2024

Sustainable Consumption F&B Industry Insights

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Research Objective and Content

Research Objective

Relying on in-depth research and rich project experience, we analyze investment trends in the industry and provide valuable insights for impact investors and entrepreneurs to analyze sustainable innovation opportunities in the Food & Beverage (F&B) industry.

Scope

The F&B industry encompasses a diverse array of segments ranging from raw material production to processing, packaging, logistics, sales, and end-use. This study zeroes in on the segments of the entire industry chain that are pivotal to sustainable innovation, with a particular emphasis on alternative proteins, sustainable packaging, and sustainable sales.

Content

Chapter 1: We delve into the intricate definition of sustainable consumption, outlining the sustainable challenges inherent to the food system and the transformative demands of various stakeholders. By mapping the six elements of the value chain against the three overarching challenges faced by the food system, we identify and categorize the innovation and investment opportunities present at each link in the industrial chain.

Chapters 2-4: These chapters provide a comprehensive analysis of the industry development and investment prospects within the realms of Alternative Proteins, Sustainable Packaging, and Sustainable Sales. We examine these sectors through the lenses of innovation opportunities, market dynamics, macroeconomic conditions, and innovative case studies. Alternative proteins is dissected into three distinct segments: plant-based proteins, cell-cultured proteins, and fermented proteins. Sustainable sales are explored with a focus on two key areas: smart kitchen systems and the repurposing of near-expired food. Meanwhile, sustainable packaging is scrutinized for its potential to mitigate negative environmental impacts and reduce food waste.

Chapter 5: Distilling the core insights of this report.

AGENDA

1. **Overview of the F&B Industry from a Sustainable Consumption Perspective**
2. Solution 1: Alternative Proteins
3. Solution 2: Sustainable Packaging
4. Solution 3: Sustainable Sales
5. Concluding Insights

F&B industry overview

This report studies the whole industry chain of F&B industry, which includes all the links of raw materials, processing and production, packaging, logistics, consumption to the end utilization.

Note: The list of enterprises in the chart is incomplete statistics, ranked in no particular order, for reference only, logos are from the official website of each enterprise.

3 main challenges for agri-food system in the context of sustainable consumption

Food system consumes large amounts of natural resources and place a heavy burden on the ecosystem

Agri-food system consumes around **70%** of the world's extracted freshwater and are a major driver of **habitat and biodiversity loss**. The Food and Agriculture Organization (FAO) reports that it contributes to 90% of global deforestation.

Food system emits large amounts of greenhouse gases and waste, leading to climate change and environmental pollution

Agri-food system accounts for one third of global greenhouse gas (GHG) emissions; more than **half of plastic solid waste** comes from the food system, which is set to grow by 70% by 2050, causing serious and irreversible pollution of ecosystems.

Food system generates large amounts of organic matter loss and waste

Approximately **14% of the food** is lost during the production phase prior to reaching retail outlets; Up to **31% of the food** is either lost or goes to waste. This figure is further compounded by the 17% of food that is discarded in domestic households, catering services, and retail environments.

References on this page: [1] *The Imperative: How the Circular Economy Can Address Biodiversity Loss* [2] *Reinventing Food, Using the Circular Economy to Promote Natural Regeneration*

Government claims: towards sustainable consumption and production

International commitments

Transforming our World: The 2030 Agenda for Sustainable Development, action plan called by UN, 2015

End hunger, achieve food security, improve nutrition and promote sustainable agriculture by 2030.

By 2030, reduce waste in production, retail and consumption and **halve global per capita food waste.**

Climate change has a significant impact on agriculture and fisheries production. Take urgent action to address climate change and its impacts, and **adapt to and mitigate climate change** through sustainable practices.

Protect marine ecosystems by supporting certified sustainable fisheries, **sustainable aquatic sourcing and reducing marine pollution**. Support sustainable agricultural practices that protect, restore and promote the sustainable use of terrestrial ecosystems, including forests, drylands, wetlands and biodiversity. These are closely linked to food production and food security.

China action

Action Plan for Carbon Dioxide Peaking Before 2030, 2021

Require all industries to accelerate the realization of **green changes in production and lifestyle** to ensure that the target of carbon peaking by 2030 is achieved on schedule.

- During the the 14th Five-Year Plan period (2021-2025), green production and lifestyles are widely practiced
- During the the 15th Five-Year Plan period (2026-2030), green lifestyles have become a conscious choice of the public, and the policy system for green, low-carbon and recycling development is basically sound.

