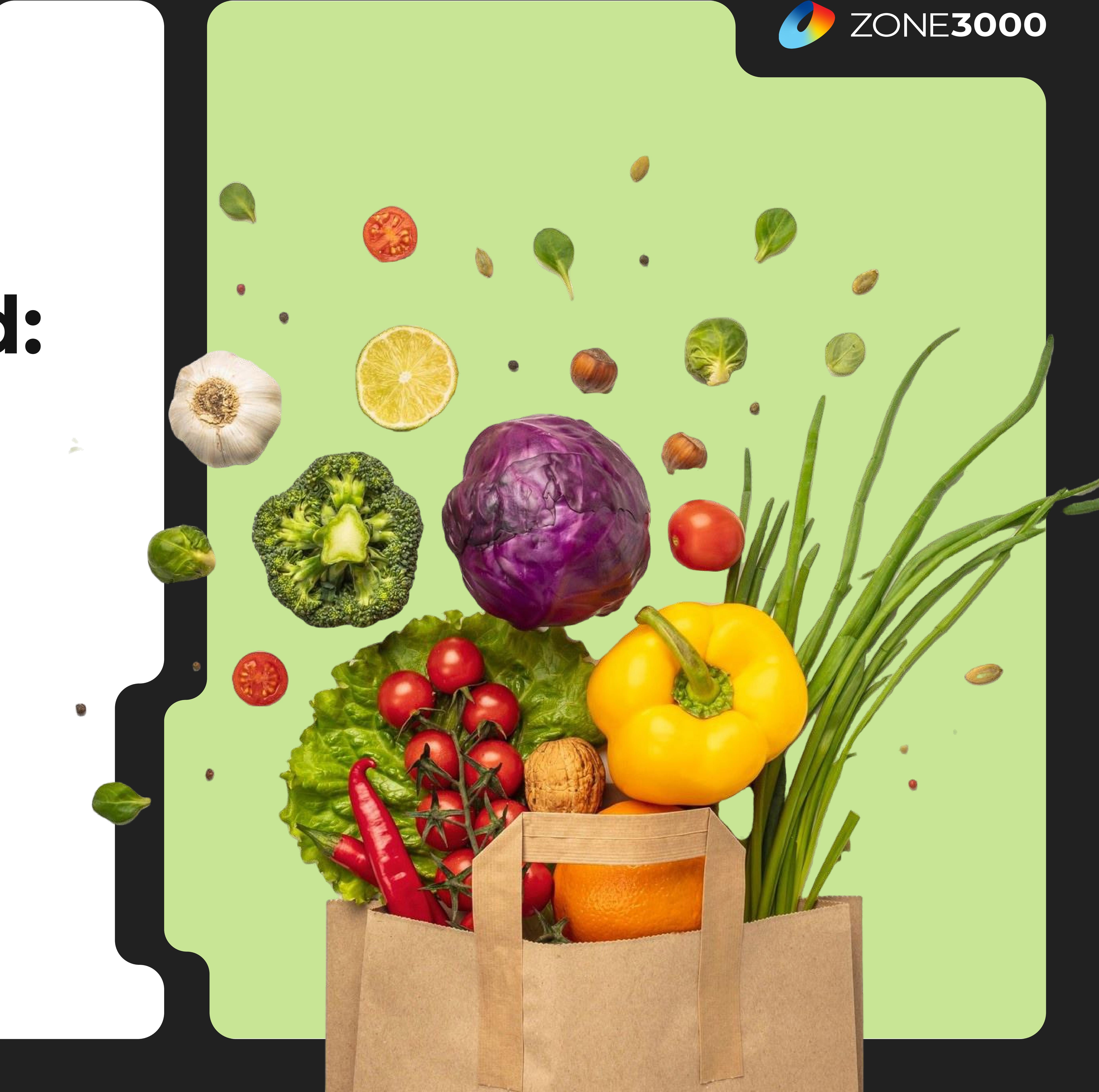


The Future of Food: Key Trends and Innovations 2024

ZONE3000

Join the Food Revolution



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About ZONE3000

ZONE3000 is an IT company focused on driving **FoodTech innovations** for restaurants and delivery platforms. With extensive experience in software development, we specialize in solutions that prioritize personalization, automation, and AI integration. Our mission is to provide insights that drive innovation in the food sector.



Understanding the future of food

We appreciate your attention to this report. We have prepared extensive insights on innovation across the food value chain, from agricultural practices to consumer products.

Innovation is emerging from various sources, including researchers, large corporations, and especially agile startups that are willing to take risks. The perception of the food sector as less disruptive for investments has shifted, resulting in significant funding for startups focused on transforming food production, shopping, and cooking.

From our analysis, we have identified 28 FoodTech trends and categorized them into six megatrends that are shaping the future of food: the resilient farm, sustainable proteins, food as medicine, the smart supply chain, instant retail, and food automation.

Additionally, we've added a deeper look into the factors driving the shift towards a new phase in food evolution – Digital Food – which follows a period of scarcity and recent abundance. For any questions about the content or how your company can adapt to the future of food, please contact us!



**What will the future
of food be like?**

The future of food is driven by three main factors combined with technological advancements, creating conditions for a food revolution:

Climate

The direct link between food and climate change necessitates significant changes in behavior. Agriculture and food production account

for **26%** of global emissions.

Population

Developed economies are experiencing population declines, necessitating automation, while parts of the world are growing, creating new opportunities.

Health

The rise of obesity and other diet-related health issues calls for healthier food options.

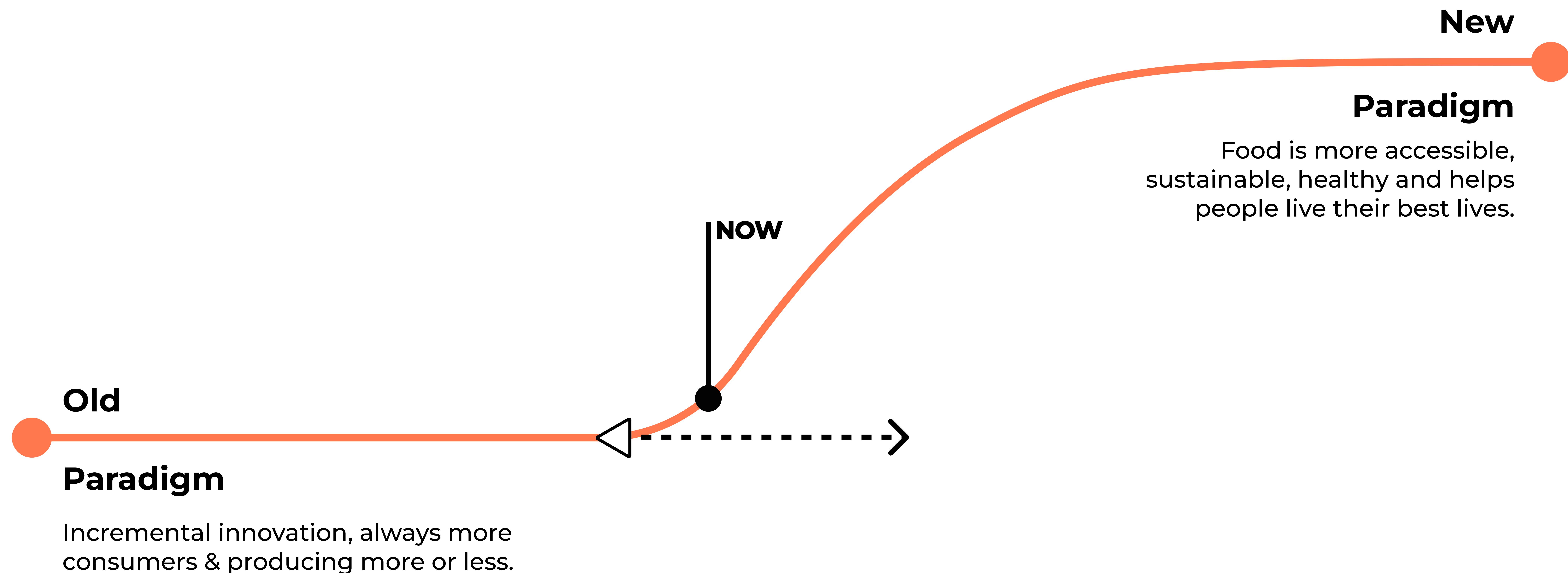
Emerging Technologies

The rise of obesity and other diet-related health issues calls for healthier food options.

DIGITAL FOOD – NEW ERA OF REVOLUTION

This exciting change is driven by startups, and it's crucial for established food companies to consider how they can adapt and find their place in the future of food.

This revolution signifies a shift from our current framework to one where food is more accessible, healthier, and environmentally sustainable. We are at the onset of this transformative journey. Yet, many industry players often perceive the future as merely a continuation of past practices. Through this report, we intend to illuminate the trends that will play a vital role in defining the future of food!



FoodTech: the future of food

Similar to other sectors, agriculture, food, and retail companies have often delegated long-term innovation to research centers. While these centers excel at producing relevant research findings, they struggle to convert these insights into new products. In contrast, startups harness this research to drive the food revolution forward. Thus, it is clear that FoodTech represents the future of food!

However, startups alone lack the necessary leverage and capital to transform the entire food supply chain.

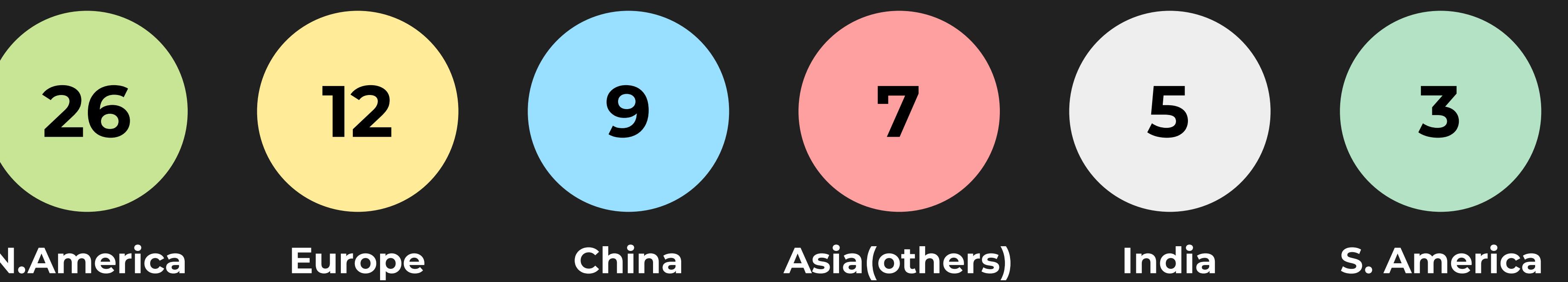
Although startups will play a significant role in this revolution, it will largely be established leaders who, through partnerships, investments, and acquisitions, will guide this transition. The food revolution is already in motion, and time is running out for those without long-term strategies.



A global movement with significant impact

Investments in FoodTech are substantial. Although there was a decline in 2022, the total investment still surpasses the combined R&D expenditures of major food corporations. These funds are becoming increasingly well-distributed worldwide, fostering robust ecosystems in the Americas, Europe, the Middle East, and Asia. Furthermore, FoodTech transcends the food sector; it is also focused on addressing critical sustainability challenges.

Distribution of the 62 FoodTech unicorns



9 of 17 UN Sustainability Goals are directly related to the agrifood system



Tracking trends over time and expectations

We have revised our mapping of the most significant FoodTech trends utilizing the following innovation curve:

1 A new technology emerges, gaining attention and eventually evolving into a "trend" characterized by a network of startups, a range of technologies or business models, and addressing B2B or B2C needs.

2 However, this initial enthusiasm diminishes as the technologies or business models struggle to scale effectively.

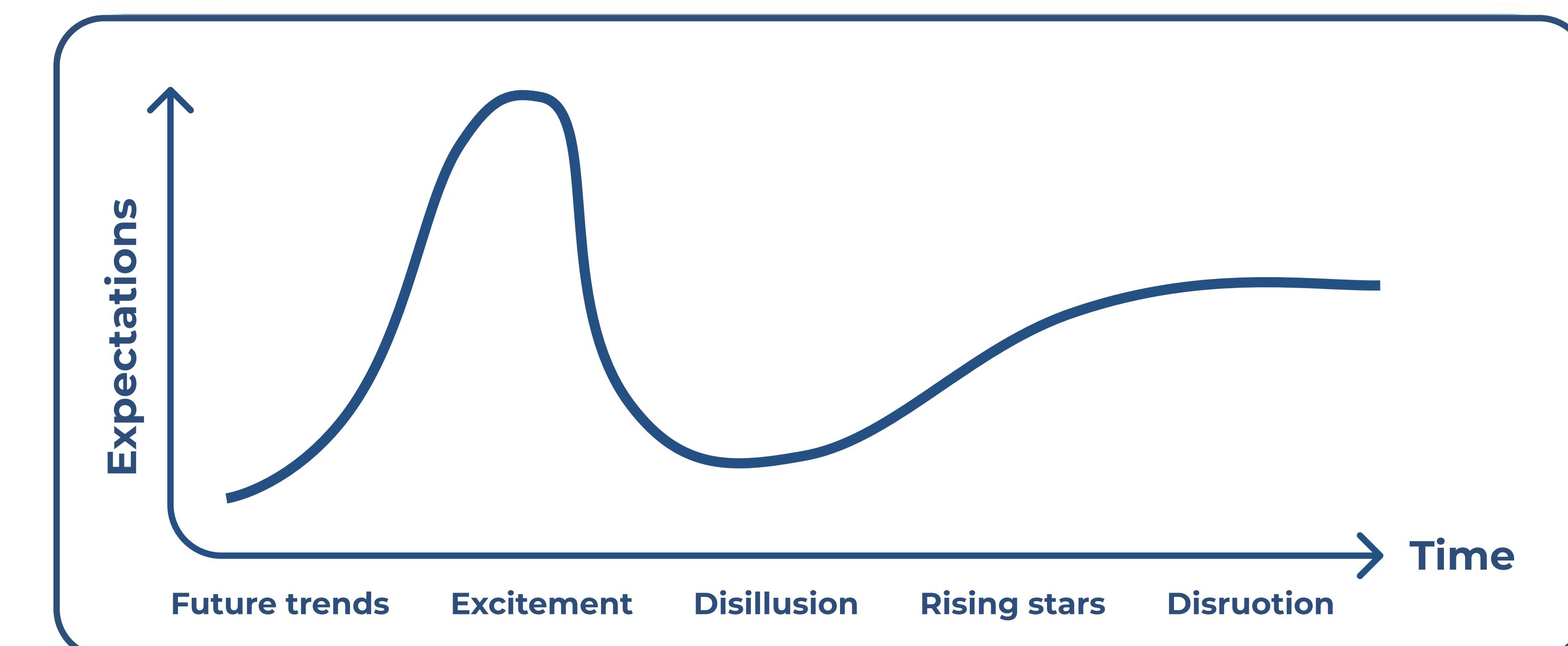
3 At a certain point, the technology begins to demonstrate effectiveness, capturing the interest of the public—including investors, corporations, and consumers—and leading to a peak of excitement.

