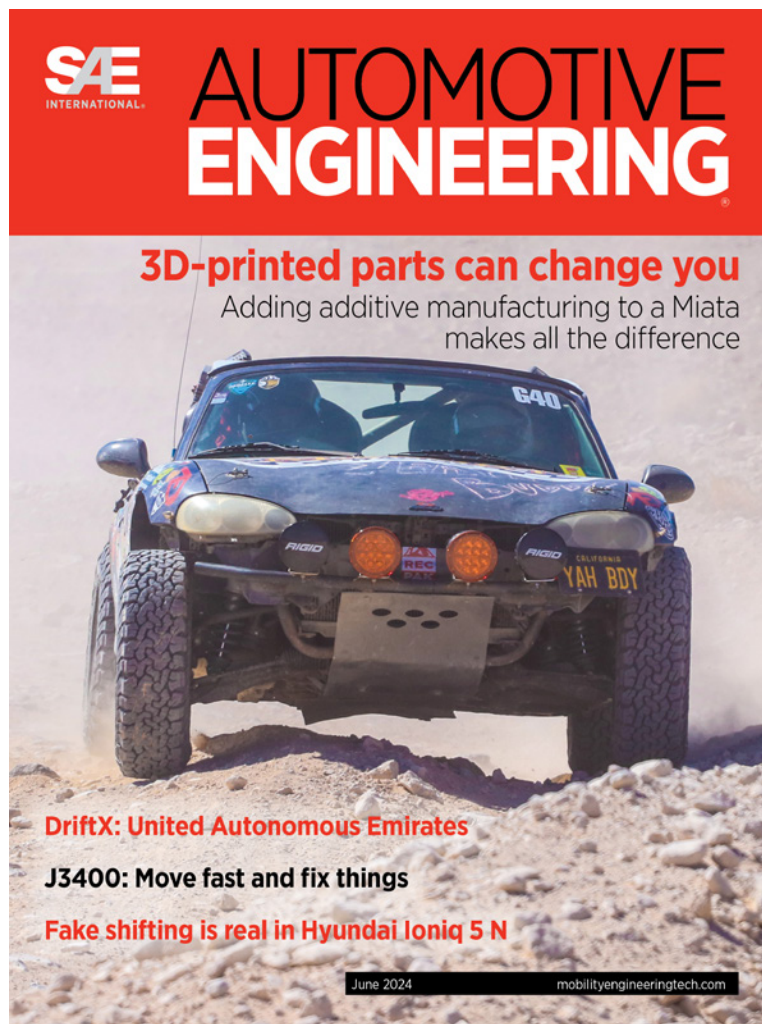


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DriftX: United Autonomous Emirates

J3400: Move fast and fix things

Fake shifting is real in Hyundai Ioniq 5 N

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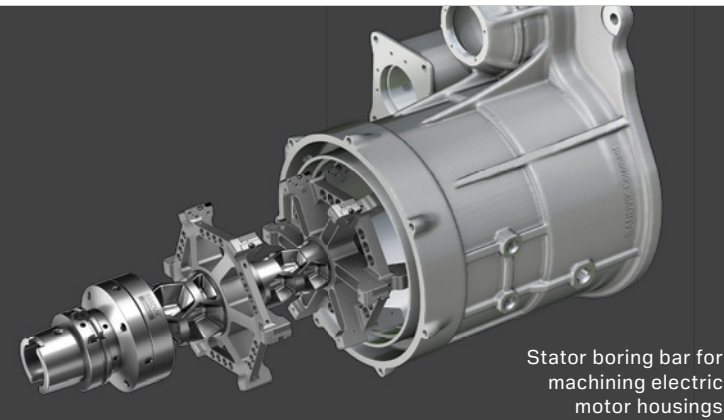


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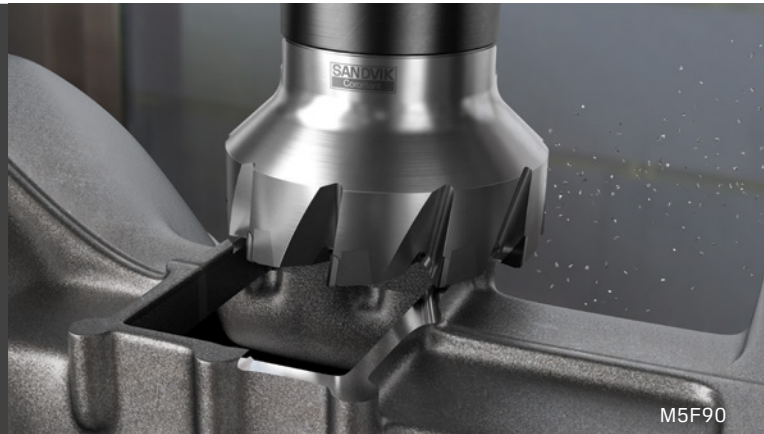
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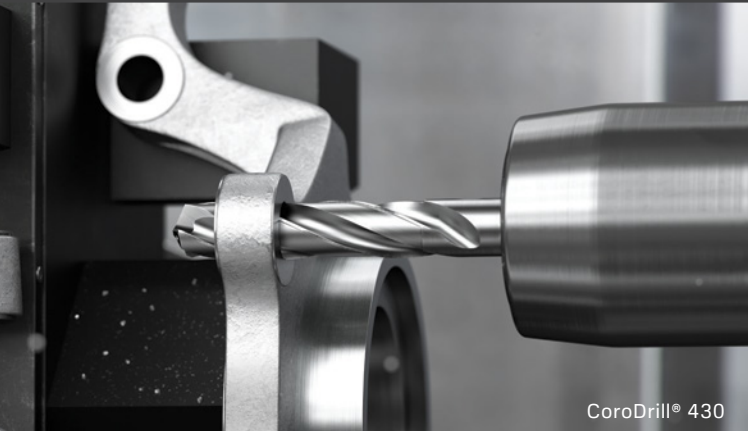
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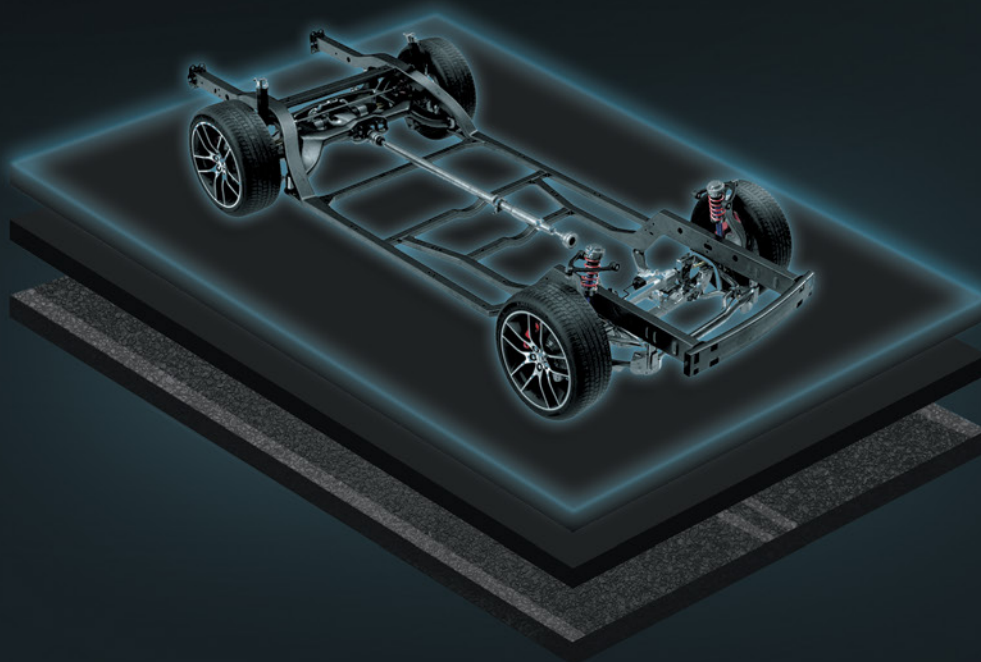
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3D-printed parts have made all the difference for an off-road Miata racer. (Image: The Mint 400)

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EV Accelerator Interview with Charlie Abend of VW

Volkswagen Group has become a leader among automakers in the transformation to clean battery electric-powered vehicles. Its Chattanooga, Tennessee assembly plant is at the forefront of this transformation. In this edition of EV Accelerator, sponsored by Keysight, we speak with Charlie Abend. As high voltage validation manager for Volkswagen of America, Abend is responsible for testing all locally produced EV batteries for the North American market. A Tennessee native, Abend joined VW Group of America's engineering development team in 2015 and moved on to high-voltage validation in 2019.

EV Accelerator: Volkswagen opened its Chattanooga battery testing lab in June 2022. Why was it important for VW to validate batteries for North America here rather than at a single global facility?

Charlie Abend: It takes a long time to test these things, but we wanted to make sure we could be hands-on with the product, be very close to the production site so we can loop in our lessons, learn from the test results, get that fed back into the production site, all while cutting our test timeline. If it takes a couple months shipping a battery overseas, that slows down getting them to the next generation of battery pack and it increases our cost.



Charlie Abend

EV Accelerator: How does your Chattanooga lab stand out compared with your other testing and validation facilities?

Abend: We're focused on the strength of our pack and making sure the energy stays safe. We do climatic tests, electrical tests, water and immersion tests, high-pressure water tests, mechanical tests, corrosion tests, a whole plethora of other, smaller testing subsets. On the pack level, we have a huge responsibility to make sure that energy stays safe while also validating on the module level and on the cell level. We know from each stage how that energy can remain safe and effectively get to the wheels.

EV Accelerator: How important is the test equipment itself?

Abend: It's hugely important. We make sure we get accurate results and compare those results with partners in Germany and China that test and produce the same battery pack design. Reliable, accurate and easy-to-maintain test benches are critical. My lab has a variety of equipment, including the most powerful load cyclers on the market when sourced in 2021. Our climate chambers can go from 180-degrees Celsius (356 F) down to minus-80 Celsius (-112 F) and see the most extremes, including environments that don't exist. We have robust mechanical shaking tables to simulate any sort of vibration or road profiles the batteries might encounter. Corrosion is a big problem, so we want to make sure real-life results can be simulated in an accelerated fashion in the lab.

EV Accelerator: How far in the future do you test batteries?

Abend: We test about two to three years in advance of what's on the road. Packs we started testing in 2021 and '22 are in our Volkswagen ID.4 SUVs coming off the line in Chattanooga. Now, we're five generations of battery pack beyond that.

EV Accelerator: How many different generations of battery systems do you test at once?

Abend: My lab has gone through 300 to 400 individual battery packs since we've started, representing six generations. Now my eyes are on the next big generations in the pipeline.

EV Accelerator: What are the challenges of testing electric

powertrains as they rapidly change and improve? This isn't like, say, replacing a V6 engine with a turbo four.

Abend: Most challenging is to maintain our personnel's safety as the battery packs evolve. When we try new, different components, our standardized processes have to adapt to make sure we stay safe as we work with the more advanced batteries.

EV Accelerator: How do you test different form factors? How varied are they in size and configuration?

