



# DECARBONIZE MOBILITY FROM END TO END TO REACH NET ZERO

Connect the automotive ecosystem and value chain  
on a science-based platform to decarbonize mobility

Meet Our Experts

The Need  
to Decarbonize

---

Sustainable Designs  
and Processes

Battery Innovation  
and Value Chain  
Management

Drive Decarbonization  
by Going Circular

---

Destination Net Zero  
is Within Reach

# MEET OUR EXPERTS



## FLORENCE VERZELEN

Industry, Field Marketing and Sustainability Executive Vice President, Dassault Systèmes

Florence Verzelen has held sales, operations and general management positions in the energy, software, automotive and retail industries for over 15 years. In the public sector, she worked for the European Commission and the Ministry of Foreign Affairs. She is also a director in leading CAC 40 companies, including Air France and PSA.



## LAURENCE MONTANARI

Transportation & Mobility Industry Vice President, Dassault Systèmes

Equipped with nearly 30 years of automotive engineering and business experience, Laurence Montanari spearheads initiatives that help automotive companies leverage the **3DEXPERIENCE®** platform to adapt and thrive in a market-changing era defined by mobility-as-a-service, sustainability priorities and new consumer experiences.



## FREDERIC MERCERON

Transportation & Mobility Solutions Director, Dassault Systèmes

Frederic Merceron is responsible for delivering innovative solutions to automotive manufacturers and suppliers, helping them create innovative consumer experiences. In his previous roles at Dassault Systèmes, he was instrumental in developing simulation lifecycle management solutions and generative body design methodologies.

## Meet Our Experts

The Need to Decarbonize

Sustainable Designs and Processes

Battery Innovation and Value Chain Management

Drive Decarbonization by Going Circular

Destination Net Zero is Within Reach



# THE NEED TO DECARBONIZE

The world is emitting around [50 billion tons](#) of greenhouse gases each year, making climate change one of today's biggest environmental challenges.

Transportation is responsible for [16%](#) of direct greenhouse gas (GHG) emissions from fuel combustion and it's projected to grow faster than any other sector. Road vehicle use alone accounts for [12%](#) of global GHG emissions.

While there is no simple fix to tackle climate change, electrification is getting road transportation on track as one of the key drivers of sustainable mobility.

Due to consumer pull and an industry and policy push of electric vehicles (EV), the number of electric cars, buses, vans and heavy

trucks on roads is expected to hit [145 million](#) by 2030 to make up 7% of total road transportation. This will reduce GHG emissions by more than one-third.

The expanding fleet of EVs will continue to reduce well-to-wheel GHG emissions, but creating a carbon-free future for automotive, transportation and mobility cannot rely on electrification alone.

There's an urgency for an end-to-end transformation that covers sustainable ways of managing automotive products, parts and services over their entire lifecycle. This includes each stage of vehicle concept, design, engineering, manufacture, use and end-of-life.

Meet Our Experts

The Need to Decarbonize

Sustainable Designs and Processes

Battery Innovation and Value Chain Management

Drive Decarbonization by Going Circular

Destination Net Zero is Within Reach

“There’s an enormous opportunity for sustainable innovation in the mobility space, which can be enabled and accelerated by technology, from researching new recyclable and lightweight materials to simulating new forms of batteries in virtual environments.”

– **Florence Verzelen**

Industry, Field Marketing and Sustainability  
Executive Vice President, Dassault Systèmes

## ROUTE TO NEW OPPORTUNITIES

With more consumers looking for greener transportation choices and stricter regulations in place, how can automotive industry players get on the fast track to decarbonize mobility in a way that satisfies market needs and supports carbon-neutral targets in the long term?

An integrated platform with science-based capabilities can help manufacturers get on the right track and gain a time advantage to reduce the carbon footprint of EV production across the entire value chain. By enabling ecosystem stakeholders to develop and deliver greener vehicles together, multiscale and multidisciplinary solutions can be implemented to power discovery, innovation and optimization from start to finish.

Although climate change is one of the world's greatest challenges, the transition from internal combustion to EVs also offers the different subsectors in the industry one of the greatest opportunities in human history – to drive sustainable innovation in automotive, transportation and mobility.

Read on to discover how an integrated platform with science-based capabilities can help drive end-to-end sustainable mobility with:



