SAE INTERNATIONAL

UPDATE

NEWS & INSIGHTS FOR MOBILITY PROFESSIONALS

TECH FOCUS: Sustainable energy technologies

In the sky or far below, SAE is working hard to enable reductions in fuel consumption.

OFFICIAL SAE MEMBER MAGAZINE
October 2022 | sae.org/update

LICENSURE

"Getting the P.E. license was reaching the goal line and making the touchdown as an engineer. The license meant I could be recognized and act as a professional engineer. It opens up career possibilities and solidifies your position in your applicable field."

Kevin Edwards, P.E., MBB
Chief Diversity and Inclusion Officer
Bechtel Corporation

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VOLUME 39 ISSUE 10

On the cover

Zeroavia has placed a big bet on hydrogen as a fuel to reduce the carbon footprint in the skies.
The Boeing Company

Digital standards are our future

Many industries are digitally transforming at a rapid pace — and the multitude of industries that we call 'mobility' is leading the transformation in all forms of transportation, whether we move people or goods. As we look at the digital transformation at SAE International, we are investing to stay ahead of the curve.

For our work, that starts with digital standards.

This is not a new venture for SAE. Since 2016, we've had resources available digitally through our SAE Mobilus platform, the definitive online library for SAE Standards — updated in real-time — that serves as a single point of access to timely technical content for the modern engineer. This platform prioritizes the user experience to make searching more efficient and accessible.

But true digitization is more than just going from paper to PDFs.

Digital standards enable a user to pull data and requirements from a standard into the tools they use to develop their products. Whether it is a requirements-tracking system, a model-based simulation tool, or some other tool used during the product life cycle, the data is referenceable and reusable to support multiple use cases.

This article by Raman Venkatesh, Ph.D., SAE International Chief Operating Officer, first appeared on the SAE Blog here. As COO, Venkatesh is responsible for strategy and global operations of SAEI generating close to $100 million in revenues as well as providing leadership to EI's international staff of 350 professionals dedicated to advancing global mobility and design engineering. SAE staffers Tory Irwin and Leslie McKay helped in development of this article.

We need to think critically about the problems industry is facing — and how digital solutions can help solve them.

One relevant and high-economic-cost example is the impact of product development challenges due to supply chain disruption. Many companies have struggled with the unavailability of parts and components they need to create their products. As a result, some companies have had to redesign their products or make unequal substitutions. Other companies have found they need to revisit the design of products not yet released to safeguard against the disruptions seen in the supply chain.

Because the interconnectivity of the product development cycle relies on many departments — many of which tend to be siloed — ad-hoc work-arounds are often implemented, resulting in the duplication of work and potential errors as static information is passed around. These longer, more expensive product development cycles stymie innovation as comprehensive

STANDARDS OF EXCELLENCE

How does digitization benefit the mobility industry when creating and referencing standards?

TRADITIONAL (STATIC PDF)

- Copy and paste or manually enter to update or share knowledge
- Limited tracking capabilities
- Updates unknown
- Must search through multiple documents to find relevant information
- Data is siloed

DIGITAL STANDARD

- One library of knowledge with expandable data points and linked information
- Interfaces with each stage of product development
- Automatic notification of updates in revised standards
- Easy query on design constraints
- Audit trails and change management

tracking remains elusive.

In the standards world, this becomes complicated when you are following multiple standards, sometimes from different origins that reference other documents. Standards also tend to be of different types depending upon industry norms, data styles and types and user expectations. Digitizing them all to make them seamlessly integrated with industry ERP or design and engineering systems is a multi-dimensional challenge. However, it is entirely worth it when you consider the rewards. When combining digital requirements from standards with other requirements, you can build a digital twin, or a digital representation of your system that shows the history of how you have gotten to the final point of product development.

You can't do that with the static PDFs of the past.

When done manually, there is risk of errors in transferring information across discrete PDFs into an enterprise-level ERP system that drives core design, development, and engineering, leading to production and post-launch support systems. Such errors can cost tens of

millions of dollars when not corrected early enough and can cause significant delays in development and launch, introducing significant opportunity cost in terms of lost revenues and market traction. Digital standards offer the potential to seamlessly embed critical technical information into product development lifecycles, allowing the engineers and leaders to focus on what matters most: getting to the right product at the right time at the right cost.

DIGITAL V.S. TRADITIONAL STANDARDS

So, what makes a digital standard such a great tool?

The table on page 3 highlights some of the key differences between a digital standard and traditional approach.

With the time savings from using digital standards, companies can achieve enormous benefits to ROI. By reducing time spent searching for information, eliminating rework due to data entry errors, and reducing the number of necessary physical prototypes through digitization, the savings add up. Mid-to large-size companies can save up to $1.5 million in time efficiency savings and cost savings. This includes the following:

- Time savings to minimize/eliminate the parsing of requirements from standards
- Time savings to search for relevant standards
- Eliminating time spent re-entering data to multiple systems (speaks to re-use of digital requirements)
- Eliminating rework due to data entry errors
- Reducing time required to prepare for audits
- Reducing the number of physical prototypes needed (assumimg digital requirements are used in combination with MBSE models)
- Reducing need for/production of custom parts

The potential doesn't stop there, either.

Choosing to standardize rather than customize allows you to search by dimensions, composition, and materials properties. This can reduce the number of parts, time, and cost that you're putting in through the development process as you prepare to go to market.

Digital standards systems also have multiple integration options. With a fully digital set of requirements, your documents can work with each other across teams and eliminate some of the built-up silos that can naturally occur when working in a hybrid or fully offline model.

As a neutral convener of industry and the world's authoritative source of advanced engineering standards, you can imagine how exciting this is for SAE as we think of the enhanced possibilities to work together across mobility sectors.

It's past time to implement digital solutions to modern mobility problems. When we do this, we all can collectively advance mobility knowledge and solutions for the benefit of humanity.

And I, for one, can't wait to see the exciting future enabled by digital standards. ■

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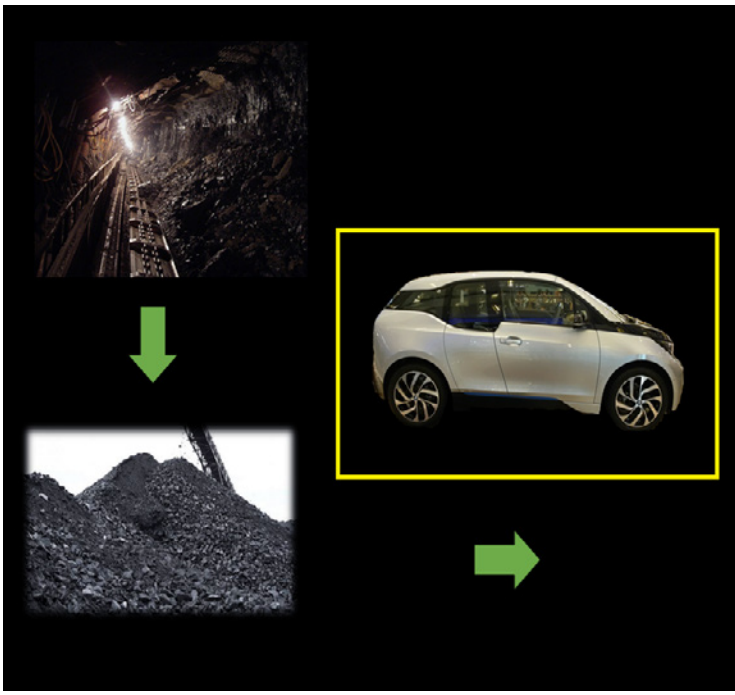
TECH FOCUS: **SUSTAINABLE ENERGY TECHNOLOGY**

Accurately assessing the contribution of transportation systems to the challenge of sustainable energy is a prerequisite for those involved with SAE International to help engineer solutions.

