



futuremotiv

Mobility solutions for a sustainable future

Issue 2: 2024

NEWS & INSIGHTS FROM THE FUTUREMOTIV TEAM

5 YEARS OF FUTUREMOTIV



cenex

Exhibition Experience



Exhibitions
& Events



Hydrogen
Insights

Welcome

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2023 has been another year of growth here at FutureMotiv, from our continued expansion into the US to our team in our UK facility growing even larger. We've worked on a range of projects this year, from creating infotainment systems from the ground up to creating fully integrated fuel cell technology that utilises hydrogen.

What we can do for our clients has only increased with our technical knowledge and as we move into 2024, we see a bright future ahead for low-carbon vehicle technology. With EVs further growing in the consumer market, further expansion of hydrogen fuel systems, electric vehicle technologies continuing to prove their strengths and new businesses quickly growing in the low-carbon vehicle space, 2024 will likely be another great year for automotive.

Our knowledge and expertise spans across the automotive space, including functional safety, energy storage solutions, control systems, and electrical integration. Since 2018, we have built a team of enthusiastic and talented experts who are focused on delivering practical, pragmatic, reliable solutions to our customers.



Mark Basten
Managing Director



RLE Annual Conference

As a subsidiary of RLE International Group, FutureMotiv has access to a worldwide network of experts and facilities to help us achieve our goals. RLE's work creating revolutionary technologies for manufacturers across the globe has only inspired the team at FutureMotiv to continue their incredible work.

Each May, RLE hosts their Annual Global Management Conference in Cologne, Germany and this year our Managing Director Mark Basten came, alongside our Vice President of Engineering USA, Varoujan Sarkissian. This was Varoujan's first conference with RLE and it was a great opportunity for us to showcase the work we've been doing around the business to RLE's senior management and managers from RLE International Group's other subsidiaries.

It was useful to get this time to collate our work, assess our business and get a look at projects from others across the RLE International Group. We might have our own operations in the UK and the USA, but it's great to get a look at how truly international the RLE Group is. With its history and resources and our own expertise, we've grown into a stand-out business in our industry, gathering talent from across the world to support our clients' needs.

These conferences aren't just helpful for letting us look outwards to the rest of RLE International Group and its subsidiaries. It also lets us look inward at the amazing work we've been able to achieve in the last year. Having a platform for our Head of Energy Storage & Power Distribution to present our HV strategy to the wider RLE Group gives

us a rare opportunity to really dive deep on what's been most important to us, and lets us assess ourselves against the huge range of talent that sits under the RLE International Group umbrella.

Of course, it wasn't all business. RLE know how to host a conference and taking advantage of the Global Management Conference to meet and mingle with the senior management of RLE Group's many subsidiaries helps us develop strategies to further support our clients and their prospects.

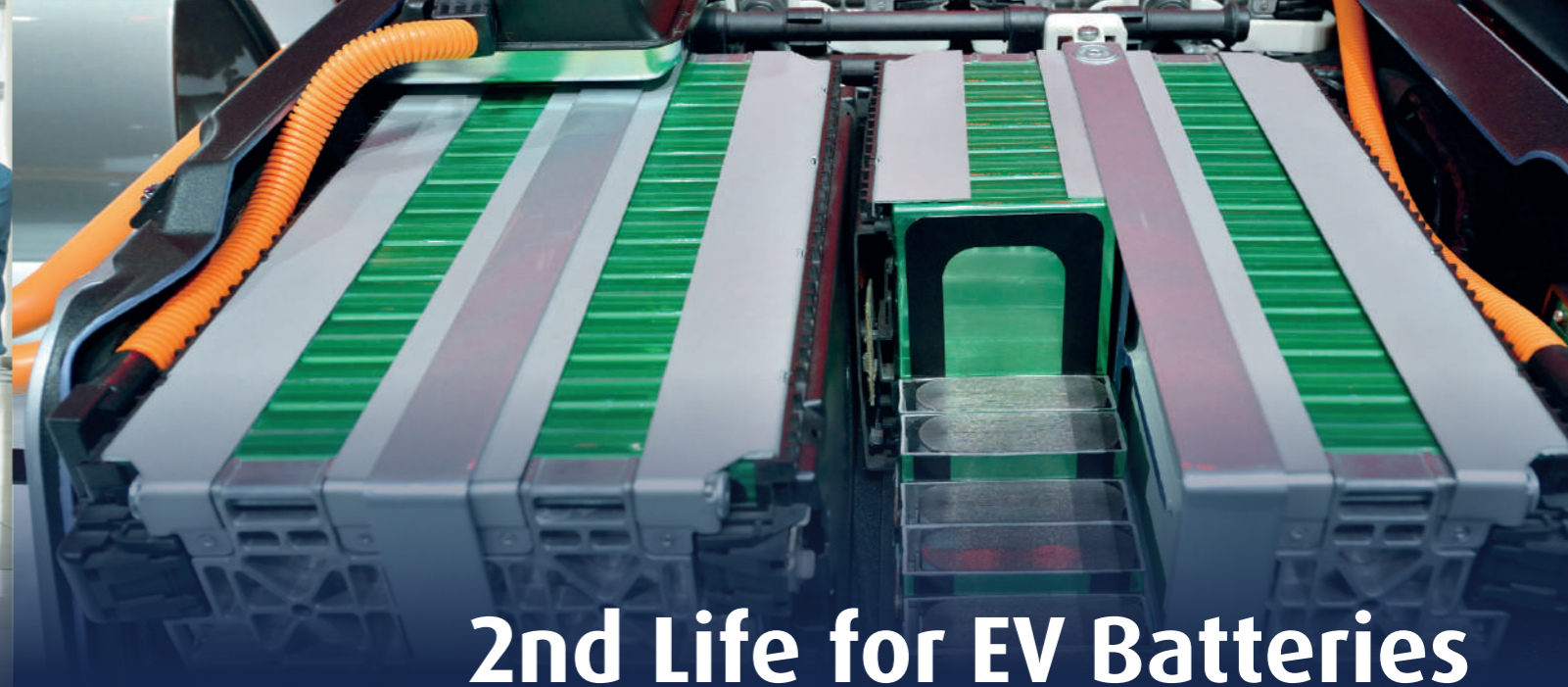
It was a fantastic time in Cologne, and we can't wait for next May where we're sure to meet even more new faces in the RLE family and explore new ideas for a low-carbon automotive future.