Abend: We can test from the module level to the vehicle level with huge, impressive test benches. We took a specific strategy with the building's design. We could have gone with a very small chamber fitting one battery pack each, but we went with larger walk-in chambers so we could fit multiple battery packs and accelerate our validation results. We even have drive-in chambers. We can test multiple packs at the same time or bring a complete vehicle and run charging tests in cold weather or hot weather. We have different shakers, one for either a half-vehicle or one battery pack, and we have a smaller one that can do module-level or circuit board tests. ■

For more: Go to [vw.com](https://www.vw.com).



Watch the full interview with Charlie.



EDITORIAL

It's not nothing, man.

Mathematicians, hold your ire. There's a hidden message in this issue that there's no difference between zero and infinity. Let me explain.

In mid-May, I attended VI-Grade's Zero Prototype Summit (ZPS). As the name suggests, the company – like so many others working in the test simulation space – is trying to provide OEMs and suppliers with the tools to reduce the number of physical prototypes that have to be developed and built before those vehicles or components reach production-ready status. We haven't yet entered the zero-prototype automotive world, but we're getting closer. You can find detailed ZPS coverage starting on page 22.

What I wanted to address here is something that didn't make the feature article, something a bit more theoretical. One of the companies sponsoring ZPS was HBK, and I spoke with COO Ben Bryson about how HBK is supporting a zero-prototype future. He saw all this talk about zero prototypes from a slightly different – and interesting – angle.

"I actually prefer the quote, 'infinite prototypes,'" he told me. "The principle being that, ultimately, in a digital world, you are not constrained by the number of different models, solutions and environments that you can operate in, in order to perfect the vehicle of your choice. That is the beauty of virtual testing."

When I thought about it later, what Bryson was really describing was the conceptual differences between what physical and digital prototypes represent. Even as we get closer and closer to not needing physical prototypes, there remain real and important differences between the two today. Simulations might be able to get us 90 or 95 or 98%

of the way to what an engineering team might want before building that first physical development mule, and that's the way we get closer to zero prototypes.

But Bryson's point is that the idea of "zero prototypes" actually represents All The Prototypes. In the digital world, you can shake out a bunch of "close but no cigar" options on your way to the physical prototypes that cover the last 10 or 5 or 2% of the work you need to do to know you've got it right. He also pointed out that the ability to test an (effectively) infinite number of variations is absolutely vital to bringing constantly updated vehicles to consumers. Thanks to advanced simulated tests of

NHV, handling, ADAS technologies and all the rest, paired with the ongoing shift to software-defined vehicles, updates can be brought to consumers in new (and, with OTA updates, late-model) vehicles much sooner than ever before, something new car shoppers are cer-

tainly interested in. It's clear that rapid changes in how vehicles come to life are the only things that will bring rapid changes in vehicles to life.

Mathematicians and engineers quickly realized up top that I wasn't talking about the actual concepts of zero and infinity as used in advanced mathematics (or just to explain wonderfully interesting concepts of the universe). As important as these ideas are for humanity's ability to calculate the details of our modern world, they're just two sides of the same coin when it comes to the rapidly advancing world of vehicle prototyping. However we end up describing the massive changes happening in the automotive industry, the answer lies somewhere between zero and infinity.

Sebastian Blanco, Editor-in-Chief

"I actually prefer the quote, 'infinite prototypes.'"

-HBK COO Ben Bryson

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Canada's bold bet

Amid all the gloom surrounding the trajectory of EV propulsion, there are still significant pockets of optimism.

Battery chemistry is making substantial strides forward, as is the relative cost of EVs as more product is focused on the middle of the market where most of the vehicles are sold. As noted in earlier columns, this will be an extended and lumpy transition.

While the hurdles are apparent, it is important to consider the long-term benefits of EV propulsion in most light vehicle applications. As such, there are several countries devoted to the format. Mainland China and Norway come to mind. One North American country is absolutely on board with electrification: Canada. The focus of my homeland on attracting EV investment of all types is apparent. Battery cell plants will be the bedrock of the commitment. These include Ontario-based facilities in Windsor (Stellantis/LG - Nextstar), Volkswagen in St. Thomas (Powerco) and, finally, Honda's mammoth announcement in Alliston. Add to this several critical mineral refinement and mining investments, as well as feeder Tier 1s manufacturing separators, cooling systems and various substrates/materials. The ecosystem spinoff is substantive.

This is not the first time Canada has taken a risk with its automotive industry. Back in the early '60s, the Canadian Government knew that the ability to build vehicles at scale was key to reducing chronic trade deficits with the U.S. What emerged was the Canada-U.S. Autopact of 1965. I happen to know more about the Autopact than most. Several members of my family worked within Windsor's automotive ecosystem, and it was the subject of my undergrad thesis in the late '80s.

The impact of the Autopact

Criteria behind the Autopact was relatively simple. As long as Canadian value-add levels at an OEM level reached 50% and total Canadian value



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While the hurdles are apparent, it is important to consider long-term benefits of EV propulsion in most light vehicle applications.

add for existing assemblers reached certain levels, vehicles and components were allowed to move duty free between both countries.

The impact was immeasurable. Before 1965, the Chrysler plant in Windsor, for example, was manufacturing nine different vehicles from several segments for the Canadian market. Low economies of scale, higher build cost and sub-standard quality (due to an extreme number of build combinations) resulted. The same experience was happening at Ford and General Motors. After the Autopact was initiated in 1965, vehicle and engine plants were able to improve efficiency and focus on fewer vehicles for distribution across both markets.

OEMs took advantage of a larger market and lower relative costs with new facility investments. Three new or expanded plants were built over the next decade. GM moved to the massive Autoplex in Oshawa (1965), Ford built in St. Thomas (1969) and Chrysler constructed the Windsor "Pillette Road" assembly plant in 1973. Canada proved that looking at efficiencies over the long-term set up the auto industry for growth. Additionally, a strong Canadian OEM industry gave rise to several component suppliers which are recognized on a global scale today.

The 1965 AutoPact was essentially replaced by the US-Canada Free Trade agreement of 1988 and the expanded NAFTA agreement of 1995. This brings us to today. Canada's commitment to electrified propulsion makes complete sense. Augmented by the U.S. IRA agreement and incentives from several levels of Canadian governments, these long-term investments will take advantage of Canada's natural resources and abundant hydroelectric power generation capacity.

While the jury is still out on the adoption slope of EVs over the next decade, it is apparent that some national governments, including Canada, are taking the long view. Similar to the bet from fifty-nine years ago, Canada is all in and pushing its chips to the middle of the table. ■

HOME CHARGING

GM Energy introduces vehicle-to-home charging solution



GM's vehicle-to-home charging unit will first be compatible with the 2024 Chevrolet Silverado EV First-Edition RST2.

The benefits of EVs are still being explored and introduced to the world. The latest is GM Energy's new bidirectional charging system.

With a host of EVs on the market and more on the way, **GM Energy** unveiled its Vehicle-to-Home (V2H) bidirectional charging solution. The wall box and companion apps will initially be available on the 2024 **Chevrolet** Silverado EV First-Edition RST2. Compatibility with other vehicles under the GM umbrella will be supported in the future.

The company says that its product suite of bundled hardware and software can be tailored to customer needs and budgets. GM Energy's online portal will guide them through the options and help educate potential customers about the technology and its benefits.

Currently, GM Energy is offering a wall unit that, when properly installed, will supply a home with power from a compatible EV. It also plans to introduce a battery storage solution and integrated solar installations.

GM Energy is partnering with Qmerit, an EV charging station installation company, to handle installations and local permitting issues. At launch, the system will be available in five states: California, Florida, Michigan, New York, and Texas.

The company is determined to take something that's been traditionally complex and make it easy for customers. "We are a one-stop shop, white-glove service from beginning to end, and through the duration of use," Wade Sheffer, vice president of GM Energy, told SAE Media.

While the initial vehicle will be the Silverado EV, GM did say that it anticipates the following 2024 MY vehicles will eventually be compatible: Sierra EV Denali, Chevrolet Blazer EV, Chevrolet Equinox EV, and **Cadillac** Lyriq. Sheffer told SAE Media that bringing other vehicles into the mix will require either a software or hardware update, potentially both. Starting with model year 2026, all GM EVs will support bidirectional charging.

If you happen to live in a mixed EV household, Sheffer sees a future where GM Energy's devices work on EVs beyond the GM lineup. "Our initial rollout is with for GM vehicles only. When possible, when the technology is there and it's available? Absolutely, it would make sense for us to look at the wider market," Sheffer said.

With the news, GM Energy is entering a space that's not traditionally part of an automaker's business. Outside of **Honda** with its decades-old lineup of generators and Tesla with

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its Powerwall, home energy management is relatively new to automotive OEMs.

GM is now joining **Ford** which has its own V2H solution for the F-150 Lightning and **Kia** which is partnering with third-party charging-station company Wallbox to bring bidirectional charging to the EV9. Not only does this bode well for the owners of these vehicles, but it's also a solution for balancing the grid during peak usage.

One of the more interesting aspects of the transition to EVs is the potential to use the vehicle in your driveway or garage to power your home. Bi-directional charging or V2H is an additional benefit of EV ownership. With it, owners can use the battery pack in their vehicles to run their home. A huge benefit in areas where blackouts are a regular occurrence.

These vehicles and their compatible wall chargers also have the potential to reduce a home's electric bill by charging at night when rates are cheaper (or

via solar during the day) and discharging into the home during peak-rate times, at least in areas where there is support from the electric utility for this feature. When it works, an EV could be a benefit to a utility, especially during times of high electricity demand. If EVs can be put into service to pull hundreds or even thousands of houses off the grid, it would reduce the need for rolling blackouts to protect the grid.

One irony of all this is that one of the main arguments against EVs is that they will bring down the electrical grid. In reality, they could be incredibly beneficial to balancing the grid during peak usage.

As V2H continues to roll out, there will be employment opportunities for highly trained electricians to install these systems. As with any product, if it catches on with customers, manufacturing could also ramp up. "We are launching in five critical and key states. And as we launch, we'll look at opportunities



GM's V2H home charger includes a 25-foot (7.6 m) cord and has a maximum charging output of 19.2kW.

where it's necessary," Sheffer said.

GM Energy's V2H product site is live with step-by-step guidance to determine the best system for your home.

Roberto Baldwin

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(In-Cable Control and Protection Device)



· Vehicle Coupler
· Vehicle Connector CCS1

SUSTAINABILITY

Sustainable ecosystem model involves multiple partners

Rooftop solar panels will soon power about 90% of PFG's Gilroy, California, operations, a starting point for cold food deliveries. The vehicles getting the various edibles and food-related products from the warehouse to restaurants, schools, hotels and other customers include new battery-electric Class 8 trucks that mate to trailers fitted with zero-emission transport refrigeration units (TRUs).

"Our Gilroy, California, location is the pilot for how we intend to develop sustainable distribution centers," said Jeff Williamson, senior vice president of operations for Richmond, Virginia-headquartered **Performance Food Group** (PFG). Williamson and others were recently interviewed by SAE Media following an Earth Day open house at the Gilroy site.