Sustainable designs and processes



Battery innovation and value chain management



Circular economy practices

Meet Our Experts

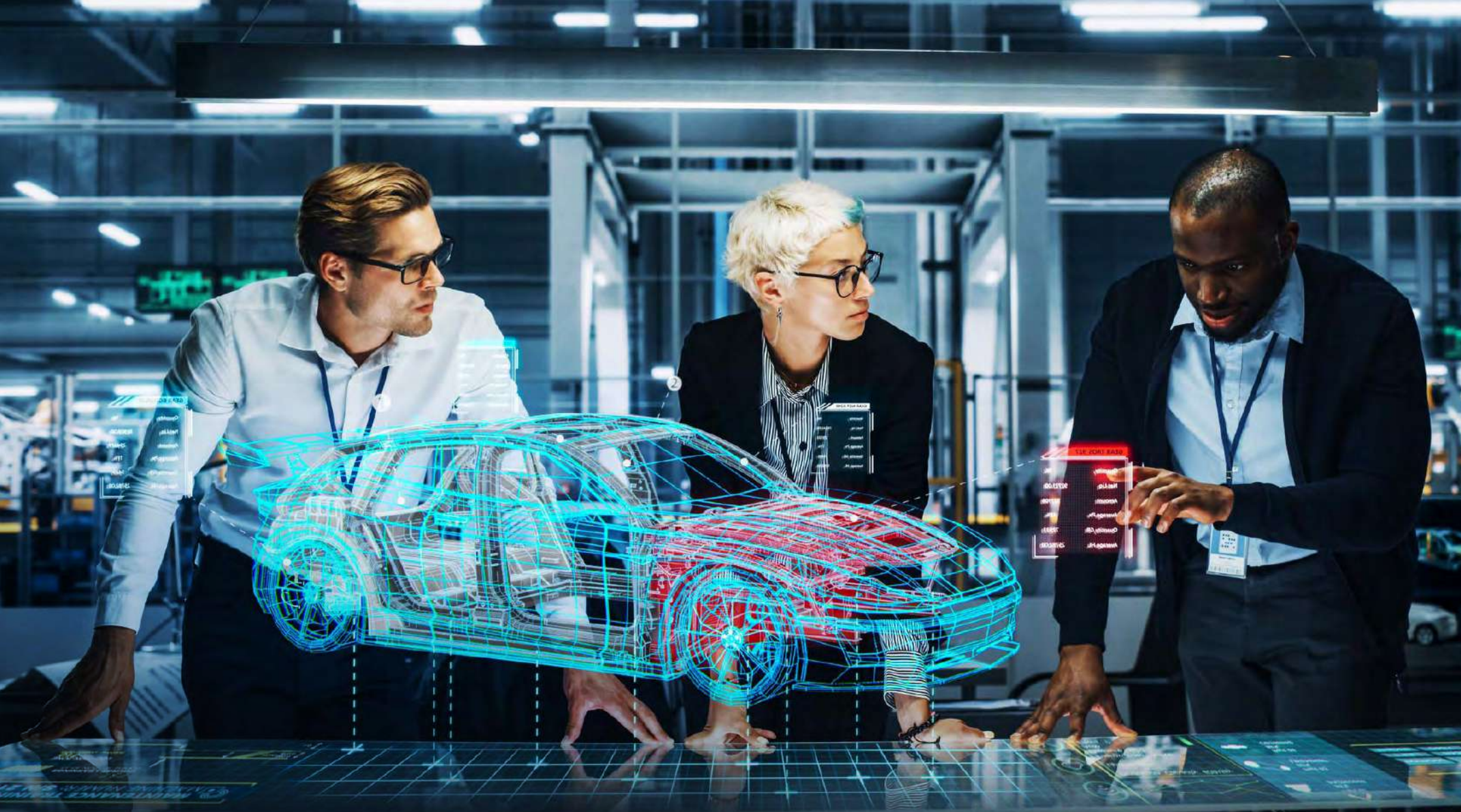
The Need  
to Decarbonize

Sustainable Designs  
and Processes

Battery Innovation  
and Value Chain  
Management

Drive Decarbonization  
by Going Circular

Destination Net Zero  
is Within Reach



# SUSTAINABLE DESIGNS AND PROCESSES

Meet Our Experts

The Need  
to Decarbonize

Sustainable Designs  
and Processes

Battery Innovation  
and Value Chain  
Management

Drive Decarbonization  
by Going Circular

Destination Net Zero  
is Within Reach

## OPTIMIZE EV DESIGN

Vehicle electrification completely upends many fundamental assumptions of vehicle design and its impact on carbon footprint. Engineers need to analyze and optimize vehicle performance and efficiency early in the development process.

“Automotive manufacturers need to bring together thousands of parts to be assembled into a complete vehicle. It's crucial to get all stakeholders involved in the process as early as possible to boost innovation and mitigate risk.”

– **Laurence Montanari**

Transportation and Mobility Industry Vice President  
Dassault Systèmes

Achieving low-carbon commuting requires optimal EV design. All else being equal, a heavier vehicle will consume more energy to reach and maintain a given speed than a lighter one.

Through the **3DEXPERIENCE** platform, manufacturers can efficiently improve their automotive design strategy with virtual twin technology and other advanced digital solutions such as computational modeling and simulation.



Meet Our Experts

The Need  
to Decarbonize

Sustainable Designs  
and Processes

Battery Innovation  
and Value Chain  
Management

Drive Decarbonization  
by Going Circular

Destination Net Zero  
is Within Reach



By digitalizing product development on a single platform, automotive manufacturers can integrate modeling and simulation technologies to create the virtual twin of a new EV and reduce reliance on physical prototype testing.