4 Some trends may resurface as established companies or new ventures discover ways to overcome these challenges.

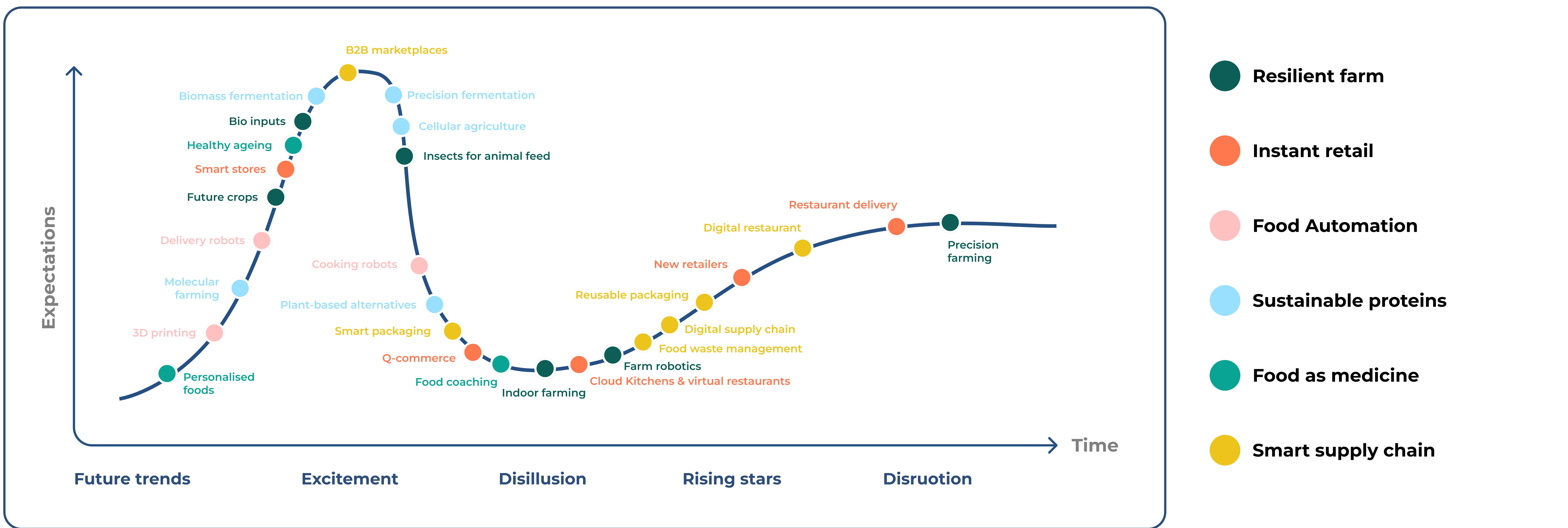
5 Ultimately, we reach a final stage where the trend becomes widely recognized and accepted by all observers.

To assess trends, we leverage our insights and discussions with entrepreneurs, investors, and major corporations. We integrate this qualitative information with quantitative data, such as investment figures and the number of startups.

The pace at which a trend progresses along the curve can vary significantly. Some trends may remain stagnant for years, seemingly waiting for a catalyst, while others can shift rapidly within a matter of months. Therefore, it is crucial to recognize that a trend's position on the curve does not necessarily indicate the speed of its evolution.



Six key megatrends influencing the future of food



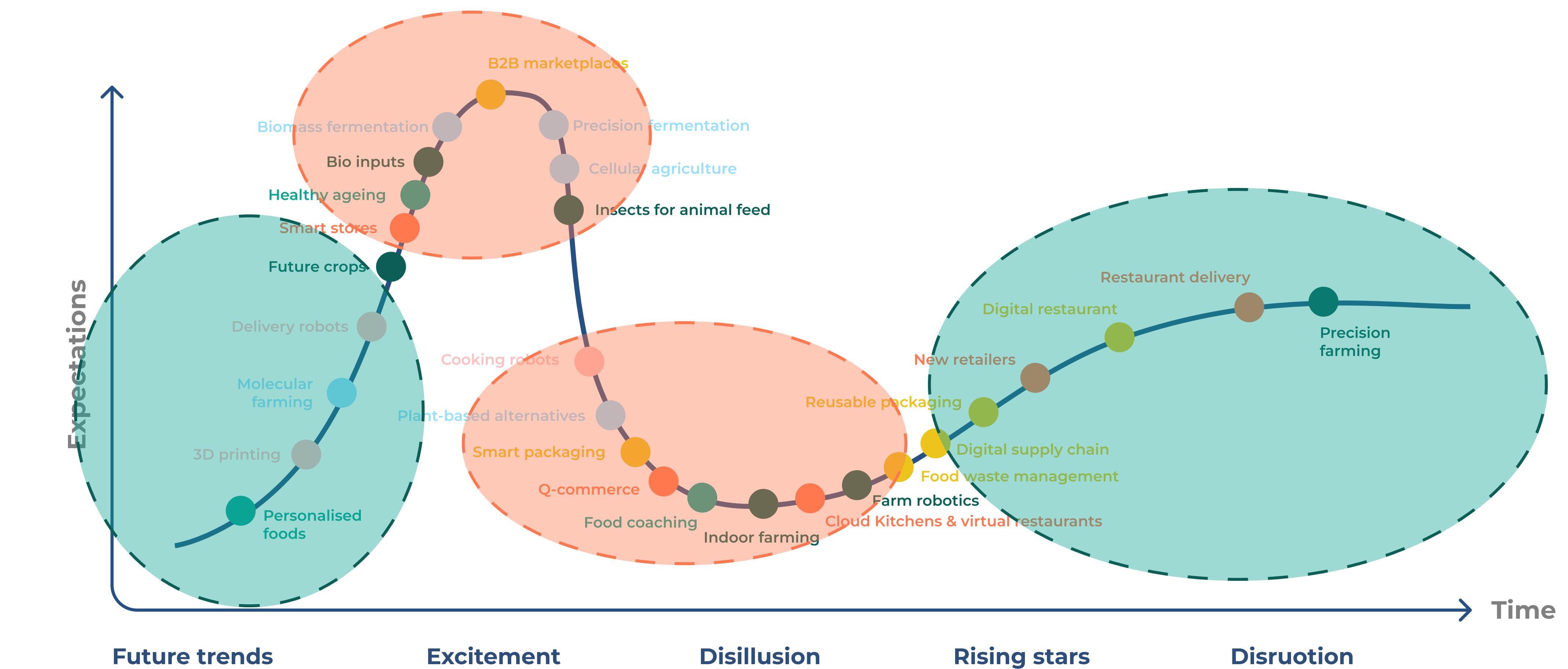
Challenging yet promising times

A notable number of trends in the disillusionment stage

Notably, plenty of trends are advancing toward the productivity and disruption stage, indicating that we anticipate further adoption.

However, we face a challenging mix of:

- A significant number of trends in the disillusion phase, with some ecosystems urgently needing reinvention.
- Plenty of trends in the excitement phase that may lead to further disillusionment.



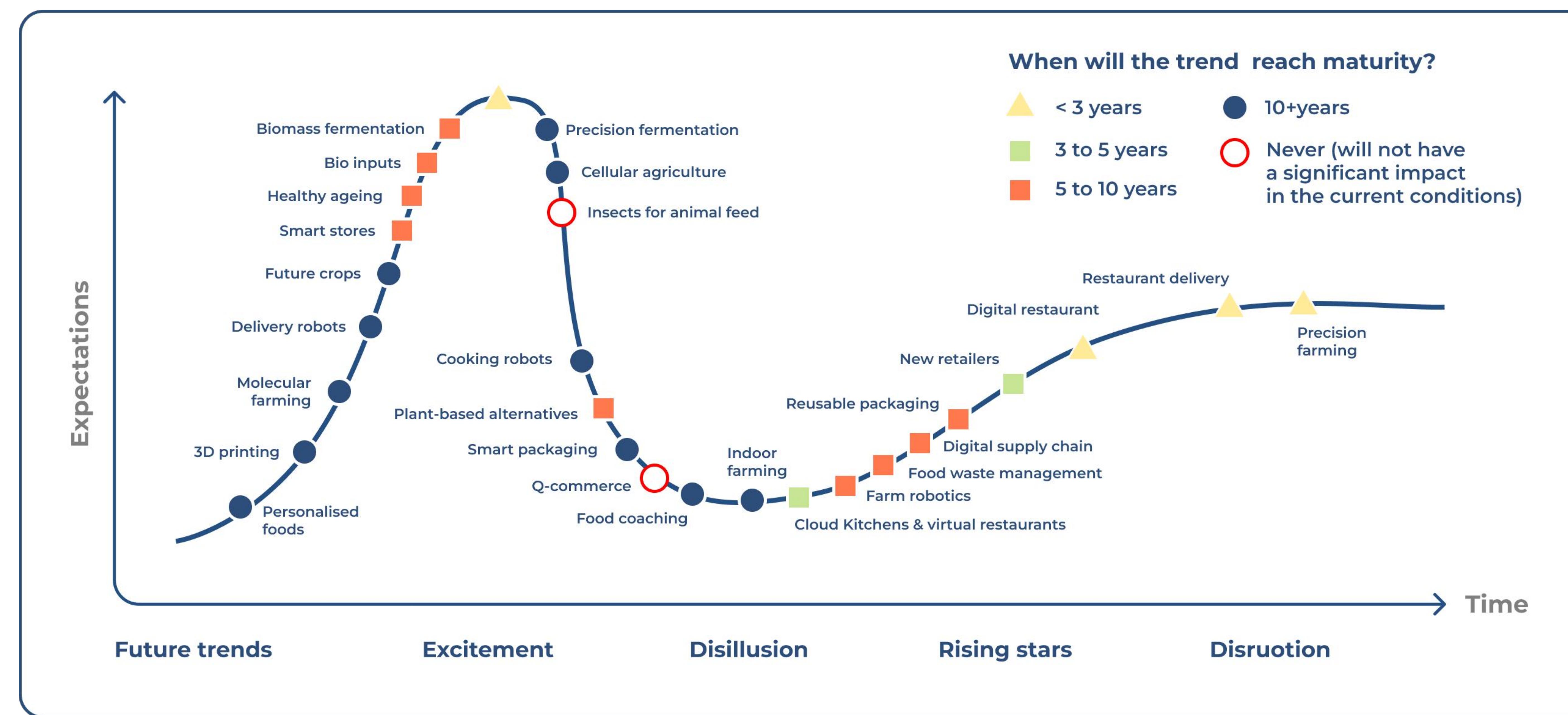
Based on this analysis, it appears that the upcoming year may present complexities for the overall FoodTech ecosystem, with only a few topics likely to transition from excitement to productivity (which seems unlikely) or experience rapid adoption (mainly those in the disruption stage).



And now, when can we expect it on our tables?

Drawing from past trends in various sectors, we have provided an estimate of the time required for each trend to reach maturity.

These estimates represent an average between the minimum and maximum time frames for a trend to achieve maturity.

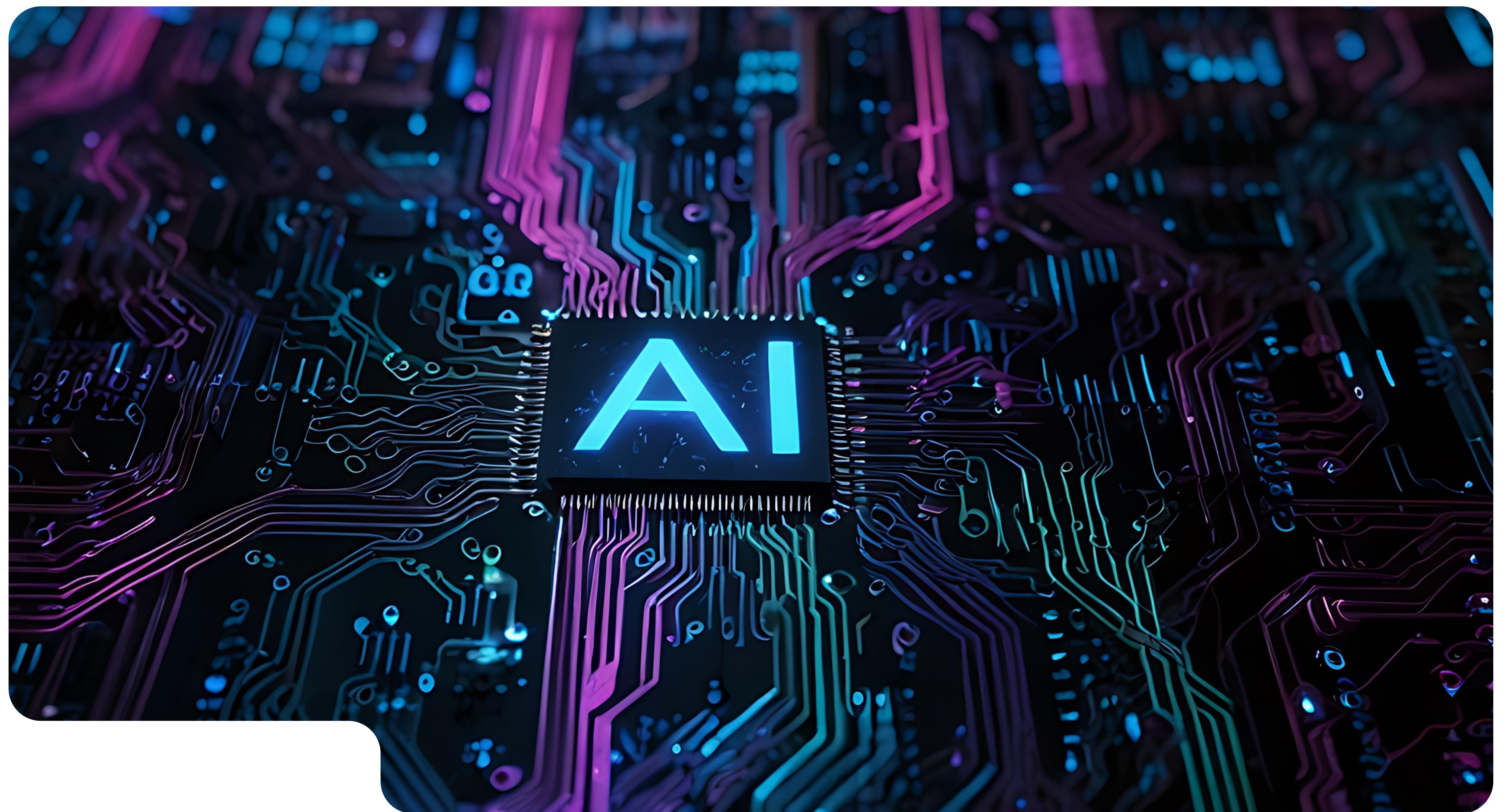


Maturity is defined as when 20 to 30% of the market has adopted the trend.