With more than 150 locations, PFG is one of North America's largest food and foodservice distribution companies. PFG's transition to a greener future accelerated with assistance from **GridMarket**, an automated, artificial intelligence (AI)-driven distributed energy project optimization platform that helps companies streamline the many facets of change.

"This is about PFG going from consuming grid power, which has a higher emissions factor, and consuming diesel fuel with its truck fleet to electrifying its fleet of trucks, trailers, yard tractors and forklifts. It's also about producing renewable electricity to support the electrified tools," Peter Schneider, director of business development and project management for New York City-based GridMarket, said about PFG's Gilroy site.

Growing a 'green' fleet

Built in 2019, the 189,000-sq.ft. Gilroy distribution center turned greener with this year's addition of a 1.58-megawatt DC rooftop solar array and a 500-kW battery back-up energy storage system. The alterations kickstart the center's eco-slant, where on a 24-hour daily basis hundreds of supplier products are

Vouchers from California's Hybrid and Zero Emission Truck and Bus Voucher Incentive Program (HVIP) were used to purchase Volvo VNR Electric trucks.



vendor-delivered to one of 28 loading bays, and a fleet of PFG trucks transport those goods to various Northern California destinations.

"For our vendors, it's up to them if they have 'green' vehicles. But we're doing outbound deliveries with a fleet of 50 trucks, which now includes six electric Volvo trucks with a seventh electric truck on order," Williamson said. "We're in the early stages of replacing our diesel-fueled trucks." Last year, PFG began a pilot program with an International eMV Series battery-electric truck and its 22-foot (7 m) Great Dane body cooled by a Carrier Transicold's Supra eCool refrigeration unit.

According to Brett Pope, director of eMobility for **Volvo Trucks North America**, headquartered in Greensboro, North Carolina, the commercial-vehicle

industry's transition to electric trucks from diesel trucks is straightforward in its simplicity. "We only changed what was necessary. So, in place of a diesel engine and the exhaust system, we have an electric powertrain," Pope said.

The Class 8 Volvo VNR Electric trucks that recently joined PFG's Gilroy fleet use a propulsion system centered around two electric motors and a two-speed transmission. "The electric motors put out the equivalent of 455 hp (339 kW) and 4,051 lb-ft (5,292 Nm) of torque, which essentially matches the 450 hp (336 kW) of the Volvo D13 direct-injection diesel engine, so drivers of the electric VNR truck feel similar power levels with a little more torque than the diesel engine produces," Pope said.

Volvo's truck uses Li-ion NMC (nickel manganese cobalt) batteries for energy

VOLVO

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An aerial view of Performance Food Group's Gilroy, California, center shows Volvo electric VNR trucks and FreeWire Technologies' ultrafast charging stations during an open house event on Earth Day, April 22.



FreeWire Technologies ultrafast charging stations' energy requirements are nearly 10 times lower than traditional charging stations, reducing peak energy demand and grid strain while providing more efficient power. Image shows Performance Food Group's Gilroy, California, site.

storage. The electric truck has six battery packs for approximately 575 kWh of storage and a driving range up to 275 miles (443 km).

'Different' ultrafast chargers

Volvo's electric trucks are charged via 15 ultrafast charging stations from FreeWire Technologies. Each charging unit has two charging ports. The Li-ion NMC battery-integrated charging stations – with multiple patents addressing system design, power electronics, battery management and software – were installed and fully deployed within four

months after groundbreaking.

"PFG was given a timeline of three years from the utility company, PG&E, to get enough power to the site to deploy ultrafast charging. For a lot of fleets, that's simply a deal-killer because they can't wait three years," said Arcady Sosinov, founder and CEO of FreeWire Technologies with global headquarters in Newark, California.

FreeWire's ultrafast chargers operate differently than other mass-produced ultrafast chargers. "When the charger connects to the power grid, it uses only a low amount of power – which already

existed on the site – to charge up the internal battery," Sosinov said.

Approximately 20 kW comes into the charging unit from the grid, but the charging station's output is 200 kW. That 180-kW difference is pushed out by the charging unit's internal battery. According to Sosinov, a fully depleted Volvo electric truck's recharge time takes between four and six hours. "That's fast for a Class 8 truck," he said.

Electric refrigeration

The Volvo electric trucks are matched with a reefer trailer equipped with a zero-emission SolarTechTRU from Mesa, Arizona-based **Advanced Energy Machines** (AEM.GREEN). A traditional TRU is diesel-powered versus AEM's patented, all-electric, 46-volt DC unit. Located in the same front-of-trailer location as a diesel-fueled TRU counterpart, the electric TRU has a conventional condenser, evaporator, compressor and electric motor.

"The battery resides underneath at mid-trailer," said Robert Koelsch, co-founder and CEO of AEM.GREEN. AEM's standard Li-ion battery pack is 109 kWh. Charging for the battery is via AEM's patented charging pads that the trailer's landing gear rest atop.

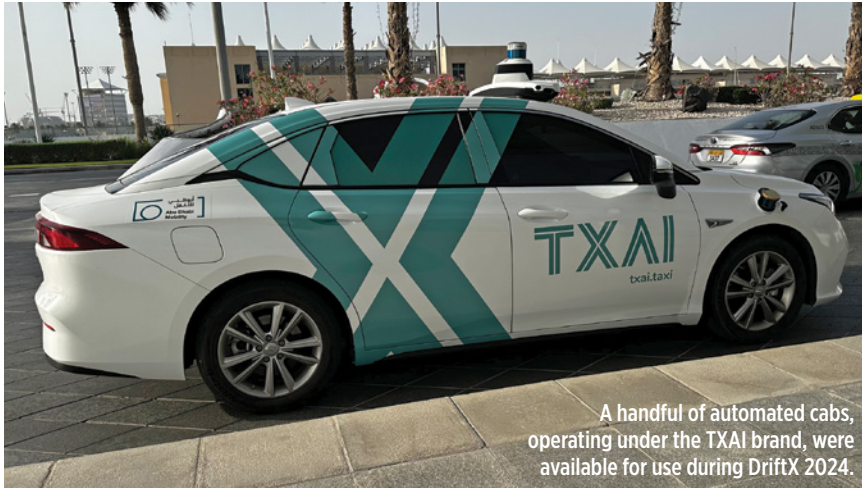
"We use AI to automate the entire charging process, so no human is plugging and unplugging cords," Koelsch said. For a completely depleted battery pack, the charging process takes about eight hours. To date, the Gilroy site has 30 of AEM's electric TRUs. Each of those electric refrigeration units is estimated to eliminate approximately 20 tons of CO₂ emissions per year versus a diesel-powered TRU.

Transitioning PFG's Gilroy site to a sustainable distribution center requires assists from multiple companies, stressed Volvo's Pope. "As a traditional truck manufacturer, we're really good at the truck part – that's not a problem. But once you go from traditional drivelines into alternative energy or battery-electric, you have to involve a lot more players," he said. "It takes partnerships to create a sustainable ecosystem."

Kami Buchholz

AUTONOMOUS DRIVING

UAE previews autonomous future at DriftX



A handful of automated cabs, operating under the TXAI brand, were available for use during DriftX 2024.

Publicly available autonomous vehicles have been operating in Abu Dhabi since 2021, providing over 16,000 rides covering more than 300,000 km (186,400 miles). If the organizers and supporters of the inaugural DriftX conference have their way, these numbers will soon be dwarfed by autonomous vehicles of all types moving people and goods across the UAE and the wider MENA region.

So far, all of these autonomous trips have been provided by the eight free, app-hailable AVs that are currently roaming around Yas and Saadiyat Islands. Motorsport fans will recognize Yas Island as the location of the Yas Marina Circuit used by Formula 1 and other racing events. The weekend after DriftX, for example, the Abu Dhabi Autonomous Racing League held its inaugural event there. It's all part of an intense governmental push to turn the Emirates into a global leader in AVs.

One of the strongest AV proponents in the UAE is the Smart and Autonomous Vehicle Industry (SAVI) cluster. SAVI was created in October 2023 by the **Abu Dhabi Department of Economic Development (ADDED)** and Abu Dhabi Investment Office (ADIO). Nayef Shahin, director of innovation and knowledge at ADIO, told SAE Media during DriftX that the various AV projects the cluster supports are meant

not just to promote the technology, but the economy as well. Shahin said he expects SAVI will contribute around 44 billion dirhams (\$12 billion USD) to the UAE's GDP by 2045 and will also create up to 38,000 jobs. AV companies from around the world have heard the sound of money shaking loose in the region and have signaled their interest.

"Today, our focus is working with

partners who would like to expand their footprint, who want to utilize Abu Dhabi as their second base or an extension of their HQs, to serve the rest of the world," he said. "Today, Abu Dhabi is well positioned. The availability of talent pool, availability of investment, it's all there."

Bayanat leads the way

Bayanat started in the UAE 50 years ago and has evolved from traditional mapping and surveying to focus on high-tech, AI-powered geospatial analytics. Some of this technology is used in the eight AVs that have driven all those autonomous miles mentioned above. The small fleet includes boxy shuttles and modified sedans, including a GAC Aion LX, that operate under the TXAI name (a blend of taxi and AI). Bayanat partners with WeRide on the SAE Level 4 vehicles for full-stack software and hardware solutions.

Riding in a TXAI on Yas Island, the software proved itself more than capable, threading the vehicle through crowds of people and around temporary



AZZ displayed its autonomous passenger shuttle at DriftX 2024, and remote controlled an automated vehicle operating in South Korea from its booth in Abu Dhabi.

traffic cones and plenty of backed-up non-autonomous vehicles trying to get to DriftX. TXAI's starts, stops and lane mergers were smoother and more "human" than other AVs I've ridden in, showing promise that when the AV revolution actually comes to the UAE, it's likely to be a comfortable one.

Bayanat's four autonomous shuttles can carry 10 people (8 with a safety driver) each and have a range of 140 km (87 miles). DC fast charging allows the EVs to fully charge in 90 minutes. The self-driving tech uses software written by Bayanat and its partners and can be remote controlled from the Integrated Transport Centre (ITC) on Yas Island, which also monitors local traffic. A Bayanat representative told SAE Media that further expansion will depend on interest from the ITC, who will decide if it is safe to put more of these AVs on the road. These shuttles were manufactured in China, with mapping and app development done by Bayanat.

Remote control: Abu Dhabi, Korea connected by AVs

Bayanat has more than 16 different partners from 20 different countries. South Korea's Autonomous A2Z displayed its AV shuttle at DriftX and said it has plans to mass-produce around 2,500 vehicles starting in 2025 for use in South Korea, Abu Dhabi, Singapore and some European countries. A2Z remotely controlled a vehicle that was moving 7,000 km (4,350 miles) away in



The Abu Dhabi Autonomous Racing League (A2RL) hosted its inaugural event on the Yas Marina Circuit in the days following DriftX 2024.

K-City, South Korea, from its booth at DriftX. Hyunwoo (Martin) Kim, A2Z project manager, told SAE Media that this kind of teleoperation can help the company fulfill the mission the Korean government is specifically looking for.

"If you look at the provinces in Korea, there are many rural areas where the average age of drivers is around 56-58, which means there are not many people who want to be a bus driver," Kim said. "They're lacking the people. So the government actually asked us to operate it autonomously."

