CONSUMER PACKAGED GOODS & RETAIL

A NEW VISION OF SUSTAINABLE PACKAGING

How manufacturers are bringing new ideas and concepts to life through the virtual twin, powered by science

DASSAULT SYSTEMES

ALICE STEENLAND

Chief Sustainability Officer

With over 20 years of experience in sustainability, finance, investment and innovative business models across all sectors of the economy, Alice has held full-time and advisory positions in large multinationals, NGOs, ratings agencies, consulting firms, startups and multi-laterals in both the US and Europe.

HRISHIKESH MOHAN

Technical Director – Consumer Packaged Goods, Home & Lifestyle and Retail

Hrishikesh is a business-oriented technical professional with 20 years' experience in delivering solutions for various Industries. He is currently responsible for ensuring the execution of DS' purpose to provide business and people with **3DEXPERIENCE®** universes to imagine sustainable innovation capable of harmonizing product, nature and life in the Consumer Packaged Goods and Home & Lifestyle Industries.

DR. LALITHA SUBRAMANIAN

Global Head, Outcome-Based Research, BIOVIA

Lalitha leads strategic research collaborations with industry to solve their scientific challenges using simulations and machine learning. For over 25 years, she has successfully delivered energy savings, enabled sustainable solutions, remediated product and process failures and driven product innovation for her customers. Such collaborations have resulted in patents and awards. She has a Ph. D. in Chemistry from IIT (Chennai, India) and a post-doctorate from Cornell University with Prof. Roald Hoffmann (Nobel Laureate).

THE SUSTAINABILITY MANDATE

Sustainable packaging is fast becoming a global imperative driven, in part, by increased awareness of environmental conservation and more stringent government legislation.

In Europe, the Circular Economy Action Plan is pushing manufacturers to take responsibility for any waste that comes from their packaging. Meanwhile, China has adopted the circular economy as part of its domestic political priority since 2018.[1]

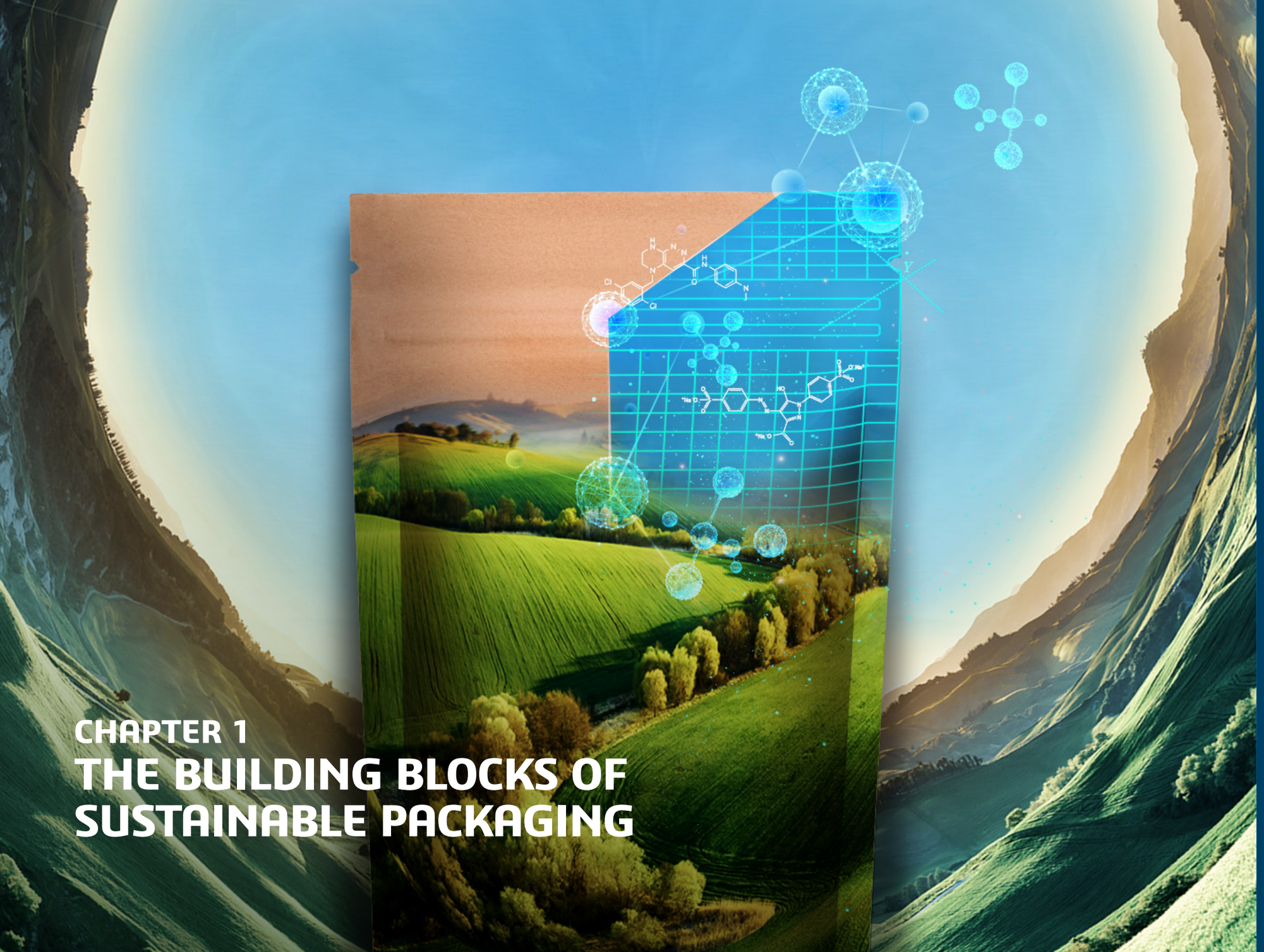
The voice of the consumer is also helping to accelerate this change. Approximately **88 percent of consumers** across the United States and the United Kingdom want manufacturers to invest in methods, processes, and technologies to improve their environmental and social footprint.[2]