"Sustainability does not need to be a battle where sides are drawn and one approach will win over all others."

-Thomas Briggs, Ph.D.

IN THIS SECTION



SwRI

The typical view an individual takes of their mobility impact.

GLOBALIZING

ABOUT THE AUTHOR

Thomas Briggs, Ph.D., wrote this article for *Update*. He is a staff engineer at Southwest Research Institute and is responsible for advanced R&D activity in the commercial vehicle powertrain area. He has been a member of SAE International for 23 years.

SwRI

The actual system boundary for mobility impact.

SUSTAINABLE MOBILITY

It's not just going electric.

What do we mean when we talk about sustainable mobility? Do we just look at the local energy and emissions balance at the vehicle? Do we look at the local grid level? National? Global? How we choose to define the problem dramatically changes what kinds of engineering and social solutions we can include in any attempt to achieve sustainability. And since the sustainability conversation usually centers on greenhouse gas emissions, the only sensible problem definition is global, as a locally-focused "solution" can easily do more harm than good on a global scale if we don't look at the whole problem.

As an individual, we are prone to looking at the smallest possible system boundary: our car that we drive. So an EV looks extremely sustainable if we simply assume renewable electricity for the input, and there are no negative outputs. But as engineers we know that the boundary is larger. Even for that single vehicle we need to include the inputs to build it, the end of life waste, and the real electrical grid mix. In other words, we need to use life-cycle analysis (LCA) to

compare an EV against the other options for personal mobility.

But that's still a small part of the mobility picture. Human mobility covers a massive range of scales, from a single person walking through huge transport ships moving raw materials and goods around the world to large airplanes carrying people and freight.

And even human mobility is far from homogeneous. Going from home to work could mean a short walk, a bus or subway ride, car-pooling, or driving fairly long distances each way. And in developing economies access to good jobs, education, and health care can require not just the means of transport, but also the infrastructure to enable it. As mobility engineers, our duty is not just to address one part of the broader mobility space but to consider how the work we do integrates with that of our colleagues working in other areas.

Let's consider the scale of mobility. The global population is around 8 billion people, and roughly 2 billion live in wealthy urban areas. The majority of the population does not have the economic resources to access the most developed mobility technology, nor in many cases the infrastructure to support it (electrical grid, gaseous fuel delivery, and so on). Sustainability ought to imply that we are developing technologies and products that can provide clean, efficient, and affordable mobility to everyone — not just the wealthy urban few. And when we consider the population, we also need to consider how much energy we consume for mobility. Most estimates are that mobility consumes 20% of global energy production today. That comes out to the equivalent of 2.8 million tons of oil or 32 million megawatt hours of electricity per year.

Clearly it is not sustainable to simply use fossil resources to continue to supply the mobility sector with energy. But when the scale of the problem comes into focus, it also does not appear sustainable to attempt to switch the entire sector to the use of low-density energy systems such as electricity and hydrogen. This is not to say that there aren't significant opportunities for those energy systems to make dramatic reductions in local greenhouse gas and pollutant emissions — there are. But building out the electrical production and distribution system in a sustainable way will require significant investment and time. So we must develop parallel solutions that satisfy the whole population.

This broader view of sustainable mobility ought to include any viable technology. This could include renewable fuels made from waste biomass, new biofuels made from non-food crops using improved production methods, hybridization to reduce carbon emissions from vehicles that cannot yet be electrified, and possibly even on-board carbon capture to allow use of fossil fuels with reduced greenhouse gas impact. No one of these

technologies will address all of the mobility needs even in a single country or market, let alone on a global scale. But in combination, they can enable much more rapid reductions in greenhouse gas emissions, improvements in ambient air quality, and provide more localizable options for mobility in all global markets.

As mobility engineers, it is incumbent on us to use our training well. As we properly consider the system boundaries for mobility energy, we can see that the full lifecycle impact of mobility technologies is what matters, not what happens at the vehicle. And we can appropriately understand the scale of energy demand for mobility so that we can select technologies that can meet that demand appropriately for each market sector.

Sustainability does not need to be a battle where sides are drawn and one approach will win over all others. Sustainability means that each person has access to mobility that allows them to live as they desire while minimizing the environmental impact and maximizing the economic utility of that mobility. If we pursue this definition of sustainability, we will be doing our jobs as mobility engineers in the best way possible. ■

Airbus

In addition to hydrogen, Airbus is also testing alternative fuels. Here, an Airbus A319 NEO is refueled with a blend of vegetable oils and fats.

Flying toward a sustainable future

Airbus VP talks carbon neutrality and workforce diversity in AeroTech speech.

As Vice President of Research and Technology at Airbus America, Amanda Simpson has a lot of responsibility on her shoulders. There's also her government background, both in the U.S. Department of Defense advising military energy projects and a presidential appointment in 2010 by Barack Obama as Senior Technical Adviser to the U.S. Department of Commerce. In that role, she advised on policy and export control issues to protect the security of the United States, that some might see as prompting secrecy.

Earlier this year at AeroTech 2022, Simpson detailed possible alternative fuel sources, with a focus on hydrogen, as Airbus looks to reach carbon neutrality by 2050. The research into innovative technologies is underway at Airbus as they partner with others across industry to reconsider not only the fuel for aircraft, but the potential shape of the vehicles themselves as new fuel sources necessitate the need for different types of engines, and could subsequently allow for more aerodynamic wings on the aircraft without needing to serve as the hub for engines.

SAE International

Airbus VP Amanda Simpson, a transgender woman and LGBT advocate, is shown here delivering remarks at AeroTech 2022 in Pasadena.

Currently in the exploration stage, Airbus hopes to have a new type of aircraft in flight by 2035, and is working alongside the rest of industry to reduce emissions and create more sustainable practices that will help curb air pollution.

"We know this is an impressive schedule, but to satisfy what we see as a critical need for our planet, we have to start working on this right now. And I'm hoping that all of you will join that endeavor to start working on sustainability. It has to be what we do," Simpson said during her address.

She's vocal about her thoughts on industry inclusivity, and the need for diverse perspectives to advance technology.

Professionally, she's passionate about bringing sustainability to the forefront of the aerospace industry. The industry is more open to this push for sustainability now than ever before, and Simpson attributes that shift in thinking to a number of factors, not least of which is an increasingly diverse, more socially-conscious group of professionals driving progress.

"Because of these voices, these more diverse opinions, they're bringing social responsibilities to the forefront, and we're seeing this increased focus on sustainability. This is only going to grow because as we in the aerospace industry start talking about it, it's resonating with the general public," she said. "They want to see this. They want to slow down the rate at which the temperatures are rising, the oceans are rising, the impacts of severe storms, wildfires, floods, famine, and all these things that come from it. And sometimes in aerospace where as engineers we want to design and we want to do something that's really neat and cool. But we're learning to become citizens of the planet at the same time, so I

think that's why there's been more of a push."

Simpson is continuing to share that message of sustainability through her many speaking engagements and conversations with industry leaders all over the world. At Airbus, she's maintaining a steady eye of the future, pushing her organization to keep moving in directions that will continue the progress they've already made.