Skyline view of Cologne, Germany



Part of the FutureMotiv team in Cologne



2nd Life for EV Batteries

With such a rapid rise in the number of EVs registered in recent years, there must now be serious consideration put into how 'spent' EV batteries are managed. Those in the industry will know that calling an EV battery spent is a misnomer in any context other than automotive. Once a battery has been retired from an EV, they still hold up to 75% capacity compared to new - so there is plenty of life left!

So why are they condemned to landfill? An efficient aftermarket supply chain is essential as part of the growing EV infrastructure globally. Second-hand batteries for cost-effective replacements may be one solution, but there is no way this can be the sole medium.

Recently, Mark presented a poll to his followers on LinkedIn asking about innovative ways to use retired EV batteries. Toyota's partnership with convenience store chain 7/11 in Japan gives a second life to used Hybrid batteries from their cars - reducing their waste and the carbon footprint. These batteries will store electricity from solar panels and be used to power drinks coolers and hot food storage.

A further ambitious project helps to solve two apparently unassociated issues: EV battery waste and the environmental impact of football (or soccer to our American friends). The Johan Cruyff Arena in Amsterdam is home to AFC Ajax, the most decorated

club in The Netherlands and four-time European Cup winners. The arena itself holds approximately 56,000 fans on a regular basis, whilst also hosting some of the biggest music artists in the world. It requires a large amount of power to run the stadium - from under-pitch heating, to floodlights, to the sound systems and light shows.

To introduce a greater volume of renewable electricity, Nissan supplied an energy storage unit comprising of batteries from the incredibly popular EV,

the Nissan Leaf, which would allow for the storage of energy captured by solar panels installed around the stadium.

FutureMotiv are focused on supporting a greener, cleaner, future for all of us. This includes taking on projects with a vision to facilitate a robust EV battery aftermarket. Our expertise in High-Voltage battery systems places us in a unique position to extract as much value as possible out of our transition to electrified transport - whilst reducing potential of EV waste.



Exposed EV floor



Advanced Automotive Battery Conference

In the fast-paced world of electric automotive vehicle design, FutureMotiv has continued to lead the way in battery systems, high-voltage systems, powertrain technology, and chassis design. Our commitment to excellence in these areas was exemplified last year when Denis, our Head of Energy Storage & Power Distribution, received a prestigious opportunity to take to the stage as a speaker at the Advanced Automotive Battery Conference (AABC) in Mainz.

This accomplishment serves as a testament to FutureMotiv's dedication to pushing the boundaries of electric vehicle technology. The AABC is a renowned platform where experts and thought leaders converge to discuss the latest trends and breakthroughs in battery technology for the automotive industry. Denis's selection as a speaker underscores his profound expertise in the field and the recognition of FutureMotiv as an industry leader in the electric automotive sector.

At AABC Mainz, Denis shared insights into our cutting-edge battery solutions, which have played a pivotal role in the development of Hydrogen HGV Battery vehicles that are more sustainable, efficient and reliable. He discussed FutureMotiv's commitment to advancing energy storage technologies, enhancing

energy density, and improving thermal management systems within battery packs. Our pioneering work in battery design has not only increased the range and performance of electric vehicles but also accelerated the adoption of electric mobility worldwide.

Denis also explored our integrated approach to high-voltage systems and pyrotechnic switches. FutureMotiv's design focuses on maximising power efficiency while ensuring the safety and reliability of electric battery systems. Our dedication to sustainability and performance has set new standards within the industry.

Being featured at AABC Mainz reflects not only our company's achievements in HV battery and fuel cell systems but also the direction in which the automotive industry is heading. We couldn't be prouder of our team's tireless dedication to innovation. Our commitment to developing electric vehicle solutions that are both environmentally responsible and technologically advanced drives us to continually strive for excellence.

In the year ahead, we will build upon

the momentum gained at AABC Mainz and continue to drive the electric vehicle industry forward, ensuring that the world's transition to sustainable transportation remains at the forefront of our mission. FutureMotiv remains dedicated to creating a cleaner, greener, and more sustainable future.



Presenting at AABC



US Expansion

Here at FutureMotiv, our position in the UK and Europe has been well consolidated over the last five years, and having those close ties to the businesses we support has been so important. Last year, we began our expansion into the US. Having a local base ready to support businesses across the US is vital and our teams there have only been growing in expertise since we started our expansion.

We now have two facilities, our Technical Centre in Phoenix, Arizona, and our Technical Workshop space in Romulus, Michigan, shared with our parent company RLE. Our Phoenix-based technical experts have become world-leading experts in thermal system development, in particular associated with hydrogen vehicles.

Unlike the UK, where shorter distances make transport times less significant, the decarbonisation of large vehicles like HGVs in the USA has to rely on the more energy-dense hydrogen as the only existing alternative to battery electric vehicles.

Of course, our Technology Centre has been working with much more than just Hydrogen. It allows us to easily access the talents across the West Coast and interact with manufacturers and startups alike.

The creativity and ingenuity coming out of Silicon Valley is unmatched and working with high-growth startups set up in and around California lets us create truly ground-shaking technology.

It's not just our work in Phoenix that's making a change; our shared Romulus facility with RLE gives our experts access to the workshop facilities we need to integrate high-voltage systems for our clients. Our Electrification team bring and continue to develop the

skills required to realise a new level of system integration.

2023 has been a great year for FutureMotiv in the US, and we're looking to the future to watch our technology efforts bloom beyond systems integration into further exploring in-vehicle software and cybersecurity, giving our clients full access to the expertise needed to create revolutionary hydrogen vehicle systems.