“ The virtual twin contains the complete definition of the new vehicle design including its geometry, electronics and software. Throughout development, the virtual twin provides a consistent and consolidated view of information.”

– **Frederic Merceron**  
Transportation & Mobility Solutions Director  
Dassault Systèmes

Analyzing a virtual twin's design, behavior and manufacturability helps manufacturers design high performance vehicles that are lighter, recyclable and can be disassembled with ease at end of life – all key contributors to reducing GHG emissions.

## Meet Our Experts

### The Need to Decarbonize

---

### Sustainable Designs and Processes

### Battery Innovation and Value Chain Management

### Drive Decarbonization by Going Circular

---

### Destination Net Zero is Within Reach

## FULLFILL INDUSTRY REQUIREMENTS

With the climate change agenda taking center stage globally, strict regulations have been put into place to minimize CO<sup>2</sup> emissions. Vehicle recyclability is a key focus area for regulators. For example, manufacturers need to adhere to Europe's End of Life Vehicles Directive.

Through the **3DEXPERIENCE** platform's digital compliance management solution, manufacturers are able to work with suppliers to aggregate information that includes breakdown of individual materials of construction and the chemical substance formulation of each material of construction.

Another industry requirement is the Worldwide Harmonized Light Vehicles Test Procedure (WLTP), which guides manufacturers on evaluating vehicle emissions and consumption as well as reporting the expected range for electric vehicles. Under WLTP, every configuration that will affect vehicle performance needs to be tested.

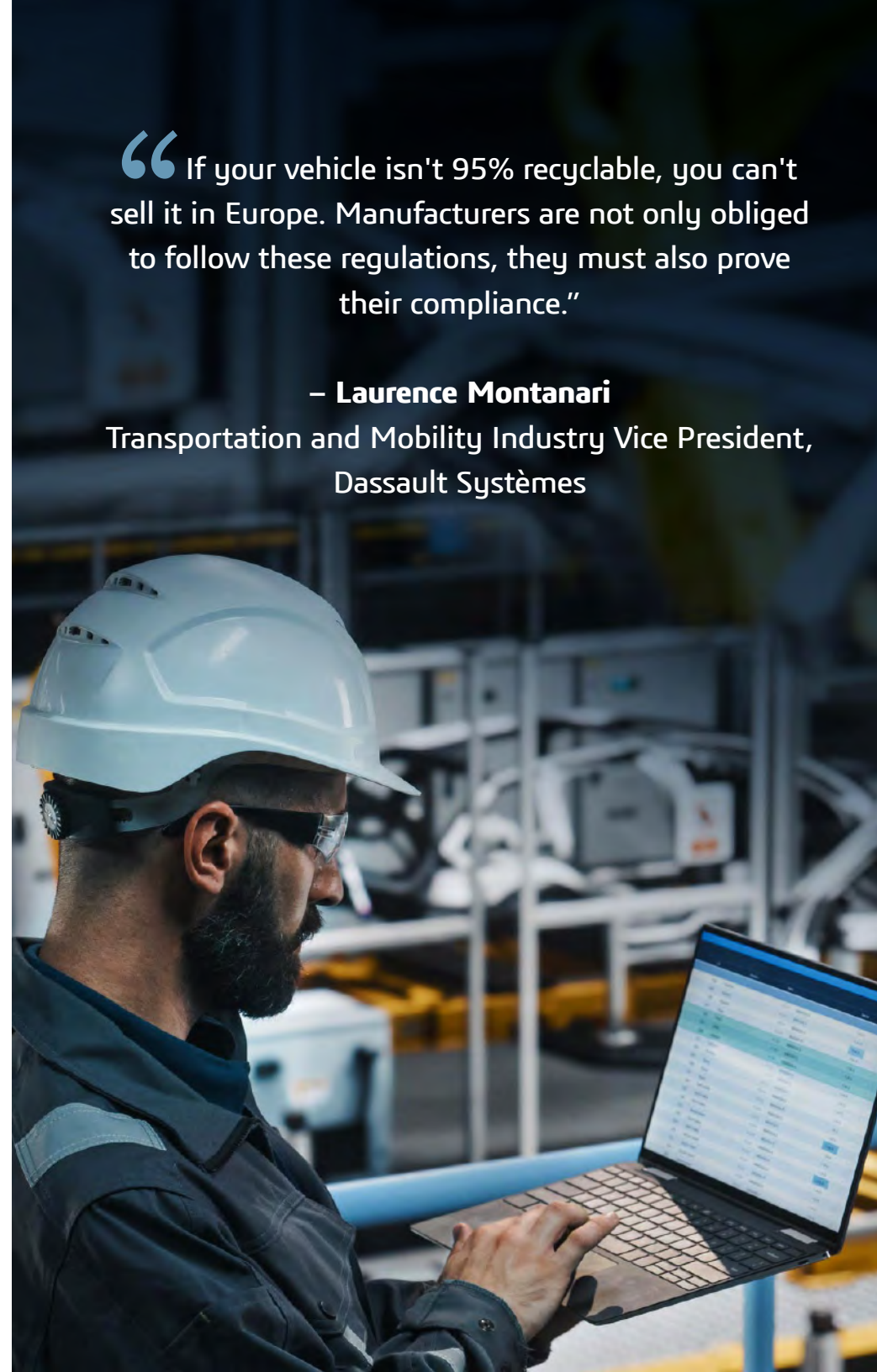
With virtual testing allowed as a substitute for physical testing at wind tunnel facilities, the entire vehicle can be analyzed virtually to cut development time and costs by avoiding the backlog at fully booked test facilities. This enables manufacturers to meet the WLTP's stringent limits on emissions while ensuring on-target vehicle launches.