The numbers also give a preview of what's to come. A recent report by Acumen Research and Consulting estimates **the value of the global sustainable packaging market to hit US$255 billion by 2026**.[3] Hence, the opportunity is ripe for manufacturers to develop packaging materials that can be reused, recycled and kept away from landfills.

To achieve this, they need to deliver new packaging experiences without compromising the integrity of the product (avoiding migration or scalping); the packaging shouldn't affect the characteristics, effectiveness or performance of the product in any way nor should there be any embrittlement or discoloration of the packaging itself.

These new packaging experiences should also be able to preserve the shelf life of the product. And with the speed that consumers are expecting change, it's time for CPG manufacturers to transition from a traditional linear working process towards **a more flexible, data-driven approach to packaging design and development**.

To accelerate the launch of more sutainable packaging into the marketplace, CPG manufacturers must create and deliver a new generation of sustainable packaging through an end-to-end development and delivery process **powered by cutting-edge science**.



CHAPTER 1
THE BUILDING BLOCKS OF SUSTAINABLE PACKAGING

As CPG manufacturers strive to make their packaging more sustainable, they have to bear in mind the sustainability goals that need to be realized beyond just the packaging material itself.

CPG manufacturers need to understand the real-world impact of their products, from package design to delivery, consumption and beyond.

Diligent companies will seek to drive sustainability throughout the entire product innovation chain, from concept to its post-use realities. They can achieve this by utilizing the laws of chemistry and physics to optimize the packaging experience from as early as the conceptualization stage.

Materials science

Every packaging material used — polymer, paper, paperboard, glass, aluminum, etc. — offers opportunities for optimization. Imagine if your product design and engineering teams could:

- Accurately predict the properties of materials that have not yet been synthesized or tested based on real-world parameters,
- Simulate and run virtual models using experimental data, instead of depending on existing models or mathematical equations, and
- Develop material-specific processes and systems that are user-friendly and intuitive.

With the right tools, product development stakeholders can quickly, efficiently and accurately test the suitability of potential materials for a package while remaining cost-effective.