FutureMotiv Senior Management Team

Efficiency in Motion: Streamlining Startup Success

Historically, the automotive market has been dominated by industry giants with deep pockets, large resources, and well-established development processes. This has made the automotive sector an extremely difficult industry for startups to break into and go head-to-head with well-known household brands that are instantly recognisable.

However, the emergence and widespread adoption of electric vehicles (EVs) has created a brand-new market, offering huge potential for startups to make a name for themselves. The EV market is still in its infancy, which makes it ripe for innovation and disruption. Startups can capitalise on this hotbed of opportunity by bringing fresh ideas, technological and design innovations, and creative business models to the table.

With the global shift towards sustainability and Net Zero, consumers are actively seeking alternatives to

conventional ICE vehicles, creating a strong appetite for EVs. This level of demand has put established OEMs on the back foot as their traditional catalogue is quickly becoming outdated and less relevant.

Although this new market presents huge opportunity for startups by disrupting the traditional automotive market, these companies are still faced with a number of barriers to entry when looking to carve out a place for themselves. These include high capital requirements, complex supply chains, regulatory compliance and significant investments in research and development.

Avoiding the Treacle

All these barriers, along with traditional heavy design processes, mean that innovation is the only way forward. Poor planning can leave a startup in what FutureMotiv call 'treacle' – where start and end goals are pin-pointed,

but not the steps needed to get from A to Z. This can leave an EV startup manufacturer stuck in an endless cycle of failing gateway reviews, falling behind on scheduled timelines, and losing faith from their investors due to a lack of progress.



An established automotive manufacturer will have an all-encompassing programme delivery plan, with clear gateways or checkpoints and reviews. These steps are then further divided into sub-tasks which are greenlit when completed, meaning the next phase of the programme or delivery plan can commence. These often-bureaucratic exercises can take a huge amount of time to process as every gateway needs multiple deliverables to review before it is possible to progress to the next development step.

Startups unfortunately don't have the luxury of time. The traditional OEM manufacturing processes just aren't going to translate to their business. They need a new model.

The best targets for EV startups to set themselves as checkpoints or physical deliverables to work towards are producing the first 'mule'; design-validation (DV); and production-validation (PV) prototypes. These three key deliverables are critical as they keep engineers on track and provide a clear set of priorities from one step to the other – but more importantly, they are entirely geared towards instilling confidence in investors, ensuring future funding in order to keep operations running smoothly.

To keep a startup in the black they need to be hitting these primary demonstration properties that will keep them focussed – getting that vehicle to the production line and keeping investors happy.

Maintaining investor confidence

Even with first-round funding secured, investment can be pulled at any time. Maintaining the confidence of investors is critical throughout the early stages of a startup. Key elements to safeguard this are:

Provide a Clear Roadmap: Create a thorough timeline for achieving key milestones.

Acknowledge and Plan Around Challenging Timeframes: EV startups that plan well can estimate more accurately the time required to complete each stage.



Risk Mitigation: Identify and mitigate potential risks early in the development process by considering all the critical tasks, dependencies, and potential obstacles from the start.

Investor Communication: Regular updates and progress reports show that the startup is focused, organised, and capable of meeting its objectives.

Milestone Achievement: Every successful milestone accomplished serves as demonstration of progress and technical capability.

What Makes FutureMotiv unique?

The breadth of FutureMotiv's capability is what truly sets us apart from others in the industry.

From working with infotainment and lighting systems, right through to battery and motor control, FutureMotiv equips EV startups fulfil their requirements by unlocking their true potential.

Architecture and design requirements regularly change, and a startup's partner needs to be flexible in their approach



Leveraging FutureMotiv

FutureMotiv specialises in electric and hybrid vehicle systems and has been supporting automotive startups at all stages of development. The innovative team have a breadth of experience meeting challenging deadlines with accelerated timing. FutureMotiv do more than engineer; we foster the mindset needed to succeed.

Another crucial service an experienced partner brings is informing startup projects when a piece of kit is 'good enough'. A strong vision will inevitably cloud one's judgement with ideas of pursuing perfection.

We know how engineers think – there will always be improvements to be made somewhere. But when a milestone delivery date is approaching, and fast, it pays to have experts by their side that can say what has been achieved is sufficient – it's pen down and onto the next process.

and adapt to those changes as a project progresses.

Operating with an agile philosophy through the development and refinement stages, FutureMotiv's pragmatic engineering capability means low-cost, agile design in a safe and creative way.

FutureMotiv is also certified with ISO 9001:2015 and ISO 14001:2015 according to ISO Quality Management and Environment procedures.



Company Events



2022 was a busy year for us, but 2023 has eclipsed our activities from last year. From supporting brand new clients with revolutionary technology, to building entire battery and fuel cell systems from scratch, our work with our clients has been exemplary this year, and our teams have worked harder than ever to create new incredible technologies.

But it's not just our work with clients that makes us a great community – we've been up to a lot more this year. From attending industry expos to hosting community gatherings, visits to and from the staff at our US facility, we've had so much on our plate!

Industry expos are a great way to network and engage with the automotive industry beyond FutureMotiv (you'll read later about our time at Cenex) and giving our team a chance to see the newest technology is so important to keeping our ideas fresh for the clients we support.

We sent four team members to the Commercial Vehicle Show in April to take a look at what the industry has in store for the next year. We've worked with our fair share of clients, designing and building low-carbon HGVs and last-mile transportation and getting an up-close look at where the industry was in 2023 was vital to our successes with those projects.

The Commercial Vehicle Show wasn't the only expo our teams got to attend – we sent our Head of Batteries and High Voltage Systems with one of our HV Battery engineers to the Battery Cells & Systems Expo, at the NEC. With concept vehicles, revolutionary systems technologies, EV conversion specialists and more from all over the world showcasing, it was an unmissable time.

Our Head of Batteries and HV Systems also spoke at the Advanced Automotive Battery Conference in Mainz, presenting our advanced fusing capabilities for heavy-duty applications and participated in a Q&A panel on Heavy Duty Electrified Power Trains.

