacket, allowing the fluid to flow through it and extract heat indirectly from the motor system.

"The issue with the current additive packages and their proprietary blend of corrosion inhibitors, is that the industry had, for a long time, moved towards ionic corrosion inhibitors for ICEs," Corrigan explained. Ionic additives include silicate, organic acid, and phosphate technologies, all of which increase electrical conductivity.

"With high electrical conductivity, if that fluid were to come in contact with the high-voltage electronics, 400V or 800V systems, you'll have a pretty violent, catastrophic reaction," he said, citing studies that show that submerging a lithium-ion battery in traditional ICE coolant results in high heat generation. "There's a good chance that [heat generation] will cause the coolant to boil with potential for fire and thermal runaway."

Such risks, combined with increased thermal performance, have spurred over 50% of EV manufacturers to adopt direct cooling strategies for the motor, according to Corrigan. This method uses an oil-based 'dielectric' fluid, with very low or zero conductivity, depending on the formula. The fluid flows directly over the motor coils. Dielectric fluids are also entering battery thermal management; with direct (also known



Prestone's EV Technology R&D team is working on next-gen low-conductivity EV thermal management fluids, said Tom Corrigan (pictured).

PRESTONE PRODUCTS CORP.

as immersion) cooling, the battery cells are submerged in the dielectric coolant.

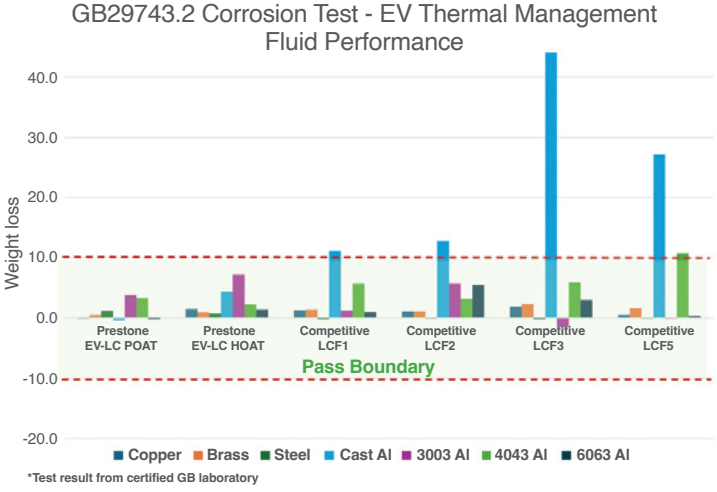
"By moving to the low-conductivity coolants we're developing, you can mitigate those issues. The opportunity for my team, the formulators, is to find synergies that maintain low electrical conductivity while ensuring sufficient corrosion protection for the OEMs," Corrigan said. "The anti-corrosion function aims to eliminate a build-up of materials or intermission of heat transfer or, worse-case scenario, a build-up of materials to the point it causes a fluid leak into areas of the battery where it's not supposed to be."

The Prestone R&D team's developments include new performance additives formulated to enhance the thermal properties of the fluids themselves to provide a more efficient heat exchange between two components. Corrigan claims that will benefit any type of cell chemistry and may help "level the playing field" for NMC versus LFP in terms of cell chemistry safety, he said. OEMs are expected to transition to the new EV thermal fluids "over the next couple years," according to Corrigan.

New China regulation

Is EV fluid maintenance by the vehicle owner—fluid changes—coming? The standard coolants used in most EVs today are "life of vehicle" and do not

New fluids coming for EV thermal management



Suppliers of EV thermal management fluids have been testing their products' conductivity levels aimed at complying with China's new GB regulation.

require a fluid change. "But as we move to low-conductivity fluids, we're seeing a 'creep' in conductivity over time," Corrigan observed. As the coolant degrades and picks up impurities in the system, it forms ionic species. Conductivity increases, and by the time it reaches 300 μS/cm [microsiemens per centimeter, a unit used to measure electrical conductance], safety concerns start to emerge. That's where we would recommend a fluid change."

A regulatory push is also looming. The Chinese government has drafted an EV-coolant-specific rule, GB 29743.2, focused on reducing electrical conductivity to mitigate battery fires. The regulation is expected to go into effect July 2026, and all vehicles sold in China must comply, according to Brian Engle, chair of **SAE**'s Battery Standards Steering Committee and director of business development at **Amphenol**, a connectivity provider.