A2Z believes it is important to have remote drivers to handle edge cases and is hoping that each remote operator will

be able to control between 10 and 20 shuttles. Kim said A2Z, which counts many former Hyundai Motor Group engineers among its staff, benefits from Hyundai's AV work that has already tapped Korean suppliers to work on autonomous vehicle components.

DriftX was not limited to road-based AVs. The event's theme was "Air Land Sea," and featured plenty of EVTOL and water-based AVs. Passenger-carrying flying AVs are not as advanced as wheeled AVs, as was made clear when one of the drones fell out of the sky and into the bay during a demonstration flight. No one was injured.

Throughout the conference, government representatives repeatedly pointed to the government's strong and ongoing support for AVs across all three domains, even when things don't always work out right the first time. SAVI's Shahin was quick to point out that the crash should not be considered a failure.

"It's not a setback," he said. "This is an opportunity. Innovation is all about iteration. It's about learning from the errors and improving. I think this is a great opportunity for the company to learn what went wrong, what should be improved, and how to make sure this never happens again. And this is why we test."

Sebastian Blanco



A large DriftX sign welcomed visitors to the first DriftX event on Yas Island in Abu Dhabi.

ELECTRIFICATION

Tier 1s rolling with the rocky transition to electrified vehicles

The jagged transition from ICE-powered vehicles to EVs and shorter lifecycles for new technologies are gnawing at Tier 1 suppliers' production volume forecasts. "It's a difficult task for Tier 1s and our sub-suppliers," Joe Palazzolo, **Dana Incorporated's** global director for electrification, said during SAE WCX 2024's final Leadership Summit session, which focused on issues facing Tier 1 suppliers. "Are we planning for 200,000 units or 20,000 units?"

Many Tier 1 suppliers have ICE-related and electrified product portfolios. But the twist is the uncertainty surrounding volumes for ICE-powered vehicles versus electrified vehicles. "It's tough right now," said Harry Husted, chief technology officer for **BorgWarner**. "When we have product ready and a contract awarded and the volume doesn't ramp up the way you planned, it's a challenge."

Chris Shamie, whose responsibilities include e-axle and hybrid systems at **Schaeffler**, knows that during the mobility industry's ongoing upheaval, things can be very transient. "We really had to make sure that we weren't giving up on the foundational business," Shamie said. "And we're trying to be nimble and balancing our resources both from an engineering point-of-view and a manufacturing point-of-view."

The uneven shift to electrified vehicles is also shortening product lifecycles as technology moves quickly with next-generation iterations. "The



WCX 2024's Thursday afternoon Leadership Summit panel featured Tier 1 suppliers. From left to right: BorgWarner's Harry Husted, ZF's Joerg Trampler, and Schaeffler's Chris Shamie.

idea of developing a propulsion system and having it in the market for 10, 15, 20 years doesn't exist anymore," Dana's Palazzolo said. BorgWarner's Husted agreed that shorter product lifecycles are becoming the norm. "What's challenging is when you don't get the full program volume that was planned for and already the product is ramping down because something newer and better is replacing it," Husted said.

Joerg Trampler, program director for electrified powertrain technology at **ZF Group**, noted that before ZF launched its fourth-generation eight-speed automatic transmission last year, internal discussions predicted a very short lifes-

pan for the product. The transmission is the technical basis for the next generation of plug-in hybrids (PHEVs) with high "pure electric" driving ranges.

"But now we look at it with a different point-of-view," Trampler said, noting the product's lifespan could extend into the late 2030s. ZF's lifespan prediction for its eight-speed automatic transmission got rosier with news from GM earlier this year. The automaker again will have PHEVs in North America via select vehicles. (GM's last U.S.-sold PHEV was the Chevrolet Volt, which ended production in 2019.) Current PHEVs available in the U.S. include utility vehicles (Jeep Grand Cherokee 4xe, Jeep Wrangler 4xe, Kia Sorento PHEV, Hyundai Tucson PHEV, Ford Escape PHEV), sedans (Toyota Prius Prime), and minivans (Chrysler Pacifica PHEV).

BorgWarner's Husted said the short shelf life for many products is a shared experience. "For us and most of the Tier 1 community, we've been supplying to a propulsion world that's ICE-based with multi-speed transmissions," Husted said. That changes with all-electric vehicles that use a single-speed transmission. "Some of your products in the new architecture just disappear."

Kami Buchholz



WCX 2024's final Leadership Summit session spotlighted Tier 1 suppliers. From left to right: Amazon Web Services' William Foy, Dana's Joe Palazzolo, moderator Jason Stein, and BorgWarner's Harry Husted.

MANUFACTURING

Traditional OEMs vs. startups: Report to cite strengths, weaknesses

An SAE white paper on the different engineering approaches taken by traditional automakers and recent arrivals indicates that each category is remarkably aware of the others' strengths and weaknesses.

Sven Beiker, a management lecturer at **Stanford University**, authored the report "Two Approaches to Mobility Engineering." He gathered commentary from every corner of the vehicle ecosystem, from suppliers to software companies to manufacturers, and summarized the findings in a presentation at WCX 2024 in Detroit. Rather than "old companies," Beiker likes to refer to traditional automakers as "incumbents." Here are a few common observations from the report, which will be published this summer:

- Newer players are better at simplifying complexity, such as Tesla's ability to build vehicles with fewer parts. Older automakers are better at managing complexity, such as integrating disparate systems.
- Newer companies are constrained by financial resources and a shortage of available talent. Traditional companies are constrained by existing staff and

"this is the way we've always done it" thinking and inflexible facilities.

- Newer companies are good at innovation in the name of customer centricity. Incumbents are very good at creating and maintaining processes.

On the innovation front, Beiker said many comments that formed the basis of the report expressed that automotive newcomers "like to try radical new solutions even at the risk of losing customers," while older companies tend to avoid market failure at all costs, sometimes resulting in "bland, look-alike products."

Looking forward, Beiker said that rather than old vs. new, the mobility market is likely to move toward "region vs. region" competition. That led to comments on how strong Chinese companies are in the EV market. Mentioning it as a Chinese strength, Beiker mentioned Ford CEO Jim Farley's admission that traditional OEMs have a tough time with software. "It's so difficult for car companies to get software right," Farley said on the "Fully Charged" podcast in June of 2023. "We have about 150 modules across the car, developed by 150 different companies, written in 100



Stanford management lecturer Sven Beiker speaks in Detroit about the forthcoming "Two Approaches to Mobility Engineering" report.

different languages, that don't talk to one another."

The WCX session was co-hosted by Monica Nogueira, SAE's director of content acquisition.

It isn't often that someone presenting a report admits that it started with a problematic premise. But that's just what Beiker did. "This report was going to be about Silicon Valley vs. Detroit," he said. "But we determined it's not really an 'either or' anymore. And, it's not just about Detroit. There are many other strongholds in the automotive industry globally... There's Tel Aviv, Shanghai and many other places." Beiker also mentioned two personal observations:

- Traditional manufacturers "tend to see the glass as half-empty" while newer companies are more optimistic.
- Though competition in the industry is fierce, each side was complementary of the other's strengths.

Chris Clonts



Sven Beiker said that traditional companies tend to think "we have a lot to lose" while newer companies have a "we have nothing to lose" attitude.



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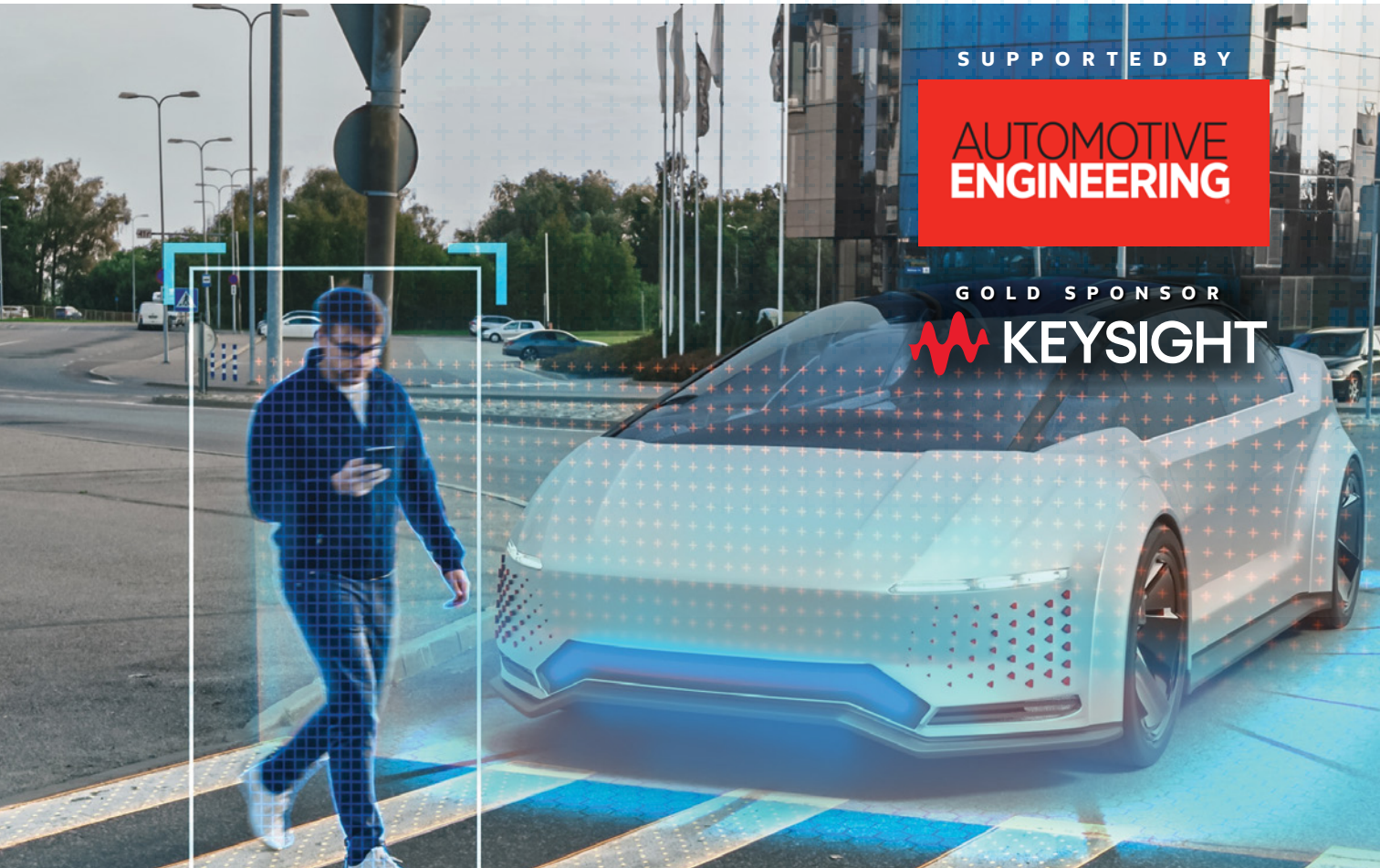
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2025 Hyundai Ioniq 5 N makes e-Shift feel real



The 2025 Hyundai Ioniq 5 N successfully brings ICE shifting feel to the normally smooth EV drivetrain.