We also showcased our work at the Motiv8 Supplier Event, hosted by various OEMs in the UK throughout the year. This was a great opportunity to talk with a range of manufacturers, startups, and suppliers about their upcoming vehicle projects.

Our successes are thanks to the brilliant work that our team carry out and without their unbeatable technical skills, we wouldn't be the company we are today. That's why celebrating our staff and the community around our business is so important. So it's not just expos and conferences that have filled our calendars in 2023. We might have had a fairly inconsistent summer when

it comes to the weather, but we did manage to get a Friday sunny enough for us to host our – now annual – staff BBQ.

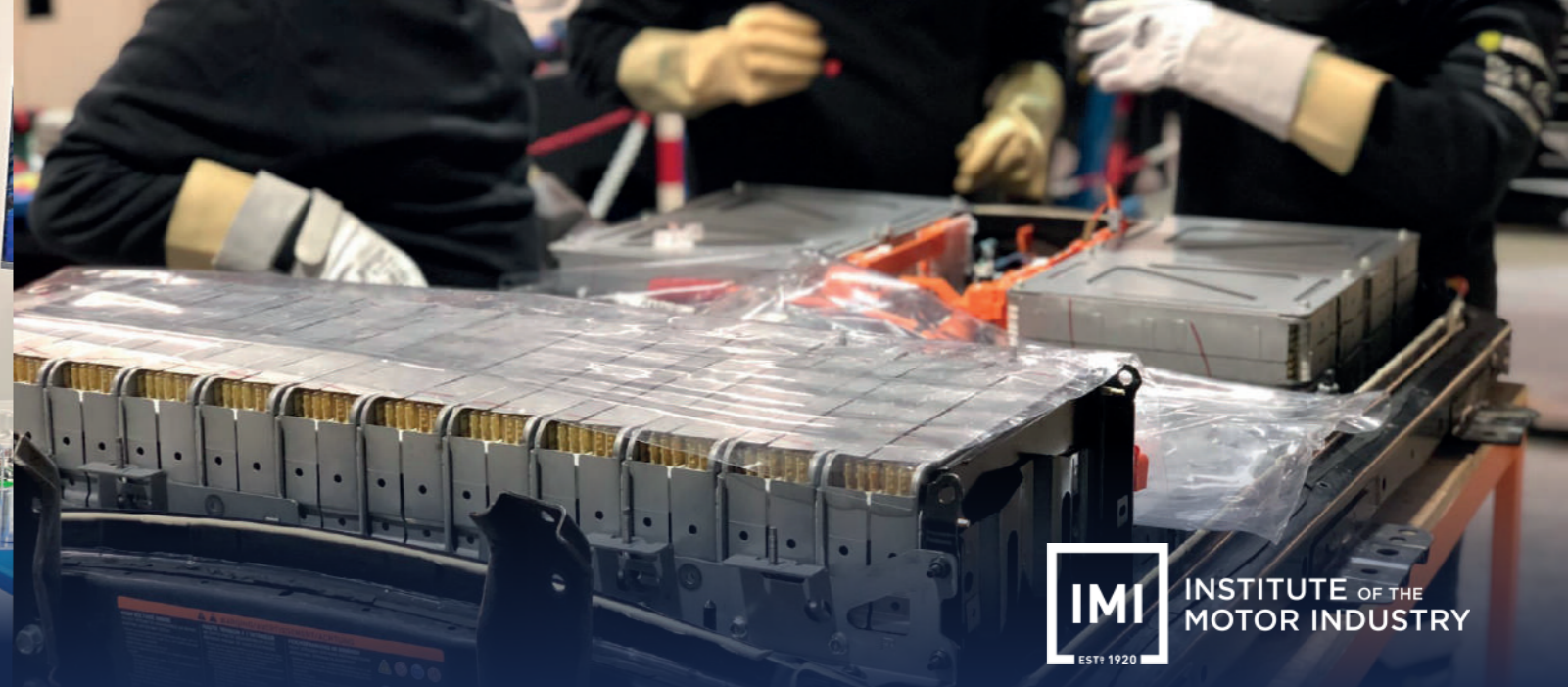
It was great to see all of the team (including our colleagues at RLE International) getting to take a break and enjoy the summer sun with a delicious hog roast.

You'll likely be reading this before we've had our Christmas celebrations, so our most recent celebration was Diwali. We pride ourselves on our diversity, not just in our expertise, but in our team's cultures. It's what sets us apart as both a business and a community.

Celebrating various events, having special treats, setting up our own decorations and coming together as a community to have a good time is our way of saying thank you to the incredible team we have here at FutureMotiv for all their hard work throughout 2023.

We're sure that 2024 will bring more events, more celebrations, and more hard work, but we know our expert team will always rise to any challenge they face.





Return to Cenex

IMI Levels 3 & 4

September saw our second time as Exhibitors at Cenex-LCV and Cenex-CAM and it was great to be back! We got a chance to see the advances in low-carbon emission technology within the UK's automotive industry and some new concepts that we will soon see realised in the low and no-carbon automotive space.

Established in 2005, with support from the automotive unit of the British Department of Trade and Industry, Cenex's goal for the last 18 years has been helping automotive businesses in the transition to low carbon and fuel cell technologies.

Cenex Low Carbon Vehicle Event (Cenex-LCV) began in 2008 and has since been connecting automotive manufacturers and start-ups with experts and partners from across the industry to help in the country-wide mission to achieve net-zero.

Held at the famous vehicle testing centre, Millbrook, Cenex sits right in the heart of British automotive developments and from its attendees and exhibitors, it's clear to see that the UK is leading the way in low-carbon automotive technology. With everything from charging systems to automated driving technology, manufacturers will

quickly be taking advantage of the innovations showcased at Cenex this year, and we were so glad we could be part of it.

The showcases at Cenex Connected Automated Mobility (Cenex-CAM) gave us an incredible insight into the trends that are revolutionising our roadways, with a range of technology from vehicle-to-vehicle communication to automated driverless innovations.