"They're basically setting a maximum limit of 100 microsiemens per centimeter dielectric measurement for new coolants with basically an aging effect allowing for up to 300 μS/cm," Engle explained. "Moving forward, it's going to require a service life for EV coolants, as opposed to being in the vehicle indefinitely. It's going to change the makeup of the coolants."

Prestone's Corrigan said the China GB threshold of 100 μS/cm "is a pretty safe value if there was an accident involving accidental contact of that fluid with the high-voltage electronics. But that's where the challenge comes in. The conductivity comes from the additives we put in to protect against corrosion. If we pull those out, we can reduce conductivity but now we compromise on corrosion. Our R&D team has done a lot of development work on technologies that allow us to pass the corrosion requirements in that [China] GB specification while maintaining low conductivity. Our fluids are around 75 μS/cm."

Watch for a separate report on sae.org on the China GB regulation and SAE's ongoing Standards work on EV thermal management fluids. ■

PRESTONE PRODUCTS CORP.

INSIDE THE QUIET, LOOMING BATTLE OVER AUTOMOTIVE REFRIGERANTS

The VW ID.4 is available with a heat pump that uses R-744 refrigerant (also called CO2).

VOLKSWAGEN

R-1234yf is used in almost every new car sold in the U.S., but the EU is discussing a ban and the industry is investigating alternatives like CO2 and propane.

by Jim Motavalli

According to its manufacturer, **Chemours**, use of R-1234yf has grown so much since the refrigerant replaced the long-established R-134a that it's now used in 95% of new cars sold in the U.S. An estimated 220 million cars on global roads are also using it. The problem with R-134a, which came in cars and trucks in the 1990s, is that it's a gas with "a global warming potential (GWP) that is 1,430 times that of CO2," according to the EPA.

Since 2017, EU legislation has banned the use of any refrigerant in new vehicles with a GWP higher than 150. That rule doomed R-134a but opened the door for R-1234yf, which has a GWP of only four. The EU is currently revisiting R-1234yf emissions rules and may ban the substance in a few years. In the U.S., the EPA stands by its use.

Fighting over refrigerants is nothing new. In 2015, the European Commission took Germany to the Court of Justice because it was allowing automakers to use banned refrigerants. At the time, **Daimler** argued that R-1234yf could cause fires in front-end collisions, but the EU said, "these concerns were not shared by any other car manufacturer." Chemours describes R-1234yf as "a thoroughly tested, mildly flammable refrigerant" and referenced an approval the European Commission gave in 2014 after a scientific review. **Mercedes-Benz** is now in favor of the newer refrigerant and said it has "implemented a comprehensive safety concept to mitigate the potential risk of fire" on cars fitted with R-1234yf, spokesperson Pascal Becker told SAE Media.

But does R-1234yf also pose serious health problems when it degrades into the environment? Chemours defended its product vigorously to SAE Media, claiming that it "delivers a 99% reduction in global warming potential versus the incumbent refrigerant [R-134a], advancing global climate targets without compromising performance." But concerns remain.

A 2021 study from the **University of Bristol** found that both R-134a and R-1234yf result in emissions of organic trifluoroacetic acid (TFA), but the latter is much worse in that regard. The study found that changing from one chemical to the other caused a "33-fold increase of the global burden of TFA, from an annual value of 65 tons formed from the 2015 emissions of 134a to a value of 2,200 tons formed from an equivalent emission of 1234yf."

Chemours said that TFA is "more than 95% naturally occurring" and comes from "a variety of manmade sources, including agriculture and pharmaceutical." The company also said, "numerous independent studies conducted over the past two decades have concluded that TFA from manmade sources does not pose a risk to the environment or human health." Chemours can point to a 2022 UN Environmental Programme report that found that produced TFA is distributed globally and evenly distributed. "This is unlikely to present a risk to humans or the environment in these locations, but changes in concentration in surface water (or soil) would respond rapidly to releases. Monitoring of the environment for residues of TFA would provide an early warning if trends in concentration indicate rapid increases," the organization wrote.

The UN report confirmed that TFA has a very long life but did not sound a warning. "Because of its lack of reactivity, TFA salts are persistent in the environment, and estimates of half-life are uncertain but could be in the range of centuries or millennia," the report said. "This persistence is not a major concern because it does not react with biomolecules. TFA and its salts are easily excreted by animals and do not bioaccumulate in food chains. Salts of TFA have low toxicity to animals and plants."