Albert Biermann, the über-engineer tapped to lead **Hyundai Motor Group's** R&D and vehicle development, officially retired in 2021. But the fingerprints of the longtime chief engineer of **BMW's** fabled M performance division are all over a run of acclaimed models from Hyundai, **Kia** and the **Genesis** luxury brand.

The electric 2025 Hyundai Ioniq 5 N is the latest with a seemingly magic touch. Literally, in the case of a world-first transmission that simulates the shifts, revs and sounds of an eight-speed, dual-clutch gearbox and ICE engine. Yet this paddle-shifted "N e-Shift" is an entirely digital overlay that disguises a familiar single-speed EV transmission.

N e-Shift is the nerve center for a 641-hp (478 kW) crossover that's designed to rock on racetracks for about 20 minutes, recharge in 18 minutes, and do it over again. Engineers from Hyundai's N Division logged more than 6,200 brutal development miles (9,978 km) at Germany's Nürburgring Nordschleife circuit, 12.9 miles (21 km) at a time. Other tech was derived from Hyundai's World Rally Championship cars. The ultimate goal was not to merely set track records for production electric SUVs, but to make the Ioniq 5 N as fun and engaging as an old-school ICE car.

SAE Media was invited to Weathertech Laguna Seca Raceway in Monterey, California. Hyundai's first bit of mischief after the track's stomach-flipping Corkscrew: a Formula 1-style push-to-pass button (called "N Grin Boost") lifts hp from 601 (448 kW) to 641 for 10-second bursts. Torque rises from 545 lb ft (739 Nm) to 568 (770 Nm). Hyundai says the Ioniq 5 N takes 3.25 seconds to hit 60 mph (96 km/h), but we suspect it's closer to three seconds flat. Top speed is 162 mph (261 km/h). The Hyundai may be chunky, with a 4,861-pound (2,205 kg)

curb weight, but it's a hoot to drive.

Dual electric motors are fed by a battery pack whose higher-density NCM cells boost capacity from 77.4 to 84 kWh, versus a standard Ioniq 5. Sitting in pit lane, we dialed up an Endurance mode that optimizes battery temperatures for longer track stints. A Sprint mode maximizes power for all-out time attacks.

A two-stage inverter is another key, boosting performance and efficiency while keeping temperatures in check. Like conventional inverters, this unit converts DC battery current to AC juice to drive the electric motors. Here, a second stage boosts current, rather than voltage, before it reaches the motors. That amplifies motor output and reduces energy losses during conversion.

Lavish upgrades boost this charming, '80s-adjacent tall hatchback to serious track spec. Battery and motor cooling are improved with a more-robust chiller, as well as low-temp and high-temp radiators. A gaping grille and active air flaps boost airflow or trim drag. A 10% stiffer chassis adds 42 more welding points and 6.9 feet (2.1 m) of added structural adhesives. Springs, bushings and three-position electronic dampers are retuned. Integrated drive axles are strengthened to handle massive horsepower and torque.

The chassis and driver's seat are lowered, and a two-inch (51 mm) wider



One downside to the Ioniq 5 N is the overwhelming amount of setting choices.

body makes room for 21-inch (533 mm) forged alloy wheels. Pirelli designed its P Zero Elect compound and tread exclusively for this rally-style SUV. A reworked grille and nosepiece inhale more cooling air, with active front air flaps and a rear diffuser. Drivers nestle into burly sport seats, with a fixed center console (with kneepads for support in fast corners) replacing the flat open floor of a standard Ioniq 5. A strengthened electric steering rack gets a faster ratio and pleasing weight, though road feedback still can't match the best ICE cars.

N e-Shift goes 'Supersonic'

The N e-Shift is the Ioniq 5 N's technical calling card. In Laguna Seca's pits, a tachometer needle on the driver's display jiggles as the Hyundai "idles". That's set to the tune of the N division's four-cylinder engine, played through 10 internal and eight external speakers. Users can choose other powertrain sounds, including a "Supersonic" inspired by twin-engine fighter jets.

As we chased 11-time Pikes Peak winner Paul Dallenbach around the hilly circuit, the tach soars to a simulated 8,000 rpm — despite electric motors that actually spin up to 21,000 rpm.

The transmission bumps against a rev limiter when I shift too late, just like in an ICE car. Select too high a gear, and the powertrain lugs. A Drift mode can simulate the "clutch kick" of a stick-shift



"Hyundai says the Ioniq 5 N takes 3.25 seconds to hit 60 mph (96 km/h), but I suspect it's closer to three seconds flat."

car to initiate rotation.

And it's all done entirely with software that adjusts electric-motor torque during shift events. Each paddled shift elicits a surprisingly natural torque interruption, including rev-matched downshifts accompanied by aural feedback. Jun Mo Lee, manager of chassis and thermal performance for Hyundai America, said the development of dual-clutch gearboxes in cars like the Elantra N guided targets for shift feel. Precisely syncing shifts to powertrain sound and tach-needle movements was crucial.

Compared to a single-speed transmission, the eight spaced "gears" allow separate torque zones and acceleration for each, as with an ICE car. Matching those gears to digitized sound gives drivers more-intuitive feedback on how fast they're moving or taking corners. After sampling the system's convincing mimicry, we expect other performance EV makers to build versions themselves.

Despite the more energy-dense battery, Hyundai says the N version charges as quickly as a standard Ioniq 5, from 10- to 80% in 18 minutes on a 350-kW charger. Both models share the slick 800-volt e-GMP platform, and its maximum 238-kW charging pace. The N model's focus on speed and handling does take a toll on the driving range, at 221 miles (356 km), compared with up to 260 miles (418 km) for Ioniq 5 AWD models.

Hyundai further claims a class-high for regenerative braking force with up to 0.6 g of deceleration. That saves overheating and wear-and-tear on mechanical brakes. Those brakes are Hyundai's beefiest yet, with four-piston front calipers and 15.8-inch (401 mm) rotors. Fans of left-foot braking can also apply the brake and accelerator simultaneously, without the system cutting power to motors.

The Hyundai's performance is cinematic, but it flunks one screen test: A 12.3-inch (312 mm) center touchscreen offers too many performance choices, including settings for motors, steering, brakes, sound, stability control, transmission, battery and electronic limited-slip differential. A pair of steering-wheel "N" buttons offer some relief by saving preset selections. But the confusing, overwrought screens can get in the way of driving.

On the upside, this hot-rod Hyundai remains practical enough for families, with five seats and generous cargo space. A \$67,475 base price swamps the \$50,725 cost of the most-affordable Ioniq 5 SE with AWD. But the forthcoming Porsche Macan Turbo EV costs nearly \$40,000 more to start, at \$106,950, with 630 hp (470 kW). A Macan 4 EV starts from \$80,450, but with 402 hp (300 kW) to 641 for the Ioniq 5 N. On top of knock-out performance numbers, this Hyundai puts up defensible numbers for value.

Lawrence Ulrich



The 2025 Hyundai Ioniq 5 N uses the "N Grin Boost" button to temporarily raise hp output from 601 to 641 for 10 seconds. Torque rises from 545 lb-ft (739 Nm) to 568 (770 Nm).

Mercedes unveils tech-heavy electric G-Class

Surrounded by celebrities in Beverly Hills, **Mercedes-Benz** unveiled the 2025 G 580 with EQ Technology on a dock in the middle of a reservoir. That mouthful of a name is met with a large offering of technology packed into the luxury off-roader. Sitting atop a 116-kWh capacity battery pack, four motors (one for each wheel), a redesigned rear axle system, and a sound system feature called G-Roar, the German utility vehicle is ready to tackle the great outdoors as well as Rodeo Drive.

While its target audience in the United States will unlikely use any of the following features more than a few times a year, the transition from gas to battery has done nothing to reduce the vehicle's off-road capabilities. If anything, it's enhanced them.

The electric G-Class is equipped with four independent motors that offer true torque vectoring and electronic differential locks. Each of these two-speed motors has a mechanically gear-reduced low range. The higher torque at low speeds is paired with two off-road modes: Trail and Rock.

As you would expect, Trail is for the average off-roading excursion, while Rock gives the electric vehicle rock-crawling



The new Mercedes-Benz G 580 with EQ Technology Edition One in South Sea Blue Magno (European model shown).

abilities. Rocking out in this way is not something the average driver will use regularly, but with its 45-year pedigree, it wouldn't be a G-Class if it couldn't take anything nature throws at it.

For those looking to exit Beverly Hills for heights devoid of asphalt, the G 580 has an approach angle of 32 degrees, a departure angle of 30.7 degrees, and a 20.3-degree breakover angle. Protecting the battery pack and situated in the

modified ladder frame is a proprietary composite carbon-fiber cover that Mercedes states is more rigid than aluminum and steel and, at 127 pounds (58 kg), would be three times heavier if made from steel.

The ladder frame found on the gas G-Class has been modified and reinforced for the electric variant. As in the petroleum-powered vehicle, the EV has a double wishbone suspension system up front with a solid rear axle in the rear. There are differences, though. The rear axle has been redesigned to accommodate the frame-mounted rear motors, which are connected to the wheels via dual-joint driveshafts. That setup allows full compression of the suspension without changing the camber of the wheels. For those traversing a rough trail, having the entire contact patch of each tire on the ground can be the difference between moving forward or being stuck. Or worse, sliding backward.

For tight corners, G-Steering turns the G Wagen around one of the rear wheels. The wheel remains stationary while the G-Class pivots around it. For a more dynamic turn, the electric G-Class will spin 360 degrees in one spot up to two times while on a dirt road or loose asphalt. The wheels on either side of the vehicle turn in opposite directions.



The dashboard of the electrified G 580 uses two 12.3-inch (312-mm) displays.

This is commonly known as a tank turn, and it's something the gas-powered G-Class could never do.

Another upgrade from the gas version is the EV's ability to ford deeper water. The electric G 580 can handle up to 33.5 inches (851 mm) of water, 5.9 inches (150 mm) more than the gas-powered G 550 and AMG G 63. While traversing up and down inclines, the vehicle handles angles up to 35 degrees without slippage and, separately, can crawl over 100-degree items in certain circumstances.

Rounding out the ruggedness, Mercedes shipped a digital off-road experience that appears on the vehicle's two 12.3-inch (312-mm) displays. In addition to the usual tilt and power distribution, the 360-degree cameras can be used to create what Mercedes calls a "transparent hood." Drivers can see the trail ahead that otherwise remains hidden by the front of the vehicle, helpful when driving alone and a spotter is unavailable.

Mercedes was upfront about the abilities of the electric G-Wagen surpassing that off the gas version. After some mild prodding, anyway. "I wanted to correct you but I cannot because in off-road capabilities, it's better," Mercedes CEO of AMG Michael Schiebe told SAE Media. When asked about the decision to use four two-speed motors instead of a dual-motor setup, the CEO said,



Cameras abound on the new G 580, allowing for a video effect called "transparent hood."

"It's just superior technology; that's as simple as it is."

The four motors output 579 combined hp (432 kW) – each motor is capable of 145 hp (108 kW) – and 859 lb-ft (1,165 Nm) that can propel the vehicle from zero to 60 mph (96 km/h) in 4.6 seconds. The electric G 580 also ships with the usual Sport, Comfort, and Individual modes found in current Mercedes-Benz vehicles for use on asphalt.

