# The Benefits of 3D Tech for Electric Vehicle Battery Assembly

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For Rivian Automotive Inc., the upstart Amazon-backed electric vehicle company, late 2021 and 2022 have been a wild ride. In its initial public offering back in November the paper tiger soared to nearly $107 dollars a share and instantly became one of the world's most valuable automakers. By January, however, its stocks had seesawed following news that a competitor was working with Amazon and in the spring unreliable delivery timelines were adding to the company's headaches.

Regardless of the recent automotive turmoil and the ever-evolving competitive landscape, one thing is clear: *belief* in electric vehicles is soaring, almost *regardless* of who's making them or who's making/shipping their constituent parts. The roadmap for the future is that companies like Tesla, like Rivian, like legacy brands, and others not yet founded, will be the ones powering the de-carbonization of the global transportation network.

For those in the business of precision measurement, automotive assembly plants and their original equipment manufacturers (OEMs), the belief in future EV sales have important manufacturing impacts. That's because as belief translates into actual middle class demand, production schedules will need to accelerate. This is especially true when it comes to lithium-ion battery assembly, the eco-friendlier engineering component that's key to EV success.

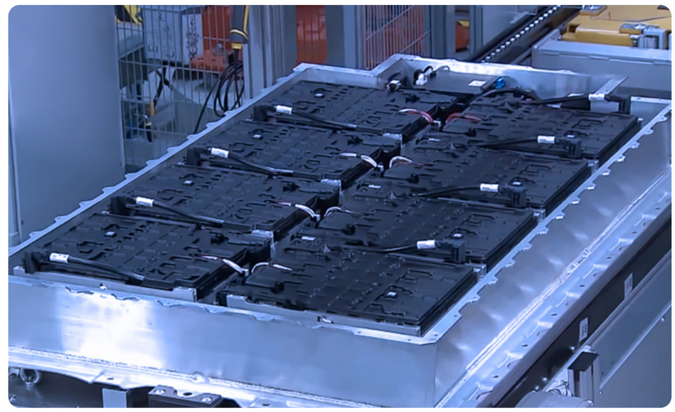
## The Fast Lane to Success

As the most fully-realized commercial alternative to the internal combustion engine (or ICE) ramping up EV production while maintaining both assembly plant and consumer safety is of paramount concern. So, too, is the need to lower vehicle purchasing costs in order to ensure predicted adoption rates actually materialize, reducing greenhouse gas emissions. At present there are 5.6 million electric vehicles worldwide and one million registered in the US. Both figures are expected to grow significantly over the next 30 years.


One of the best ways to achieve the three-way goal of production efficiency, consumer and worker safety and long-term climate benefits, is by adopting 3D laser scanning as well as contact and non-contact portable coordinate measuring machines, or PCMMs. That includes the real-time reality capture of not only the component parts of lithium-ion batteries to confirm whether or not they have gone out of or will go out of tolerance, but also the industrial machines themselves, aiding human workers in EV manufacture.

By lowering costs, reducing waste, cutting down on rework and speeding production, manufacturing expenditures will tick downward and the environmental benefits will only increase. Add in the accelerating adoption rate of the “smart factory” — an IoT-enabled supercenter where WiFi-connected PCMMs, cobots, and remote sensing devices share measurement and machine output data in real-time to augment digital twins of said factory, providing facility managers unprecedented line-of-sight on overall plant performance — and the result is even more significant efficiency and safety gains. Considering that the automotive sector is already regarded as a leader in smart factory adoption, dedicating around 2.2% of revenue to that end, its likely that those gains will only increase, amounting in some estimates, to up to $167 billion industry-wide, according to Paris-based Capgemini, an IT services and consulting firm.

## EV Battery Building Basics



For EV battery production, smart factories and existing PCMM/laser scanning can help maximize incremental technology gains. And from those advances, capitalize on additional benefits. As it stands, EV batteries comprise 30 percent of the total electric vehicle cost. And of that 30%, 40% is manufacturing costs. Efficiency gains here allow dollars to be re-distributed toward R&D, for example, where future innovations will likely increase battery range while further reducing charging time. This is critical as it’s the two areas where consumers continue to feel trepidation about making the ICE to EV switch.

Ideal for measuring and inspecting high-tolerance, high-end parts, PCMMs seamlessly scan across diverse surface materials regardless of contrast, reflectivity, or part complexity without any special coatings or target placement. They can also perform in-process verification so that each lithium-ion battery that comes off the assembly line is inspected in real time and conforms to established specs. This is true for a part’s complete run, but also for first article inspection. PCMMs with ergonomic design, hot swappable batteries and multiple probe tips means that parts/equipment inspection can continue with marginal interruption.