And though she's proven she's a force for forward progress, Simpson would rather you focus on the changes she's contributed to rather than her as the contributor.

"While I may be remembered as an innovator, as a trailblazer, or someone who broke down some barriers within the LGBT community, particularly in the industrial systems aerospace and even government positions, I'd rather people remember that these things are moving forward than to know that it was me who was behind it," she said.

Want to know even more about Airbus's trailblazing Vice President of Research and Technology? Check out the chapter on Amanda Simpson in the SAE International book "Flight Paths to Success: Career Insights from Women Leaders in Aerospace." ■

SAE International announces the SAE Heavy-Duty Diesel Symposium is coming back next year

Join us at the Heavy-Duty Diesel Sustainable Transport Symposium in Gothenburg, Sweden on May 3-4, 2023, at the Chalmers Conference Centre.

While electrified powertrains are adaptable to many light- and medium-duty applications, internal combustion engines will continue to have a need in the heavy-duty sector. As such, alternative fuels, fuel economy, and carbon dioxide emissions will be key subjects covered in the SAE 2023 Heavy-Duty Diesel Sustainable Transport Symposium.

While this gathering will continue to focus on emission control strategies for internal combustion engines, there will be coverage on alternative powertrains such as those with batteries, fuel cells and possibly hydrogen. A session on life cycle analysis and recycling is also planned. It is recognized that all of these topics are very important to the OEM's technical personnel and suppliers around the world working in this transitioning transportation sector. Attendees will have the opportunity to learn from and interact with experts from the

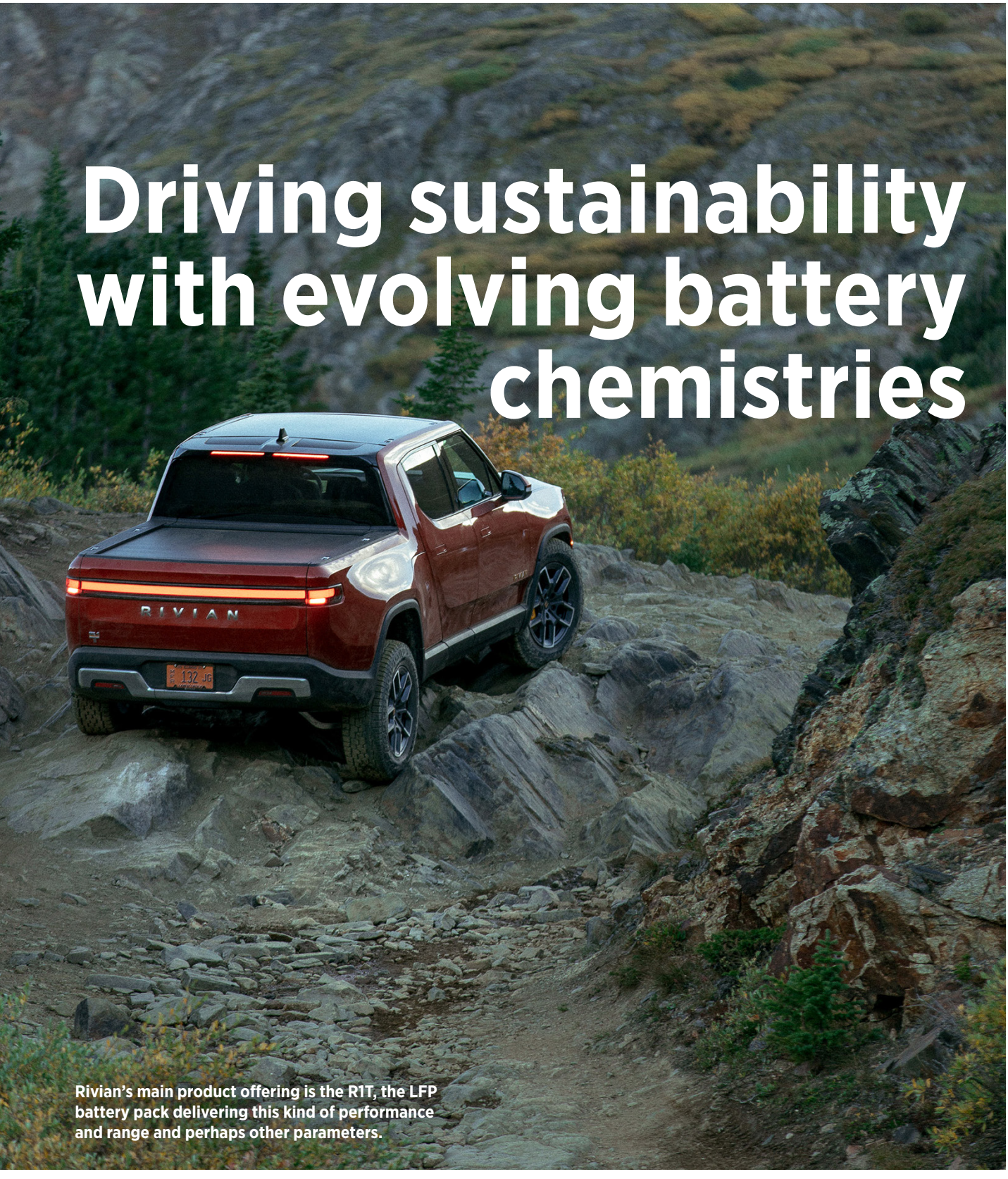
global heavy-duty diesel powertrain industry who understand the current and future challenges upon them.

Session topics include:

- Challenges of Global Regulations and Standards Outlook
- Technologies/Solutions for Future Emission Standards
- Euro VII
- ICE Powertrain Technology Trends
- Emission Control Systems - Catalysts and Substrates
- Alternative Technologies
- Impact of CO2 Regulation and Alternative Fuels on Emissions
- Sustainability of Truck Mobility
- Life cycle of CO2 emissions to reach neutrality
- Panel Discussion on Sustainable Transport

Visit www.sae.org/hdd for more information. Registration and hotel details will be available by mid-December. Contact Melissa Jena at melissa.jena@sae.org with any questions or for exhibit and sponsorship details. ■

Driving sustainability with evolving battery chemistries



Rivian's main product offering is the R1T, the LFP battery pack delivering this kind of performance and range and perhaps other parameters.

Rivian

The many advantages of electric vehicle (EV) technology, as well as the rapid technological advancements that have pushed EVs into the mainstream, have redefined the automotive industry in the past decade. The appeal of zero tailpipe emissions and replacing gasoline with electrons has made EV adoption an essential objective for fighting climate change while reducing oil consumption, and industry is rising to meet the challenge. As many policymakers have embraced the societal benefits of electric vehicles, drivers have been delighted by newer models with longer ranges, shorter recharge times, greater utility, and unmatched acceleration. These capabilities also enable EV drivers to adventure in wild places and reconnect with nature without contributing to local air pollution.

As EV technology has proliferated, important questions have surfaced about how we meet growing demand for electric vehicle batteries. Specifically, the industry must face the challenge of sourcing certain critical minerals for which existing commercial supplies are concentrated in countries that may lack adequate labor protections, environmental safeguards, or transparency.

Rivian

Rivian trucks on the trail.