For example, manufacturers can leverage computational fluid dynamics simulation to optimize aerodynamic designs and improve overall vehicle performance.

“ If your vehicle isn't 95% recyclable, you can't sell it in Europe. Manufacturers are not only obliged to follow these regulations, they must also prove their compliance.”

– **Laurence Montanari**

Transportation and Mobility Industry Vice President,  
Dassault Systèmes



Meet Our Experts

The Need  
to Decarbonize

Sustainable Designs  
and Processes

Battery Innovation  
and Value Chain  
Management

Drive Decarbonization  
by Going Circular

Destination Net Zero  
is Within Reach



# BATTERY INNOVATION AND VALUE CHAIN MANAGEMENT

Meet Our Experts

The Need to Decarbonize

Sustainable Designs and Processes

Battery Innovation and Value Chain Management

Drive Decarbonization by Going Circular

Destination Net Zero is Within Reach



## BETTER BATTERY LIFE AND PERFORMANCE

While the motor is the source that actually propels an EV, the battery pack is its heart and soul. The rapid transition to electric drive will increase global battery production, with [90%](#) of battery demand coming from EVs over the next two decades.

Lithium-ion battery production is a crucial differentiator in the industry's net zero initiatives. Although EVs create a lower carbon footprint over the course of their lifetime compared to conventional vehicles, lithium-ion battery production emits a significant amount of carbon dioxide and this emission could become more substantial as longer-range electric vehicles with larger batteries become mainstream.

Adapting to today's global imperative to be more sustainable calls for faster and better innovation to make batteries last longer and preserve their efficiency.

Increasing battery density enables longer vehicle lifetimes and fewer replacements, cutting down the carbon footprint to manufacture more EVs and batteries.

Additionally, higher charging and discharging efficiencies will lead to lower energy consumption during the battery's use phase. Cell designs using recycled materials and battery chemistries with lower carbon intensity can also reduce emissions in the manufacturing phase.

Meet Our Experts

The Need to Decarbonize

---

Sustainable Designs and Processes

Battery Innovation and Value Chain Management

Drive Decarbonization by Going Circular

---

Destination Net Zero is Within Reach

Battery development can be complex, costly and time-consuming when it comes to finding new active materials or processes. A key capability to simplify and accelerate module and cell engineering is the virtual twin.

Built on mathematical and physical laws, it represents an accurate and dynamic model of a battery pack integrated into a full vehicle model. System-level simulation connects the battery model to the other EV components in order to analyze how they interact.

Battery packs integrated into full vehicle models can be simulated for realistic test conditions. Simulations of durability and battery degradation model the behavior of EV components across their entire lifespan, allowing years of use to be modeled and analyzed within hours to optimize battery engineering.

Through the **3DEXPERIENCE** platform's chemistry modeling capabilities, manufacturers can optimize battery design materials for aging. With a model-based, multi-discipline system simulation, they can validate molecular level characteristics to optimize an individual cell's mechanical, thermal, diffusion and electrical behaviors.

“The virtual twin is extremely helpful for building and operating complex systems. It allows thousands of stakeholders to test a 3D replica in different simulated scenarios to optimize the design for sustainability and performance. 85% of the EVs in the market today were designed with Dassault Systèmes' virtual twin technology.”

– **Florence Verzelen**

Industry, Field Marketing and Sustainability  
Executive Vice President, Dassault Systèmes



Meet Our Experts

The Need  
to Decarbonize

Sustainable Designs  
and Processes

Battery Innovation  
and Value Chain  
Management

Drive Decarbonization  
by Going Circular

Destination Net Zero  
is Within Reach

## SUSTAINABLE MATERIALS, RESOURCES AND TECHNIQUES

Lithium-ion battery production for EVs is energy intensive and produces substantial GHG emissions because of the high heat and sterile conditions involved to extract and refine minerals like lithium, cobalt and nickel.

With lithium consumption expected to increase by [400%](#) by 2025, manufacturers need to find sustainable solutions to address challenges across the lithium-ion battery value network.

