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BSI Net Zero Week webinars

Decarbonize transport: achieve zero-emission vehicles

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Inspiring trust for a more resilient world.

In a series of insight-packed webinars, BSI's Net Zero Week presented a multi-sector view of the collective challenges and what's being done to tackle them.

The second webinar in BSI's Net Zero Week focused on road transport. It explored the role of emerging technologies, supported by standards, in helping deliver zero-emission vehicles.

The host was Kate Busuttil, BSI's Senior Standards Manager of Mobility, Materials and Manufacturing.

She began by saying there is no single solution for decarbonizing transport; we need to connect standards, policy and regulation with transport network optimization, infrastructure and investment, and enabling technologies.

Kate then gave a short introduction to BSI. "As the national standards body, we're a neutral convener of experts. We bring together people from government, industry, research labs, trade associations and consumers, getting them all into one single committee to try and develop standards. It's the only way we can get it right."

Supporting transport decarbonization

BSI has already developed a huge body of work that supports the transport sector, with standards ranging from safety to electric vehicle charging. "Now we're developing programmes to help the sector decarbonize," said Kate.

"We're partnering with UK government and innovators on connected vehicles; supporting electric vehicle battery development; and working on standards for smart EV charge-points, next-generation materials manufacture, and smart mobility."

During the session we covered four topics:

Topic one: Achieving zero-emission vehicles: the Faraday Battery Challenge

Topic two: Composite materials as a strategic enabler of zero carbon transport

Topic three: Developing a power electronics supply chain

Topic four: Zero-emission technologies in freight transport

Achieving zero-emission vehicles: the Faraday Battery Challenge

The first speaker was Jacqui Murray, Deputy Director of the Faraday Battery Challenge.

Why the UK is funding battery innovation

Beginning with the scale of the challenge ahead and the Climate Change Committee's analysis of the pathway to net zero, Jacqui highlighted the importance of low carbon solutions for electrification. This is especially vital in surface transport.

"The good news is that the high-level roadmaps and timescales for transition are clear", said Jacqui. "So is the role of regulation and technology. But the less good news is that although we can move to electric vehicles, there's no inherent reason why we should prosper from the transition."

And that's where Faraday comes in. Backed by the UK government, the Faraday Battery Challenge is investing in research, innovation projects and scale-up facilities for batteries to be used in the electrification of future vehicles. As well as helping the UK move to zero-emissions vehicles, this will create new opportunities and supply chains. It will also make the most of the growing batteries market – estimated to be worth £5bn in the UK and £50bn across Europe by 2025.

The beginning of batteries

In 2008 the automotive industry began collaborating to support a transformation in internal combustion technology and a reduction in CO2 emissions per kilometre. "But in 2016, we realized that by 2030 we needed to slash emissions from around 130g/km right down to 67g/km. We knew we'd soon start bumping up against what's actually feasible with internal combustion engines."

It became clear that manufacturing a car for 2030 meant making technology decisions now. They needed 42 months for design and development, and a 10-year production phase.

"So in 2016 we realized the pathway to zero had to transform. And that's when batteries came to the fore as a step-change in passenger cars."

Topic one

How Faraday works

Faraday was set up to look at why more people aren't buying electric cars today, and to deliver solutions to meet the targets for mass UK adoption. It has three pillars: the Faraday Institution, with 450 researchers; 125 organizations working on collaborative R&D projects; and a new £130m Battery Industrialization Centre that can help commercialize new products and materials through to market.

Faraday also works alongside other partners, such as the Advanced Propulsion Centre through which Faraday launched the Automotive Transformation Fund. This provides £1bn of new funding to support at-scale industrialization of electric vehicle technologies.

The benefits of collaborating

Collaboration is extremely important, said Jacqui. "I'm really keen on creating communities of practice. This is where BSI have really come to the fore; they're a real strength for the UK. They allow us to move away from our own work teams and come to events where we can really talk, be more imaginative and get more radical innovation."

The BSI-Faraday standards programme has been working on health and safety in the manufacturing process and on the environmental impact of batteries. For example, PAS 7061 Batteries for vehicle propulsion electrification sets out good practice for the safe handling of battery packs and modules.