As always, innovation offers a path forward. Lithium-ion has been the predominant battery chemistry for electric vehicles and personal devices so far, but it's just one of many viable battery chemistries. Lithium Iron Phosphate (LFP) batteries demonstrate that new chemistries can be paired with the right use-case to create a win-win for manufacturers and drivers. This chemistry is still relatively young, but notably does not require cobalt or nickel, and is manufactured from safer and more abundantly available minerals. Current LFP technology is ideal for applications where lower costs, safety, and extended durability are prioritized over incremental range gains and extreme high-performance. As Rivian's commercial vehicle technology evolves, we are focused on just a few of

ABOUT THE AUTHOR

Shown here speaking at WCX 2022, Chris Nevers, Senior Director of Environmental Policy, Rivian Automotive, wrote this article for *Update*. The 9-year member of SAE International and WCX session organizer.

Rivian

Rivian's main product offering is the R1T, the LFP battery pack delivering this kind of performance and range and perhaps other parameters.

these advantages:

- **Carbon Intensity:** Our preliminary research has found that manufacturing LFP batteries emits about 15% less carbon compared to other chemistries on a net kgCO2e/kWh basis.
- **Durability and Life-Cycle:** LFP batteries have about double the number of charge cycles in their vehicle-use lifetime than other existing lithium ion technologies.
- **Safety:** LFP batteries offer the safest cathode technology available. For example, Iron Phosphate is commonly used in organic agriculture as a fertilizer.
- **Range:** We anticipate our LFP Standard Pack to offer broad utility, and the current range for our delivery vehicles is well suited to delivery routes and customer needs.
- **Cost:** The absence of materials like cobalt and nickel in LFP batteries makes them significantly less expensive to source.

Many medium and heavy-duty (MHD) commercial vehicles are the perfect use-case for LFP. MHD vehicles comprise just 10 percent of vehicles on the

road but contribute a startling 25 percent of all transportation sector greenhouse gas emissions, according to recent EPA estimates. The disproportionate carbon emissions from the sector are dwarfed by criteria pollutants: MHD vehicles contribute more than 60 percent of tailpipe nitrogen oxides ("NOx") and particulate matter ("PM"). In 2020, approximately 60 percent of those NOx and PM emissions occurred in urban areas, typically concentrated around freeways, ports, and warehouses.

Since MHD vehicles often spend a significant amount of time idling, electrifying these vehicle classes is essential to reduce unhealthy emissions in urban areas, protecting the health of both workers and local residents. The societal benefits are significant: A 2021 study by EDF found that eliminating tailpipe emissions from new medium- and heavy-duty vehicles by 2040 could provide up to $485 billion in health and environmental benefits as a result of pollution reductions.

Like all technologies, LFP batteries have pros and cons. For example, this technology does not currently offer the energy intensity of other battery chemistries—but historically rapid acceleration and 400+ miles of range are not necessary for all vehicle applications.

SAE International

The author (second from right) speaking at a WCX 2022 session, "Sustainability: It's in Everyone's Business Interest."

LFP batteries also hold unique potential for second life applications. After several years of usage, vehicle batteries may no longer offer their original range but can still offer valuable storage capacity. Because they offer more charge cycles throughout their lifetimes, LFP batteries are better suited for use in stationary storage than other chemistries. Furthermore, battery engineers are just scratching the surface of recycling technologies to create a circular economy for battery minerals. Second-life and end-of-life recycling is a dramatic improvement over petroleum fuels, which are extracted, refined, and combusted into the atmosphere with no possibility for recycling.

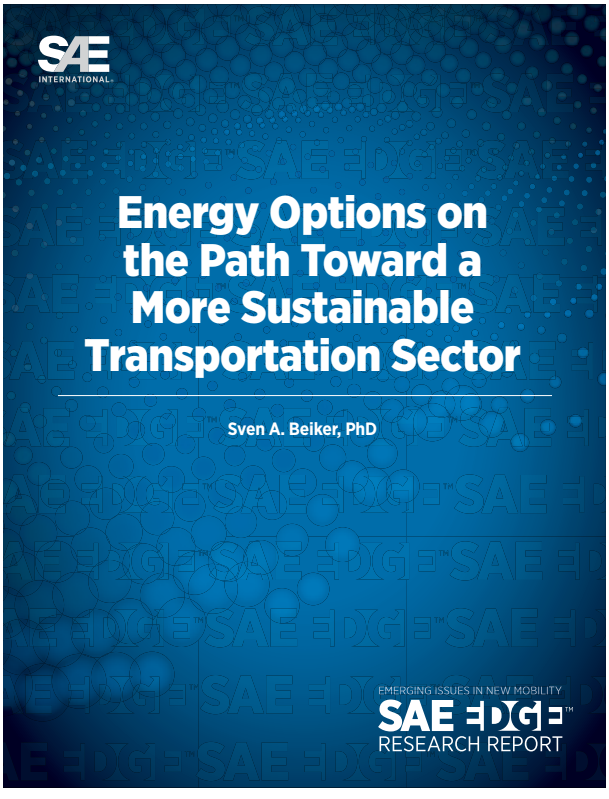
As batteries and electric motors proliferate in applications from e-bikes to tractor trailers, industry must continue research and development of new chemistries to find other win-win scenarios like LFP batteries in commercial vehicles. ■

Plotting the path to a sustainable transportation sector

The transportation sector has an enormous demand for resources and energy, is a major contributor of emissions (i.e., greenhouse gases in particular), and is defined largely by the kind of energy it uses—be it electric cars, biofuel trucks, or hydrogen aircraft. Given the size of this sector, it has a crucial role in combating climate change and securing sustainability in its three forms: environmental, societal, and economic.

In this context, there are many questions concerning energy options on the path toward a more sustainable transportation sector. Is hydrogen the fuel of the future? Is there enough electricity to power a fully electric transportation sector? What happens when millions of electric vehicle batteries need to be decommissioned? Which regulatory measures are effective and appropriate for moving the sector in the right direction?

True to the nature of SAE EDGE Research Reports, Energy Options on the Path Toward a More Sustainable Transportation Future does not aim to answer all those questions. It does, however, highlight and discuss the most pressing issues in terms of what is simply unanswered at this point. It also addresses solutions on the horizon which experts are still debating. Therefore, this report is directed at practitioners in the transportation and energy sectors who want a comprehensive picture assembled by experts in the fi eld, who wish to better tell different perspectives apart, and who will prepare their respective organizations for what is arguably one of the biggest transformations in our lifetime. ■



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ABOUT THE AUTHOR

This article is drawn from the introductory section of Dr. Sven Beiker's new SAE EDGE Research Report, Energy Options on the Path Toward a More Sustainable Transportation Sector. An expert in the field, Beiker has written several reports for SAE International.

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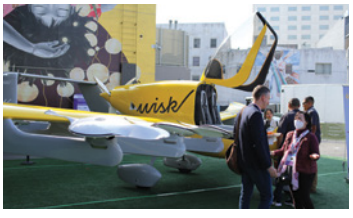
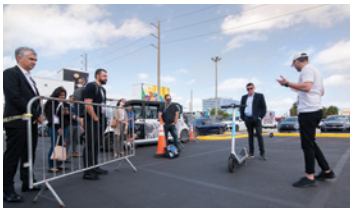




"This event really has become a marquee gathering of new mobility partners connecting top technologists and startups with policymakers and transportation leaders."

Carlos Monje

Under Secretary of Transportation for Policy,
U.S. Dept of Transportation

SAE International

Participants in a WCX 2022 panel discussed the topic of sustainability. On stage from left: panel moderator Frank Menchaca, Chief Growth Officer for SAE International; Bryan Rubio with Ideanomics; Harry Husted with BorgWarner; Chris Nevers with Rivian; and Kevin Butt with Toyota, whose is also shown on the big screen at right. Matt Nelson participated remotely.