To adjust aerodynamics in their favor,

Mercedes has slightly altered the vehicle to reduce drag with a spoiler on the roof, a slightly raised hood, A-pillar cladding, and aero wheels.

Mercedes is still rolling on a 400-volt system with AC charging topping off at 11 kW and DC fast charging supported up to 200 kW. At launch, the vehicle will be outfitted with a CCS port, but a CCS to NACS adaptor will be available from Mercedes by the end of the year. Mercedes will eventually add a NACS port to the vehicle.

Inside, you get the Mercedes feel you've come to expect from the brand. There are touches of the luxury found in the Mercedes EQS or EQE, but with some old-school nods. The buttons and toggles found in the legacy vehicle are still here. While making the G-Wagen electric was important to Mercedes, it didn't want to change the vehicle's character, which is why it hasn't undergone an exterior design change. Regardless of powertrain, the vehicle needs to look like a G-Wagen.

Pricing and availability for the U.S. market haven't been announced, but we expect the Edition One launch version of the EV G-Wagen to clock in just slightly south of \$200,000 with availability during the second half of 2024.

Roberto Baldwin



Despite plenty of updated tech, the Mercedes-Benz 2025 G 580 with EQ Technology still looks like an old-school G-Wagen.

A CONSUMER'S VIEW: Perry Parts 3D-printed bump stops

Making a Miata feel at home off-road takes ingenuity and some help from modern 3D-printing tech.

by Emme Hall



This year Buddy became the first Miata to race in the Desert Challenge during King of the Hammers in Johnson Valley, CA. He raced against trucks twice his size but with the addition of the Perry Parts bump stops — and some chromoly shock mounts — he was able to finish the 35-mile course with no major damage.

I have always loved off-road racing. I love the innovation, grit and determination it takes to get across the finish line after 250, 500 or even 1,000 miles (402, 805 or 1,609 km) of racing.

I have also always loved Miatas. I bought my first NA in 1994 and never looked back. I currently own a 2004 Mazdaspeed Miata and a 2001 lifted Miata.

Yep, you read that right. I combined my love of the roadster with my love of the dirt. The car's name is Buddy and he's the best thing you've ever laid eyes on. But it hasn't been without hardship.

I'm far from a mechanic and I've done some things to Buddy that would make SAE standard-setters weep. The not-stock **Odyssey** battery is resting on a wooden platform surrounded by spray foam. The wires to the **Rigid** off-road lights make their way forward via some questionable holes in the firewall and don't even ask about how much the fenders have been cut with a sawsall and pummeled with a sledgehammer to accommodate my **BFGoodrich** KO2 all-terrain tires.

However, I wasn't willing to McGyver my way through a new suspension set-up. After a year or so running **Koni** Rallycross coilovers, Buddy got a huge upgrade with a set of **Fox** 2.0 units with **Hyperco** springs. I love the Fox shocks and have run them on other off-road race cars, but the 8.5-inch (216 mm) stroke is too long for Buddy's stock control arms. I needed bump stops.

If you think there is a website called OffRoadMiataBumpStops.com you'd be wrong. These aren't off-the-shelf parts I can install in an afternoon. I needed something custom. Affordable would also be good.

For almost a year, I've been working with Patrick Perry from **Perry Parts**, manufacturer of 3D-printed bump stops. If you're picturing layers of cheap plastic, think again. Perry uses extrusion to build his

bump stops, combining the durability and consistency of injection molding with the short lead time flexibility of traditional 3D printing.

Perry retrofits his printers with a custom printhead that can take high-end injection molding materials and melt them to the consistency of honey. This substance is then compressed and metered out the nozzle. The process is reliable, repeatable and highly customizable.

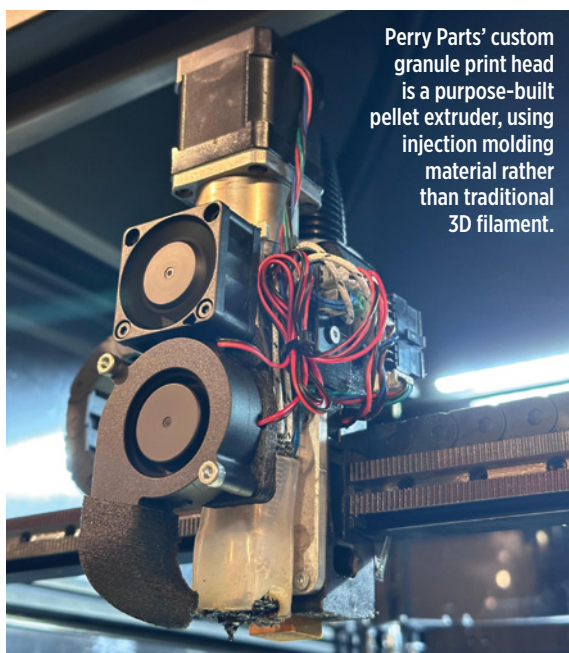
The company recently pitted its products against the best of the aftermarket as well as **Toyota** OEM bump stops. Independent third-party tests showed Perry Parts offered up to four times more damping than the competition and matched top competitors in engagement timing and suspension protection.

Perry offers turn-key solutions, but he really enjoys working with weirdos like me who need a custom solution. To make Buddy's bump stops, he took a few parameters — weight, drivetrain and axle type — and made me a set of testers.

My old Konis had rubber bump stops installed on the shaft of the shock. I didn't really want to take apart the Fox every time I tried a new set of bump stops, so I had a talented fabricator make up some chromoly mounts. These were a world apart from the stops that came on the Konis. I am not nice to Buddy, constantly utilizing all the travel I have on whoops in the desert and it's not uncommon for all four wheels to leave the ground. I'm used to hearing the suspension slam



The Mint 400 features a smooth infield with plenty of opportunities to fly.



Perry Parts' custom granule print head is a purpose-built pellet extruder, using injection molding material rather than traditional 3D filament.



Buddy takes on the two-day Rage at the River desert race in Laughlin, NV before the Perry Parts bump stops were installed. After 60 miles of racing, the passenger front upper shock mount gave up the ghost and we couldn't race Day Two.

against the mounting points and control arms. In the past, I just gritted my teeth and kept going.

Buddy now almost feels like a whole new car. Sure, the Fox shocks are better in the desert than the Konis, but I no longer clench up when I see a big hole ahead. Perry's bump stops keep the front end stable, dissipating the extreme forces the car has to endure. I've got some pretty good chromoly upper shock mounts thanks to my fabricator, but the lower control arms are still stock and were never meant to take such abuse. Yet here I am, running the same control arms with nary a crack in sight.

The bump stops in the rear are still too stiff. What's cool is that Perry takes feedback and can dyno the bump

stop, measuring what I like or don't like about the ride quality. Then, using that data, he can tune the shape and internal structure of the bump stop to make it stiff, softer, more or less progressive – whatever I want.

I've raced on the too-stiff rear stops twice – I'm a busy gal, time gets away from me and sometimes good enough is good enough – becoming the first Miata to race during King of the Hammers in Johnson Valley, California. Sure, I came in last, but who cares? I got a Miata around some of the toughest desert landscapes in the world and drove the car home. I also repeated my class win at the Mint 400 this year, taking 40 minutes of my previous time and adding 5 mph (8 km/h) to my average speed. Was that just 25 mph (40 km/h)? Yes. But trust me, that is fast enough in a little Miata.

I've finally got the time to install the new, softer set of rear bump stops, and then it will be off to the HootieX rallycross in Oregon at the annual Gambler 500 event. That will be a great first test of the new rear bump stops, and I'll finally have Buddy's suspension dialed in. After that, I swear, I'll work on the wiring! ■



VI-grade introduced a Driver-in-Motion Full-Spectrum Dynamic Simulator for multi-attribute virtual tests.

by Sebastian Blanco

VI-grade's Driver-in-Motion DiM50 can be used with the company's WorldSim software that creates a virtual world.

Despite rainy skies above northeastern Italy in mid-May, the mood at **VI-grade's** 2024 Zero Prototype Summit (ZPS) was decidedly sunny. VI-grade's partners from around the world were on hand to see the world premiere of the company's new Driver-in-Motion Full-Spectrum Dynamic Simulator (DiM FSS) that allows for multi-attribute applications.

An update to VI-grade's advanced DiM units, the DiM FSS is a carbon fiber cockpit with shakers that can be mounted on top of VI-grade's existing dynamic simulators to provide NVH simulations at the same time as dynamic simulations.

May was a busy month for the Darmstadt, Germany-based VI-grade (owned since 2018 by Spectris plc). VI-grade is part of HBK's Virtual Test Division (HBK is itself part of Spectris plc). HBK CEO Ben Bryson told SAE Media that VI-Grade's virtual test tools can significantly improve time to market - "in some cases, it's halved," he said - while reducing costs by up to 20%. These benefits, as well as getting real-time, accurate feedback, are of particular interest to premium brands, he said.

"Companies like **BMW** and **AMG** need to know that their brand is protected through the innovation cycle, and that the products that they've designed, their physical attributes, the structural load and dynamics, match how the driver feels in that environment," he said.

Bentley Motors participated in ZPS with a presentation on the "Importance of a Virtual-First Mindset in Engineering." The automaker backed up this viewpoint by announcing earlier in the month that it would use VI-grade's Compact FSS Simulator to build virtual prototypes of upcoming EV models, noting specifically that the digital tools would be used to improve NVH development and ride and handling tuning. Bentley will install the Compact FSS at its new Driver-in-the-Loop (DiL) Hub that it is building in Crewe, UK.

In the U.S., the University of Michigan's advanced mobility research center, **Mcity**, also announced in May that it would use VI-grade's Compact Simulator to test autonomous technologies with VI-grade's VI-WorldSim software stack.

EDAG's Zero Prototype Lab opening soon

But perhaps the biggest news out of ZPS was independent engineering services provider EDAG Group announcing it would open the first EDAG Zero Prototype Lab (ZPL) in Wolfsburg, Germany, this spring featuring VI-grade's Cable Driven DiM500 Simulator. Jonas Grötzinger, senior expert for vehicle motion and performance vehicles at **EDAG**, told SAE Media that the ZPL already has two other VI-Grade simulators - a desktop unit running and a Compact FSS simulator both running Autohawk16 - but it's the DiM500 that is more likely to convince OEMs, including nearby VW, to use EDAG's services. The DiM500 has 5 meters (16 ft) and 1.5G of longitudinal and lateral movement and 298 mm (12 inches) and 2.5G of vertical movement.