When we refer to "never," we mean that the trend may fail to scale or may need to be reimaged entirely due to technical or market challenges.

Where is Artificial Intelligence?

Some frequently discussed topics, technologies, or categories are missing from the hype curve. Two notable examples are:



Artificial Intelligence (AI). Although widely discussed, we view Artificial Intelligence and generative AI primarily as tools that enhance various trends. They can be applied in numerous ways, such as optimizing supply chain decisions to reduce food waste or accelerating processes in alternative protein development. This perspective may evolve if we observe a trend where companies utilize AI in a manner that stands apart from other identified trends.

Direct-to-consumer (DTC) brands. Products created by startups for direct consumer sales are vital to the innovation ecosystem. However, the methods entrepreneurs use to enter the market have matured significantly. While still exciting, this represents a "mature trend" that can now be analyzed in the context of broader consumer trends, such as the emergence of new beverages and pet supplements, which do not fit within the discussed hype curve.

THE RESILIENT FARM

Megatrend 1

The resilient farm: what is it about?



ZONE3000 recognizes AgTech as a vital element of the FoodTech ecosystem, rather than a standalone sector. Despite the existing separation between upstream and downstream players, disruptive innovations are driving integration across the farm-to-fork value chain.

Key trends are steering us towards sustainable and resilient farming, including the rising demand for locally sourced foods, a decrease in available farmers and labor, increasing energy costs, and climate change impacts on arable land. The merging of technology with agriculture also plays a crucial role.

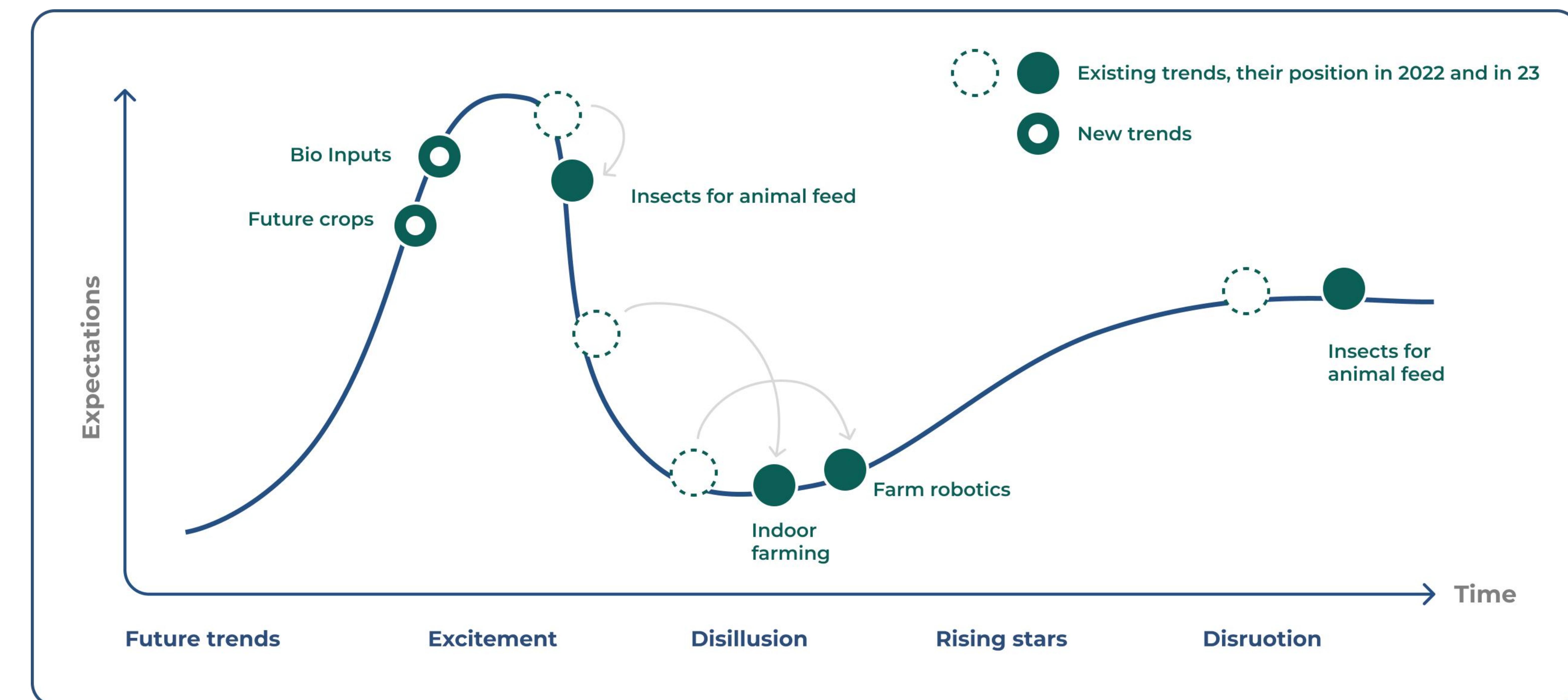
This trend is unfolding in two main ways:

1 Focus on enhancing traditional farms through automation and intelligence.

2 Urban, indoor, and next-generation farming solutions. After a period of favoring the latter, interest in traditional farming methods is resurging in terms of investments and hype.

Six food trends influencing the future of farming

We have identified six trends that are transforming traditional farming practices. This year, two new trends have emerged, with indoor farming notably shifting from excitement to disillusionment due to the ongoing energy crisis.



Precision farming

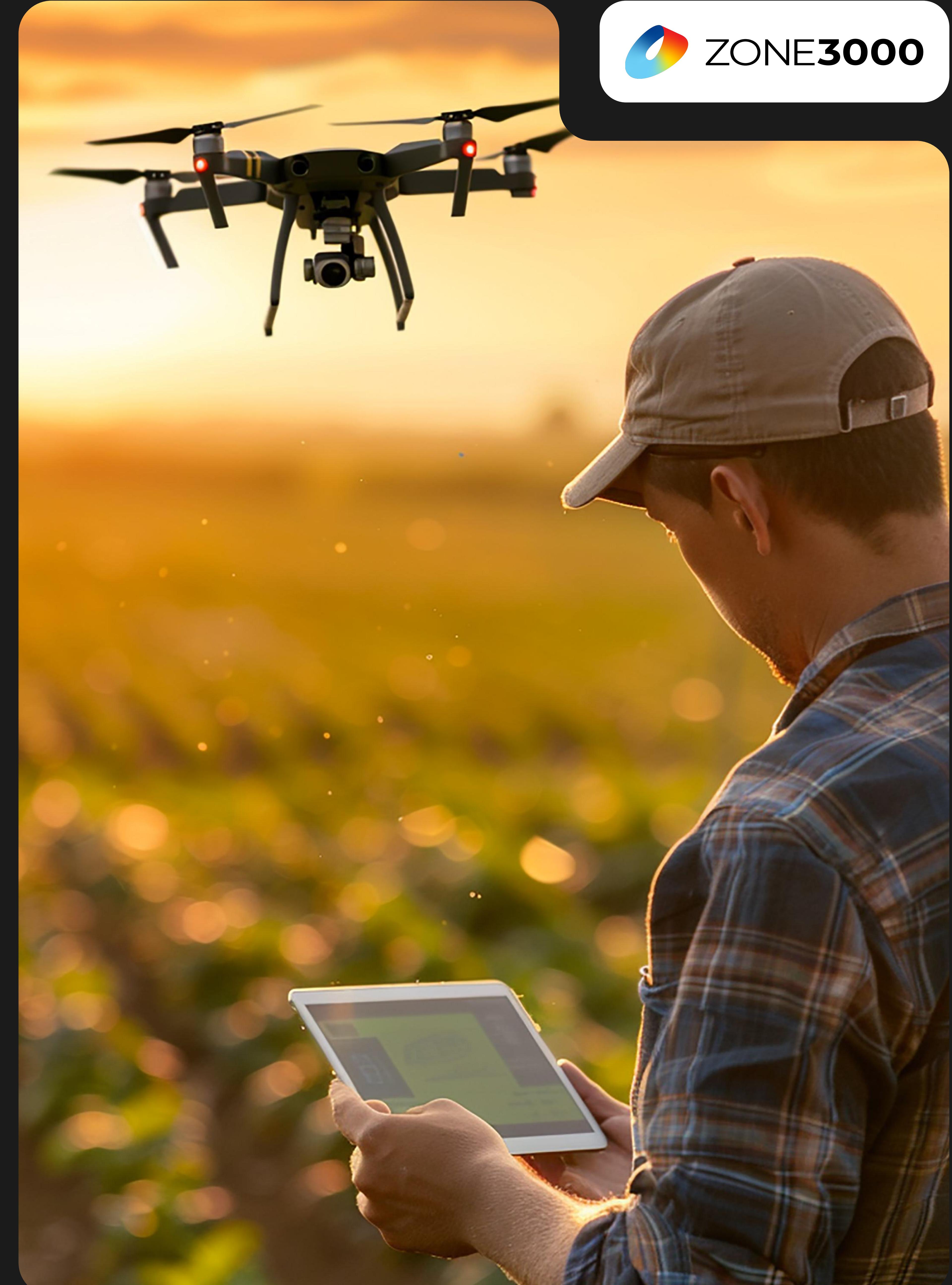
A well-established ecosystem

Precision farming is a management approach that relies on measuring and analyzing field data to enhance agricultural productivity. Its goal is to boost food production by refining decision-making, improving product traceability, and ensuring quality.

A mature yet less disruptive sector

As one of the oldest and most developed ecosystems in Ag/FoodTech, precision farming features many established and profitable companies, including Gro Intelligence (USA), Aerobotics (South Africa), and ENKO (USA).

While the precision farming ecosystem is advanced, it has not yet fully matured. A significant challenge remains: increasing the accessibility of its software and tools. The future may hinge on the adoption of Artificial Intelligence and initiatives from major software companies like Google, SAP, and Microsoft, which are entering this field.



Farm robotics

The first step toward autonomous farming

Farm robotics has moved past the disillusionment phase. After facing challenges in previous years, a wave of new companies is emerging in this sector, accompanied by rising investments.

The number of operational field robots doubled from

2020 to 2021.

Unlike traditional automatic devices that perform repetitive tasks, these robots, developed by startups, are equipped with Artificial Intelligence and Machine Learning vision systems.

The growth of this sector is driven by two main factors: the increasing demand for autonomous farms due to a shrinking pool of skilled labor and the push for sustainability through reduced input usage.



For example, Vitibot (France), a leader in vineyard care robotics, was acquired by the Italian manufacturer SAME Deutz-Fahr.

Indoor farming

Confronting a harsh reality

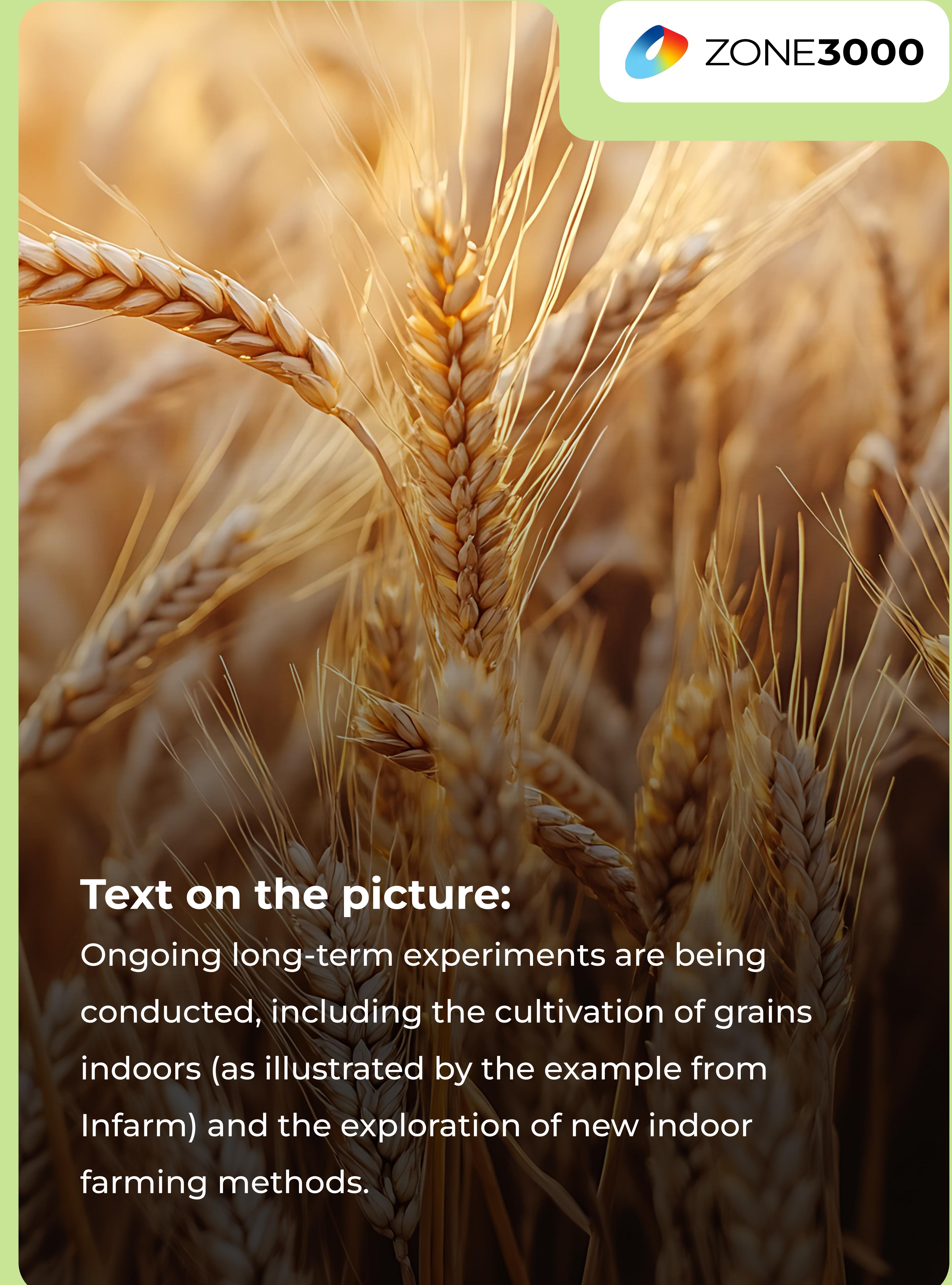
Indoor farming refers to startups focused on developing urban and indoor agricultural systems, such as Plenty, Infarm, and Intelligent Growth Solutions. These initiatives aim to shorten the distance between production and consumption while enhancing yields, quality, and sustainability.