Sustainability is a lifecycle mindset

Industry leaders seek to standardize what the often-hyperbolic term 'sustainable' means for suppliers, OEMs, and their products.

"Going green" is a mantra that most if not all automotive OEMs and suppliers profess to follow. SAE International is also committed to the dialogue, with its recently announced Office of Sustainability. But what do these terms mean in practice? "There is no more important challenge for the industry than the commitment to build vehicles that share and create a cleaner and more efficient environment," Harry Husted, VP and chief technology officer of BorgWarner, said during the SAE WCX 2022 leadership panel, "Sustainability: It's in Everyone's Business Interest" on April 6.

What happens today and tomorrow sets the stage for the future. "Forever means sustainability. And in the mobility space, it means electrification," said Chris Nevers, Senior Director of Public Policy for EV newcomer Rivian, whose product line-up includes the R1T pickup truck and the R1S SUV. Automakers around the globe are

adding EVs to their product stables, with virtually every vehicle OEM committing to a full, or very significant, shift to electrified vehicles in the coming years. As the number of EVs increases, so too are the number of charging stations.

Electrify America, which has the most public fast-charging stations in the U.S., recently announced its network will add 100 charging stations with solar awnings and 350-kW fast charging. "We think that 350-kW charging, which allows a vehicle to recharge at about 20 miles of range per minute, is the game-changer. It's the essential 'thing' to enable mainstream Americans to go electric and switch from gasoline," Matthew Nelson, director of governmental affairs at Electrify America, told the WCX audience via remote link. He added that the company's charging stations are powered with renewable energy.

For electrified commercial vehicles, wired charging isn't the only option, according to Bryan Rubio, director of Energy Services for Ideanomics. One of the company's subsidiaries, Wave, is a provider of wireless charging (125 kW to 500 kW) for commercial EVs. In simple terms, Wave's charging pads are roadway-embedded to enable wireless power transfer over a 5-inch to 8-inch (127 to 203mm) air gap to a receiving pad on the vehicle's undercarriage.

The company's wireless inductive charging powers America's largest mass transit electric bus fleet (the Antelope Valley Transit Authority in California). "Will wireless charging be as prolific in the passenger vehicle space as it will be in the medium- and heavy-duty space – that's a great question," Rubio said.

Kevin Butt, regional environmental sustainability director for Toyota's North American Environmental Sustainability Programs, encouraged industry leaders to look at sustainability with wide-ranging vision. "Where do we get the power to power the chargers? That's the bigger sustainability question," Butt asserted. "There needs to be balance. We need to think about the whole lifecycle of how we're doing this."

He also advocated for green practices across the automotive supply chain. "We have green supplier requirements," Butt said, referencing Toyota contractual agreements that set targets of 3% carbon reduction on an annual basis. "We're not just telling them that. We're helping them with that," Butt said, citing webinars and seminars on the subject matter.

"This space of sustainability requires mutual understanding, mutual definitions, and mutual cooperation to be able to move us collectively into a space where we are actually achieving the targets that we're looking at," Butt declared. Collaboration and the sharing of ideas is one way to help all parties succeed with sustainability goals. "This shouldn't be exclusive. This should be an area where we can work together and share that best practice and share the progress that's being made," he said. ■

Decorated SAE Fellow gives sustainability the attention it deserves

With today's emphasis on decarbonization of the transportation sector — including aviation — establishment of the SAE Sustainable Aviation Award in Honor of Ramesh Agarwal could not be more timely.

Named after the highly accomplished academic at Washington University, the award "recognizes individuals or teams (SAE members or non-members) who have made an impact on sustainable aviation, whether working in industry, government, or academia," said Nicol Lachimia, SAE Awards, Scholarships & Events Specialist. "Examples include innovations related to sustainable aviation fuels; materials and coating technologies to make planes lighter, more aerodynamic, or more resistant to wear and tear; reducing noise; improving air quality; and topics related to circular economy, machine learning and artificial intelligence in the context of sustainable aviation. Innovations related to creating significant sustainable technologies or practices within the aviation infrastructure are also welcome."

Other contributions that may be considered include:

-Measurable efforts to decrease C02 emissions & decrease in greenhouse gas emissions

-Advancements in the development &/or use of sustainable aviation fuels (SAF) or hydrogen as a fuel source

-Impactful efforts to the ecosystem

SAE International

Dr. Ramesh Agarwal has carved out a name for himself in computational fluid dynamics.

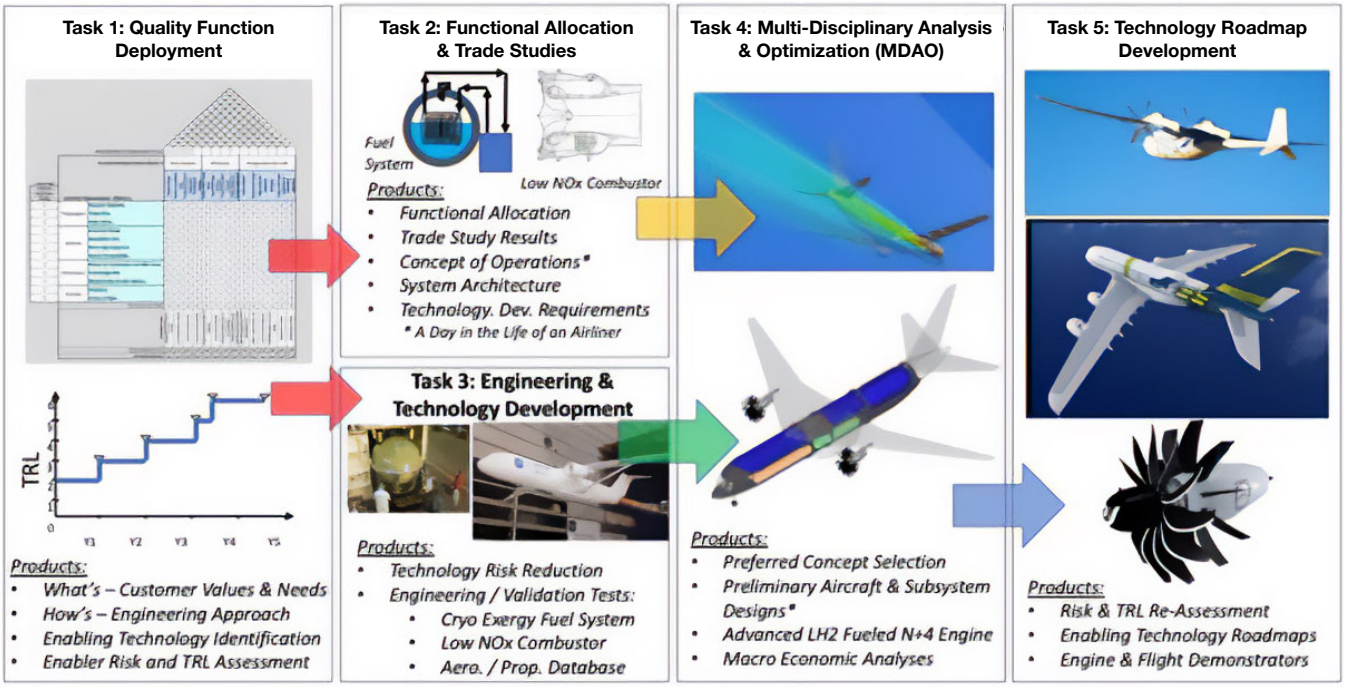
-Improvements in infrastructure

-Global market based measures for aviation emissions

-Advancements in electric or hybrid-electric propulsion, and other innovative propulsion technologies including powerplant-airframe integration approaches

-Technological Innovation as related to airplanes, airport infrastructure and/or airplane support equipment

Agarwal spelled out in more concrete terms the impact of the new award, telling *Update* he



SAE International

Systems Engineering Plan for Zero Carbon Emission Hydrogen Aircraft

hopes it "will provide recognition to the work of other outstanding individuals working in various technologies such as aerodynamics, propulsion, materials, fuels, air traffic control, etc. to make the aviation sector greener. It will provide more national and international visibility to this important area for engineering research, technology development, and policy formulation as the world moves towards addressing the control of greenhouse emissions."

