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The shifting landscape of EV batteries: Watt's next?

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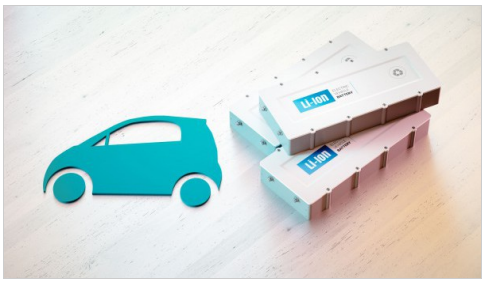
Q&A with Unico



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Battery swapping is an approach in the electric vehicle (EV) industry, featuring two solutions: full battery swaps and modular systems. Full swaps allow for battery replacement at stations, providing convenience but requiring infrastructure investment. Modular systems enable drivers to add battery packs for longer trips, offering flexibility and reduced vehicle weight. Both solutions depend on advancements in battery technology and infrastructure to be effective. As the industry evolves, optimizing performance and safety will be key to widespread adoption. To learn more about this area and other EV battery developments, we spoke to Unico's VP of Engineering, Don Wright. Unico develops lithium-ion batteries for applications such as EVs and renewable energy systems.

Key takeaways:

- The shift toward hybrid vehicles presents challenges for developers, particularly in optimizing battery performance and cost. E-axle development will enhance motor integration for EVs and hybrids.
- Recent layoffs at Tesla reflect a focus on operational efficiency, potentially influencing the broader EV industry to streamline processes and enhance innovation through talent redistribution.
- Future trends suggest that EV battery costs will decrease through the circular economy, maximizing value from first and second-life applications.
- The future of EV testing will harness AI and digital twins for quicker development cycles while maintaining the importance of physical validation. Automotive lithium-ion batteries undergo more testing compared to those in consumer electronics or stationary storage, ensuring safety and performance under conditions.
- Breakthroughs in battery technology, including higher current formation techniques and thermal management, promise efficiency and safety. While improvements in lithium-ion technology will drive short-term adoption, breakthroughs in alternative chemistries will be vital for long-term acceptance and performance.

The following is an edited transcript of the conversation.

S&P Global Mobility: Can you explain the different battery swapping solutions available and their implications for development and testing in the EV industry?

Don Wright: Battery swapping is a promising innovation in the EV industry, with two main solutions emerging: full battery swaps, where a depleted battery is replaced in minutes at dedicated stations, and modular systems, which allow drivers to add extra battery packs for extended trips. While full swaps offer convenience, they require complex infrastructure, whereas modular systems provide flexibility and lighter vehicles. Both approaches, however, hinge on advancements in battery technology and infrastructure to become truly viable.

How do you assess the lifespan of an EV battery, and what factors contribute to determining its residual value post-first life?

Assessing an EV battery's lifespan involves rigorous testing and real-world data collection, analyzing factors like charging patterns and temperature exposure. Residual value is determined by the battery's health, tracked usage and potential for second-life applications, such as energy storage. Emerging tools like battery passports further help evaluate a battery's value post-first life by providing a transparent history of its performance.

With the potential shift back to hybrid vehicles, what challenges do you foresee for EV powertrain and battery developers?

The shift back to hybrid vehicles poses challenges for EV powertrain and battery developers, particularly in optimizing battery performance, cost and efficiency. E-axle development, which enhances electric motor integration, will play a key role, benefiting both EVs and hybrids. This synergy between the technologies promises mutual innovations, driving improvements in energy efficiency, regenerative braking and power management across both vehicle types.

What role do you believe industry standards play in the rapidly evolving battery sector, and how can they impact innovation?

Industry standards are crucial for the fast-evolving battery sector, ensuring safety, interoperability and consistent performance. They provide a foundation for innovation, enabling technologies to work seamlessly across manufacturers and boosting consumer confidence. Standardized interfaces for battery health and safety could streamline development, reduce costs and foster collaboration, ensuring that advancements benefit the entire ecosystem.

What are the critical design factors that EV OEMs must prioritize when developing battery systems?

EV OEMs must prioritize three key factors when designing battery systems: longevity, ensuring batteries retain at least 80% capacity after 8-10 years; safety, with advanced Battery Management Systems to prevent thermal issues; and cost efficiency, balancing affordability with high performance through innovations in battery chemistry and manufacturing. These factors are essential for delivering reliable, competitive EV solutions.

How do you think the recent layoffs at Tesla will affect the broader EV industry landscape?

Tesla's recent layoffs, mainly in administrative roles, reflect a shift from expansion to operational efficiency. While technical teams remain unaffected, the move could push the broader EV industry to streamline operations and focus on cost management. Additionally, displaced talent may find opportunities in other EV companies, potentially driving innovation through a dynamic exchange of expertise.