Automotive manufacturers can take a virtual model-based approach to sustainable battery resource extraction, development and production.

Through the virtual twin experience, manufacturers can access a single, accurate 3D representation of complex and high-volume data to explore material and process options before validating decisions without physical battery prototypes.

For example, they can explore a new catalyst for lithium extraction that can eliminate the need for extraction fields in a processing plant.

Reinventing a mining process, however, is complex and the idea must be tested and proven to work before regulators, investors and local communities approve it. Manufacturers can use the virtual twin of a new catalyst as an in silico model to simulate and analyze how lithium will behave and plan for its safe extraction over its lifecycle.

Engineers can also assess and experiment with every aspect of the battery pack – from chemistry and materials – to cell, module, and pack design while minimizing their raw materials use.

Modeling ideas for new materials and processes in the virtual world and testing these new methods to demonstrate their safety, sustainability and viability can help manufacturers avoid costly trial-and-error associated with physical prototypes. Additionally, virtual twin technology encapsulates and automates best practices by utilizing reusable protocols.



Meet Our Experts

The Need to Decarbonize

Sustainable Designs and Processes

Battery Innovation and Value Chain Management

Drive Decarbonization by Going Circular

Destination Net Zero is Within Reach



## AN INTEGRATED ECOSYSTEM

EV battery innovation can't be carried out through standalone initiatives because battery production is deeply embedded in the EV manufacturing ecosystem and doesn't exist in isolation.

For optimal results, manufacturers must ensure that the value network isn't hindered by silos caused by manual dispatch, conversion and control.

To integrate the value chain and break down silos, all stakeholders must be connected in one place – especially those of Computer-Aided Design (CAD), Engineering (CAE) and Manufacturing (CAM) tools and Product Lifecycle Management (PLM) systems.

“The optimal platform unites diverse stakeholders in one collaborative environment. With complete visibility, manufacturers gain valuable insights to optimize the vehicle at every lifecycle stage.”

– **Frederic Merceron**  
Transportation & Mobility Solutions Director,  
Dassault Systèmes