Facing disillusionment

After several years of notable growth, particularly in terms of investments and the establishment of new facilities, the indoor farming sector is now experiencing a significant challenge. The ongoing energy crisis has made the path to profitability for many projects increasingly uncertain, leading several startups to either scale back or completely cease operations.

Solutions for the future

Despite these challenges, indoor and urban farming is not finished. These farms present viable solutions to the issues posed by climate change. We anticipate a "rebirth" of the ecosystem, driven by new business models and a shift where startups operate more as technology companies than traditional farm operators.



Text on the picture:

Ongoing long-term experiments are being conducted, including the cultivation of grains indoors (as illustrated by the example from Infarm) and the exploration of new indoor farming methods.

Insects for animal feed

Disillusionment?

The ecosystem of startups focused on insect farming for animal feed has been developing for nearly a decade. Initially aimed at human consumption, this sector has transitioned to mass production, bolstered by significant investments (over €500 million for Ynsect in France) to establish industrial facilities. However, there is increasing disillusionment as these facilities prove more complex to operate than originally anticipated.

Moreover, costs have not decreased as expected, partly due to the ongoing energy crisis. Consequently, this sector is becoming less attractive to new investors. We foresee a consolidation process where startups will be evaluated based on the specific type of insect they focus on. Concerns are growing regarding the ecosystem's ability to fulfill its promise and achieve maturity, with only a few exceptions.



Bio inputs

The emerging ecosystem

The companies in this sector are focused on creating a new generation of organic fertilizers that are more efficient, lasting longer and enhancing soil fertility over time.

Startups are approaching bio inputs in two primary ways. Some are developing biological alternatives to synthetic mineral fertilizers, like Micropep, while others are seeking solutions to minimize fertilizer usage by improving seed varieties to reduce dependency on inputs.

Managing expectations: when will it shift from proofs of concept to mass market?

The ongoing energy crisis and the rising costs of traditional fertilizers are driving interest in this sector. However, despite the current attention, these solutions account for only a small fraction of the global fertilizer market, and many companies remain primarily in the research and development phase.



Future crops

Developing crops to sustain 10 billion people

Startups focused on "future crops" are dedicated to enhancing seed quality with multiple objectives in mind: improving disease resistance, increasing yields, controlling flowering, enhancing nutritional content, and extending shelf life.

For instance,

\$75 million

has been invested in Tropic Biosciences, a UK-based company utilizing CRISPR technology to boost resistance in tropical crops.



Step 1

Locating the right sequence



Step 2

Cutting the targeted DNA sequence



Step 3

Repairing (and changing) the broken DNA strand

Various technologies are used by startups, including:

Genetic hybridization. This involves crossing different plant varieties to produce desired traits.

Gene editing with CRISPR-Cas9 technology. This increasingly utilized tool allows for precise modifications to the genetic code of seeds, enabling the alteration of specific characteristics. An example of this is Better Seeds, based in Israel.

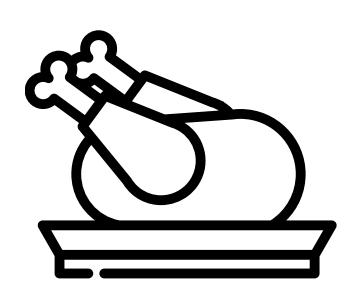
SUSTAINABLE PROTEINS

Megatrend 2

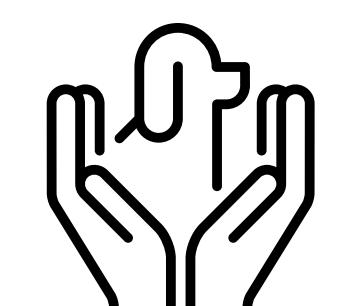
Sustainable proteins: what is it about?

The field of alternative proteins is gaining significant attention, drawing in thousands of entrepreneurs and attracting billions of euros in investments, while also sparking considerable debate. One of the most straightforward ways for individuals to lessen their environmental impact is by altering their food choices. In fact, animal proteins contribute to as much as 18% of global greenhouse gas emissions.

We can identify at least five distinct technological approaches to alternative proteins. Companies in this space share several characteristics:



They primarily aim to replicate familiar animal products, such as meat and dairy, which is viewed as an effective strategy to help consumers transition to alternatives and embrace a flexitarian lifestyle.

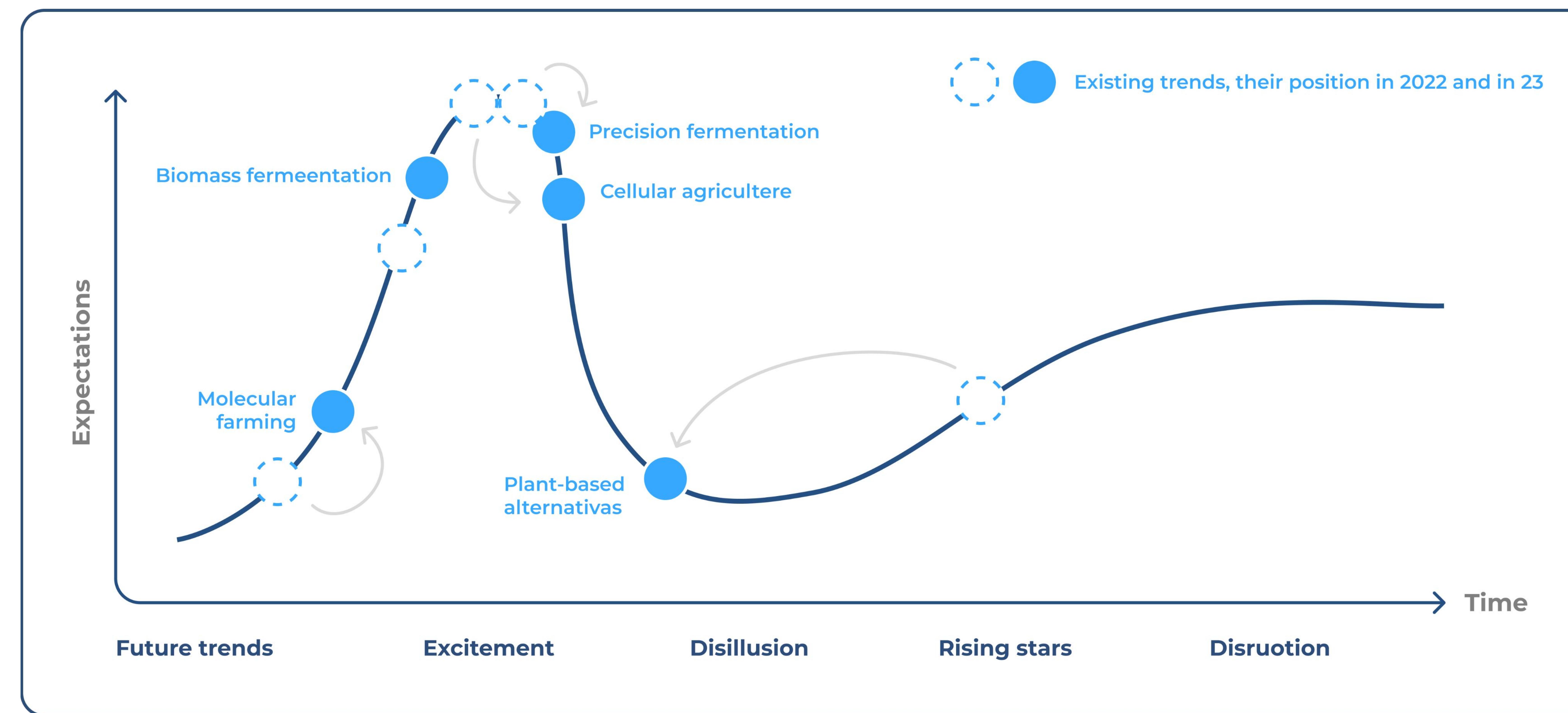


They position themselves as healthier, more sustainable, and more animal-friendly options, going beyond mere substitutes.



A variety of technologies are vying to replace traditional meat and dairy products. Currently, at least five different technologies are in competition for this market. However, we have removed insects intended for human consumption from this list.

This is because the market for edible insects has not developed as anticipated, leading to a decline in interest and the closure of most startups in this area after they entered a phase of disillusionment.



Scale and acceptability

The two challenges facing all protein alternatives

Beyond plant-based options, various alternative protein technologies are progressing, albeit slowly. All these technologies face two significant challenges:

1 **Scale:** the need to produce larger quantities at the lowest possible cost.

2 **Acceptance:** gaining approval from regulators and acceptance from consumers.

The coming years will be critical in addressing these challenges, as many industry leaders are awaiting the completion of their pilot and commercial facilities while also anticipating new regulatory approvals in key markets.

A key question remains:

how can we finance and organize the industrialization of alternative proteins?

It is estimated that tens of billions will be required over the next decade to ensure that alternative proteins can significantly impact climate change, particularly for constructing facilities and bioreactors. One potential solution could be distributed production, akin to the concept of cloud computing, where bioreactors are utilized in a decentralized manner.



Plant-based foods

A reality check

The plant-based sector is experiencing a reality check. For the first time in five years, we've had to adjust our trend projections downward. The industry collectively overestimated the readiness of plant-based products for widespread adoption. Significant hurdles remain, including taste and price disparities, consumer hesitancy to change habits, and health concerns about highly processed alternatives.

However, the sector is responding. New facilities are under construction to boost capacity and reduce costs. Startups are developing cleaner label formulations, some leveraging AI. Industry players are collaborating to improve communication with decision-makers and consumers.

At **ZONE3000**, we remain optimistic about this ecosystem's future, even as consolidation continues among brands lacking strong value propositions.



Cellular agriculture

The next frontier

Cellular agriculture, while conceptually simple, faces complex challenges in scaling profitably. The process involves culturing animal cells to recreate proteins, fats, and tissues for various applications including meat, seafood, and dairy alternatives. Currently, products are mostly in experimental stages, with market readiness estimated at 3-5 years minimum. Mass accessibility timeline remains uncertain.

Key challenges include reducing medium costs and eliminating animal-derived components, identifying optimal, stable stem cell lines, enhancing taste and texture, and scaling production effectively. The first large-scale facilities are slated for 2025, with the largest aiming to produce 13,000 tons of meat. To achieve a 1% reduction in global emissions, approximately 1,000 such facilities would be needed – a feasible but long-term goal.



In 2023, the US joined Singapore in authorizing cultivated meat sales, setting the stage for intense public debate as products reach consumers.

When cultivated meat products hit the market, the debate between companies and those pushing for bans will likely intensify.

Precision fermentation

Reimagining dairy

Precision fermentation (PF) involves inserting the genetic code of a desired protein (dairy, egg, and beyond) into a micro-organism, which then produces it through fermentation.

Most PF startups focus on dairy proteins, but applications extend to egg proteins, flavorings, colorants, infant formula, honey, and coffee. Today, all players in this field operate with B2B business models, developing partnerships with established brands to reach consumers. A notable example is Perfect Day, the most advanced startup in this space, which has multiple products on the US market utilizing its protein. However, the situation differs in Europe, where PF faces regulatory challenges. A request for authorization to market PF products in Europe has been submitted and is expected to provide insights into the technology's future on the continent within 18 to 36 months.

In the US, the regulatory landscape is less restrictive, but efficiently scaling production, particularly for casein (a key protein in cheese-making), remains a significant challenge.

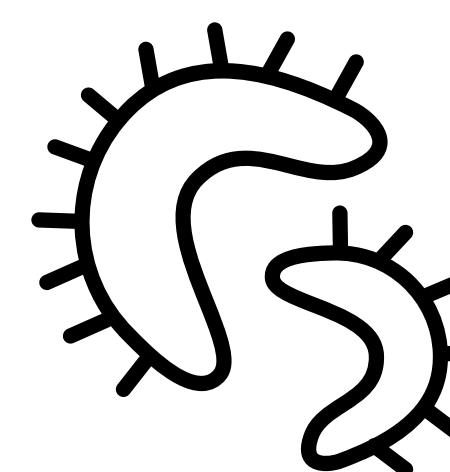
As PF technology approaches price parity, the focus will shift to scaling production capabilities and facilitating the transition for current farmers.