An SAE Fellow (2001), Agarwal has carved out a name for himself in industry and academia. "I spent the first 25 years of my career in industry, where the work was always focused on product development using R&D," he said. "In the late 1970s, industry recognized the importance of computational tools/technology for product development to reduce the expensive testing costs and long development times. Those were the early days of CFD [computational fluid dynamics]."

"There were no commercial codes," Agarwal continued. "All the development was done in-house. I happened to be at the right place at the right time in the industry. It allowed me to do basic research in developing technology for the building blocks of CFD — namely, geometry modeling, mesh generation, numerical algorithms, and turbulence modeling. More importantly, it also allowed me to develop CFD software ready for application.

"I was assisted in this endeavor by many capable scientists/engineers. I have always developed CFD technology as a tool for practical applications, not only in aerospace but also for a wide

SAE International

SAE Ramesh Agarwal Computational Fluid Dynamics Award presented at the 2022 SAE International Awards Ceremony by SAE President Sri Srinath (far left) and Dr. Agarwal (far right) to Philip Roe of the University of Michigan.

variety of other applications in mechanical, civil, and biomedical engineering and in energy and environment. My current work in sustainable aviation also employs CFD as a tool for analyzing novel aircraft and propulsion design concepts."

SAE had previously established the SAE/Ramesh Agarwal Computational Fluid Dynamics Award, about which you can lear more by clicking on the link above.

Both awards were established with a generous gift from the Agarwal family and honor Dr. Agarwal, who is the William Palm Professor of Engineering at Washington University in St. Louis.

"Personally speaking," Agarwal told *Update*, "it is a tremendous honor to be recognized by a prestigious professional society such as SAE for contributions to emerging area of Sustainable Aviation."

Agarwal has also been on the receiving end of SAE awards, the most prestigious being the SAE Medal of Honor, which was bestowed upon him in 2015. Plus, he has served on several of the committees that select winners of certain awards.

The first SAE award he won was the SAE/AIAA William Littlewood Lecture Award, in 2009. The title of the associated SAE International Journal of

Aerospace article that he wrote was "Sustainable (Green) Aviation - Challenges and Opportunities."

Agarwal has also been deeply involved with SAE going all the way back to the 1990s and all the way across the globe, serving the organization at the section, national, and international levels.

"SAE has been very supportive of my activities and has provided me with an opportunity to participate in many important committees and honored me with many awards," he told *Update*. "It has contributed a great deal in my professional development, recognition, and international visibility."

Update asked Agarwal to describe some of the work he is currently doing. In response, he said:

"I am very proud of my recent work in turbulence modeling funded by NASA. I have developed three turbulent and transitional flow models, which I call the Wray-Agarwal (WA) family of models. These are listed on the prestigious NASA Turbulence Modeling Resource (TMR) website. Almost all fluid flows are turbulent. Their numerical simulation requires the solution of Reynolds-Averaged Navier-Stokes (RANS) equations with a turbulence model.

The WA family of turbulence models are increasingly being used worldwide for a wide variety of complex 3D industrial applications. Since it is a relatively new turbulence model proposed after 30 years in the literature, it will take some time for it to go into commercial CFD codes and get more widespead use. But I am very optimistic. The link for a description of the model can be found here.

Agarwal is also busy in the area of hydrogen-powered transonic commercial aircraft. "This work addresses one of the ideas/approaches for almost emissions-free aviation by 2050 for medium and long-range commercial aircraft," he said.

We hope this TECH FOCUS section was helpful to you. If you would like to comment on any of the articles in it, email us at **update@sae.org**. Use the same email address if you would like to submit an article for an upcoming *Update* TECH FOCUS section; please refer to the editorial calendar below.

Future FOCUS Index

NOVEMBER
Smart cities/IoT

DECEMBER
Vehicle dynamics

Lilium

Lilium, developer of an all-electric vertical take-off and landing (eVTOL) jet, recently achieved "main wing transition" on its technology demonstrator Phoenix 2. The company claims it is the first ever full-size electric jet aircraft to transition from hover to wing-borne flight.

Two new standards for sustainability in the skies

SAE International's E-40 Electrified Propulsion Committee has released its first two standards documents to enable electrified propulsion for aircraft.

ARP8676 - Nomenclature & Definitions for Electrified Propulsion Aircraft establishes common language on a new domain, new technologies, and new architectures that describe electrified propulsion aircraft to reach a common interpretation.

AIR8678 - Architecture Examples for Electrified Propulsion Aircraft categorizes electrified propulsion architectures and includes relevant examples. This document also provides common definitions for the elements of architectures by defining:

- Elements of electrified propulsion architectures, including any private power generation and distribution systems as well as energy storage elements
- Interfaces to/from the electrified

propulsion system
- Interfaces within the electrified propulsion system
- Energy management and storage architecture of an electrified propulsion system

"Sustainable flight is a critical goal for the aviation industry. The SAE E-40 committee has made great strides to achieve this target by issuing these initial consensus documents on nomenclature and architecture examples to set the benchmark for electrified propulsion," said David Alexander, senior director, standards, SAE International. "We are proud to support the talented committee members from across the aviation community to accelerate this innovation as E-40 continues with work on safety and endurance testing."

E-40 committee chair Richard Ambroise of Lilium GmbH added, "The decarbonization of aviation is urgent and inevitable. The importance of innovative architecture and technology to move towards this goal has never been more important. The industry is coming together to create change and the SAE E-40 committee is a transformative tool which will set the standard and pave the way toward new aircraft architectures. The publication of ARP8676 and AIR8678 is the first step on the journey."

The SAE International E-40 Electrified Propulsion Committee is a technical committee in SAE's Aerospace Propulsion Systems Group with the responsibility to develop and maintain technical reports (Aerospace Standards, Aerospace Recommended Practices, and Information Reports) covering electrified propulsion for aircraft. The committee recommends standardized nomenclature, defines applicable terms and example architectures, and addresses considerations for performance, airworthiness, safety, aircraft integration, components, and interfaces within and between propulsion system and other aircraft equipment. ■

SAE International

Alan Nye, recipient of the 2022 SAE Medal of Honor, delivers remarks at April's WCX awards ceremony.

Accolades for engineer all-stars

For any professional society, honoring the individuals who are most effective in advancing its field is a key component of the glue that allows the organization to achieve even more forward progress.

SAE International's recognition program is as robust as any society's, with its many discrete awards. For most awards, anyone can nominate someone else.

"There are so many wonderful efforts to further mobility technology across industry, and we're honored to lend SAE's voice of authority and credibility to those who are doing the work," said Nicol Lachimia, Awards, Scholarships & Events Specialist at SAE International. "We've seen our collegiate and early career level winners go on to do some amazing things. And for longer serving industry members, an SAE Award serves as a marker of lifetime achievement. It's a really special thing to be involved in."