With well over 100 speakers, and seminars going on throughout the event, it was a fantastic opportunity to see what innovations the UK automotive space has achieved over the last year. The technology on display at Cenex showcases the strength of the UK as a world leader for clean, low-emission transportation.

It wasn't just an opportunity for us to see what other businesses had to offer. We also got a chance to showcase our own technologies, from our work with high voltage systems integration to getting to talk about our work with hydrogen fuel cells. Our team did a fantastic job presenting our revolutionary technology and it was great to catch up with some of our business partners who

were also attending. If you didn't get the chance to speak with us this year, we're already in the process of making exhibiting at Cenex a tradition here at FutureMotiv so make sure you're there next year to see what we've been up to!

We're so grateful to the community of intelligent, driven automotive experts we have both here at FutureMotiv, and in the wider UK community. The collective innovations featured at Cenex show that a cleaner, brighter, automotive future is much closer than many people think.



In an effort to bolster what FutureMotiv can offer to our clients, a few of our engineers who are involved in HV work have completed IMI Levels 3 & 4, not only qualifying them to perform diagnoses and repairs on live high-voltage vehicle electrical components, but providing them with a unique insight into the optimal configuration of these components within a vehicle.

In March, another contingent stepped up and completed their training. Here, we've gathered some of the comments of those who have attained their Level 3 & 4 qualifications:

Special Projects Engineer – L3 & L4
"Coming from an electronics background and gaining Level 3 & 4 in High Voltage for Electrical Vehicles has given me a new range of abilities. Recently I was

afforded the opportunity to fly to the US and diagnose an issue with a high-voltage battery. In a little under a week, the issue was identified, repaired, and the vehicle up and running ahead of a demonstration show."

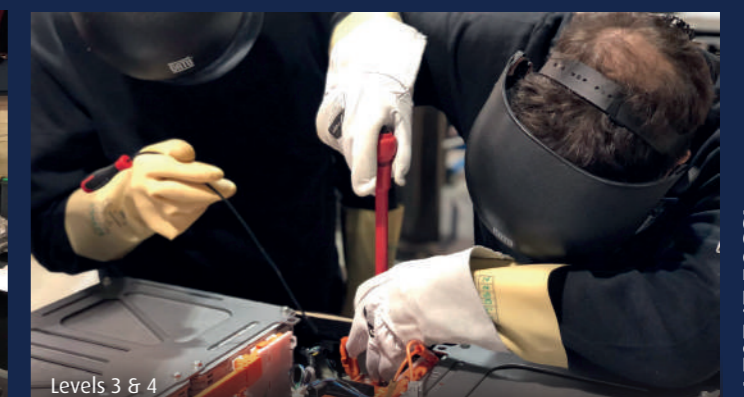
Principle Battery Systems Engineer – L3 & L4
"I'm a battery engineer so high voltage systems and live working is part of my day-to-day. I feel that formal training in this area is important as the dangers involved are too great to be taken lightly. In providing the training, we're demonstrating a special emphasis on safety and upholding our high standards.

"The training allowed me to apply the principles to different types of electric vehicles having only worked on HV batteries in the past. It's also helped

me build an appreciation for the clear process documentation required."

HV Project Engineer – L3
"Being IMI Level 3 certified has helped me realise the importance of safety procedures and using the correct equipment while operating on – and also repairing and replacing – components for hybrid and electric vehicles."

HV Electrical Engineer – L3
"Having the certification has allowed me to safely work on HV projects. It demands diligent working and working with colleagues who have the certification helps build team mentality, letting me work with the security and trust that safety measures are checked by multiple individuals."

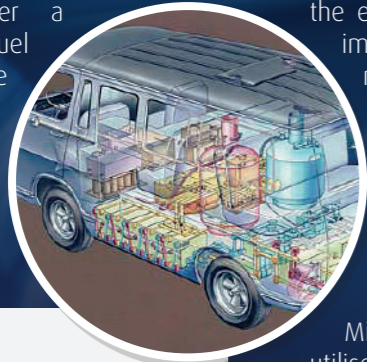


Hydrogen: The Future of Fuel?

“Hydrogen fuel might be the only zero-emission fuel alternative to rival petrol and diesel engines on range.”

Hydrogen fuel as a concept has been around for decades. In fact, General Motors released a concept van – The Electrovan – in the mid 1960s, but it’s only in the last 5 years that we’ve started to see real growth within the market. Demand is increasing, as is supply, and its various applications across the automotive industry might soon make it a real competitor to other clean fuel alternatives like battery electric vehicles (BEVs).

Unlike BEVs which use a battery to power a motor, hydrogen fuel is entering the market on two fronts – with the hydrogen fuel cell (FCEV) and with hydrogen combustion (HCE).



The Electrovan

Both have clear upsides to BEVs, but the lack of existing infrastructure has held back both technologies in centring themselves in the mainstream just as BEVs have done in the last few years.

The hydrogen fuel cell uses a process called reverse electrolysis where hydrogen and oxygen are combined to form water, electricity, and heat.

This powers the car, but because a fuel cell needs time to spool up, and is most efficient when operating at a consistent rate, a battery is needed.

This makes hydrogen vehicles operate similarly to a hybrid vehicle: the battery is used when the car starts and needs to accelerate, and recharges when braking thanks to regenerative braking technology. Because of this, hydrogen vehicles require a lot of effort on the part of the manufacturer. It isn’t just the hardware that plays a huge factor on the efficiency of an FCEV; software implementation on how these many parts interact has to be greatly considered.

In spite of these challenges, it is the vehicles that use fuel cells that have been the leader in the market for Hydrogen vehicles. The Toyota Mirai and Hyundai Nexo both utilise FCEV technology and the other passenger vehicle concepts that we could see entering the market over the next few years also take advantage of it.

On the other hand, Hydrogen combustion engines are much easier to understand, and much more accessible to your everyday consumer. There is very little difference between a hydrogen combustion engine and a petrol and diesel combustion engine. It’s this that, for a lot of manufacturers, puts hydrogen combustion above hydrogen fuel cells – as only a few modifications are needed to allow existing combustion engines to use hydrogen fuel.