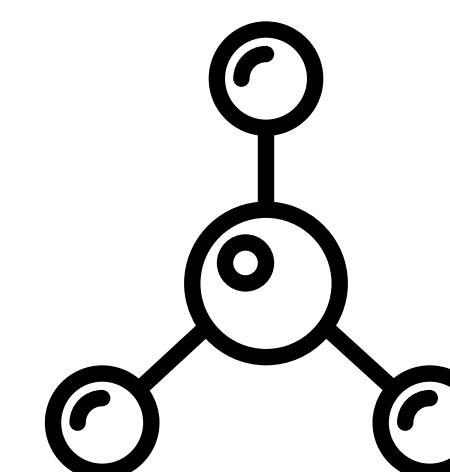
Biomass fermentation

New protein frontiers

Biomass fermentation (BF) identifies and utilizes microorganisms capable of producing exceptional amounts of protein through fermentation. This technology offers new protein sources for alternatives to meat, dairy, and fish. There are two main categories of BF startups:

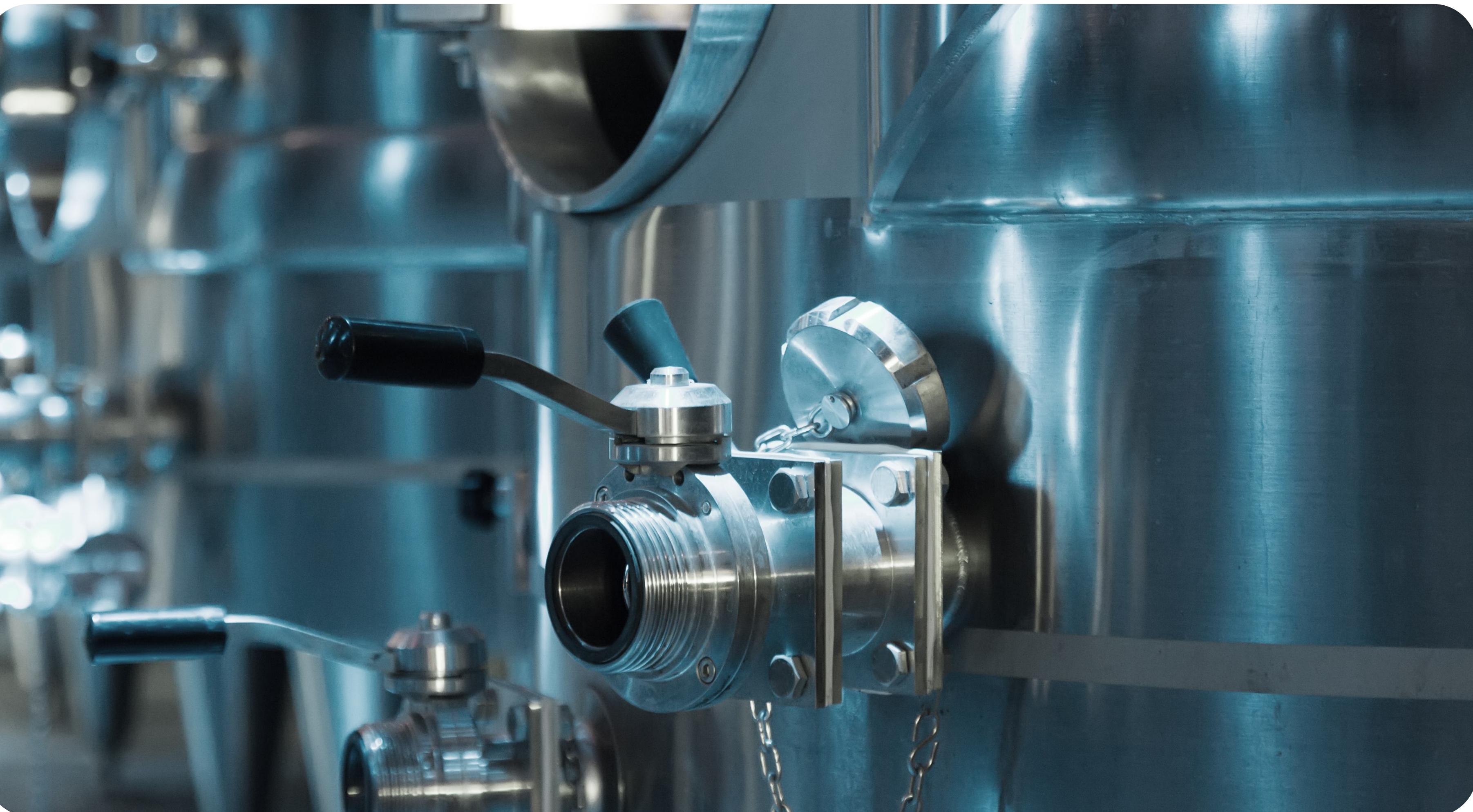


those using microorganisms that produce protein in "uncontrolled" environments, ensuring rapid, low-cost production;



companies like Solar Foods (FI) that use carbon dioxide to feed microorganisms and create protein powder.

Biomass fermentation encounters similar challenges as other technologies, particularly in terms of regulatory hurdles and the ability to produce tasty products for consumers.



Molecular farming

Plants as bioreactors

Molecular farming utilizes genetically modified plants to produce desired proteins, essentially turning plants into bioreactors. The current focus is primarily on dairy proteins, but the potential extends to various food and cosmetic proteins. Key players include Moolec (UK) and Nobell Foods (USA), which focuses on cheese and meat alternatives.

The technology is potentially more scalable than precision fermentation or cellular agriculture, with broad applications beyond food proteins. However, it's mostly experimental at present, with low protein yields relative to plant size. Large-scale open-field experiments are expected in 2-3 years, and these results will determine the approach's true potential.



INSTANT RETAIL

Megatrend 3

Instant retail: what is it about?

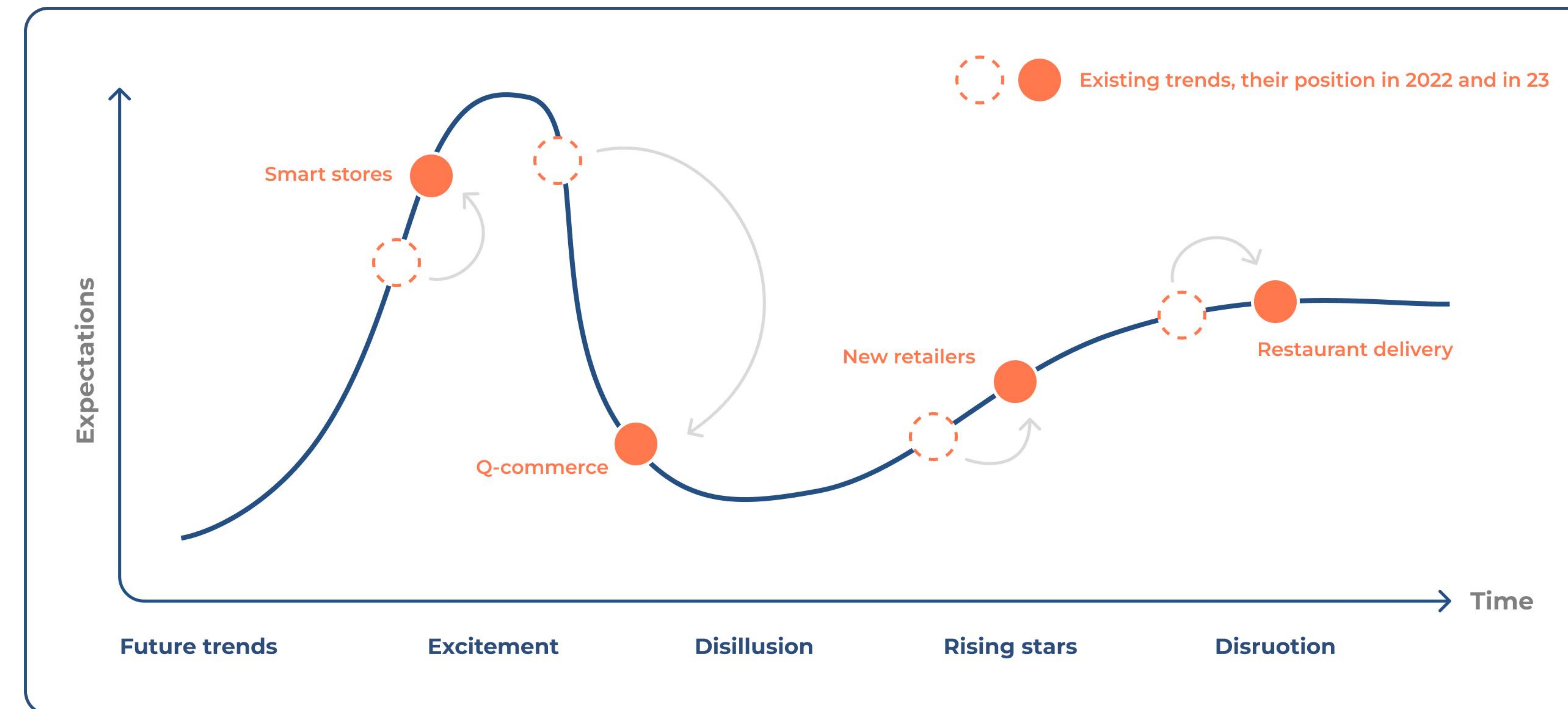
Retail is evolving rapidly on multiple fronts. Not long ago, the discussion focused on the viability of food e-commerce and the growing demand for grocery delivery. Today, the conversation has shifted towards the speed of its expansion, how physical stores can adapt, and defining the future of food retail.

Despite ongoing debates around quick-commerce (grocery delivery in 30 minutes or less), we refer to this evolving landscape as instant retail. This concept encompasses all innovations that allow consumers to access food quickly and conveniently from their devices. Instant gratification goes beyond fast delivery; it's about providing access to foods that align with consumers' values and needs at the click of a button. This idea extends to ethnic marketplaces, anti-food waste platforms, autonomous stores, and restaurant delivery services.



Four trends beyond the hype

Instant retail unifies trends across the innovation spectrum, from established restaurant delivery to futuristic autonomous stores. We've included "new food brands" as a separate trend to reflect the growing discussion around the future of direct-to-consumer startups.



Smart stores

The slow revolution

Smart store technology encompasses several concepts:

Upstream warehouse automation
(e.g., Ocado's facilities for grocery delivery)

In-store product identification tech (e.g., Trigo) for checkout-free experiences

Fully automated "connected convenience stores" (e.g., Boxy)

The ecosystem is currently small with few emerging ventures, dominated by large tech groups like Amazon. There's potential for faster adoption in Europe and North America due to labor shortages. Applications extend beyond traditional retail to petrol stations, industrial areas, and offices.



Quick-commerce

Consolidation and beyond

Quick-commerce, which promises grocery delivery in under 30 minutes from “dark” stores – small warehouses in urban centers – took the FoodTech world by storm, growing at breakneck speed.

However, after a rapid expansion fueled by abundant cash, the landscape dramatically shifted in 2022, leading to swift consolidation. As a result, the number of players has shrunk, making the market more sustainable.



Is this the end of quick-commerce? Despite what many critics say, we don't believe it will fade away so quickly. The traditional model of dark stores combined with salaried drivers may struggle in developed economies with high labor costs and zoning restrictions but remains viable in middle-income countries with booming urban populations and limited convenience store networks.

Restaurant delivery platforms like DoorDash may continue to explore grocery delivery, but their growth will likely remain limited due to the persistent challenges of picking and delivery costs. In the long term, we anticipate significant disruptions in the grocery market, especially around quick delivery. However, the real change may come from emerging technologies like delivery robots rather than from the current quick-commerce model.

New retailers

Profitability over growth

New retailers are startups reinventing online grocery retail by rebuilding entire infrastructures from the ground up. Unlike traditional retailers, these startups focus exclusively on their online operations, treating their digital platform as the main business rather than just another store. These new players fall into two categories:

1
The heavyweights: brands like Picnic, Rohlik, and Oda offer similar products to established retailers but focus entirely on online shoppers. Despite some financial challenges, they are doing well by catering exclusively to the digital market.

2
The innovators: these disruptors bring fresh ideas like subscriptions, reusable packaging (The Modern Milkman), imperfect fruits and vegetables and damaged products, or ethnic produce (Waysia in France, Yobaba in Germany).

Both groups represent a shift in focus from growth-at-all-costs to building sustainable and profitable business models that meet the demands of today's online shoppers.



Restaurant delivery

Reaching maturity

The landscape of restaurant delivery has evolved, with major marketplaces connecting consumers to restaurants now operating as mature, publicly traded entities. This shift necessitates regular data communication to investors, offering insights into their path toward profitability.

Some companies, like DoorDash in the USA, appear to have a more direct route to profitability compared to others, such as Deliveroo. Four key trends are emerging:

While most platforms are considering delivery automation, it remains as distant a prospect as it was a decade ago.

1

Driver status regulation is no longer a primary concern, except for some European regulations that may indirectly reduce competition.

2

Global consolidation continues.

3

All players have expanded into grocery delivery, either through partnerships with large retailers or via their own stores. Post-Instacart IPO, this is viewed as a potential avenue for profitability.

4

Services to clients (restaurants) and advertising are becoming increasingly crucial to their business models.

FOOD AS MEDICINE

Megatrend 4

Food as medicine: what is it about?

The concept of "food personalisation" is evolving into a more comprehensive approach we now term "food as medicine". This shift reflects a growing synergy between the health and food industries. The recent success of Novo Nordisk's Ozempic and Wegovy, initially developed for diabetes management but gaining traction as weight loss solutions, exemplifies this trend. While these pharmaceuticals are costly, they highlight the immense potential for developing healthier food products. We're witnessing the dawn of a nutritional revolution that could lead to universally accessible personalized diets.



Key aspects of this paradigm shift include:

1

2

3

Food as medicine: innovative ingredients and nutritional interventions designed to enhance health outcomes.

Precision nutrition: utilizing DNA analysis, microbiome profiling, and glucose monitoring to determine individual dietary needs.

Tailored dietary solutions: customized supplements, meal plans, and nutritional guidance based on personal health data.

The need for food personalization

Despite widespread knowledge about healthy eating, collective behavior often contradicts this understanding, similar to the disconnect between climate change awareness and meat consumption.

Two critical factors drive the need for food personalization:

- 1 Abundant research demonstrates that simple dietary changes can significantly impact health.
- 2 Many diseases, deaths, and rising healthcare costs are directly linked to food. Projections suggest over half the world's population will be overweight by 2035, straining economies and health systems.