The SAE Medal of Honor sits atop a litany of prestigious recognitions as one of the most coveted in industry. This award, created in 1986, recognizes an individual's overall contribution to SAE International's success. In 2022, Alan Nye, Ph.D., retired Professor with the Department of Mechanical Engineering, Rochester Institute of Technology (RIT), earned the honor. ■

SAE Awards

"I have poured my energy into SAE over many years because I believed it was important and I truly enjoyed it," Nye said in his acceptance speech, held as part of SAE's WCX 2022 conference in Detroit earlier this year. "Having this be acknowledged by receiving the Medal of Honor was an unexpected thrill and I am truly grateful."

Click here to see a full list of SAE International award programs.

Four SAE awards have a looming nomination deadline of November 1:

SAE International

Many of SAE's awards allow for multiple winners.

SAE Medal of Honor

Alan Nye, Ph.D., retired Professor in the Department of Mechanical Engineering, Rochester Institute of Technology.

Alan Nye

SAE Arnold W. Siegel Humanitarian Award

The most recent winner of this award is Dr. Subir Chowdhury, Ph.D., Chairman and CEO of ASI Consulting Group.

Subir Chowdhury

L. Ray Buckendale Lecture

Ameya Joshi, Ph.D., is the most recent winner of this award. He is Director, Emerging Technologies & Regulations, Corning Inc.

Ameya Joshi

John Bachman

Trevor Elliott

Ben Lawler

Ralph R. Teetor Educational Award

The three most recent (2022) winners of this award are:

- **John Bachman, Ph.D., California State University LA**
- **Trevor Elliott, Ph.D., University of Tennessee Chattanooga**
- **Ben Lawler, Ph.D., Clemson University**

Share your ideas to move the mobility industry forward

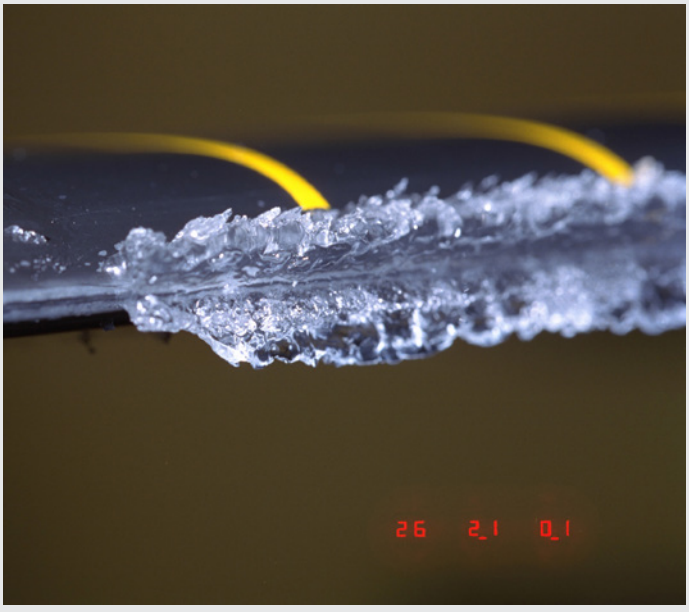
Your experience, research and ideas can help shape the future — and SAE International provides the perfect platform for sharing your expertise. With just a 250-word abstract, you can start on the road to a bigger career and increased recognition across the global mobility industry, while providing valuable information that will help today's engineers make critical decisions. If your abstract is selected, you'll tap into a variety of high-profile speaking and publishing opportunities that will elevate your professional profile.

New to speaking and publishing? No problem. We offer a variety of resources to support you every step of the way. Start now, with just one paragraph!

Most SAE technical papers are submitted for publication in conference proceedings (at right, see list of looming submission deadlines).

Papers and articles can be submitted outside of events, and at any time; for example, you can submit articles for SAE journals or for discrete publication on SAE Mobilus, SAE's main technical resource platform with access to SAE's 226,000+ high-value resources.

Click here to see all opportunities. ■



NASA, Glenn Research Center

This image shows one possible type of ice accretion that the icing tunnel at NASA's Glenn Research Center can produce.

Looming Submission Deadlines*

- **International Conference on Icing of Aircraft, Engines, and Structures**
  November 30
- **Powertrain, Fuels & Lubricants Meeting & Exhibition****
  April 4
- **Small Powertrains and Energy Systems Technology Conference*****
  March 28

*Not all SAE conferences accept papers
**Conference description not yet available
*** Submission portal does not open until November 3, 2022

SAE Foundation fuels STEM programs for 3,330 students this fall

Thanks to the SAE Foundation's community of donors, volunteers, and organizational partners, this fall more than 3,330 students throughout the United States will have access to SAE's award winning A World In Motion (AWIM) PreK-high school STEM education.

With 20+ STEM programs including Fuel Cell, Straw Rockets, Cybersecurity, Pinball Designer, and Motorized Toy Car, young learners have the unique opportunity to work together in small teams on fun, hands-on and minds-on STEM projects.

AWIM's adaptable curriculum engages students of all learning styles, most recently implemented in neuro-diverse classrooms at New Story School in Monroeville, PA. Students in the summer program were thrilled to participate in the Straw Rockets challenge.

Teacher Amber Gazda quickly noticed her students were able to express their ideas and talk about the scientific process. "This experience was new for everyone. With a hands-on STEM activity like Straw Rockets the students are encouraged to ask bigger, critical thinking questions."

SAE Foundation

Staff and student at New Story Schools Monroeville following the AWIM Straw Rockets program.

SAE Members and Volunteers continue to play a vital role in expanding SAE's life-changing STEM learning at New Story School and schools in hundreds of local communities, raising more than $40,000 year-to-date and providing invaluable mentorship while serving as classroom volunteers.

As the season of giving approaches, there will be many opportunities for you to make a difference and support SAE's STEM education programs, STEM scholarships and educator training, and invaluable mentoring. Thank you to the SAE Foundation community for impacting the lives of students.

Donate to the SAE Foundation or browse volunteer opportunities near you. ■

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VEHICLE MATERIAL COST ENGINEER, Warren, MI, General Motors. Analyze &evaluate Hybrid &Battery Electric Vehicles power electronics &electric motors syss, &subsyss incl stator, rotor, park mechanism, on-board charging module, DC-DC converter, inverter, integrated power electronics &low voltage wiring harness, using Tc Vismockup &NX tools to obtain technical data incl dimensions, tolerances, material, &part drawings using assy requirements. Plan, lead, &assure accurate technical assessments of piece cost of materials &vendor tooling investment, using Tc Vismockup, TcPCM &GMCO$T tools &DFSS &DOE methodologies, of psngr vehicle electrification cmpnt designs, from inception to production at U.S. &global high volume vehicle assy &cmpnt mfg plants. Create vehicle parts list (mass, specs, &dimensions) using NX&Vismockup. Evaluate global component costing using GMCO$T tool, &estimate vehicle component &supplier tooling costs through analysis of content of raw materials, component mfg processes including Surface Mount Technology (SMT), diecasting, stamping, injection molding, forming, machining, heat treatment, welding, plating &assy reqrd eqpmnt for cmpnt mfg facilities, &required cmpnt volumes. Required travel to supplier sites in MI/MEX/CHN/TH to inspect/validate supplier mfg systems, up to 28 days P/A. Bachelor, Mechanical, Industrial, Electrical, or Automotive Engrg. 24 mos exp as Engineer, performing financial evaluation of technical concepts in electric motor &DC-DC Converter &Inverter in electric psngr vehicle applying understanding of production processes incl casting, stamping, injection molding, heat treatment, machining, &SMT, or related. Mail resume to Ref#27324-6310, GM Global Mobility, 300 Renaissance Center, MC:482-C32-C66, Detroit, MI 48265.