Meet Our Experts

The Need  
to Decarbonize

Sustainable Designs  
and Processes

Battery Innovation  
and Value Chain  
Management

Drive Decarbonization  
by Going Circular

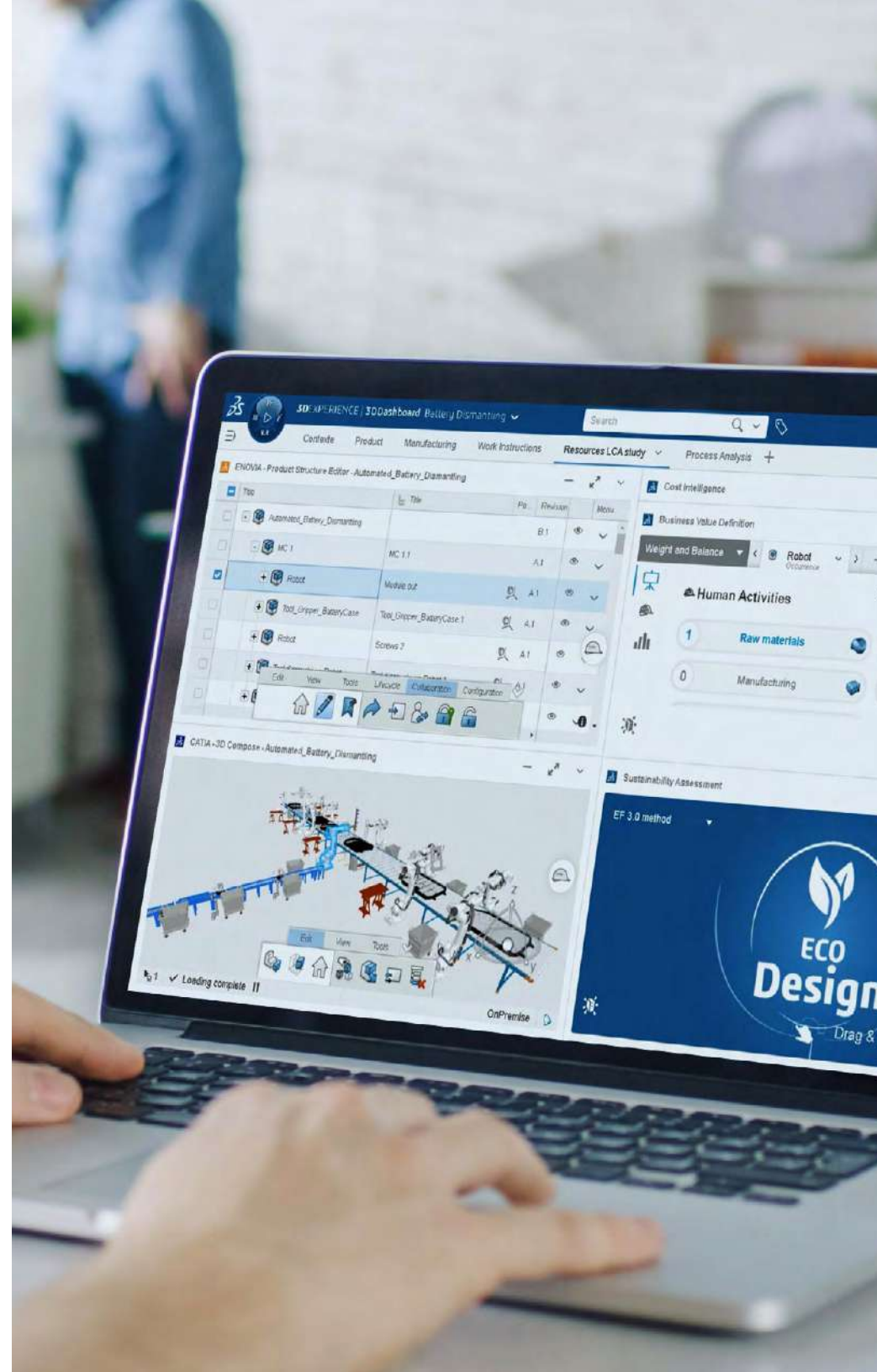
Destination Net Zero  
is Within Reach

The **3DEXPERIENCE** platform brings together systems engineering, modeling, simulation and project management tools to support collaboration and streamline all processes on a single cloud-based platform.

Manufacturers can plan, manage and ensure traceability of environmental performance across the entire battery product and process lifecycle. Integrating data and processes enables them to:

- Minimize errors and increase efficiency
- Identify and mitigate GHG emissions
- Accurately target sustainability efforts
- Demonstrate environmental impact to regulators and stakeholders
- Increase compliance with global sustainability regulations

As the single source of truth that collects and verifies important information through an accountable and transparent process, the **3DEXPERIENCE** platform is crucial for the success of the [Battery Passport](#), which serves as a valuable resource to achieve sustainable mobility targets.



Meet Our Experts

The Need to Decarbonize

Sustainable Designs and Processes

Battery Innovation and Value Chain Management

Drive Decarbonization by Going Circular

Destination Net Zero is Within Reach



# DRIVE DECARBONIZATION BY GOING CIRCULAR

Meet Our Experts

The Need  
to Decarbonize

---

Sustainable Designs  
and Processes

Battery Innovation  
and Value Chain  
Management

Drive Decarbonization  
by Going Circular

---

Destination Net Zero  
is Within Reach



## CLOSE THE LOOP

23 million EV cars are targeted to be sold globally in 2030, leading to [5,750,000 tons](#) of retired batteries by 2040.

Discarding these batteries into landfills – with toxic compounds possibly leaking into the environment and defective or degraded cells potentially causing landfill fires – will be dire for long-term sustainability goals.

To reduce their environmental impact, creating a circular supply chain by recycling the batteries' raw materials will be crucial.

Model-based engineering is a key driver for change and manufacturers can leverage circular economy practices to help reduce the carbon footprints of retired EV batteries. These batteries can be reused, repackaged or 'second-life' cycled.

Through the **3DEXPERIENCE** platform, manufacturers can leverage simulation technology to virtually analyze the recycling cost of several battery chemistries and various recycling methods to find the optimal recycling process.

Meet Our Experts

The Need  
to Decarbonize

Sustainable Designs  
and Processes

Battery Innovation  
and Value Chain  
Management

Drive Decarbonization  
by Going Circular

Destination Net Zero  
is Within Reach



With this insight, manufacturers are able to avoid energy-and-emission-intensive material processing while enabling valuable metals such as cobalt and nickel to be recovered. This helps lower demand for these raw materials and secure an alternative raw materials supply chain.

By leveraging in silico modeling and virtual twin technology, manufacturers can also test and validate how a second-life battery market can enable retired vehicle batteries to support the electric grid for years, further reducing GHG emissions attributed to all vehicles.

## DECARBONIZE THE GRID

Renewables are projected to produce over half of global electricity production by [2035](#) and global industries are transitioning to more sustainable power generation options for their needs.

The transition to an energy mix featuring more renewable energies is picking up pace with over [300](#) diverse global companies committing to procure 100% of the electricity needed for their operations from renewable sources.

With significant cost reduction and new innovations in sustainable energy sourcing and management, switching to renewable energy sources can help automotive manufacturers cut down on their long-term carbon footprint.



Meet Our Experts

The Need  
to Decarbonize

Sustainable Designs  
and Processes

Battery Innovation  
and Value Chain  
Management

Drive Decarbonization  
by Going Circular

Destination Net Zero  
is Within Reach

“ At Dassault Systèmes, we’re able to make use of our extensive experience in other industries that link to mobility. For instance, we work with energy and materials businesses that produce hydrogen, electricity, nuclear and so on. We also have customers in the cities and territories industry that manage energy production and storage infrastructure including smart grids. It makes great sense to involve these companies in the automotive ecosystem.”