JCB is one such manufacturer, adapting one of their current ICE production lines to create hydrogen-powered combustion engines instead. Of course, as industrial vehicles don’t require significant range or usage like commercial or passenger vehicles, they aren’t hindered by the hydrogen combustion engine’s biggest flaw – combustion engines that use hydrogen are not as energy efficient as fuel cells that do.

The CO2 emissions might be much lower than a petrol or diesel ICE, but a hydrogen combustion engine still emits Nitrogen Oxide (NOx) which is still considered when looking at what emissions contribute to air pollution. To counter this, HCEs are usually built



to take in twice the amount of air that is required for complete combustion. In doing this, the air/fuel ratio means that NOx can’t form which significantly reduces their power output to around half of a similarly sized combustion engine.

To counter this, most vehicles with a hydrogen combustion engine use larger

engines or turbochargers to counter-balance the inefficiencies caused by this process. This still means that retrofitting hydrogen engines into existing vehicles is much easier. If hydrogen becomes widely available, the savings made by not having to buy an entirely new vehicle might outweigh the cost of using the more inefficient hydrogen engine.

Two of the biggest hurdles for mass adoption of low and no-emission vehicles is that firstly, the infrastructure to support BEVs will struggle to match the current infrastructure supporting ICE vehicles and secondly, the vast majority of commercial BEVs cannot match ICE vehicles in terms of range. Hydrogen-powered vehicles are in a much worse position in terms of infrastructure – there were over 1,000 public charging points as early as 10 years ago in London alone, and there are currently not even 10 hydrogen refuelling stations in the entire UK – but hydrogen

vehicles match and surpass their zero-emission alternatives, BEVs, when it comes to range.

This is mostly thanks to hydrogen vehicles not needing the heavy battery used to power BEVs, but hydrogen itself is more efficient by weight than even petrol and diesel – and fuel cells are much more efficient with the energy they produce than combustion engines. You might think that this means hydrogen can surpass ICE vehicles in range, but hydrogen’s efficiency by weight doesn’t translate to efficiency by volume.

Most commercial vehicles that use hydrogen require a lot of space just for the large tanks used to store the hydrogen within the vehicle. The Toyota Mirai has three such tanks, leaving many feeling the interior is much more cramped compared to BEVs and even ICE vehicles. This hasn’t stopped other manufacturers attempting to



use hydrogen fuel on much smaller vehicles. In fact, Welsh manufacturer Riversimple recently unveiled the Rasa – a tiny, 655kg two-seater vehicle capable of managing up to 300 miles when fully fuelled – and several other manufacturers have revealed concept versions of hydrogen-powered coupe or sports cars. Hyperion Motors, a hyper car manufacturer in California, released their Hyperion XP-1, which might not be as small as the Riversimple Rasa, but can achieve 0-60 in 2.25 seconds and a top speed of up to 221 mph.

As hydrogen becomes more accessible, we might also see hydrogen injection technology begin to bridge the gap between people using ICE and significant hydrogen adoption. Hydrogen injection relies on injecting a small amount of hydrogen into a combustion engine alongside the air intake to make it more efficient. The technology can significantly reduce the emissions and fuel consumption of vehicles that use it and because it can be installed easily into existing ICE vehicles, it becomes an even cheaper alternative than the cost of adapting existing engines to run solely on hydrogen or replacing the vehicle outright.



The cheaper, more accessible HCEs and hydrogen injection technology compared to ICE show that the real thing holding hydrogen fuel's mass adoption back is the lack of access for individuals and businesses alike.

Hydrogen fuel's biggest critics say that a huge portion of the hydrogen produced still uses fossil fuels. In fact, over 95% of hydrogen is created by taking naturally-forming methane gas and using steam reformation to extract the hydrogen from the carbon and oxygen, a process that requires great effort to capture the carbon emissions from it.

The low-carbon answer to this is actually much more energy-intensive – the electrolysis of water. By using renewable energy like nuclear, wind, solar, and hydroelectric, hydrogen fuel does become much greener. Unfortunately, to create 1 kg of hydrogen fuel requires around 39 kWh of electricity. The Toyota Mirai's 122-litre tank can hold 8.6 kg of hydrogen, meaning that the energy to fill up one tank of a Toyota Mirai requires as much energy as it would to power the average UK household for nearly a month and a half. BEVs require a much smaller amount of energy to fully charge – between 40-70 kWh depending on the model – but as countries, industries and businesses look to move towards Net Zero, the lower cost of upgrading to hydrogen might be the linchpin to have the technology surpass existing BEVs.

Hydrogen's accessibility will move forward as access to renewable energy does, and though understanding of the technology has existed for centuries (yes, centuries), the last few years has seen a gigantic shift in interest in hydrogen as a fuel alternative.

JCB, Toyota, and Hyundai aren't the only companies to throw their hats into the ring for Hydrogen – and it isn't just industrial and passenger vehicles to give Hydrogen a go.

The increased demand for clean-air cities has meant that public transport has been encouraged to adopt clean fuel alternatives, and several cities have seen hydrogen as the best alternative to petrol and diesel.

Transport for London (TfL) runs a small fleet of hydrogen buses across one route in the city alongside their electric

counterparts. The increased range and quick refuelling time means that the hydrogen buses can spend more time on the road than the other electric buses used by TfL. London isn't the only city using hydrogen. In the city of Zhangjiakou in China, 444 of the hydrogen-powered buses previously used in the 2022 Beijing Winter Olympics are now the preferred method of public transport within the city. Temperatures can drop as low as -30°C, and the water output from the reverse-electrolysis within the fuel cell can freeze – causing the fuel cell to operate less optimally.



Hydrogen Train

This has only helped in the wider improvement of fuel cells, encouraging them to spool up quickly. And now the city doesn't just use hydrogen to power its buses, but also its street cleaning, logistics, and even heavy cargo. The Chinese government have made efforts to push towards hydrogen fuel as a cleaner alternative to electric cars (as China is the largest electric car manufacturer). The country has relied on coal for its energy, but with the increased rise in renewable energy, hydrogen might be the best way to transport goods across the country.