INSIDE THE QUIET, LOOMING BATTLE OVER AUTOMOTIVE REFRIGERANTS

Refrigerant R-1234yf is now used in 95% of new cars sold in the U.S.

Repairman holding monitor tool to check and fix a car's air conditioner system.

Where the EPA stands

The **EPA** has taken a similar position, telling SAE Media that TFA "does not interact with biological molecules and, due to its high solubility in water, it does not bioaccumulate. It is unlikely to cause adverse effects in terrestrial and aquatic organisms." The agency says that the TFA concentrations "that would be formed, even under high assumptions of use, would still be far below the threshold for causing adverse effects."

As an alternative, the EPA has studied CO2 as a refrigerant and found it "acceptable." EPA is also "continuing to evaluate new alternatives for [the] motor vehicle air-conditioning sector," the environmental agency said.

Environmental groups are not convinced they should stop worrying about accumulating TFA. "The question is why the auto companies, with all of their ability to identify emerging chemicals of concern, were using R-1234yf in the first place?" Jeff Gearhart, research director at the **Ecology Center** in Ann Arbor, Michigan, told SAE Media. "This is yet another missed opportunity to identify a hazard before it becomes a global pollutant."

The **New Jersey Department of Health and Senior Services** describes TFA as a "corrosive chemical," exposure to which "can severely irritate and burn the skin and eyes with possible eye damage," and cause "coughing, wheezing and/or shortness of breath." And the German consulting and engineering firm **Refolution Industriekälte GmbH** said in 2021 that "TFA in drinking water can potentially damage the liver and have other impacts, for example, on the hormone system."

The EPA declared R-134a "unacceptable" for new vehicles as of model year 2021 but has not taken any action against R-1234yf and does not classify it as an environmentally persistent per- and polyfluorinated substance (PFAS) chemical. A study from consulting firm **Ducker Carlisle**, however, said that "many OEMs and thermal-management suppliers anticipate that the EU will implement a regulation banning R-1234yf by 2030." A proposal that would include it on a list of banned chemicals is under review at the **European Chemical Agency**, the report said.

The EPA did not respond to SAE Media's inquiries on this subject. A 2023 petition to the European Parliament proposed banning R-1234yf and replacing it with carbon dioxide (CO2). The agency said this year that it was considering restricting the use of R-1234yf.

The auto industry is already investigating alternatives to R-1234yf. Dana Nicgorski, director of engineering at **Bosch** with responsibility for thermal management, told SAE Media that "the definition of what constitutes a PFAS is not standard in the world, and the European definition covers a whole lot more chemicals. Absent an EPA ban, some companies might adopt natural alternatives voluntarily."

Bosch is studying CO2 and propane as future refrigerants. "Air conditioning and heat pumps are moving toward propane, and we think automotive will move next," Nicgorski said. He added that propane is "thermodynamically superior" and systems using it will likely "cost a bit less than a system using 1234yf, with fewer components." That latter point might blunt auto industry concerns, but the switchover is likely to be costly. Propane is a climate issue when burned but does not have a high GWP when released as a gas. Leaks might still be an issue, but Nicgorski said today's hermetically sealed air conditioning units are not emitters like belt-driven systems.

At the ATMOsphere conference on refrigerant alternatives in Berlin in September 2024, Stefan Elbel, the head of **TU Berlin**'s department of heat transfer and heat conversion, said, "Time will tell which one is the better option, propane or CO2. From an environmental standpoint, though, you could say it doesn't matter as both are great options."

The EPA doesn't necessarily agree, writing, "Hydrocarbon refrigerants, such as propane, are highly flammable and are not acceptable alternatives for motor vehicle air conditioners under the Clean Air Act and the EPA's Significant New Alternatives Policy (SNAP) Program. The use of these refrigerants…can result in fire or explosion, possibly causing injury and property damage. It may also void your car's warranty."

FROM LEFT: CHEMOURS; JU.STOCKER/SHUTTERSTOCK.COM

A coalition of environmental groups recently investigated widely used PFAS in Michigan rainwater and reported in August 2024 that TFA was "the largest contributor in two out of three sample locations and one of the largest in the third location."

Michigan researchers test rainwater to find out where and how TFA collects in the local environment.