Jacqui concluded:

"Watch this space, we have more codes of practice and design guides coming, and it all plays into the roadmap for the future. It's a place where we can really start to get all our industry onto the front foot."

Topic two

Composite materials as a strategic enabler of zero carbon transport

Next to speak was Stella Job, Sustainability Manager at Composites UK.

What are composites?

In this context, Stella was talking about composites as fibre reinforced polymers. With a high strength-to-weight ratio, they're useful in transport for making parts lighter and for being extremely durable.

Stella stressed that life-cycle assessment (LCA) is important when choosing the right materials. Bristol University research shows how LCA helps decision-making on the use of carbon fibre (CF) in automotive. Comparing steel parts with CF in cars, it looked at potential fuel savings over distance and concluded that breaking even would require at least one or two closed-loop recycling rounds to justify the use of CF. It also showed that we should be using CF in trucks and freight vehicles, which travel a greater average distance before reaching end of life and needing to be recycled.

This raises questions for the short, medium and long term, like whether we can make car structures last longer or make zero-impact CF.

Composites in use

Looking at composites as strategic enablers, Stella highlighted the weight reduction potential of composites with an example of a car's rear dead beam weight being reduced by 53%. Other key potential application areas for composites are hydrogen storage tanks, flywheels for energy storage in buses and trains, and battery boxes for EVs.

Composites can also play a role in the new systems (such as Hydrogen) for creating energy for vehicle propulsion and in vehicle safety through the use of bio-based resin, which is highly fire-resistant and so can be used in mass transit interiors and heat-shielding engine bays.

Topic two

How standards are enabling innovation

The 2019 BSI-Composites UK report “Developing a UK Standards Strategy for the Uptake of Light Materials by the Transport Industry” is designed to improve industry standards and test processes and encourage more recycling. Stella said that more standards were needed to improve further the use of composite materials by the transport industry.

Future challenges

Further Improvements the transport industry can make include:

- Conducting more rigorous lifecycle assessments
- Pursuing low-cost, high-volume manufacturing
- Increasing recycling in supply chains
- Using more sustainable raw materials
- Encouraging legislation to drive the right long-term approaches

As with many other sectors at this time, the composites supply chain needs economic stability and access to capital; it’s vital not to lose our strategic capability. But above all, said Stella,

“We need a new mindset. There’s been a dramatic change in the last year: it’s no longer about asking how we can be a bit more sustainable, it’s asking how we can be zero impact.”

Developing a power electronics supply chain

Next was Alastair McGibbon, the Head of Collaborative R and D at the Compound Semiconductor Applications Catapult.

Alastair began saying that power electronics is the core technology in smart power management. It's often the critical path for some of the big routes to decarbonization, like batteries and electric vehicles. CSA Catapult also focuses on advanced packaging solutions, where a move from silicon to wide bandgap semiconductors like silicon carbide is enabling power electronics to become smaller, lighter, faster and more robust.

This creates challenges – not least for standards – because power electronics have a much higher power density. So we need to look carefully at system sizes and how a system interfaces with an electric vehicle.

The importance of integrating solutions

Power electronics works across multiple sectors. So an automotive development will be equally applicable for energy or industrial use.

CSA Catapult is involved in over £100m of collaborative projects. Alastair gave the example of the ESCAPE project,where McLaren Applied was the end-user and 12 partners in the supply chain worked on areas from the chip to packaging and inverter development. It demonstrates how CSA is growing the UK's capability in all the different areas required for next-generation power electronics.

Developing a chip is just the first challenge; integration is key.

"You've got to look at the packaging, the control, the capacitors, the thermal management system and how everything functions in high-temperature environments, so co-design is crucial. You can't just optimize one thing; you've got to work across a disaggregated supply chain and find a core integrated solution."

Topic three

Strong UK capability

This is changing the supply chain. Instead of the traditional linear component manufacture and integration, we're moving to a future that breaks the concept of components, with highly flexible miniaturization, integration and manufacturing. "This requires a lot of innovation," said Alastair, "and there's a lot of UK capability in this space."

A quick look at the opportunity paths for an enabling technology showed, for example, how a silicon carbide chip could be used in modelling simulations … which could be used in applications such as wireless charging … which could enable next-generation automotive electronics. Alastair showed how the UK capability runs from the semiconductor supply chain to power electronics providers, Tier 1 integration and end markets.