It isn't just road-bound vehicles that have seen an increase in usage of hydrogen-power. The German regional transport authority (LNVG), were one of the earliest adopters of a hydrogen-powered train. The electrification of train lines – or lack thereof – means that hydrogen fuel cell powered trains might be the most optimal way to create green-energy railways. It is much cheaper to upgrade trains to hydrogen-

fuel cells than it is to completely rethink and rebuild existing railway infrastructure.

Germany's fleet of hydrogen-powered trains consisted of 14 fuel cell trains built by Alstom. After conducting a cost analysis they found that running electric trains on its remaining lines would be cheaper than continuing to utilise the much less accessible hydrogen fuel. This recent hurdle in hydrogen train technology hasn't stopped other governments from investing in hydrogen – earlier this year California signed a deal to purchase four hydrogen fuel cell trains from Stadler for \$80 million.

This investment was only a small portion of the \$10 billion investment the Governor announced to help reduce the state's carbon emissions and with much of the USA looking to reach net zero, proper clean hydrogen infrastructure will rely on huge investments from both local and national governments. These would be the first hydrogen-powered



“Petrol and diesel engines can be easily adapted to run on Hydrogen.”

trains in the US and if we see wider adoption across California, it's likely that other states will follow.

The size and scale of America's railway system is unique to the country and the large distances require technology that can handle long ranges. Battery electric suffers in this regard, and in places where implementation of electric railways is too expensive, or downright impossible, hydrogen might be the only green answer.

You might be thinking that cost alone is slowing down a wider adoption of hydrogen, and that does have a significant impact, but hydrogen fuel has had an infamous reputation in the public eye. The Hindenburg disaster didn't just cripple the Zeppelin industry; hydrogen has only ever seen substantial use in the air as rocket fuel – and there's only one single example of a hydrogen-powered plane – the Soviet Tu-155 prototype.

Taking its first flight in 1988, the Tu-155 required a fuel tank that took up one third of the space within the plane to function. Of course, after the fall of the Berlin Wall, the Tu-155 fell into obscurity and its manufacturer, Tupolev, never made a follow-up.

This doesn't mean that hydrogen-powered planes have completely disappeared from the zeitgeist – commercial aircraft manufacturer Airbus have revealed that they plan to use hydrogen to power a low-carbon commercial aircraft that could be on the market as early as 2035.

The fears people might have around hydrogen fuel are largely unsubstantiated – hydrogen fuel is in fact safer in many ways than petrol and diesel. Because of its small atomic

structure, any spillage of hydrogen will seep through most materials, and its weight means that gasses coming from it go directly upwards. This means that lit matches have to be directly above a hydrogen leak before any ignition can take place.

As hydrogen fuel usage becomes more common, it's likely that people will become more comfortable with the technology, just as they have with BEVs. Unfortunately, with little existing access for your average person, it's likely that interest in hydrogen will have to come from automotive and transport manufacturers and from governments looking for clean fuel alternatives before hydrogen passenger cars can really take off.

The last few years have seen hydrogen investment increase massively – whether from corporations or from governments. It's expected that the last two decades of prototype and concept technology have paved a fairly secure groundwork for the technology

to be expanded upon across a range of markets.

If you're interested in a deep dive into hydrogen fuel, the history of the technology within the automotive space, its current place in the market and its future as an alternative fuel source, we recently published an extensive guide called *Hydrogen: the Future of Fuel?* which you can read on our website – simply head to our News & Insights page.





The Art of Dreams

Goodwood Festival of Speed

With Summer came one of the UK's biggest car shows, Goodwood Festival of Speed. With 2023 being Goodwood's 30th anniversary, it was a great opportunity to celebrate the best of automotive. This year saw the introduction of FOS TECH, Goodwood's brand new goal to showcase world-changing innovations to ignite a fascination in technology for the next generation of engineers.

Goodwood has a history with Battery Electric Vehicles; its signature event, Hillclimb's, record was set by the McMurtry Spéirling, an all electric hypercar, in 2022. 2023's showcase did not disappoint, with the central display this year celebrating 75 years of Porsche sports cars.

We sent one of our senior engineering team, who is also a Trustee of Greenpower Education Trust, along with two other team members to look at the range of incredible businesses showcasing their latest innovative technologies and solutions. Greenpower Education Trust were charity partners of Goodwood this year and their showcase is built upon their drive to kickstart young people's careers in engineering by giving visitors a look at some of their best Kit Cars.

With almost every major OEM showcasing in some capacity, it was great to get a look at the amazing technology of the past, and what the future might hold for automotive. Several OEMs were debuting their next generation of vehicles - and it wasn't all hypercars! We saw a huge amount of brand new EVs this year. Hyundai revealed their performance electric vehicle, the IONIQ 5 N, their first all-electric N model. Rolls Royce

revealed the Rolls Royce Spectre which silently blitzed its way around Hillclimb, with only the sound of tyres screeching against the tarmac to break it. Then track car manufacturer Caterham surprised guests with a look at the EV Seven, a 322 bhp, fully-electric track car weighing just 700 kg.

Seeing more and more low-carbon vehicles at this event really shows how mainstream battery technology is quickly becoming. And with Toyota unveiling its hydrogen-powered Toyota GR Yaris concept car (and even giving petrol-head Rowan Atkinson (Mr Bean) a go behind the wheel), it is likely that at next year's festival, we will see even more alternative fuel vehicles debut and we'll be there when they do!



Goodwood Festival 2023



Community Work

FutureMotiv have spent the last year continuing to engage with our communities, raising money for charity, participating in STEM activities with the next generation, and acknowledging the work and dedication of our team.

Youth Participation

Our ethos is to provide sustainable solutions for low-carbon vehicle technology. In part, this is to create an environment for future generations that is not damaged beyond repair.

We know, however, that this work does not stop with us. We need to inspire young engineers to pursue STEM subjects, so they can continue this legacy. Nurturing future talent was part of our function in MIRA Technology Institute's Speed Networking event,

speaking to 12-14 year olds about a potential future in a STEM-centric workplace.