– **Frederic Merceron**

Transportation & Mobility Solutions Director,  
Dassault Systèmes

Meet Our Experts

The Need  
to Decarbonize

---

Sustainable Designs  
and Processes

Battery Innovation  
and Value Chain  
Management

Drive Decarbonization  
by Going Circular

---

Destination Net Zero  
is Within Reach



Roughly half of EV batteries' [CO<sup>2</sup> emissions](#) are produced from electricity usage in the manufacturing process. This makes decarbonization of the grid the single largest driver of emission reductions for EVs, both in the manufacturing and use phase.

A [30%](#) decrease in grid carbon intensity can reduce emissions from the battery production chain by about 17%, in addition to even larger reductions in the use phase.

The **3DEXPERIENCE** platform's systems simulation technology can play a vital role in the conception of grid decarbonization to ensure that all components are correctly designed and work together as a system.

Manufacturers can simulate and test the design of high-voltage power-grid components such as transformers that require electromagnetic, thermal and structural effects to be considered simultaneously.

With a virtual twin of the entire grid system, manufacturers can accurately run a tightly-integrated, multi-domain analysis to measure how each domain of physics is tightly linked to the others. For instance, electric currents can overheat the device, while vibrations can cause mechanical damage.

Meet Our Experts

The Need to Decarbonize

Sustainable Designs and Processes

Battery Innovation and Value Chain Management

Drive Decarbonization by Going Circular

Destination Net Zero is Within Reach

## POWER UP LIFECYCLE ASSESSMENT (LCA)

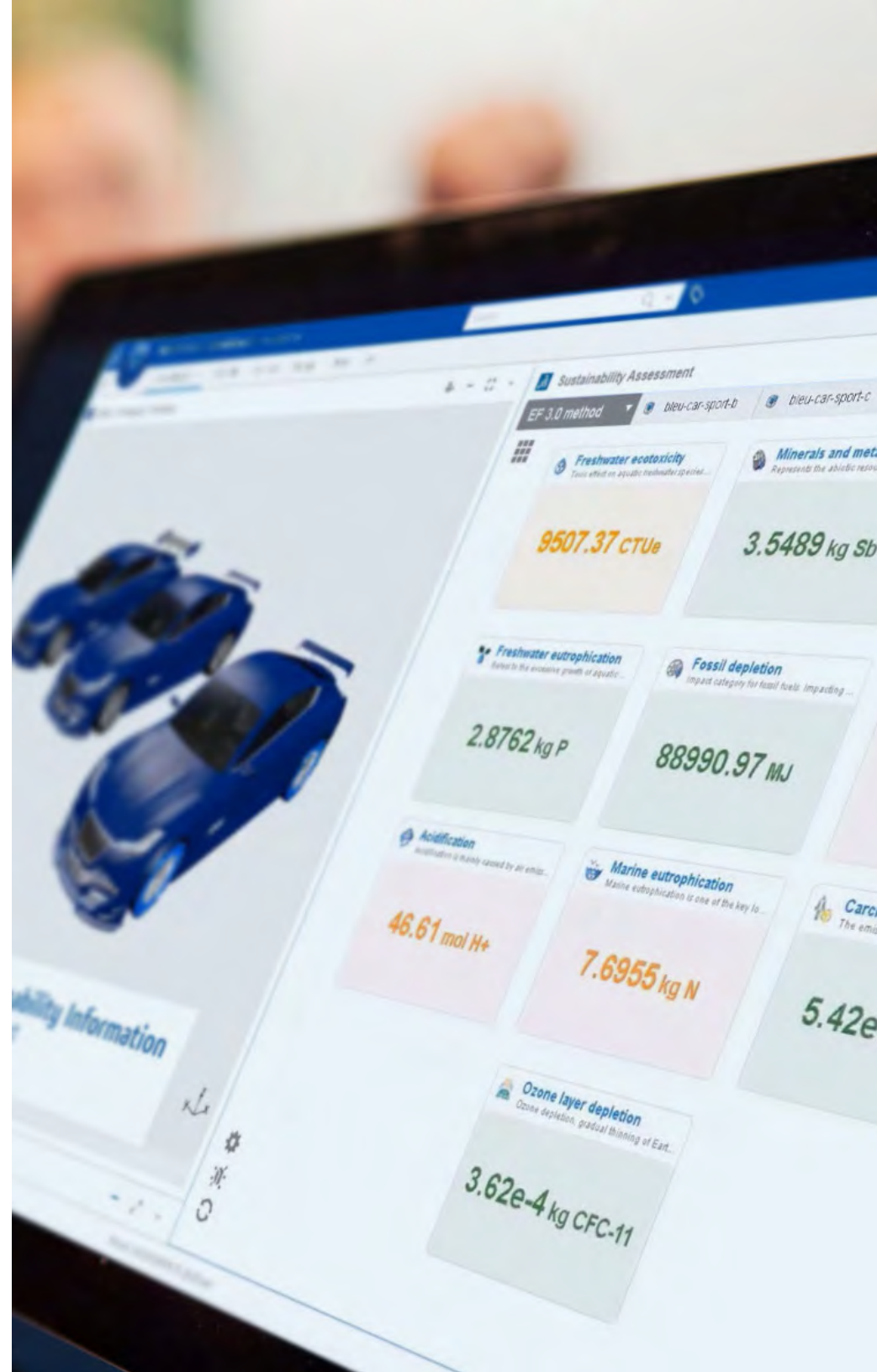
Gaining access to the correct information at the right time is integral to making sustainable business decisions.