ADVANCED BATTERY INTEGRATION LEAD ENGINEER, Warren, MI, General Motors. Design &integrate advanced high voltage (HV) battery pack (RESS) of Battery Electric Vehicle (BEV) psgr vehicle incldg battery cell modules, structural cmpts, battery electrical HW, &battery thermal sys cmpts to meet battery level rqmts w/ competitive cost. Coordinate integration of HV battery pack w/ vehicle underbody structure to enable flexible vehicle architecture bandwidth w/ best-in-class space, mass, &structural efficiency to meet vehicle level rqmts. Collaborate w/ engrs &battery architect to integrate cmpts' design. Dvlp overall HV battery pack layout &package battery cell modules, structural enclosures, battery power electronics, Battery Disconnect Unit, wiring &bussing, battery cooling cmpts, &battery TRP mitigation cmpts into required design envelopes meeting each subsys functional rqmts, &solve interference &packaging issues in battery pack. Organize &host wkly PDT meetings to review HV battery design to progress engrg feasibility &maturity. Master, Mechanical, Electrical or Automotive Engineering, or related. 6 mos exp as Engineer, designing or integrating Li-ion HV battery pack (RESS) prototype from concept to product for BEV or commercial vehicle meeting vehicle application rqmts, or related. Mail resume to Ref#370, GM Global Mobility, 300 Renaissance Center, MC:482-C32-C66, Detroit, MI 48265.

DENSO HAS MULTI, IMMED OPENINGS FOR DESIGNENGINEER IIIS in Southfield, MI to design packaging for automotive body electronics modules; BS in Mech Eng or rel. + 5 yrs exp; will accept MS + 3 yrs exp; must incl. 3 yrs w/ CATIA or NX,CAE,GD&T; will accept equiv. combo of edu/train/exper. Send resume: Denso Int'l, 24777 Denso Dr., Southfield, MI 48033. Job Code: LC22-102.

VEHICLE SYSTEMS ENGINEER-CHASSIS &ACTIVE THERMAL MANAGEMENT (CATM), BEV, Warren, MI, General Motors. Identify, evaluate, support &select technical &budget solutions of US, global, &emerging market gasoline ICE &BEV truck & sport utility vehicle (SUV) System Management Team reqrmnts, performance &issue escalation processes for CATM subsystems incldg (chassis) braking, suspension, steering, &engine/suspension mounting syss, &cooling/AC syss, coolant/refrigerator modules, &radiators. Support &coordinate Design Release Engineers to design, validate &release production parts to comply w/ program dates &production design intent, using Siemens NX &Tc Vismockup tools. Recommend &generate feasible CATM solutions to achieve vehicle proposed reqrmnts &performance. Coordinate SMT engineering impact responses for Program Content Change Requests. Conduct System Status Review meetings to track progress &capture issues requiring escalation. Provide program inputs to Component (CTS) &Subsystem (SSTS) Technical Specs development. Required travel to vehicle assy plants in MI, TX, KS &MO to evaluate &ensure proper installation of automated equipment, up to 8 wks P/A. Bachelor, Mechanical, Automotive, or Electrical Engrg, or related. 36 mos exp as Engineer, engineering &developing truck &SUV chassis structure systems or mounting systems using NX &Tc Vismockup tools, &engineering or developing CTS &SSTS, or related. Mail resume to Ref#21883, GM Global Mobility, 300 Renaissance Center, MC:482-C32-C66, Detroit, MI 48265.

FINITE ELEMENT ANALYSIS (FEA) ENGINEER, Brose North America, Auburn Hills, MI. Perform, analyze, &validate linear &non-linear CAE simulations, using LS-DYNA, ANSA, META-Post, &Oasys PRIMER tools, of psgr vehicle light weight/high strength steel structures for front seat syss for Front/Rear Impact, Luggage Retention, &Seat Belt Anchorage tests according to US FMVSS#208 Occupant crash protection, #210 Seat Belt Assembly Anchorages, #225 Child Restraint Anchorage Syss, &UNECE R14 Safety-Belt Anchorages, R16 Child Restraint Syss, R32 Vehicle Behavior in Rear-End Collisions, R17 Strength of Seats safety standards for seats. Work on preprocessing in ANSA &post-process simulated load cases using META-Post to validate seating syss w/ safety standards. Generate reports for sims w/ solutions to failures that may occur during sims &propose design countermeasures. Develop &use kinematics in ANSA to evaluate seat in various seat positions. Develop kinematics in Oasys PRIMER. Evaluate load cases for structural failures, safety criteria, &OEM reqrmnts. Master, Mechanical or Automotive Engrg, or related. 12 mos exp as Engineer or Analyst, analyzing or validating CAE simulations using LS-DYNA &META-Post tools of vehicle light weight/high strength steel structures or seats, &performing CAE sims according to U.S. FMVSS incl No. 210 Seat Belt Assembly Anchorages, or related. Mail resume to Ref#34408, Brose, Human Resources, 3933 Automation Ave, Auburn Hills, MI 48326.

SENIOR DESIGN RELEASE ENGINEER, Warren, MI, General Motors. Engineer, design &release conventional ICE, BEV &AV brake lines &ICE psgr vehicle fuel lines, using Teamcenter &Tc Vismockup tools. Perform qlty assessment reviews to ensure variation/failure modes are documented &comprehended. Develop &maintain template DFMEA for brake &fuel lines. Conduct benchmarking analysis incl performance testing &physical analysis. Support cmpnt integration w/ other engrg teams. Develop &maintain technical specs &design best practices for brake &fuel lines. Produce EWO &TWO, using Engineering Change Management tool, &bill of material builds &build site directions to address issues identified by mfg plants &suppliers. Continuously improve product designs, release, &validate fuel syss cmpnts, to assure qlty, reliability, &compliance w/ regs, such as U.S. FMVSS 301 (Fuel System Integrity), 105 (Hydraulic &Electric Brake Systems), &116 (Motor Vehicle Brake Fluids). Bachelor, Mechanical, Automotive or Chemical Engrg, or related. 24 mos exp as Engineer, engrg or designing psgr vehicle fuel line, brake line, or fuel tank system, &developing or maintaining cmpnt level DFMEA, or related. Mail resume to Ref#1292, GM Global Mobility, 300 Renaissance Center, MC:482-C32-C66, Detroit, MI 48265.

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SAE International Sections are local units comprised of 100 or more SAE International Members in a defined technical or geographic area. The purpose of local Sections is to meet the technical, developmental, and personal needs of the SAE Members in a given area. For more information, please visit sae.org/participate/membership/sections.

Collegiate Chapters at SAE International

Collegiate Chapters are a way for SAE International Student Members to get together on their campus and develop skills in a student-run and -elected environment. Student Members are vital to the continued success and future of SAE. While your course work teaches you the engineering knowledge you need, participation in your SAE Collegiate Chapter can develop or enhance other important skills, including leadership, time management, project management, communications, organization, planning, delegation, budgeting, and finance. For more information, or how to find your local Chapter, please visit students.sae.org/chapters/collegiate/.

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