The Implementation Plan for Promoting Green Consumption, 2022

Facing the goals of carbon neutrality, government will vigorously develop green consumption, enhance the awareness of conservation among the whole population, oppose extravagance, wastefulness and overconsumption, expand the supply and consumption of green and low-carbon products, and promote the green transformation and upgrading of the consumption structure.

- Improve food production, storage, transportation and processing standards, strengthen management of savings and losses, and enhance the processing and conversion rate
- In-depth development of **food-saving actions** such as “Clean your plate" and strengthening of supervision of food producers and operators in the fight against food wastage
- Promoting recycling and disposal of **food waste and resource utilization**
- Strengthening scientific research and platform support in the field of green food consumption
- Guiding consumers to **establish civilized and healthy** food consumption concepts

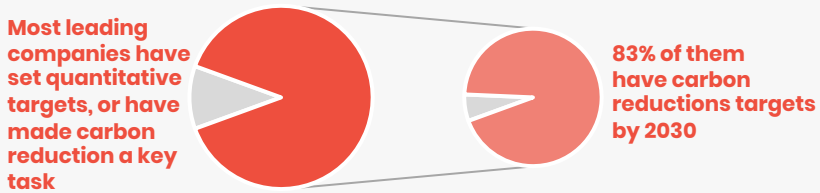
References: [1] https://www.unep.org/explore-topics/resource-efficiency/what-we-do/sustainable-consumption-and-production-policies [2] *China Council for International Cooperation on Environment and Development Summary Report on Sustainable Consumption and Green Development Commission for International Cooperation on Environment and Development Summary Report on Sustainable Consumption and Green Development* [3] *United Nations Sustainable Development Goal 12 Report* [4] *United Nations Guidelines for Consumer Protection* [5] *NDRC Implementation Program for Promoting Green Consumption*

Industry demand: F&B companies are actively seeking breakthrough solutions

Insight 1

After combing through and analyzing **the sustainability strategy goals of** about 20 top Fortune or Forbes-ranked **F&B companies**, this report finds:

Carbon/GHG emissions



In order to achieve corporate carbon reduction targets, companies tend to focus on five areas: **energy/power, logistics, packaging, waste recycling, and supply chain procurement**.

Almost all of the companies that have set quantitative sustainability targets related to packaging mention **"recyclability"**, with Nestlé, PepsiCo, and Yizzie International, among others, identifying the reduction of virgin plastic use as one of their targets. Some companies (e.g. Mars and Nestlé) emphasize the **reusability of** packaging**.**

Insight 2

百威可持续发展

PEPSICO GREENHOUSE COLLABORATIVE ACCELERATOR

Enterprises actively seek internal and external breakthrough sustainable solutions

- 2023 Budweiser China 100+ innovation Lab has been looking for innovative solutions for **zero carbon action, material revolution, recycling Future, frontier manufacturing, eco-green industry, and imagine business**.
- PepsiCo launches "Green Accelerator" program in Asia Pacific to discover breakthrough solutions in both **sustainable packaging and climate action.**

Insight 3

Industry opportunities

Transformational potential of disruptive technologies for the industry: Plant-based and synthetic proteins are the product development technologies that traditional dairy giants are focusing on.

Industry challenges

Risks and uncertainties of disruptive technologies: costs, market acceptance, compliance, etc.
Scarcity of successful cases: limited successful sustainable projects in the industry.