Further to this, FutureMotiv, in collaboration with our parent company RLE International Group and Coventry College worked to create a syllabus tailored to real-life requirements in electrical engineering, in order to showcase the current challenges associated to a world adopting EVs, whilst making sure knowledge can build on the subject.



Charities

When the team want to raise a bit of money for a cause, we do it full throttle!

In aid of Comic Relief, for Red Nose Day this year, the entire FutureMotiv team came together to raise smiles and funds. In addition to embracing the spirit of the day, employees showcased their culinary talents with homemade dishes, turning the event into a gastronomic celebration.

November hosted a physical challenge for some of the FutureMotiv team in aid of MacMillan Cancer Support. The challenge involved completing 100 press-ups or 100 squats every day throughout the month.

This strenuous effort was an enormous achievement and raised funds for a wonderful cause.



FutureMotiv Team

Employee Appreciation

We would be nothing without the dedication, endeavour, and work ethic of our amazing team.

On International Women's Day, FutureMotiv celebrated the diversity within its team by spotlighting the perspectives of women working in typically male-dominated career sectors. The company takes pride in being an inclusive employer and are indebted to the women upon which we rely across the whole FutureMotiv organisation.

Employee Appreciation Day was another occasion to show gratitude for our entire team's commitment to our values. We surprised everyone with healthy treats and positive messages - just a small token to emphasise how grateful we are to have such a fantastic group here at FutureMotiv.



Infotainment

One of the most promising developments in future mobility is Vehicle-to-Vehicle (V2V) communication via 5G networks.

By leveraging these networks, the automotive industry is undoubtedly undergoing a transformative shift towards greater connectivity and intelligent automated systems. The technology holds immense potential to revolutionise road safety and enhance the overall driving experience.

V2V communication refers to the exchange of information between vehicles in real time. Through this, vehicles will communicate with each

other, constantly sharing data on relevant metrics. This information is then processed, and actions determined, ultimately improving road safety by preventing collisions and optimising traffic flows.

At the heart of V2V communication is the 5G network. Compared to its predecessor, 5G boasts significantly faster speeds, lower latency, and increased bandwidth, meaning a greater volume of devices can communicate at a much faster rate.

V2V communication enables vehicles to exchange data regarding their position and speed, using this to

predict intentions and act to achieve the most efficient and safe outcome. This information is used to determine potential hazards, such as sudden braking or lane changes, allowing vehicles to predict, and subsequently avoid, collisions. This technology, combined with smart infrastructure has the potential to save countless lives on the road. According to Kia, "Autonomous vehicles can be trained to be safer than human-controlled cars. With sensors and cameras, they can enhance the safety of a driver as well as pedestrians by eliminating human error."

Sharing real-time traffic information, V2V communication helps to optimise traffic

flows to reduce congestion. Vehicles can collectively adjust their speed and routes based on the shared data, minimising delays and improving overall transport efficiency.

Commutes become smoother, benefiting both individuals and the environment through reduced fuel consumption and emissions.

Leveraging V2V communication, adaptive cruise control systems can synchronise with nearby vehicles. This feature further enables a smooth and coordinated flow of traffic, again reducing the risk of disruption whilst enhancing fuel efficiency.

While V2V communication over the 5G network holds immense promise, its widespread

implementation faces a few challenges: standardising protocols, addressing cybersecurity concerns, and establishing robust maintenance and infrastructure.

5G currently stands as a battleground between mobile phone operators

and manufacturers, and vehicle manufacturers. Mobile phones are now ubiquitous – especially in Western society – so a debate is fuelled by how much control should be relinquished to the driver's phone: when driving, will V2V communication come from the vehicle or the mobile phone?

Looking ahead, the future of V2V communication is bright. As 5G networks continue to expand and mature, we can anticipate further advancements and refinements in V2V systems. Additionally, the integration of V2V communication with emerging technologies like autonomous vehicles and smart city infrastructure will unlock unprecedented possibilities for safer, more efficient transportation.

Vehicle-to-Vehicle communication facilitated by the 5G network is poised to revolutionise road safety and transform the way we navigate our streets. By enabling seamless data exchange between vehicles, V2V communication looks to enhance safety, optimise traffic flow and pave the way for a smarter, more connected transportation ecosystem.

As this technology continues to evolve, we can anticipate a future where accidents are minimised, traffic congestion is reduced, and the joy of driving is seamlessly intertwined with cutting-edge connectivity.



FutureMotiv Team working on infotainment



Learning Sessions

In the dynamic and ever-evolving landscape of the modern workplace, the pursuit of knowledge is a key driver of success. FutureMotiv actively invest in the continuous learning and development of our team to remain at the forefront of innovation and competitiveness.

That is why, in partnership with our parent company RLE International, we launched our 'Lunch and Learn' sessions. These sessions bring employees together either virtually or physically to expand their knowledge, and gain a little insight into the working lives of their colleagues.

By fostering an environment where ideas flow freely, companies can harness the collective intelligence of their workforce, leading to innovative solutions and approaches to challenges.

Regular Lunch and Learn sessions contribute significantly to the professional development of employees. The exposure to diverse subjects not only enriches individual

skill sets but also empower participants to take charge of their own learning and development.

Our Lunch and Learn sessions provide an informal setting for employees to connect and foster relationships that extend beyond the confines of the workplace, creating a wider appreciation of workloads and requirements between colleagues.

Regular communication is a cornerstone of a healthy work environment. Lunch and Learn sessions break down communication barriers by providing an open forum for discussion. Employees feel

more comfortable expressing their ideas and leadership can use these sessions to communicate company updates, goals and strategic initiatives in a more informal and interactive manner.

In the fast-paced and competitive landscape of the modern workplace, companies that prioritise continuous learning and development are better equipped to navigate change and achieve sustained success. The Lunch and Learn concept has proven to be a powerful tool in fostering a culture of learning, collaboration, and growth between FutureMotiv and RLE International.



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Choose FutureMotiv for your next project.

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