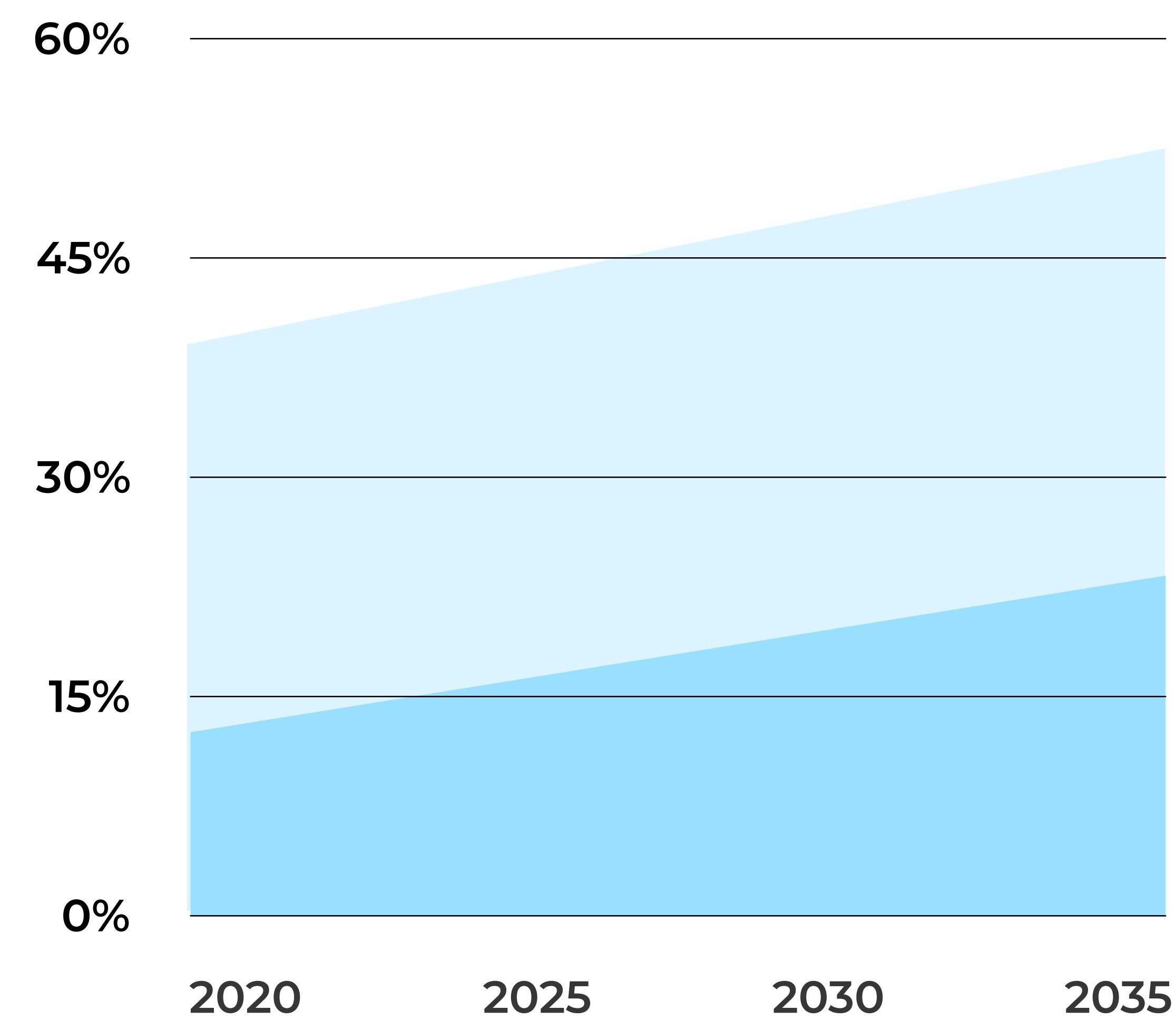
Food as medicine and personalization aim to address these issues by:

- 1 Developing healthier food products using new technologies.
- 2 Offering personalized advice on dietary improvements.
- 3 Creating easy-to-use personalized food products and supplements.

More than half of the world's population will be overweight by 2035

Share of the global population with:

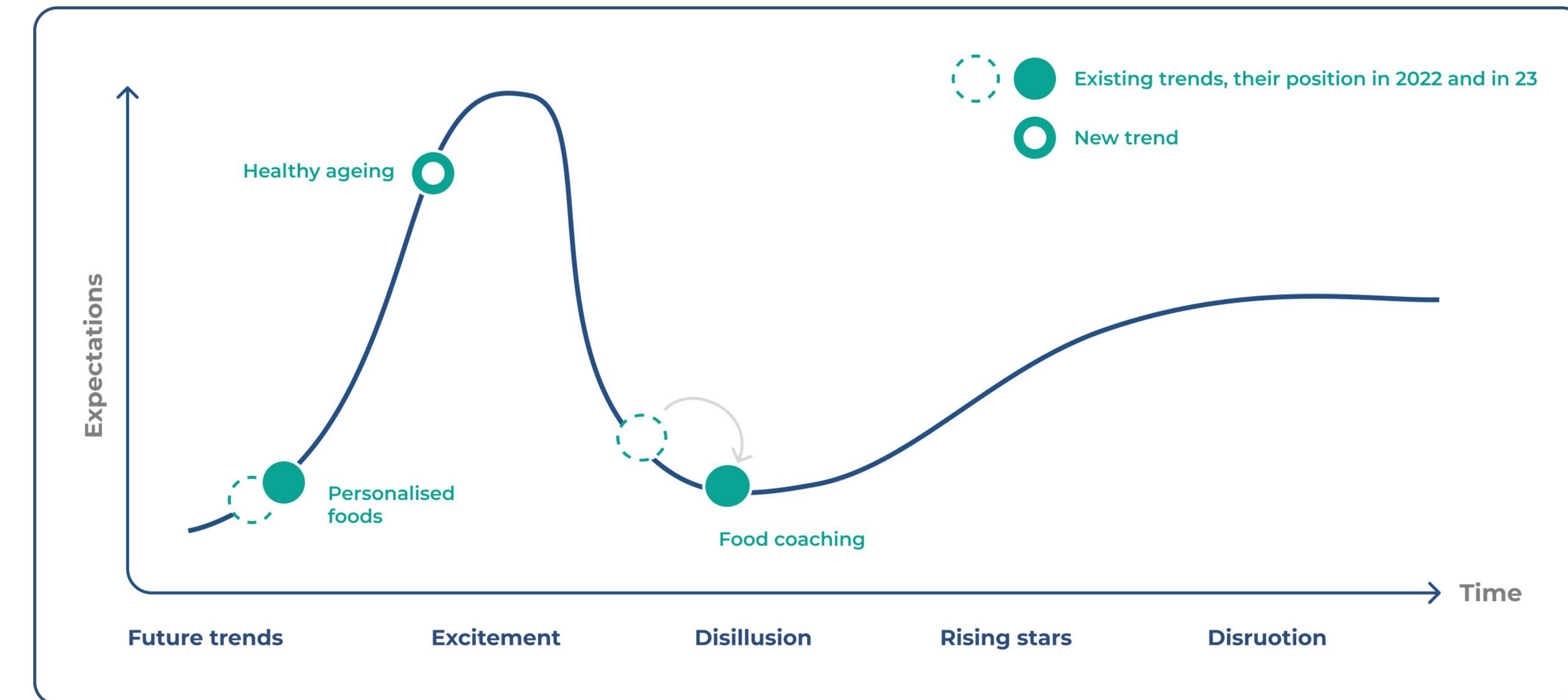
 obesity (BMI > 30)
 overweight or obesity (BMI > 25)



A potentially massive impact, but limited players

We are introducing a new category: **healthy ageing**.

Although still in its infancy, it showcases a growing interest from both consumers and large food companies in healthier food innovations. This is critical as shrinking populations in developed economies force food companies to seek new growth drivers beyond an increasing consumer base.



Food coaching

From services to devices

Food coaching startups aim to help consumers manage diets and follow nutrition plans. Many utilize devices and testing kits to gather user data and provide dietary recommendations:

- ◆ DNA testing (e.g., Genopalete - US)
- ◆ Breath analyzers (e.g., Lumen - Israel)
- ◆ Microbiome testing (e.g., Zoe - UK)
- ◆ Blood samples or glucose patches (e.g., Clear.bio - NL)

However, most data relies on correlations, leading to potentially conflicting interpretations across startups. Greater scientific rigor is needed for broader adoption.

Another category comprises nutrition platforms offering online tools and personalized plans (e.g., Noom - US).



Healthy ageing

Ingredients for longevity

Within the sustainable protein ecosystem, innovators are developing ingredients to positively impact health. Two main categories emerge:

1 Age-adaptive nutrition: cutting-edge ingredients enhance existing foods with nutrients that become scarcer in our bodies over time. Examples include genetically modified foods (especially vegetables) and ingredients derived from breast milk, created through advanced fermentation techniques.

2 Processed food evolution: ingredients designed to mitigate the long-term health impacts, particularly healthier oils, fats, and sugars.



Personalized food

Tailored nutrition solutions

Personalized food aims to create products or supplements tailored to individual needs. Two primary approaches are evident:

1 Customised food supplements or meals, based on tests like DNA or microbiome analysis. Although this model faces adaptability challenges, it is the most realistic nowadays. Examples include Care/of (US, acquired by Bayer) and NGX (UK).

2 Evolving micronutrition: some startups are exploring “supplement” printers for home or office use, though high costs and unconvincing technology have led to setbacks, as seen with Mixfit’s recent closure.



FOOD AUTOMATION

Megatrend 5

Food automation: what is it about?

The food industry lags behind others in automation, still relying heavily on unskilled labor in kitchens, warehouses, delivery, and customer service. This disparity is striking, especially when considering how science fiction often depicts food-related automation as a hallmark of the future. However, the reality is far from these futuristic visions, with many cooking and delivery robot startups facing closure.

A paradigm shift in approach

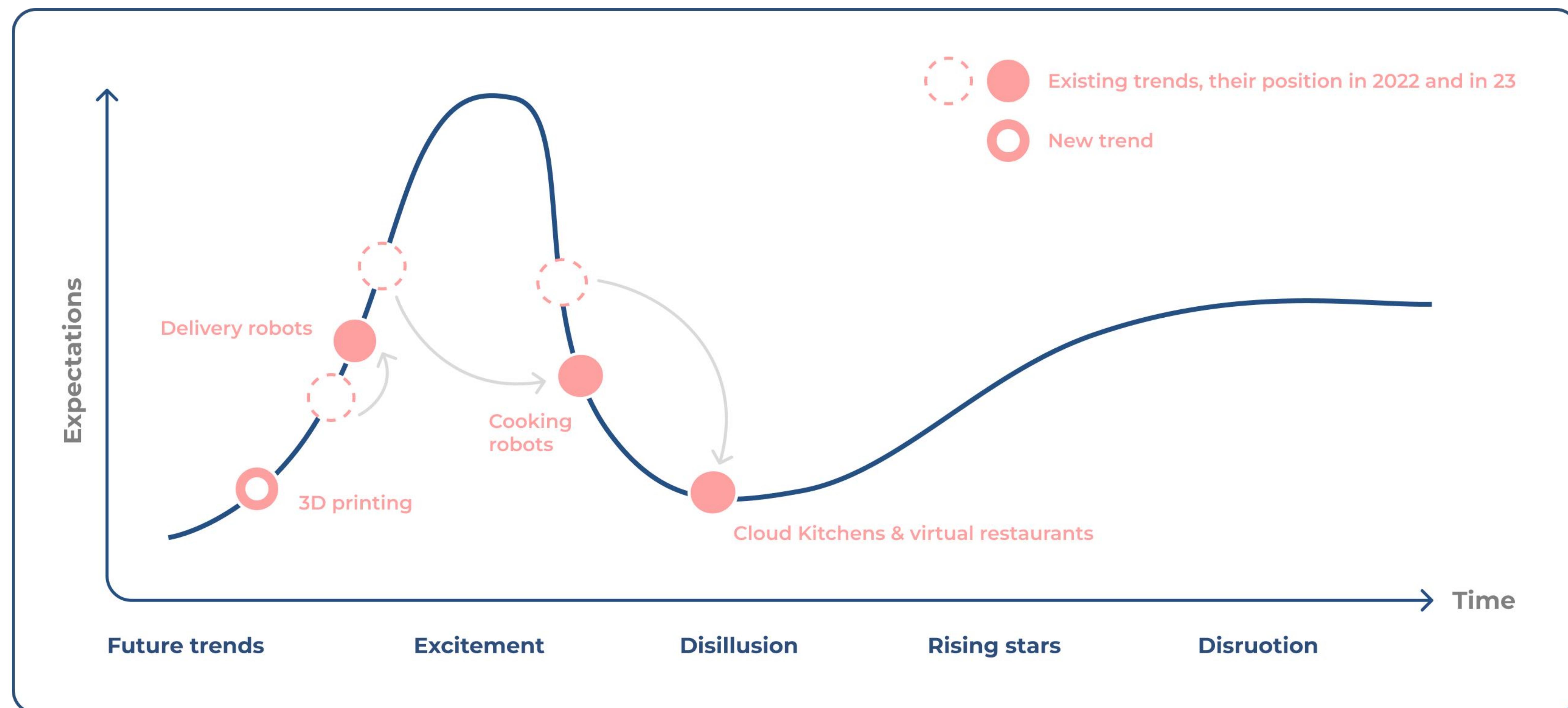
For years, startups attempted to replicate human actions using complex and expensive technologies like robotic arms. This approach proved unsuccessful. Now, a new wave of ventures is drawing inspiration from the food industry itself. The focus has shifted from emulating chefs with robotic arms to scaling down factories to restaurant size. This paradigm shift, while promising for food preparation, has yet to translate into autonomous delivery, where experiments continue without imminent large-scale deployment.



Automation trends reshaping the food value chain

ZONE3000's analysis has identified four key trends shaping food automation:

- 1 Cloud kitchens and virtual restaurants
- 2 Cooking robots
- 3 Delivery robots
- 4 3D printing



This represents an expansion from our previous analysis, with 3D printing emerging as a significant new trend, particularly in its relationship with the alternative protein ecosystem.