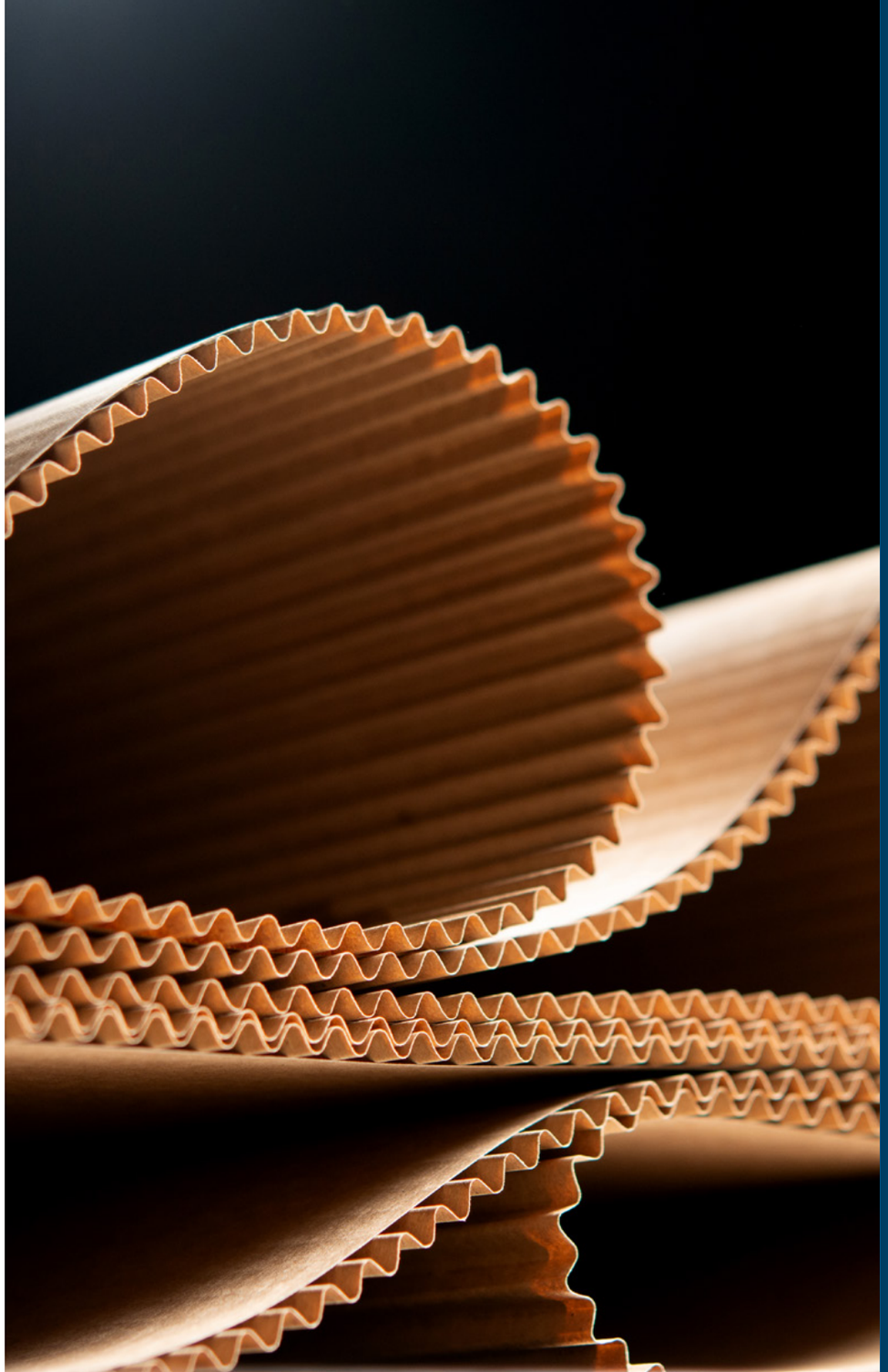
CPG manufacturers must ensure that packaging materials preserve the product, maintain its shelf life, retain product integrity throughout transportation and logistics, and be further utilized in various post-use scenarios.