"We choose the DiM500 because we can do one-to-one cueing for a lot of relevant maneuvers, including double lane change maneuvers, in combination with a good ride comfort performance," he said. "On a smaller simulator, like a DiM250 or DiM400, you have to use lower cueing so it's not one-to-one to the force you



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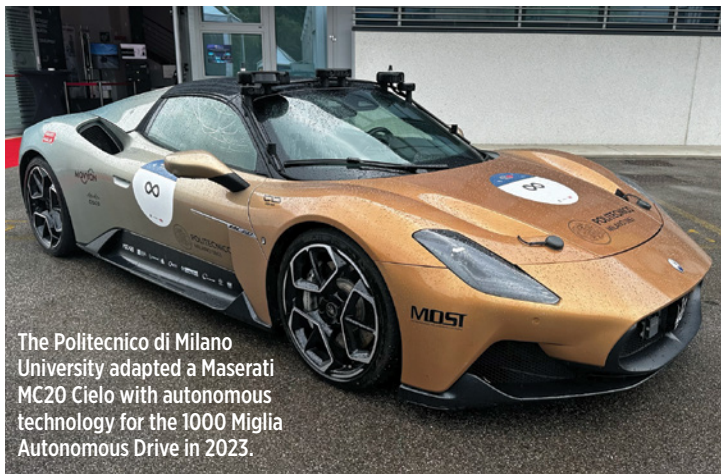


SAE Media Group

Zero Prototype Summit 2024: *THE FUTURE IS CLOSER THAN EVER*



Compared to the original DiM150 and DiM250 simulators, the DiM400 uses a unique cable drive system on the lower stage to enable a larger motion envelope for even longer time exposure.



The Politecnico di Milano University adapted a Maserati MC20 Cielo with autonomous technology for the 1000 Miglia Autonomous Drive in 2023.

get on the body, it's maybe 0.5 or 0.7. That means the driver has to adapt his feeling to the simulator."

It's the combination of simulators that Grötzinger said sets EDAG's ZPL apart.

"We also have an FSS simulator in the lab because we want to combine the attribute development between the handling and steering with the attribute development in NVH and higher frequency ride comfort, and I think this combination is unique on the market," he said. "The additional desktop simulator [can be used] to update models, to develop models, and do small checks of the models before using the other simulators."

The combination of the DiM500 and the FSS simulator also means EDAG can run completely new tests by regenerating data from real-world tests or from simulations.



VI-grade's Guido Bairati at ZPS 2024.

"If you really want to change the way you develop vehicles, if you really want to accelerate product development, if you really want to decrease the number of physical prototypes, you have to believe in what simulation and simulators can do."

"You can also make a combination out of this. You can hear only the input from the front axle, or only the input from the rear axle, or from both. You can add wind noise or remove wind noise, and so on. It's quite good for the engineers because it's quite difficult to do it in the real world or on the proving grounds," he said, laughing. "It's not possible to remove one axle and then drive the car again."

"With the DiM500, we can only run structural inputs up to a certain level of frequency," he said. "With the FSS simulator, there's no limit between the structural transfer path and airborne transfer path. Of course, the airborne noise will be simulated in the FSS simulator. And we can use airborne noise that was measured from a car on the proving ground and use the signals in a simulator as well as we can use transfer paths from the simulation."

The more, the merrier

VI-grade managing director Guido Bairati told SAE Media that the more simulators a company uses, the better its overall virtual testing becomes.

"If you really want to change the way you develop

vehicles, if you really want to accelerate product development, if you really want to decrease the number of physical prototypes, you have to believe in what simulation and simulators can do,” Bairati said.

“Believing in a simulator means that you start using simulators in all different locations like Ford is doing, like Stellantis is doing, like Honda is doing, and you need to have a number of simulators in order to study all different disciplines virtually using digital twins. That’s the only way to be able to really say that you are changing the way you develop vehicles and that you are shrinking the development time.”

Despite the sunny predictions at ZPS, there were some clouds obscuring exactly when the industry will reach truly zero-prototype development capability. During breaks and informal conversations, many attendees told SAE Media they face steep challenges getting their companies to fully invest in virtual testing, despite the potential benefits. Bairati, though, said he thinks companies are closer to zero prototypes than they’re willing to say.

“I’m fully convinced that in 2024, a vehicle can be developed fully, virtually,” he said. “That means the first prototype you build, it’s basically right. But



The Politecnico di Milano University used VI-grade’s DiM400 and VI-WorldSim software to improve its test vehicle’s autonomous perception capabilities.

some of the decision-makers are still old-school engineers, and they don’t really believe that simulation models can reach the level of reliability and predictability that they actually are able to reach. It’s a cultural shift.” ■

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HIGHLAND TECHNOLOGY

The Lesson of J3400: MOVE FAST AND FIX THINGS

The standard may have changed everything, just not how you think.

by Roberto Baldwin



“We have to implement, we can’t get stymied. We can’t get in the mud on fighting to the death about a form factor or something like that.”

laborate you really do drive things further, faster, and smoother,” Hipel said. “I like that and I think that J3400 is a bit of an example of that.”

What happens next in the industry requires focus, such as Hipel’s work with the **Charge X Consortium**. The group, comprised of 85 private sector members and three labs, is working to identify and create solutions for issues identified at charging stations. Considering the current fail rates and the move to expand charging infrastructure at an ever-quicken pace, it’s vital that these issues are addressed quickly to ensure a smooth EV transition.

Move fast and fix things

For Hipel and the Joint Office of Energy and Transportation, that requires focus on the task at hand. “Where those gaps are, we can come to the standards bodies and the private sector and just say, ‘we think there’s a gap. Do you think there’s a gap?’ Because at the end of the day, it’s private sector-led, government enabled,” she said. “I think that shift, at least within our office, is really powerful in terms of moving quickly to find that next thing to solve, resolve, and then improve as we go. But we have to implement, we can’t get stymied. We can’t get in the mud on fighting to the death about a form factor or something like that.”

The hope is that moving quickly as an industry signals a cultural shift -- a moment in time when the industry is interested in collaborating to solve big problems quickly.

J3400 is no longer in the hands of Tesla. The company recognized the value of handing it over to the industry to be standardized. What happened next was a collaboration that helped push the rest of the automotive world to support the interface. Now every major automaker plans to use NACS in future EVs.

Facebook had a motto “move fast and break things.” In hindsight, it was a terrible way to roll out technology. The broken “things” snowballed into huge issues. The automotive industry looks to be doing things a bit differently by moving quickly and fixing things and those that join in are reaping the benefits. ■

At WCX 2024, a panel called “The Wake of J3400 (NACS), Are Standards Still Needed?” discussed Tesla’s emerging charging standard. From left: James P. Flaharty (Toyota), Rebeca Delgado (Intel Automotive), Andy Jeffers (GM, retired), Sarah Hipel (Joint Office of Energy and Transportation), Christian Thiele (SAE International).

On May 25, 2023, **Ford** made an announcement that seemed unimaginable. For those in the EV and standards industry, it caught many by surprise. Ford was partnering with Tesla to move away from the CCS (J1772/CCS) standard that’s on a majority of electric vehicles and would switch to the Tesla NACS (North American Charging Standard) in the future.

“When the J3400 news broke or the NACS partnerships broke, it kind of went around the regulatory ‘there’s no way around that’ and it was just the worst day because I thought we were going to lose, open, collaboratively created standards,” Sarah Hipel, standards and reliability program manager for the Joint Office of Energy and Transportation told the audience at SAE’s WCX 2024. Hipel was on a panel titled, “In The Wake of J3400 (NACS), Are Standards Still Needed?”

Hipel was joined by Rebeca Delgado, CTO of **Intel Automotive**, James P. Flaharty from **Toyota North America R&D** and chair of the motor vehicle council at SAE, and Christian Thiele, director of ground vehicle standards for SAE International. The panel was moderated by retired GM manager Andy Jeffers and the group discussed the importance of standards as a way to set guardrails for development but allowing disruption within the confines of the standard.

“The industry has always benefited from standards,” Delgado told the audience. “In the right place, it’s [a] very clear [way] to foster innovation, because slow is smooth and smooth is fast.”

Yet, J3400 was anything but slow. The news broke in May of 2023 and by December the Technical Information Report (TIR) was published with the potential of the standard being solidified by the end of 2024.

Hipel said that after the news broke, during talks with Tesla it was clear that the company wanted to participate in the standardization of NACS. Others in the industry came on board and NACS moved from a Tesla-controlled interface to one built up and standardized by SAE and its partners both in the public and private sector.

The speed at which J3400 has been adopted is a sign that, when needed, the industry (both private and public) can move quickly to benefit all. “When you come together to create standards and col-

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The Automotive Division of the Society of Plastics Engineers (SPE®) is announcing a "Call for Nominations" for its **53RD-Annual Automotive Innovation Awards Gala**, the oldest and largest recognition event in the automotive and plastics industries. This year's Awards Gala will be held Wednesday, **NOVEMBER 13, 2024** at the Burton Manor in Livonia, Michigan. Winning part nominations in 10 different categories, and the teams that developed them, will be honored with a **Most Innovative Use of Plastics** award. A **Grand Award** will be presented to the winning team from all category award winners.

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Vacuum conveyors



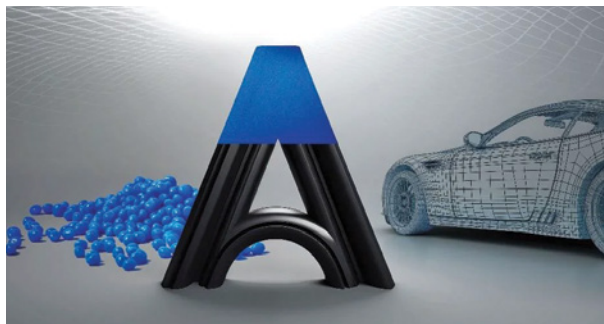
Piab (Hingham, Massachusetts) introduced the piFLOW am vacuum conveyor. The unit features Piab's COAX vacuum technology as well as a butterfly valve. Piab states that the butterfly valve is not sensitive to pressure fluctuations and is able to keep a material batch inside without the pump being mounted. It has a standard TC connection which makes it simple to integrate for the customer. Piab also claims the unit is easily integrated with any type or brand of 3D printer, sieve, hopper and other

intermediate vessel. The product is controlled by pneumatic or electrical control units. The piFLOW am is made of stainless steel and can reportedly withstand a material temperature of up to 140° Fahrenheit (60° Celsius). The conveyor unit weighs 33 lbs. (15 kg) and reaches a maximum feed pressure of 101.5 psi (7.2 bar).

<https://www.piab.com>

SPOTLIGHT: MATERIALS

Adhesion compounds



KRAIBURG TPE (Waldkraiburg, Germany) launched new EPDM adhesion compounds designed for automotive exterior sealing. These compounds reportedly offer improvements in material technology, adhesion, durability and processability. The company states that they are specifically formulated for automotive exterior parts with UV resistance such as glass run channels and sealing profiles featuring molded corner joints and end caps. Kraiburg states that it has successfully tested the compounds in comprehensive trials since 2023. The compound features constant EPDM adhesion quality as well as optimized flow properties that provide a broad processing window and increased design flexibility in part and tool design while maintaining performance standards. Additionally, the compounds offer weathering resistance, color stability, low surface friction behavior and wear and tear resistance.

<https://www.kraiburg-tpe.com>

Cabin monitoring

Melexis (Tessenderlo, Belgium) and **emotion3D** (Vienna, Austria) launched an automotive in-cabin monitoring solution based on 3D time-of-flight technology.