Cloud kitchens

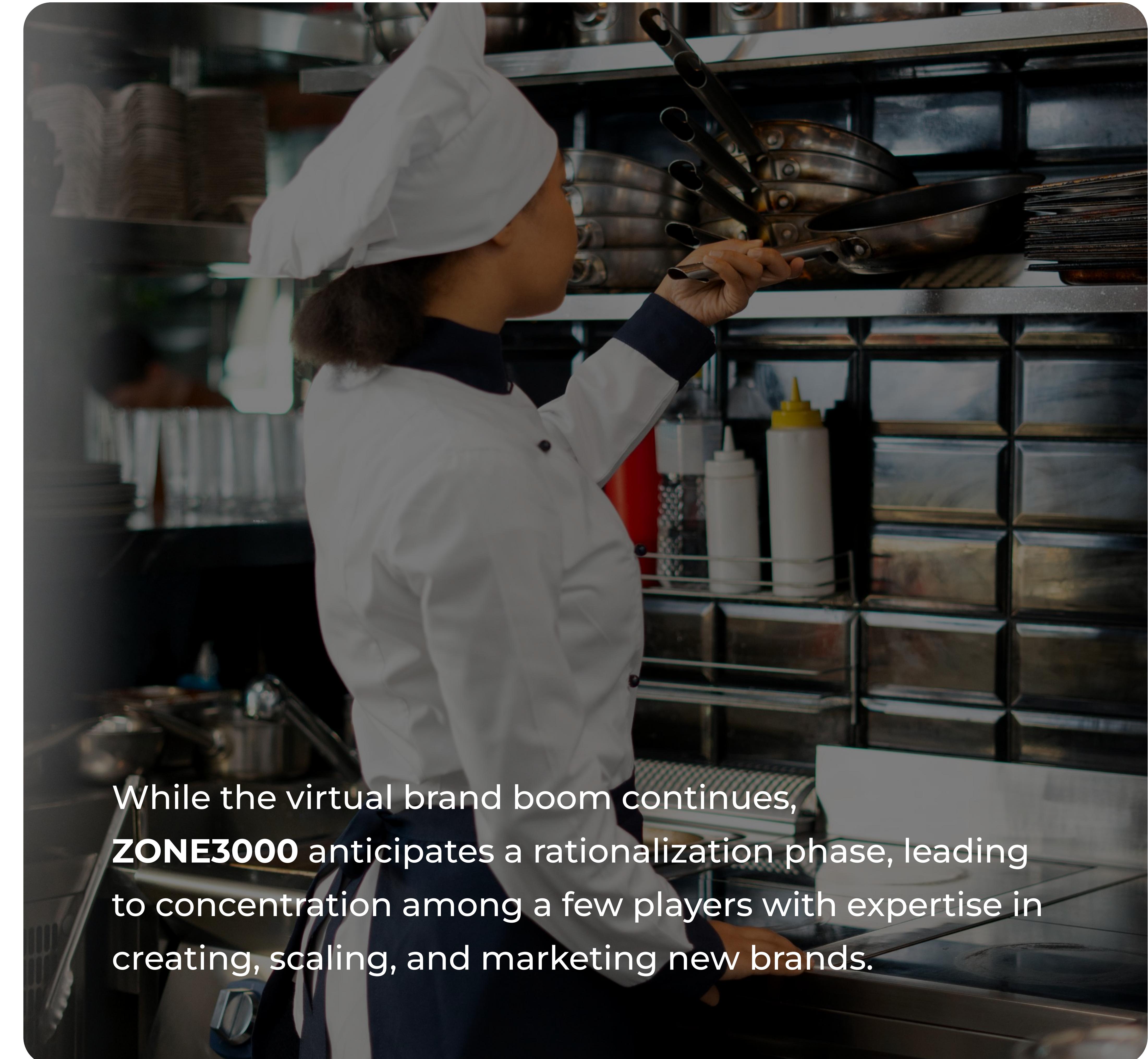
A reality check

Cloud, dark, or ghost kitchens primarily function as space operators, managing modular kitchens for rent. These operators are essentially real estate managers, raising substantial capital to build and lease kitchen spaces. However, current market conditions are challenging this model. After a rapid expansion in locations, vacancy rates have reached unsustainable levels, prompting expectations of closures or model revisions.

Virtual restaurants

Marketing experts in the digital realm

Virtual restaurants specialize in creating online-only restaurant brands, menus, and marketing materials, operating exclusively through delivery platforms. The business model has evolved from integrated operations to franchising, with many offering their brands to existing restaurants as a sales-boosting tool. This trend is amplified by influencer-launched brands (Mr Beast in the USA).



Cooking robots

A renaissance through innovation

The cooking robot ecosystem encompasses diverse technologies:

- 1 Collaborative robots replacing employees for complex tasks
- 2 Automated restaurants capable of preparing multiple recipes "chef-style"
- 3 Automated kiosks and vending machines offering customizable meals



Recent years have seen numerous setbacks in this sector, including high-profile shutdowns like Zume in 2020, and DoorDash's closure of acquired salad robot maker Chowbotics. These failures raise questions about the problem-solving capacity and profitability of such solutions. For instance, the economic justification for investing in a \$25,000 robotic arm solely to serve coffee appears difficult to defend.

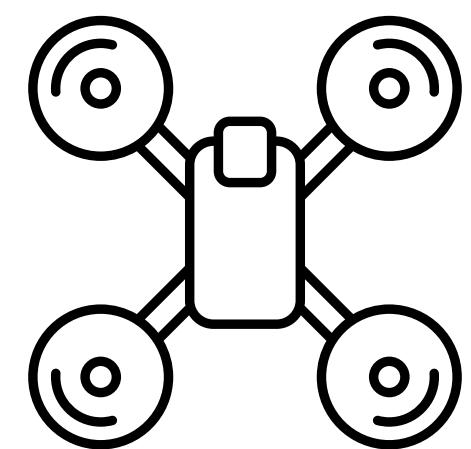
Emergence of a new generation

A new wave of startups is reimagining robotics solutions, focusing on integrating more cost-effective mechanical tools rather than complex robots into traditional kitchen setups. Companies like Hyphen and Sweetgreen (which acquired Spyce in 2021) are pioneering this approach, emphasizing human-robot collaboration.

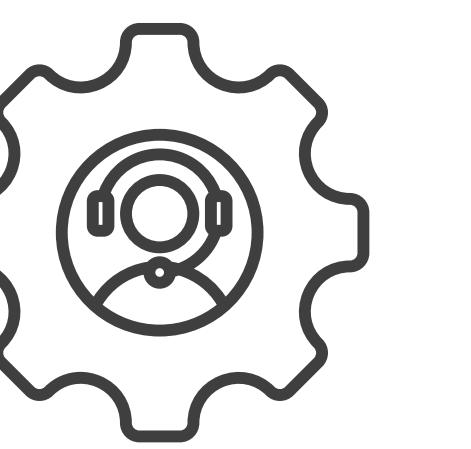
Delivery robots

Navigating challenges

Defining characteristics:



Ability to navigate
sidewalks, roads, or air



Varying levels of autonomy, from
fully autonomous to teleoperated



While the pandemic and subsequent labor shortages initially boosted robotic delivery experiments, outcomes have fallen short of expectations. Recent months have seen a surge in down rounds, shutdowns, and workforce reductions among prominent players like Starship Technologies and Nuro (despite its previous \$1.5B+ funding).

Similar to autonomous cars, delivery robot experiments continue to show promise, but widespread, scalable deployment in daily life remains a distant goal. We observe that the timeline for mainstream adoption is extending beyond initial projections.



3D printing

Finding its niche in FoodTech

3D printing in food involves creating novel food forms with precise portions and shapes. Two primary applications have emerged:

Creative gastronomy. Companies leverage 3D printing for enhanced food creativity, addressing issues from food waste to personalization.

For instance, Nourished (UK) produces customized chewable supplements, while others create intricate shapes with chocolate or sugar.

2 Alternative Proteins. 3D printing enables precise texture and ingredient control, particularly beneficial for plant-based and cellular agriculture companies. Notable examples include:

- Redefine Meat (Israel): plant-based meat
- Revo Foods (Austria): plant-based fish
- Aleph Farms (Israel): cellular agriculture meat products



THE SMART SUPPLY CHAIN

Megatrend 6

The smart supply chain: what is it about?

The supply chain, often overlooked, is a critical yet outdated part of the food industry that needs a digital upgrade. Around 40% of food produced never gets consumed, with 15% not leaving farms in the UK and 16% in the US.

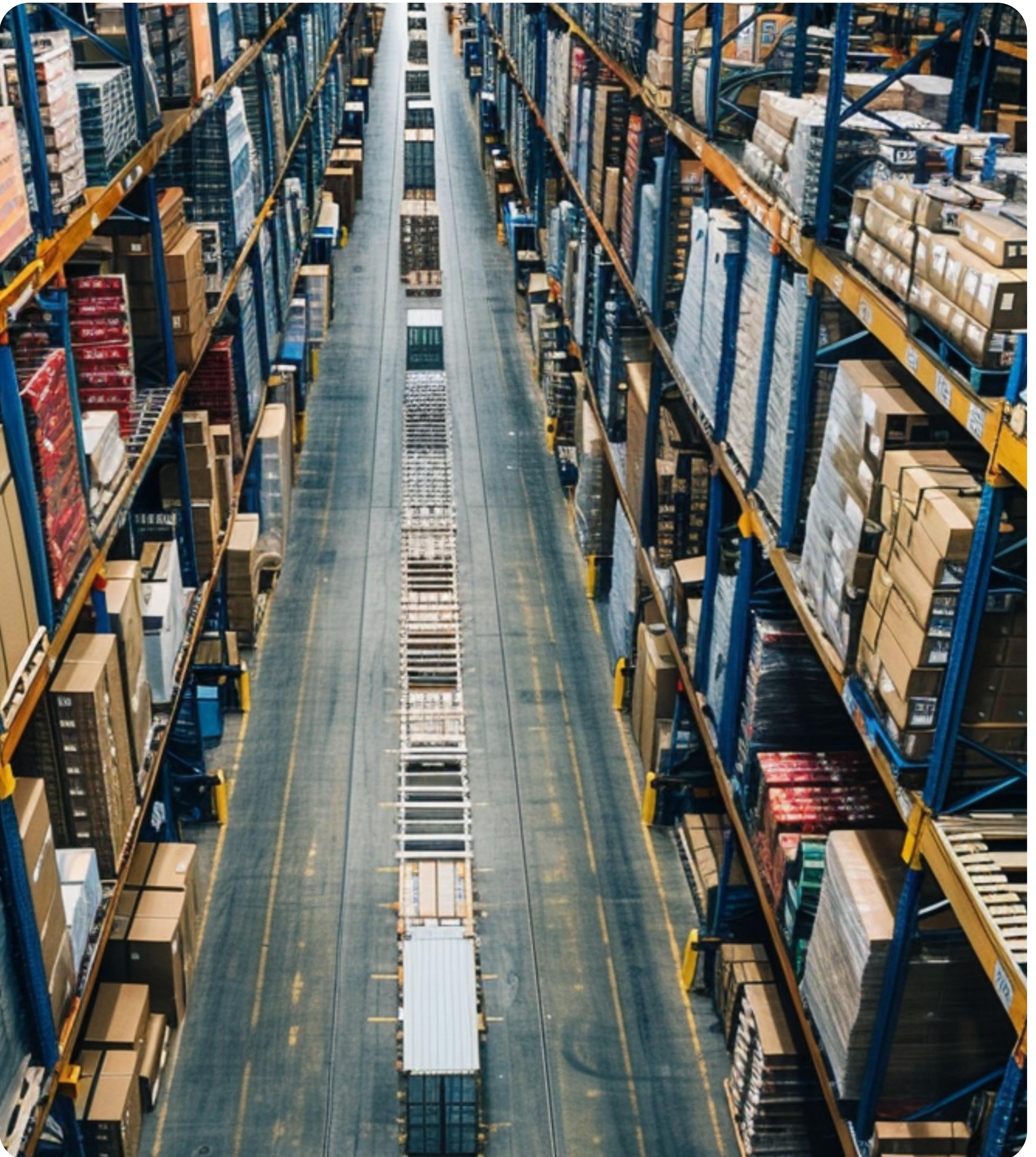
Two key forces drive this megatrend:



Combating waste: this includes minimizing both packaging and food waste, crucial for tackling climate change as both companies and consumers focus on reducing their environmental impact.

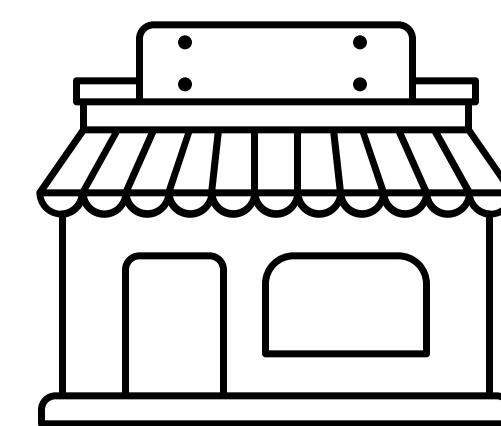


Digital transformation: the integration of digital tools aims to cut labor costs and increase standardization. The rise of B2B marketplaces and advanced digital solutions allows for consistent consumer experiences across stores and restaurants. This trend aligns with reduced availability of unskilled labor, especially in foodservice, and the demand for standardization by CPG firms and restaurant chains.

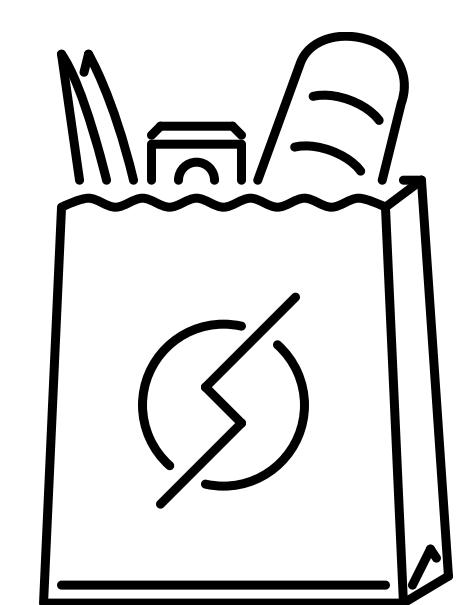


An underrated ecosystem

Six major trends are driving the development of smart supply chains, with two emerging as distinct categories:



B2B marketplaces: previously grouped with digital supply chain services, B2B marketplaces have expanded significantly, warranting a separate focus.



Reusable packaging: split from “smart packaging” due to the rise of startups spurred by new regulatory incentives.



The digital restaurant

Expanding service ecosystem

Startups focusing on digitizing restaurants and other sales points are flourishing, fueled by a new generation of tech-savvy restaurateurs. Key service areas include:

- **Booking systems**
- **Management** of online orders and delivery (e.g., Deliverect)
- **Payment solutions:** From ePOS systems to mobile table payments
- **HR management**

Consolidation & future

Some startups struggled post-pandemic, facing funding challenges that led to numerous acquisitions, especially in ePOS and payment sectors. This trend of consolidation is expected to continue as the demand for integrated, customizable service suites grows among restaurateurs.



Smart packaging

A growing field of opportunities

Smart packaging focuses on reducing food waste, extending shelf-life, and creating environmentally friendly packaging with biodegradable or compostable elements.

Biodegradable solutions

Biodegradable refers to products that can break down naturally in suitable environmental conditions. This sector is growing rapidly, with numerous startups exploring innovative technologies (e.g., Tipa in Israel). This area is expected to gain more attention from new entrepreneurs.

Protective layers

An innovative twist in packaging involves protective layers directly applied to fresh products, such as fruits, vegetables, meat, or fish, to extend shelf life and reduce waste. Companies like Apeel and Sufresca are leading this sector by using protective coatings that keep moisture in and oxygen out, doubling product longevity.