BOTH IMAGES: THE ECOLOGY CENTER

Alternatives already available

Volkswagen Group started offering CO2-based, PFAS-free heat pumps in the ID.3 and ID.4 in 2020, as well as on the Audi Q4 etron. Ford's electric Explorer, built on VW's MEB platform, also has an optional CO2 heat pump. Ford has said that it sees propane, code name R290, as the best refrigerant for next-generation thermal architectures.

Michael Garry, editor at large for **ATMOsphere**, a global market accelerator with a mission to clean up cooling, said, "The natural refrigerant that is most slated to replace [R-1234yf] (particularly in electric vehicle heat pumps) is CO2. Propane is also discussed as a natural option but has gotten less traction in the field so far."

The **Alliance for Automotive Innovation**, which represents over 20 automakers, declined to comment on a potential European ban on R-1234yf. Instead, it referred us to a letter it sent to Minnesota's Pollution Control Agency in 2023 when the state was considering PFAS legislation. "Banning use of the refrigerant now currently used in our vehicles, as the Minnesota PFAS law might do, would…result in OEMs having to significantly redesign and re-engineer our recently revamped mobile air-conditioning systems and vehicles, possibly even with the need to retrofit older vehicles," the Alliance said. "The definition of PFAS needs to be revised to exempt these substances."

If TFA is officially labeled PFAS, it would run afoul of states that have enacted PFAS bans. California has one of the country's strictest bans, but it was Maine that became the first U.S. state to ban the sale of products containing intentionally added PFAS and is scheduled to start addressing refrigerants in 2040.

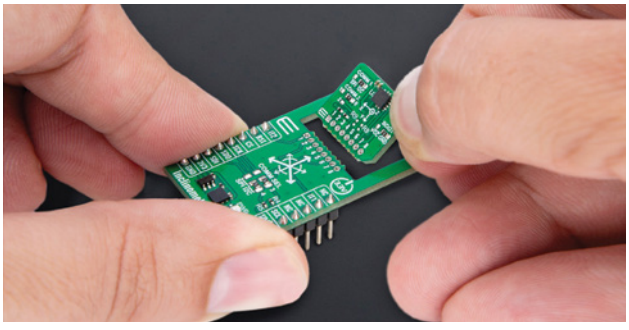
Heidi Pickard, a postdoctoral fellow in the School of Engineering and Applied Sciences at **Harvard** who has studied TFAs, said, "Many of the [refrigerants] that are currently used…can degrade into short-chain PFAS like TFA, which is accumulating in the environment. Europe is pushing for the ban of PFAS as a class, but it's unclear if this will include TFA."

The **European Automobile Manufacturers' Association** said in a 2023 report that switching from R-1234yf to an R-744 system (which uses CO2) would add 300 euros ($334.73) to the cost of making each car with air-conditioning. "This would mean a 1.7-billion-euro [$1.89 billion] increase per year for the vehicle manufacturers in the EU and loss of competitiveness on [the] worldwide market," the report said. It also predicted parts shortages as a result of the change. ■

PRODUCT BRIEFS

SPOTLIGHT: PROCESSORS & SEMICONDUCTORS

Click boards



MIKROE (Belgrade, Serbia) announced a new feature for its range of click boards that reduces size, weight and power consumption for second-level prototyping and production. With Click Snap, users can reportedly develop systems using add-on peripheral boards and development boards equipped with the mikroBUS socket. The portion of the board with the specific active peripheral circuitry can be snapped free of the rest of the click board and used as a system-on-module (SoM). The new Snap feature is Inclinometer 4 Click, which is designed to measure angles of slope or elevation of an object. This board features the FXLS8971CF, a three-axis low-g MEMS accelerometer from NXP Semiconductor with selectable full-scale ranges of ±2/4/8/16g and features such as selectable output data rates, motion detection and a 144-byte output data buffer.

https://www.mikroe.com

GaN power ICs

Cambridge GaN Devices (Cambridge, United Kingdom) announced two new packages for the company's ICeGaN family of GaN power ICs that reprotedly offer enhanced thermal performance and simplify inspection. Developed for Cambridge, the DHDFN-9-1 (Dual Heat-spreader DFN) is a thin, dual-side cooled package with a small, 10x10-mm footprint and wettable flanks to simplify optical inspection. It offers low thermal resistance (Rth(JC) and can be operated with bottom-side, top-side and dual-side cooling, offering flexibility in design and out-performing the often-used TOLT package in top-side and, especially, dual-side cooled configurations. The DHDFN-9-1 package has been designed with dual-gate pinout to facilitate optimal PCB layout and paralleling, enabling customers to address applications up to 6 kW.