CPG manufacturers are now diversifying and experimenting with a slate of new materials. Bioplastics, for example, have increased in popularity due to its ability to deliver the same performance, but without the environmental pitfalls of virgin plastic.

Recent breakthroughs have resulted in bioplastics being produced from cellulose or lignin, obtained from non-food plants such as giant reed. It can also be derived from waste wood and agricultural by-products that would otherwise serve no other function.[4] **However, is it the best choice for your product?**

Innovative CPG manufacturers need to know if their packaging's chemical properties could be hazardous to product performance, humans or the environment. For example, if a biodegradable plastic container adversely reacts with the food stored in it, project stakeholders must quickly intervene to select a better-performing material **before committing to production**.

Furthermore, how a package reacts to the stresses of logistics or performs when consumers interact with it is a crucial consideration for sustainability. With the right tools, packaging stakeholders can simulate the real-world physical, chemical and biochemical performance of the many materials used in their packaging before moving to production so that they can be sure it's the **best choice for their consumers** as well as the environment.



For example, heavier packaging is a strain on transportation. But how light or thin can you make a package before it breaks or the pressured liquid inside bursts it open?

Powerful virtual tools that can apply real-world physics to ensure that the package meets these requirements:

Technical performance:
Does the package protect its contents?

Cost:
Is the design cost-effective?

Resource consumption:
Does the packaging design optimize materials and energy?

Post-use:
How will the materials be efficiently and effectively sorted and broken down when it's recycled or upcycled?

There is a way for CPG manufacturers to ensure their packaging's real-world performance, and that's utilizing the power of **the virtual twin** – a virtual model of the package where science-based tools are used to determine how a package can be optimized in order to meet or exceed sustainability goals.

CHAPTER 2
USING THE VIRTUAL TWIN TO ACCELERATE SUSTAINABLE PACKAGING

The time for incremental change is over; experts say we are less than a decade away from the 'point of no return' for climate change.[5] Progress must now be made through disruptive new designs and business decisions that have enterprise-wide ramifications. **This is where the virtual twin can be leveraged**.

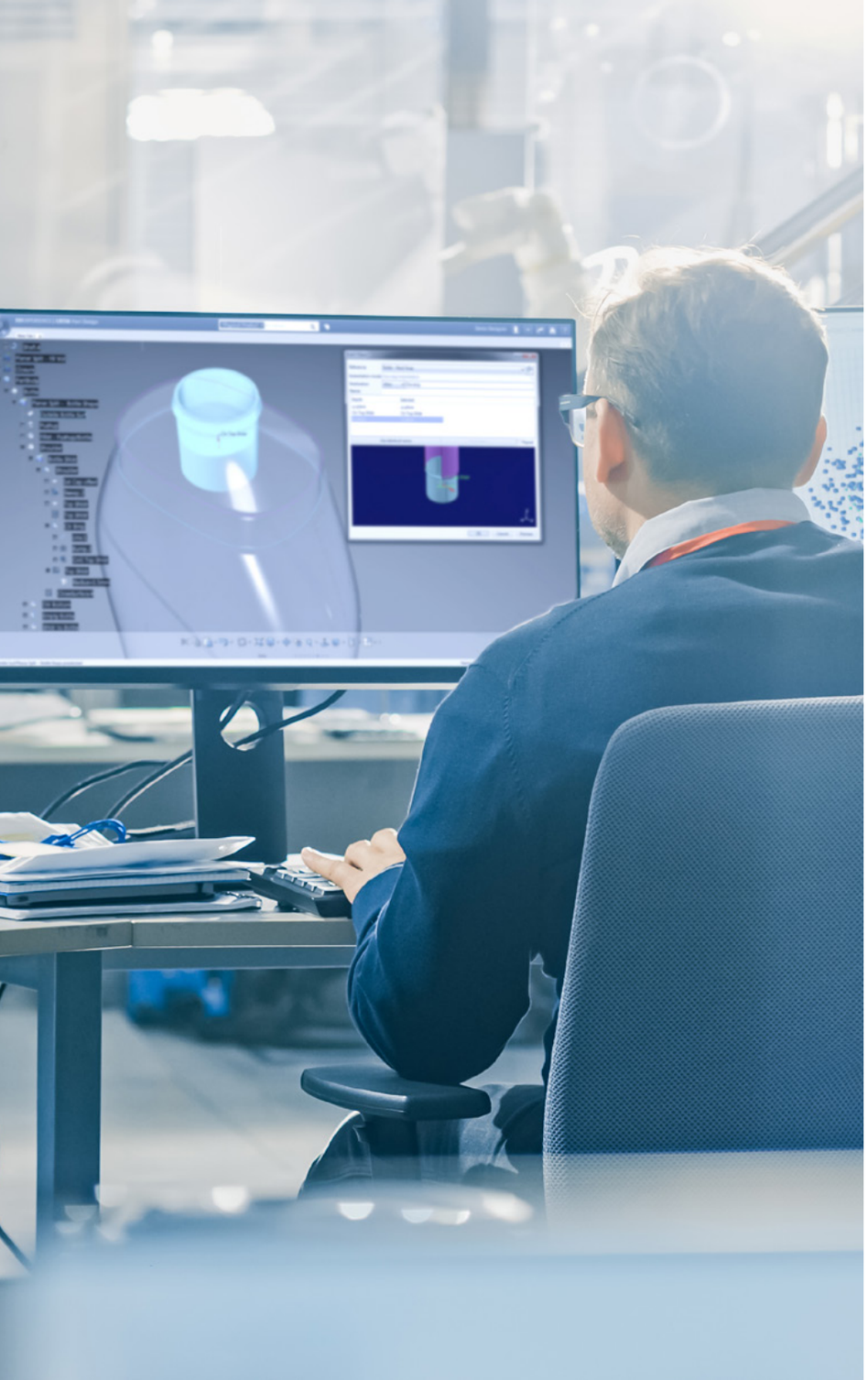
The virtual twin is a digital replica of the real-world, be it an object (like a package) or a system (like a manufacturing or logistics or recycling environment), that's realistically rendered and **bound by mathematical and physical laws**.