Reusable packaging

Expanding through regulatory push

Reducing foodservice waste also involves tackling packaging waste. To minimize environmental impact and comply with regulatory restrictions, a new wave of startups specializing in reusable packaging has emerged. These companies can be divided into two main categories:

Startups managing reusable packaging:
(e.g., Vytal, Germany)

Startups integrating collectors and RFID-tagged reusable systems: (e.g., Cuploop, Estonia)

Regulation as a driving force

Regulation, such as the 2021 European Union's Single-Use Plastics Directive, has spurred growth in reusable packaging solutions across Europe, emphasizing sustainable alternatives and phasing out single-use plastics.



Food waste management

Shifting from discounts to procurement solutions

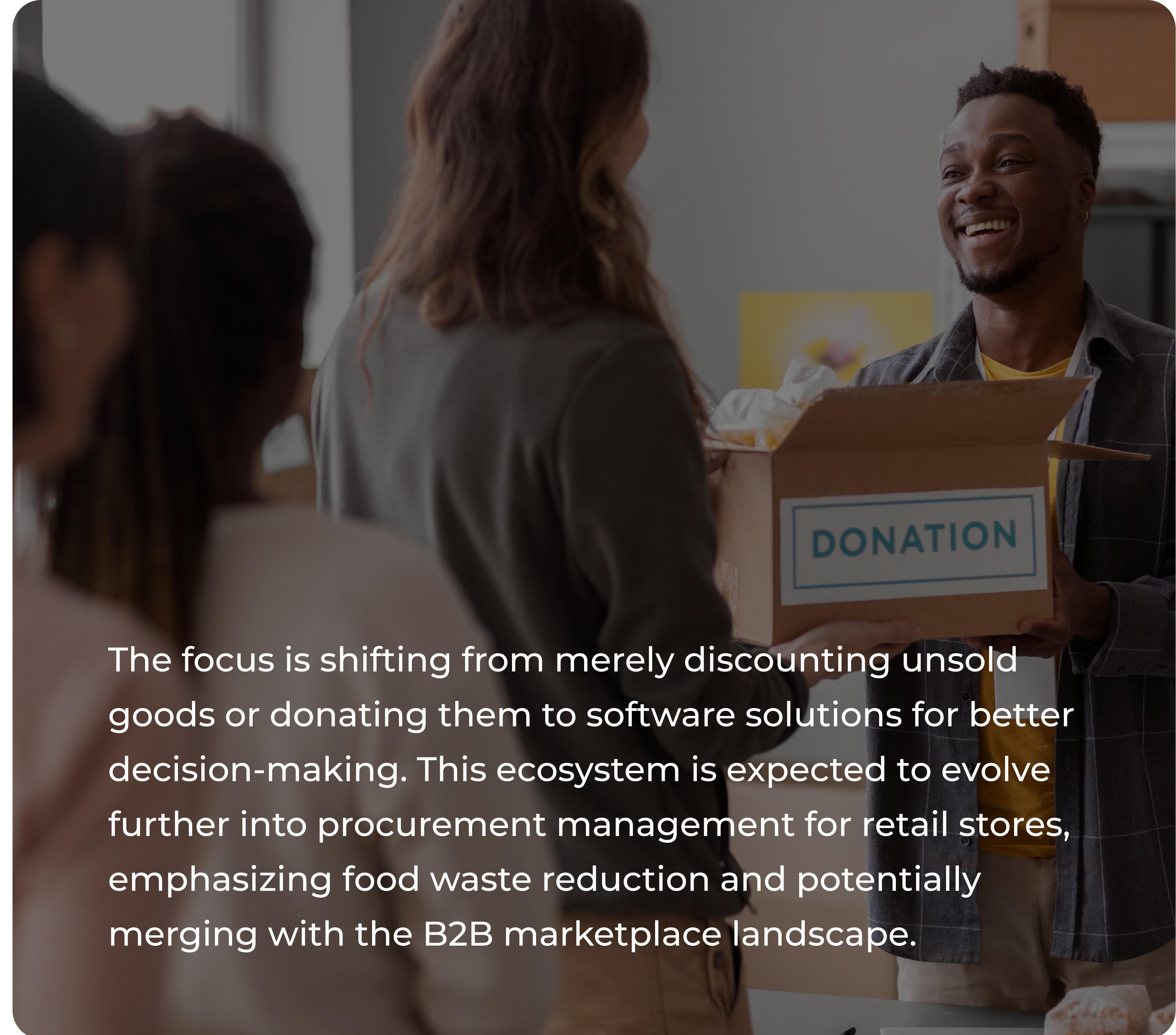
Various solutions are being developed along the food supply chain – from farms to restaurants and grocery stores – to minimize food waste:

Foodservice: tools like Winnow's scales help monitor and reduce food waste.

Unsold food: apps connect customers with businesses offering surplus food (e.g., Too Good To Go).

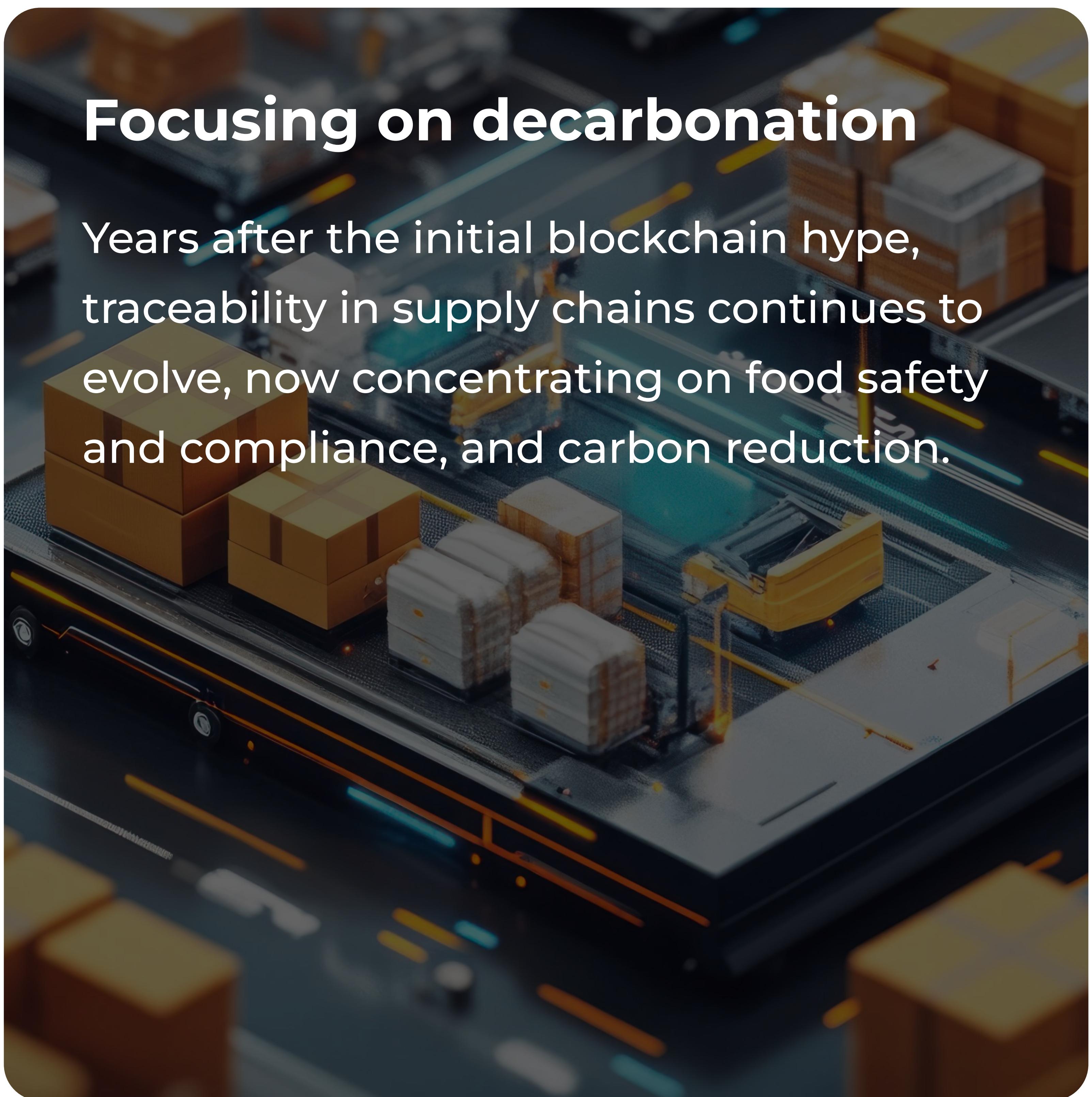
Shelf solutions: dynamic shelf life labeling and AI-driven pricing (e.g., Innoscentia, Smartway).

Consumer appliances: tools for home use, such as composters (e.g., Lomi).



The focus is shifting from merely discounting unsold goods or donating them to software solutions for better decision-making. This ecosystem is expected to evolve further into procurement management for retail stores, emphasizing food waste reduction and potentially merging with the B2B marketplace landscape.

Digital supply chain



Focusing on decarbonation

Years after the initial blockchain hype, traceability in supply chains continues to evolve, now concentrating on food safety and compliance, and carbon reduction.

Currently, startups in supply chain digitalization are primarily focused on carbon counting. Several companies provide platforms for calculating the life-cycle assessment and carbon footprint of products (e.g., CarbonCloud, CarbonMaps). A significant challenge is collecting data related to livestock and agricultural production. Additionally, startups are developing carbon credit trading platforms, such as Agreena, which helps farmers adopt regenerative agriculture practices, issue carbon credits, and sell them in the voluntary market.

Protective layers

Some startups are also focused on informing consumers about the CO2 emissions associated with their purchases. This includes initiatives like climate footprint labels on packaging (e.g., Oatly) or tools that allow restaurateurs to calculate and display the carbon impact of their dishes on menus (e.g., Klimato).

How much CO2e do you put on your plate?



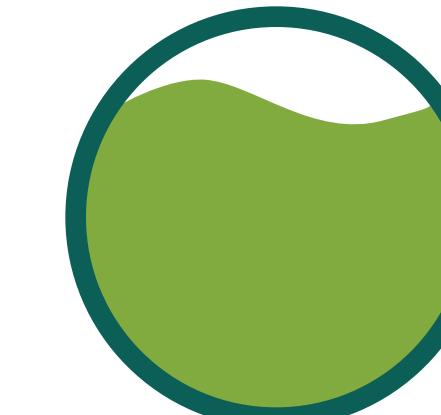
Low

0.1-0.5 kg CO2e



Medium

0.6-1.5 kg CO2e



High

1.6+ kg CO2e

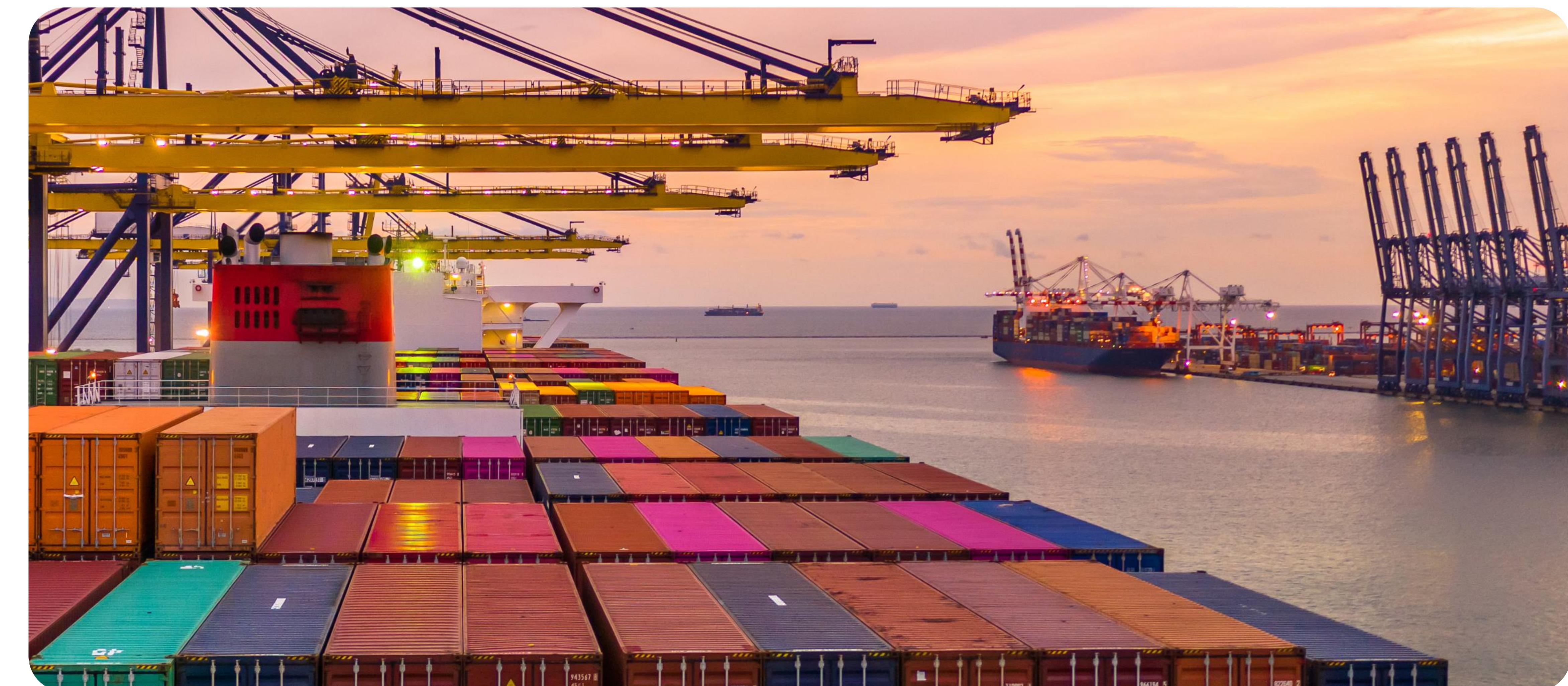
B2B marketplaces

A thriving ecosystem

B2B marketplaces are gaining traction, shifting from grocery delivery to digitizing the procurement processes for restaurants and small retailers worldwide. These platforms facilitate the entire supplier-store interaction through apps and messaging systems.

A young ecosystem

This market is still maturing, with a range of players, from 100% digital platforms (e.g., Choco in Germany) to those that integrate logistics (e.g., Cheetah in the US). Competition remains high, especially from large players like ABInBev Bee's, making the landscape complex and competitive.



Explore the future of food
and see how **ZONE3000**
can drive your success at

zone3000.com

Contact us at:
contact@zone3000.com