Similarly, the technology that ensures product quality control can also ensure the machines assembling the batteries are on par. Combined with the latest artificial intelligence and predictive analytic algorithms, (as part of the smart factory) spot checks on assembly machines can be performed automatically, alerting maintenance engineers via WiFi networks of the need to replace a faulty device, before a damaged battery ever leaves the factory in the first place.

When it comes to plant layout, assembly line efficiency and worker safety, here, too, 3D laser scanning can prove a useful tool. By capturing in real-time the exact orientation and spatial positioning of personnel, machines and assembly lines and converting that information into millions of points of data, facility managers can better assess what will work best in a plant expansion or its retrofit to service alternative needs, sometimes with entirely new equipment.

Compared to manual measurement techniques, tape measures, calipers, etc., as well as larger, more expensive, and assembly line-separated fixed coordinate measuring machines, PCMMs are leagues ahead.

## ‘Charged’ for the future

Ultimately, every EV lithium-ion battery that rolls off the assembly line follows a nearly identical template. According to a 2020 Elsevier-published feasibility study on lithium-ion batteries and the potential of automated assembly:

Lithium-ion batteries are made up of cells joined together via ultrasonic weld to make a module. (Ultrasonic welding — “a solid-state welding process that produces a weld by local application of high-frequency vibratory energy [in the range of 20 kHz to 40 kHz] while the work pieces are held together under pressure” — is ideal for welding across dissimilar materials and across multiple layers.) Multiple modules constitute a pack. Packs are stacked and welded together with mechanical fixings that can be disassembled with ease if servicing is required. These modules can include individual thermal management systems, which are used to control cell temperature.

In addition to the materials required for the anode, cathode and electrolyte (the building blocks of any battery) they also require cooling systems, battery management systems, insulation packages, central module contractor systems, sensors and housing for both individual modules and the entire battery pack itself. For the casual consumer, filled with the belief that EVs contain few moving parts and are thus less complex machines compared to their traditional combustion vehicle cousins, it’s important to highlight the above complexity. It also underscores just how many components go into lithium-ion battery creation and electric vehicles overall and by extension the value that 3D laser scanning and PCMMs represent in scanning so many individual parts.

As the global community prepares for COP 27 in November in Egypt, the importance of widespread electric vehicle adoption couldn’t be clearer as the world continues to emit gigatons of heat trapping, climate warming carbon dioxide into the atmosphere. In 2019 the annual figure stood at 43 billion tons. And for the last 10 years that’s meant a 2.4 parts per million per year increase in its atmospheric concentration.

So while it’s true 3D laser scanning and PCMM parts analysis are key to aiding various forms of safety, for the assembly line manufacturer and for the EV consumer alike, the ultimate safety may yet come in the form of how these companion precision measurement technologies, working as part of the smart factory of the (near) future, help enable a greener, cleaner future for us all.

If there's to be any hope of reversing human-accelerated climate change, it will rely on our collective embrace of a low-carbon future. And electric vehicles and their powerful lithium-ion batteries, smartly built, in increasingly smart factories, are central to that mission.

## Speedy Takeaways:

- Even if electric vehicle adoption rates remain low compared to the total number of internal combustion vehicles on the road today, belief in their accelerating popularity is a paramount driver of future growth.
- One of the best ways to achieve production efficiency, consumer and worker safety and long-term climate benefits, is by adopting 3D laser scanning as well as contact and non-contact PCMMs.
- 3D laser scanning and PCMMs help lower costs, reduce waste, cut down on rework and speed production. And as manufacturing expenditures lower, the environmental benefits will only increase.
- The smart factory — an IoT-enabled supercenter where WiFi-connected PCMMs, cobots, and remote sensing devices share measurement and machine output data in real-time to augment digital twins of the factory in question — will provide facility managers unprecedented line-of-sight on overall plant performance.
- For EV battery production, smart factories and existing PCMM/laser scanning can help maximize incremental technology gains. Ideal for measuring and inspecting high-tolerance, high-end parts, PCMMs seamlessly scan across diverse surface materials regardless of contrast, reflectivity, or part complexity without any special coatings or target placement and can also perform in-process verification so that each battery that comes off the assembly line is inspected in real time and conforms to established specs; true for a part's complete run or as first article inspection.

## About the Author

Rich Nobliski is the Integrated Marketing Director for 3D Metrology for FARO Technologies, Inc. A versatile and adaptable professional with a deep understanding of the 3D Metrology market including market trends and extensive experience in software as a service marketing, Rich is able to strategize and work hands-on with complete marketing campaign/ program execution. He has also made a positive impact in the manufacturing field at FARO, Siemens Digital Industries Software, and volunteers supporting the next generation of marketers with the American Marketing Association. His professional credentials include: Master of Business Administration in Project Management and Marketing, Bachelor of Science in Computer Integrated Manufacturing and a variety of marketing awards.