Can you discuss the importance of EV battery health and the standards currently in place for health testing?

EV battery health is essential for performance and longevity, with capacity tests being a basic method to assess it. Industry standards, set by organizations like SAE and IEC, guide more rigorous testing to ensure consistency. Advanced diagnostics and battery management systems provide real-time data, helping to monitor battery health and extend its lifespan, ensuring EVs remain efficient and reliable.

What trends do you see influencing the cost of EV batteries, and how low can prices realistically go?

EV battery costs are poised to drop significantly through the circular economy. By maximizing battery value across its first life, second life as energy storage, and material recycling, the effective cost of batteries could be reduced drastically. Coupled with advances in technology and recycling efficiency, this approach promises a more affordable and sustainable future for electric vehicles.

How do you envision the future of EV testing and certification evolving, particularly in terms of accelerating battery development?

The future of EV battery testing will be revolutionized by AI and digital twins, allowing virtual simulations to accelerate development cycles and improve accuracy. However, validation through physical tests and industry-wide standardization will remain key to ensuring reliability and safety. This hybrid approach promises faster innovation and more efficient certification processes for battery technologies.

Can you briefly outline the different testing demands of automotive lithium-ion batteries versus other commercial applications, such as consumer electronics or stationary energy storage?

Automotive lithium-ion batteries face far more rigorous testing than those in consumer electronics or stationary energy storage. EV batteries must endure extreme temperatures, vibrations, and crash simulations to ensure safety and performance, while consumer electronics batteries are tested for everyday usage and charging cycles. Stationary batteries focus on long-term reliability and capacity retention in controlled environments, with less emphasis on impact or extreme temperature resistance.

Can you briefly outline the different testing demands of automotive lithium-ion batteries versus automotive lead-acid batteries? How do you quantify and assess the impact of cyclability?

Testing automotive lithium-ion batteries involves rigorous conditions including cyclability tests, extreme temperatures, and safety assessments to ensure long-term performance and safety. I am not an expert on lead acid battery testing so I can't comment there. Cyclability is quantified by tracking capacity retention and state of health across numerous charge-discharge cycles, providing insights into how well the battery maintains performance over time.

What battery technology breakthroughs are you anticipating and most looking forward to in the coming years?

Exciting breakthroughs in battery technology are on the horizon, including higher current formation techniques that could extend battery life by up to 50%. Additionally, AI and digital twins are set to

revolutionize battery testing and optimization, while advanced thermal management will improve performance in extreme conditions. These innovations promise to significantly enhance the efficiency, safety and environmental impact of future electric vehicles.

Do you believe that batteries for BEV applications will achieve wide consumer acceptance with improvements to incumbent lithium-ion technology, or do you believe that a technological breakthrough in alternative chemistries or electrolyte types is required?

Incremental improvements in lithium-ion batteries, such as better energy density and faster charging, are already addressing key concerns like range anxiety, and are likely to drive wider BEV adoption in the near term. However, breakthroughs in technologies like solid-state and lithium-sulfur batteries, with their potential for higher performance and safety, will be crucial for the long-term evolution of the industry and broader consumer acceptance ... if the solid-state packaging challenges can be overcome.

Achieving a linear charging profile when receiving high power levels remains one of the biggest technical challenges to battery makers and OEMs when looking to improve battery charging. Can you outline the levers at the disposal of the battery management system calibrator to improve this? Do you believe a linear 0-100% SOC charge can ever be achieved without degrading battery health?

Achieving a fully linear 0%-100% charging profile at high power levels is challenging due to the need to slow down charging as batteries approach full capacity to protect their health. While it's unlikely we'll see linear charging without degrading battery life, high-speed charging from 20% to 80% is both practical and effective, offering quick range boosts during road trips. The key is balancing charging speed with battery longevity, adapting our expectations and taking advantage of fast-charging infrastructure.

Do you see a role for supercapacitors in mainstream automotive applications moving forward? If so, in what function and at the expense of which other energy storage medium, if any?

Supercapacitors have a niche role in automotive applications, particularly for delivering rapid bursts of energy in systems like regenerative braking. However, their high cost and lower energy density make them less competitive against evolving battery technologies like Lithium Iron Phosphate (LFP). While they won't replace conventional batteries, supercapacitors could complement them in hybrid systems, optimizing performance in specific high-power applications.

The Global auto battery cell production capacity tracker - June 2024 is an update of the EV battery capacity forecast developed by S&P Global Mobility in February 2022. The tracker captures plant-level lithium-ion cell capacity for 2023-2030 period and tracks 214 plants in six key regions— Greater China, Europe, Middle East, North America, Japan/Korea, and South Asia. The database also gives details on what will be the volume from LV segment at each of these plants and the expected level of utilization.

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