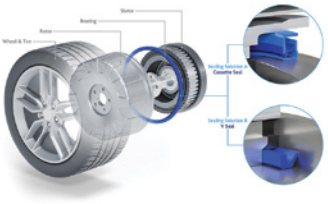
https://camgandevices.com

MUX modules

Pickering Interfaces (Clacton, United Kingdom) offers a new high channel count microwave MUX family (models 40/42-788) based on Radiall mechanical microwave switches. The family is available with bandwidth options from 8GHz to 40GHz and versatile switching configurations, including single or dual SP8T, SP10T or SP12T multiplexers. They are suited for many uses across the RF spectrum where extremely low insertion loss and ultra-high isolation are critical. These modules are said to provide the highest RF and microwave switching performance available within a Pickering switching system as well as the highest channel count microwave multiplexer switches available from any PXI vendor. This can result in fewer switches and associated interconnections being required for high channel count microwave switching applications, improving signal quality and ease of programming.

https://www.pickeringtest.com

Wheel motor seals



Freudenberg Sealing Technologies (Weinheim, Germany) has developed a pair of seal designs specfically for in-wheel motors. The cassette seal reportedly offers a double sealing lip and mating contact surface installed in a closed system, featuring precisely matched materials made of stainless steel and special rubber compounds. The required speed ranges and contamination protection can be scaled. The cassette seal also offers a long service life and high functional reliability. It is capable of achieving up to 500,000 km and protection class IP67. This makes it a maintenance-free, self-lubricating solution throughout its entire service life. The second design, a V-seal, works in an open system and features wear-resistant elastomers with excellent sliding properties. According to Freudenberg, this seal creates a plug-and-play solution designed for flexible applications.

https://www.freudenberg.com

Image sensors

OMNIVISION (Barcelona, Spain) announced the OX12A10 12-megapixel resolution CMOS image sensor with TheiaCel technology. OMNIVISION states that the sensor improves automotive safety by providing enhanced resolution and image quality. The OX12A10 is suitable for high-performance front machine vision cameras for advanced driver assistance systems and autonomous driving. OMNIVISION states that the 12MP OX12A10 harnesses the capabilities of next-generation lateral overflow integration capacitors (LOFIC) and OMNIVISION's DCG high dynamic range (HDR) technology to eliminate LED flicker regardless of lighting conditions. OMNIVISION's TheiaCel solution also achieves a wider dynamic range than earlier automotive HDR architectures. The OX12A10 is currently available for sampling and will be in mass production in Q3 2025.

https://www.ovt.com

Brake sensing

Melexis (Tessenderlo, Belgium) announced the MLX90424 for automotive brake pedal sensing. The unit integrates two position-sensing ICs and a wake-up switch all isolated in a single package. The solution can be powered directly by 12 volts and handles precise measurements of linear displacement up to 30 mm (1.18 in). The MLX90424 also offers redundancy through its dual linear position sensing, while the integrated magnetic switch allows the implementation of a power-saving mode. When compared to a current brake pedal module including separated position sensors and switches, the fully integrated MLX90424 ensures that both the position sensing and switching element are placed together at the ideal location.

https://www.melexis.com

Magnetic sensors

Mencom (Oakwood, Georgia) introduced a new line of magnetic sensors designed to meet the needs of industrial environments such as automation, manufacturing and process control, automotive and aerospace. The company states that these sensors provide reliable and versatile solutions for a variety of applications. The sensors are available in reed and GMR types, are designed for easy installation using either a clamp or screw system. They operate within a voltage range of 10 to 100V and 5 to 30V, respectively. The reed sensors have a maximum load capacity of 10 W DC and a switching current of up to 400 mA, while the GMR sensors can switch up to 150 mA and detect field strengths of 2.8 mT.

https://www.mencom.com

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Q&A

Envorso wants to help OEMs make better software in-house

At the Reuters Automotive USA 2024 conference in Detroit, SAE Media spoke with Stuart Taylor, chief product officer of Envorso, a consultancy with a mission to help OEMs and Tier 1 suppliers write better software. Companies have been plagued with issues around software written both in-house and via outside contractors.

There is a debate around just what "software defined" means in "SDV." Is there a solution that would get everyone on the same page?