As an accurate representation of real-world conditions that uses real-time data, the virtual twin allows CPG manufacturers to **assess changes virtually before implementing them physically**.

In the context of packaging design, the virtual twin empowers packaging designers to replicate material properties down to the molecular level. This allows them to quickly create and validate multiple design concepts while integrating real-world variables into the design simulations.

The resulting 3D model is a hyper-realistic rendering of the packaging in a real-world setting that adheres to **real-world physics and molecular behavior**.

With powerful scientific tools, packaging stakeholders can change or swap material properties, increase the material thickness, play with diameters, modify a label position, alter decorations and more.



Let's see what the virtual twin can bring to the table at every step of the product development workflow:

Choosing the best material

CPG manufacturers are constantly looking for new material options to satisfy consumer demand and deliver new packaging experiences. With the virtual twin, they can precisely determine the best material composition for more sustainable packaging without compromising the product's integrity.

"The virtual twin is a game-changer for sustainability in general. There's no other tool on the market that can help you develop disruptive packaging designs without the need for huge development and prototyping costs. That's why we see it as a critical tool for CPG manufacturers."

— Alice Steenland
Chief Sustainability Officer,
Dassault Systèmes

Designers will be able to predict and understand the relationships of a material's atomic and molecular structure with its properties and behavior. They can construct, manipulate and view models of different materials to determine the most sustainable option without the need for physical prototyping. Furthermore, they can even pull elements from previous product models to speed up new packaging development.

For example, suppose a user wants to modify a bottle's uniform thickness to reduce its overall volume without affecting structural strength. In that case, **the platform will run the required calculations and simulations** in the background. Even saving mere millimeters in product thickness can add up to significantly lower costs and a reduced carbon footprint in manufacturing and transportation.

Rapid design and prototyping

Utilizing the virtual twin on existing packaging designs is an excellent and efficient way to explore changes that can be made with minimal effort but with **big payoffs in sustainability**.

For example, a plastic window on a food package could be replaced with a paperboard panel and graphic image instead. Whether it's reducing the amount of material used or changing an element of the packaging, these small changes can **provide significant benefit when multiplied by thousands, or even millions, of packages**.