"Most importantly, we have the capability to scale up, so the UK is very well positioned for the next generation of markets. The size of its capability brings a lot of opportunity and we're working very closely with the supply chain to develop that."

Topic four

Zero-emission technologies in freight transport

The final speaker was Anthony Velazquez, Head of Environment and Decarbonisation at research not-for-profit DLL.

How to decarbonize heavy goods fleets

Anthony explained that the main route to decarbonizing heavy goods fleets is to decarbonize energy pathways.

At the moment, 95% of logistics fleets are powered by diesel and internal combustion engines (ICE), which produce high levels of pollutants. While ICE biodiesel and biomethane yield much lower GHG emissions and are cleaner than diesel, they still generate pollutants. That's why electric powertrains are fast gaining traction, particularly the use of hydrogen fuel cells for heavy-duty vehicles.

Looking at the optimal energy pathway and powertrain efficiency together reveals considerable differences. For example, Anthony showed that a grid-powered battery vehicle would yield around 300g of CO2 equivalent per kilowatt-hour of effective fuel use. But switch to renewable electricity, and the emissions from the same powertrain plunge to around 28gCO2e/kWh of effective work.

Research shows the most efficient powertrain approach is the catenary system (85.5%), followed by battery electric vehicles (76.5%) and fuel cells at 45%. "But it's not as simple as that," said Anthony. "Although catenary powered and BEV are more efficient and cleaner than fuel cell vehicles, the relevance of these alternative powertrains becomes clearer when we look at the whole energy system."

Why? Because the energy system has constraints. On any given day we consume about one terabyte an hour. Because we're phasing out coal and people are unsure about nuclear power, electrifying transport is quite complicated. If we also want to electrify heating because we're phasing out natural gas, it becomes extremely challenging. What's more, the interconnectors that we need to import green electricity from mainland Europe cost billions; over 2000km, the losses are significant.

This whole-systems energy picture is why policymakers are becoming interested in other fuels such as hydrogen.

Topic four

Trial results

TRL's monitoring and evaluation trials for Innovate's UK Low-Emission Freight (LEFT) program have shown that spark ignition natural gas vehicles save around 20% of greenhouse gas emissions over long-haul duty cycles – but when used in city logistics, they actually increase carbon emissions. However, using the right energy pathway (biomethane, instead of CNG) results in GHG savings of around 80%.

"Our research shows that we reach near net-zero heavy goods fleets when we move towards electric powertrains. Battery electric heavy goods vehicles with green electricity can yield 92% and 96% GHG savings in long-haul and city logistics respectively."

Turning to the new Hyundai fuel cell and DAF electric HGVs models already available (or about to be) in Europe, Anthony compared and cited advantages for fuel cell HGVs: more power, higher payload, twice the range, and ten times faster refuelling. The potential economies of scale will lead to cost parity by 2030.

You can watch the webinar on demand. Find out more on the BSI Net Zero page

Why choose BSI?

Climate change has emerged as one of the biggest challenges of our time. Several factors have prompted countries around the world to commit switching to low-carbon economies. It's estimated that warming above 2°C will expose nearly 3bn people to severe climate risk. If warming can be cut to 1.5°C this figure could be halved.

Despite progress in recent years there is still much work to be done. The Paris Agreement aims to achieve net zero balance in the second half of this century and seeks accelerated action from governments across the globe to meet this goal.

Major milestones have already been defined. For example, by 2025, a full net-zero policy package must be in place, and by 2035 almost all new investments (such as cars and heating systems) should be zero-carbon. Further details will be added in the coming months to maintain the UK's credentials ahead of COP26.

As energy costs continue to rise and climate change concerns grow in the public consciousness, low-carbon technology will play a significant role in the world's future plans. It is no longer a question of if the UK will fully embrace the low-carbon economy. Rather, how efficiently we can manage the transition.

The recent global events provide a unique opportunity for many to 'Build Back Better', embedding sustainability with real commitment and in a manner, which evidence each individual effort and strengthen the global effort. Now is the time for action.

So, how will your organization play its part in the energy revolution towards net zero? BSI is here to help with a full range of tailored solutions to support your Net Zero journey.

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