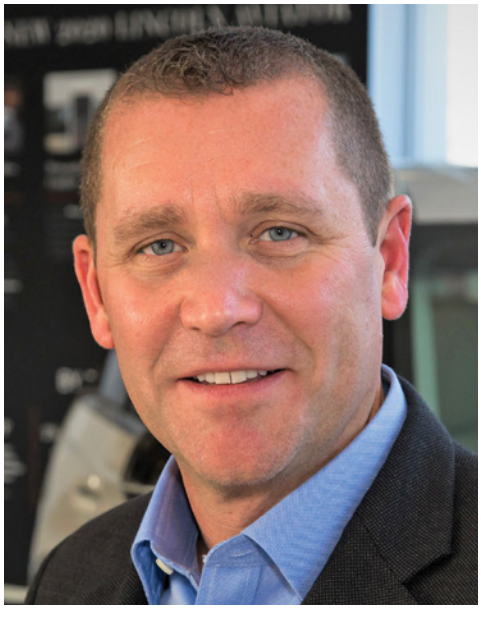
If you think back to what we did when we were defining the ADAS levels, that's what software defined vehicle now needs. It says, okay, you are this, you are at this point along the journey, and your next step is this. The concept is not new. In fact, we've been doing it in the industry for many, many years, as long as I've been in the industry.

Part of the problem we see in these new-to-OEM segments, such as the battery industry, is that the companies need to learn faster and iterate faster.

To a certain extent, fail fast is kind of an industry trend word. But the reality is, when you're working in those smaller, cash-constrained OEMs – a startup environment – they are willing to take risks but fail early in the process so they can pivot to doing the next thing. Instead of it being a straight long shot to the outcome, they jig backwards and forwards, and they get to the answer much quicker. And we need that thinking in the traditional OEMs and the traditional tier ones.

Is part of the OEM difficulty that development has traditionally been done in pieces and subsystems, rather than as a whole?

Conway's Law is a great one, if you know computer science from the 1960s, [roughly, software will have the structure of the organization producing it.] If you don't have a systems level of thinking, then it's very hard to integrate. What we're seeing from an industry standpoint is that the challenge is much bigger compute centers, so better silicon, higher powered compute, allowing you to consolidate much more of the in-vehicle decision making at a higher level, and allowing those software stacks to be well integrated and to work effectively with each other. The challenge of getting to that place is a shorter path for the startups, because in their mind, that's the logical outcome. The OEMs have a high dependency on the technical capability of those suppliers, and then they have the challenge of integrating that again.



Envorso's chief product officer, Stuart Taylor, says the company's consultants work alongside OEM and tier one software developers.

"Settling on an architecture that is going to be capable now and in the future, and building your software around that, happens at startups much faster than for the traditional OEMs."

What has happened in the industry is they've hired many of those good software engineers from their tier ones and their teams have struggled. Resetting some of that and making sure that we talk a lot in electronics about architecture, settling on an architecture that is going to be capable now and in the future and building your software around that, happens at startups much faster than for the traditional OEMs. Getting out of that is the challenge.

What's different about the way you approach software consulting?

[Envorso is] in there with that OEM or with that tier one supplier. Getting our hands dirty and having those difficult discussions as a team is an essential part of driving towards a better outcome. I think where a lot of traditional consulting companies fall short is they'll give you a beautiful pattern book of "just follow this playbook, and you'll be fine in the report." The reality is that every business has nuance. It has characters. It has aligned goals or misaligned goals. And I think being there at the table, working on it, with the customer, is essential.

Chris Clonts

ENVORSO

WEBINARS

DESIGNING AN HVAC MODELING WORKFLOW FOR CABIN ENERGY MANAGEMENT AND XiL TESTING

Wednesday, December 11, 2024 at 9:00 am U.S. EST

As the automotive industry embraces electrification and the expansion of xEV technologies, maximizing vehicle range is of the utmost importance. Efficient cabin climate control is paramount for enhancing passenger comfort and optimizing energy consumption. This 45-minute webinar will introduce a virtual HVAC modeling workflow that enables precise analysis of climate system energy usage, facilitating effective controller design and comprehensive X-in-the-loop (XiL) testing.

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With EVs accounting for an increasing proportion of supplier and OEM product-development investment, what are the new vistas in NVH abatement? This 60-minute Webinar from the editors of *Automotive Engineering* will present evolving methods for addressing various aspects of EV NVH — and examine how ever-advancing simulation methods promise new possibilities for assessing and countering NVH issues in EVs.

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