For packaging under development, iterations are made easier because changes to the packaging can be implemented quickly. Designers can rapidly come up with alternative design concepts that can be **visualized in a digital environment**. Hundreds of concepts can be created and validated before a single physical prototype is even created.

Streamlining manufacturing

Ensuring manufacturability at the design stage is another key contributor to sustainability. Manufacturing costs can be lowered by optimizing how to **produce, assemble and deliver** packaging to consumers in the most efficient way.

By creating a virtual twin of the entire production line, CPG manufacturers can control the placement of machines and resources with a 3D representation of the workspace. This allows them to **optimize the manufacturing workflow** before physically assembling the production line.

Additionally, CPG manufacturers can also identify potential bottlenecks that may occur during production and design workarounds to **eliminate or even reduce these disruptions**.

Another benefit of optimizing production workflow within a virtual space is a leaner inventory. Smarter management of raw materials and inventory is vital for smooth production and lower costs. By having full visibility of the production workflow, smarter decisions can be made regarding the rate of production, the quality of the packaging and the speed in which they can fulfill customer demand.

> “Our customers approach us with needs in mainly three aspects of packaging: rapid decision-making tools to enable formulation design, failure remediation of packaging, and screening bioderived/biodegradable substitutes for current packaging materials. By using multiscale simulations and chemistry-savvy machine learning, we’re able to virtually design and create web-based solution that can be accessed through the **3D**EXPERIENCE platform.”
>
> — Dr. Lalitha Subramanian
> Global Head, Outcome-Based Research,
> BIOVIA

Optimizing logistics

Logistics is a significant sustainability consideration for moving thousands, if not millions, of packages. By having full transparency of the production workflow, CPG manufacturers can also **better optimize truck loads and reduce instances of empty miles**. In the long run, this will lead to a reduction in the number of last-mile trips and a lower carbon footprint.

Additionally, **lightweighting** can also help CPG manufacturers reduce the overall carbon footprint and costs of their product throughout the supply chain. This is achieved through:

Material substitution
Changing the properties of the packaging by replacing one of the materials with a more sustainable option

Packaging redesign
Modifying the specifications of the packaging to reduce its overall volume and reduce the quantity of materials used

For example, a bottle of vodka can be made from PET (polyethylene) plastic instead of glass so that it's shatterproof and more lightweight, making it **less costly and more efficient to transpor**t. However, the most successful lightweighting requires precise scientific optimization. It can only be achieved through highly accurate virtual models designed using the virtual twin.[6]

Post-use realities

Despite the potential benefits of bioplastics, the **biodegradability of bioplastics still requires a significant investment**. Depending on the type of polymer used, discarded bioplastic will either be sent to a landfill, recycled or sent to an industrial compost site.

Industrial composting heats the bioplastic to a high enough temperature that allows microbes to break it down. Without the intense heat, bioplastics won't degrade on their own in a meaningful timeframe.

As an example, let's go back to the vodka bottle that we discussed earlier. If it was made from a PLA (polylactic acid) bioplastic, would it have the same strengths and properties as standard PET plastic? How much energy would be needed to break it down into recycled plastic pellets, **compared to regular PET plastic**?

These variables can be tested and validated through the virtual twin, as the 3D model follows all real-world characteristics and parameters. As such, CPG manufacturers will be able to **obtain the exact end-of-life characteristics** of this PLA vodka bottle at a fraction of the time and cost.

CHAPTER 3
A NEW ACTION PLAN FOR SUSTAINABLE PACKAGING

Sustainability is a group effort, and that means connecting all the players in the packaging ecosystem — materials suppliers, converters, co-packing merchants, brands, retailers and many more — to collaborate and communicate with each other.

When CPG manufacturers can leverage a science-based solution to optimize their products, they can **confidently demonstrate their commitment to a better future**.

We've seen how the virtual twin can better optimize every step of the packaging innovation process for more sustainable outcomes, but it doesn't stop there.

Packaging optimization is part of a bigger, new reality where product development teams can **simulate product innovations and production processes** within a fully realized virtual world, molecule by molecule, for a new generation of consumers.