The system reportedly overcomes limitations of established driver monitoring systems by utilizing 3D ToF cameras and Melexis' automotive-qualified MLX75027 true VGA ToF sensor as well as emotion3D's CABIN EYE software. The system simultaneously generates IR and distance images, thereby mapping a full scene in three dimensions. This information is used to accurately assess driver fitness to drive while indicating the location of other occupants in the vehicle, detecting limb position and tracking movements and body or hand gestures. Direct access to measured distance data greatly improves image segmentation options, reduces the computational load and thus lowers system cost.

<https://www.melexis.com>



Displays

CarUX (Singapore) announced it has released its 55-inch (1,397 mm) local dimming automotive display equipped with active privacy view technology.

The display reportedly prevents hazards caused by distracted drivers while providing advanced audiovisual entertainment to front-seat passengers. The display also features an 8K high-resolution screen with an active screen cooling system. The displays are equipped with CarUX's ID Touch, which can identify the user who is currently touching the screen via an independent electrode hidden in the driver and passenger seats when both the driver and passenger are operating the display at the same time in the cockpit. This is to further restrict drivers from operating audiovisual entertainment functions while driving, providing higher-spec safety resolution solutions.

<https://carux.com>



Cabin sensing design

Eyeris Technologies (Palo Alto, California) announced their partnership on a production reference design to improve safety and comfort of the automobile cabin. This jointly developed reference design integrates Eyeris' advanced monocular three-dimensional (3D) sensing AI software algorithm into Leopard Imaging's 5-mega-pixel (MP) backside illuminated (BSI) global shutter (GS) camera, which uses OMNIVISION's OX05B image sensor and OAX4600 image signal processor (ISP). The depth-aware driver monitoring system and occupant monitoring system production reference design were showcased during CES 2024 at Leopard Imaging's booth. Eyeris displayed its latest technology inside its demonstration vehicle and at select automotive tier-one partner locations.

<https://www.eyeris.ai>



Lidar

Hesai Technology (Palo Alto, California) announced the AT512 ultra long-range ADAS lidar. The AT512 offers a range of 300 meters (985 ft.) at 10% reflectivity with a maximum range of over 400 meters (1,300 ft.) and a 12,300,000 points-per-second point-rate. The system offers a 120-degree horizontal field of view and a 25.6-degree vertical field of view. The AT512 is reportedly designed to enhance ADAS systems by improving the vehicle's perception capabilities by providing 3D environmental scans at high resolution, which improves a vehicle's ability to detect objects at long range. Hesai states that AT512-equipped ADAS systems will have 40% more reaction time to avoid dangerous road conditions and significantly improve transportation safety.

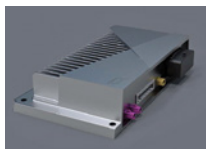
<https://www.hesaitech.com>



Lighting control unit

Marelli (Auburn Hills, Michigan) developed an automotive lighting domain control unit platform that is able to control vehicles' front lights, rear lights, and all new 360° lighting features. Marelli has also introduced the "MCU LESS" intelligent driver concept, enabling the opportunity to centralize all lighting software into domain ECUs. Marelli's portfolio includes a suite of control unit solutions for automotive lighting, ranging from basic lighting controllers that meet distributed power supply systems, to centralized CAN communication controllers that support adaptive matrix headlamps, to high-definition rendering controllers represented by micro-LED and Digital Micromirror Device (DMD) technologies.

<https://www.marelli.com>



Communications platforms

Green Hills Software (Santa Barbara, CA) and STMicroelectronics and Cetitec announced a collaboration to deliver an integrated and configurable communications platform for use in zonal controllers for the centralized EE vehicle architecture of the SDV. This solution consists of Green Hills' μ -velOSity real-time operating system (RTOS), ST's Stellar Integration MCU platform, and Cetitec's advanced networking stacks, gateways and routing frameworks. ST's Stellar Integration MCUs provide a 10x increase in performance compared to previous generations of vehicle MCUs and adds required features such as extensible memory and OTA (over-the-air update) support, allowing OEMs to update and add new features during the lifetime of the vehicle. Running on ST's latest Stellar MCUs, Green Hills' μ -velOSity RTOS benefits from access to the latest hardware updates of the Stellar P and G microcontrollers.

<https://ghs.com>



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Autonomous driving (AD) and advanced driver assistance systems (ADAS) represent a critical domain in the automotive sector change ahead. AD/ADAS capabilities are challenged by increasing development complexity, cost, regulations, safety targets, customer demands, and overarching global dynamics. This 45-minute webinar will explore modern technology that offers an end-to-end approach to AD/ADAS and delivers advanced functionality driven through software transformation and engineering services.

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Wednesday, June 26, 2024 at 2:00 pm U.S. EDT

To adapt to new customer demands such as convenience, safety, autonomy, and electrification, the automotive industry is moving to software-defined vehicles (SDVs) based on more powerful electrical/electronic architectures. Designers find themselves in need of safe and scalable combinations of real-time and applications processing. This 30-minute webinar will explore ways to meet the evolving needs of SDV development including a solution for central compute based on super-integration processors.

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PRODUCT COMPLIANCE CHALLENGES FOR WIRELESS RADIO DEVICES IN VEHICLES

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Designing wireless products for normal commercial environments is well understood by most designers. However, because vehicle regulations are different from the Federal Communications Commission or European Commission marking requirements, manufacturers often struggle to find, test, and certify to ensure they meet all the demands. This 30-minute webinar discusses the industry and legislative conditions to ensure that manufacturers create compliance strategies that are right for their products.



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The Fiat 500e is back

After a hiatus of five years, **Fiat** is reintroducing the 500e to the U.S. The EV, which is new to the U.S. in 2024, has been sold in Europe for the past four years. So, what's new? We spoke with Stellantis to get the answers.

The original Fiat 500e “survived” in the U.S. from 2011 to 2019, but the model hardly changed over those nine years, and sales dropped precipitously. What’s different now?

Unlike the old car, the new 500e was designed and engineered to be an EV, which simplified certain elements of the development. Also, the car has operated in Europe since 2020, and that advance helped speed up the introduction to North America. The 2024 Fiat 500e is about 30 pounds (14 kg) lighter than the previous model and offers improved dimensions:

	Previous 500e	New 500e
Weelbase	90.6 in (2,301 mm)	91.4 in (2,322 mm)
Length	142.0 in (3,607 mm)	143.0 in (3,632 mm)
Width	64.0 in (1,626 mm)	66.3 in (1,684 mm)
Height	60.0 in (1,526 mm)	60.1 in (1,527 mm)
Weight	2,980 lb (1,352 kg)	2952 lb (1,339 kg)

More importantly, the new 500e offers greater range, fast charging, more technology, safety systems, Uconnect 5 and better electrical architecture.

Are there changes to the motor?

Old: 111 horsepower (83 kW) electric-drive motor with permanent-magnet, three-phase synchronous electric drive motor with 147 lb-ft (200 Nm). New: 117 hp (87 kW) AC three-phase with permanent magnetic rotor; peak torque is now 162 lb-ft (220 Nm).

What about the batteries?

The previous 500e used a 24-kWh liquid-cooled/heated lithium-ion battery. The new chemistry is lithium-ion nickel manganese cobalt. 42 kWh. Cell configuration is 96S 2P. The battery can be recharged at a DC charging station at up to 85 kW, which is enough to add 31 miles (50 km) of range in just five minutes.

How do you heat the vehicle and battery?

To heat the cabin, we have an HV air PTC (it is not a heat pump). We use an HV coolant heater to heat the battery.

How and who decided on the range for the U.S.?

The range of the Fiat 500e is directly related to packaging and technology. We designed and

engineered the 500e to maximize range in a city car package with enough range to handle city commutes for multiple days without needing to charge.

Does a city car really need 150 miles (241 km) of range? The previous 500e offered 87 miles (140 km) of range.

That's a great argument and customers will tell us from their purchases. As EVs become more prevalent, we will see shifts in range demand as we have seen shifts in vehicle type. Because the Fiat 500e is built from the ground up to be an EV, we can easily make adjustments to adapt.



The 2024 Fiat 500e comes to the U.S. with more range, faster charging and better electrical architecture.

“We designed and engineered the 500e to maximize range in a city car package with enough range to handle city commutes for multiple days without needing to charge.”

The 500e has three regen modes. Do European drivers use their cars differently than Americans in this regard?

The European variant has the same features. The 500e is a city car and can benefit from all three modes of operation. Also, just because we give our customers multiple features and lots of content, that doesn't necessarily mean everyone will use 100% of those features.

Will Fiat be doing anything to educate Americans about the differences between ICE, hybrid, PHEV and EV powertrains? This is a major issue with all manufacturers trying to sell alternative powertrains in the U.S.

We believe the first part is to ease the transition and that is why we provide a Level 2 charger or charging credits with every 500e purchase. Also, it is more about the core product than anything. We designed and engineered the Fiat 500e to be a car that truly lends itself to city use. This is logical and will attract people looking for logical transportation.

John Dinkel

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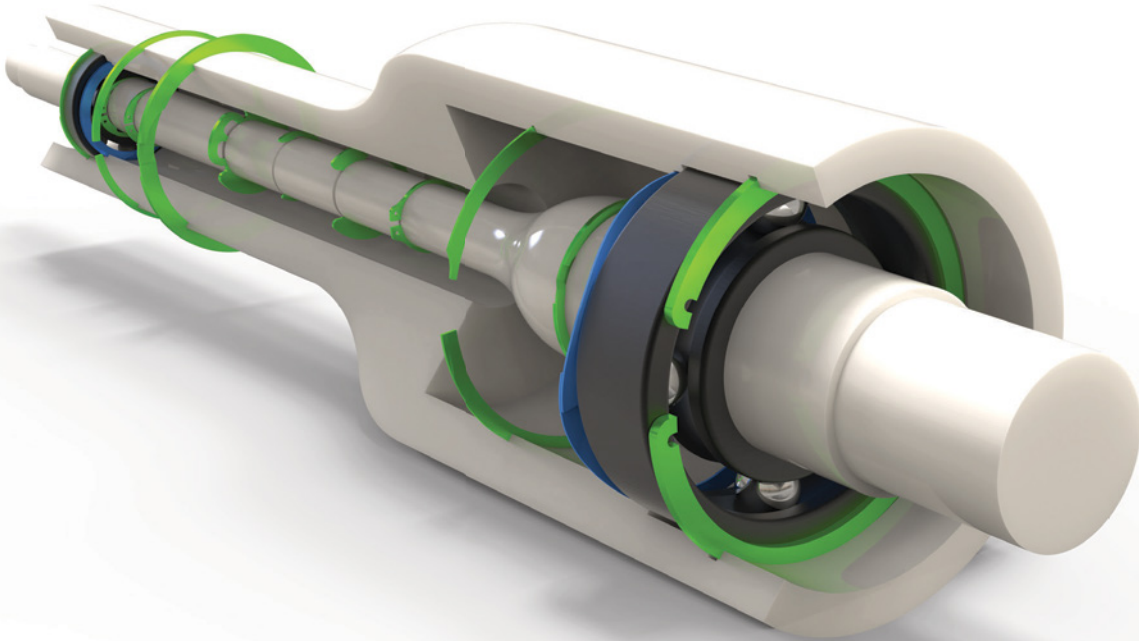
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