For a comprehensive sustainable mobility strategy to succeed, EV manufacturers need a clear understanding of how they can integrate eco-design into their vehicle development processes and weave sustainability into the entire enterprise value network.

To turn data into actionable insights, automotive manufacturers must first shift to a platform that automates data analysis from different sources such as design, engineering, manufacturing and logistics in one digital environment, such as the **3DEXPERIENCE** platform.

The [LCA](#) solution, available on the platform, analyzes primary data from internal manufacturing processes and secondary data from external sources to help automotive manufacturers quantify the environmental impact of end-to-end business operations, from sourcing raw materials to delivering finished EVs.

By integrating all ecosystem participants on a single platform, manufacturers have the end-to-end visibility they need to make effective decisions supported by lifecycle assessment data to accelerate sustainable innovation and drive circular economy practices.



Meet Our Experts

The Need  
to Decarbonize

Sustainable Designs  
and Processes

Battery Innovation  
and Value Chain  
Management

Drive Decarbonization  
by Going Circular

Destination Net Zero  
is Within Reach



# DESTINATION NET ZERO IS WITHIN REACH

Decarbonizing our transport system requires a whole system approach and digital tools like knowledgeware, simulation and digital continuity can support faster, more efficient processes for future-focused sustainability initiatives.

The single greatest empowering agent of this transformation is digitalization, and in particular virtual twin technology and its simulation capabilities.

At the heart of this reinvention is Dassault Systèmes' **3DEXPERIENCE** platform, which unifies each function of a product lifecycle from ideation to end-of-life and ties all these different disciplines together to work towards a common goal to attain a carbon-neutral factory floor.

The platform's cradle-to-cradle approach leverages a single source of truth to optimize low-carbon processes and operations throughout the industry's entire value chain.

By connecting everyone in a centralized and collaborative environment with complete visibility for collective decision-making and full lifecycle assessment, all stakeholders can continuously innovate to deliver sustainable products and services in automotive, transportation and mobility.

Meet Our Experts

The Need to Decarbonize

Sustainable Designs and Processes

Battery Innovation and Value Chain Management

Drive Decarbonization by Going Circular

Destination Net Zero is Within Reach



“ We call this a virtual enterprise where manufacturers are not limited by physical factors and silos. Instead, they can easily work with stakeholders around the globe to boost sustainability in the automotive industry.”

– **Laurence Montanari**  
 Transportation and Mobility Industry  
 Vice President, Dassault Systèmes

Ready to get on the fast track to a sustainable future in mobility? Discover the latest automotive insights and strategies [here](#) for a clear roadmap to navigate challenges and race ahead of the competition.

© 2022 Dassault Systèmes. All rights reserved. 3DEXPERIENCE, the Dassault logo, BIOVOIX, GENOVA, SOLUTIONS, SONIA, ENOVA, EXPLORE, NETWORKS, MEDDOTS, CENTRIC PLM, 3DSCAPE, SIMULIA, DELMIA, and IFC are commercial trademarks or registered trademarks of Dassault Systèmes or its subsidiaries in the United States and/or other countries. All other trademarks are owned by their respective owners. Use of any Dassault Systèmes or its subsidiaries trademarks is subject to their express written approval.

Our **3DEXPERIENCE®** platform powers our brand applications, serving 11 industries, and provides a rich portfolio of industry solution experiences.

Dassault Systèmes, the **3DEXPERIENCE** Company, is a catalyst for human progress. We provide business and people with collaborative virtual environments to imagine sustainable innovations. By creating ‘virtual experience twins’ of the real world with our **3DEXPERIENCE** platform and applications, our customers push the boundaries of innovation, learning and production.

Dassault Systèmes’ 20,000 employees are bringing value to more than 270,000 customers of all sizes, in all industries, in more than 140 countries. For more information, visit [www.3ds.com](http://www.3ds.com).



**3DEXPERIENCE®**

Meet Our Experts

The Need to Decarbonize

Sustainable Designs and Processes

Battery Innovation and Value Chain Management

Drive Decarbonization by Going Circular

Destination Net Zero is Within Reach