The **3DEXPERIENCE** platform expands the realm of the virtual twin to a plethora of stakeholders to realize **collaborative innovation** so that the best actions for sustainability can always be brought to the forefront, from ideation to production.

Smart management of supply and inventory of sustainable production materials is vital for efficient production and lower costs. By having the appropriate amount of raw materials with the right quality at the right time, CPG manufacturers can make the best of their resources, **reduce waste and deliver according to schedule**. With a more optimized value chain, CPG manufacturers can vastly improve sustainability metrics and contribute to the circular economy.

Closing the loop

In a circular economy, materials continuously flow around a closed-loop system, rather than being used once and discarded. Moving towards a circular economy is a collaborative endeavor that involves players at every stage of the cradle-to-cradle chain.

The most innovative packaging design **is only as good as its ability to be broken down**, recycled into its original components and sent back to begin the packaging development again. Sustainable packaging is as much about recyclability as it is about reducing material usage and waste.

The virtual twin can help in this aspect by **virtually replicating the entire life cycle of the packaging** within a circular economy. Then, based on stakeholders' input, packaging designers can then modify a multitude of variables such as the materials used, long-term reusability, rate of decay, total energy and water used and rate of recyclability, among others.

Interested to learn more about the circular economy? **Click here** to find out how we're helping manufacturers with game-changing packaging sustainability.

> "The whole concept of sustainable packaging isn't the responsibility of just the brand or the retailer. The whole ecosystem needs to be in the loop — suppliers, retailers, recyclers, governments and consumers. True circularity in this complex scenario can be achieved more quickly by means of a 'system of systems' approach with the virtual twin."
>
> — Hrishikesh Mohan
> Technical Director, Consumer Packaged Goods, Home & Lifestyle and Retail, Dassault Systèmes

A future with carbon labeling

The logical next step of sustainability transparency that has already started to trickle into the marketplace is carbon labeling. Carbon labeling describes the carbon dioxide emissions created as a by-product of manufacturing, transporting or disposing of a consumer product.

Carbon labeling is an opportunity for CPG manufacturers to deliver **a greater degree of transparency** by providing more information to consumers.

Carbon labeling is also an initiative supported by the public; a survey of over 10,000 consumers in Europe showed that over two-thirds support carbon labeling on products.[7]

The **3DEXPERIENCE platform empowers** CPG manufacturers to virtually replicate the entire life cycle of the packaging within a circular economy, giving them the additional benefit of **more accurately measuring** the amount of carbon dioxide emitted as a result of their production processes.

As a result, they'll be able to **confidently report their carbon levels** on these labels as well as pinpoint where interventions can be made to improve their carbon emissions.

Moreover, they'll be able to incorporate other stakeholders in their supply chain in these efforts so that a more effective result can be accomplished throughout the entire supply chain.

IT'S TIME FOR A NEW VISION OF SUSTAINABLE PACKAGING

Science is the beating heart of the **3D**EXPERIENCE platform, powering every product development process. It is behind every virtual twin brought to life, every simulation generated, every packaging design rendered and perfected, and every optimization executed.

It powers the accurate design and simulation tools on the platform that enable CPG manufacturers to be confident in attaining and demonstrating their sustainability ambitions.

The **3D**EXPERIENCE platform is the critical differentiator that can help CPG manufacturers solve their current and future sustainable packaging challenges by ensuring that their sustainability efforts translate into tangible, measurable and effective results throughout the supply and value chains.

To find out how you can deliver a new vision of sustainable packaging to consumers, connect with us today.

DASSAULT SYSTEMES | The 3DEXPERIENCE® Company

Europe/Middle East/Africa
Dassault Systèmes
10, rue Marcel Dassault
CS 40501
78946 Vélizy-Villacoublay Cedex
France

Asia-Pacific
Dassault Systèmes K.K.
ThinkPark Tower
2-1-1 Osaki, Shinagawa-ku
Tokyo 141-6020
Japan

Americas
Dassault Systèmes
175 Wyman Street
Waltham, Massachusetts
02451-1223
USA