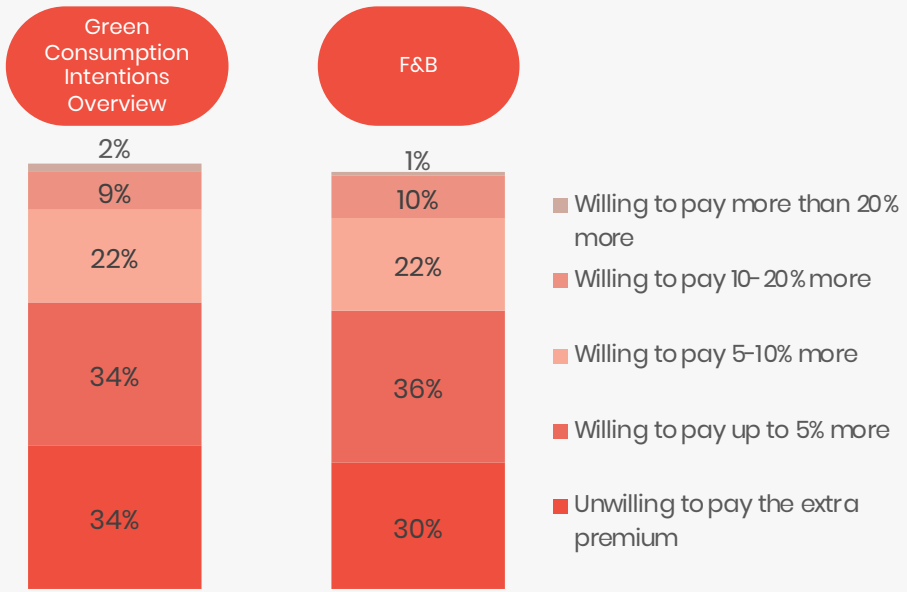
Industry trends

Laying the groundwork ahead of time: companies remain convinced of the trend towards sustainable consumption, driven by consumers and policy
Key issues: carbon reduction (e.g. low carbon energy/electricity for factory operations), sustainable packaging, waste recycling, healthy eating, etc.

Consumer demand: Sustainability has become an important consideration in consumer decisions

Chinese consumers have some willingness to pay a green premium

Nearly 40% of consumers consider "green" as one of the top three factors in purchasing F&Bs, with more than 15% citing it as their top priority. And **70% of consumers** are willing to pay a green premium for F&B.[1]



Consumer concerns about food and packaging sustainability

Trends in low-carbon diets

More than **half of the respondents** said that they often make a conscious effort to eat more vegetables on a low-carb diet or choose **plant-based** low-carb alternatives such as oat milk on a regular basis.[2]

The rise of alternative proteins

Concerns about health, animal welfare and climate have led consumers to look at alternative proteins, says McKinsey study.[3]

Food sustainability concerns

For food, respondents most valued **low-carbon and clean production** processes, low-emission transportation and environmentally friendly packaging.

Impact of Sustainable Packaging

Data from *Shorr Packaging's Sustainable Packaging Consumer Report 2022* shows that sustainability is at the forefront of consumers' concerns and even influences their purchasing decisions. In addition, **47% of consumers** surveyed said they would be willing to pay a higher price for sustainable packaging products.[4]

References: [1] *Deloitte's 2023 China Consumer Insights and Market Outlook White Paper*[2] *Business Gateway Consulting's 2023 Sustainable* Consumption Report
[3] https://www.mckinsey.com/capabilities/sustainability/our-insights/feeding- the-world-sustainably
[4] *Shorr. The 2022 Sustainable Packaging Consumer Report*

Sustainable transformation path and investment opportunities in the F&B industry (1)

Industry Value Chain	Raw Materials	Production Process	Produact Packaging	Logistics	Sales	End Use
	Raw materials for F&B	Processing method or process	Packaging design, packaging materials	Transportation logistics、warehousing	Sales models, store operations, new retailing	Waste treatment and disposal

	New Material Replacement	Process/Procedure Innovation	Sustainable Packaging	Green Logistics	Sustainable Sales	Resource Recycling
Sustainability Innovation Pathways	Selection of alternative food production methods that reduce negative environmental and social impacts, while ensuring food security and production efficiency	Optimize traditional production processes through information intelligence, biotechnology and other means to improve food production efficiency and reduce environmental and social risks	Promote reduction (including material substitution), reuse, and recycling to reduce the environmental impact of packaging in products while extending the shelf life of food products.	Apply modern management models and green packaging concepts in the logistics process, taking into account environmental impact and resource efficiency.	In the procurement of F&Bs, attention is paid to the ladder utilization of F&Bs to reduce over-purchasing and production due to the	Promoting the recovery and recycling of organic waste
Reducing Consumption of Resources	**Cell-cultured proteins** **Fermented proteins** eco-agriculture	**Synthetic biology applications** **Plant-based proteins processing** Water management Reduced product loss	**Compostable packaging** **Reusable packaging** **Recyclable Packaging** CGF Gold Design Principles	**Green logistics Packaging** Smart Cold Chain Shared supply chain/logistics	**Near-expired Food Intelligent kitchen system** Green Retail Stores and Operations Sustainable Restaurants and Operations green marketing	**Compostable packaging** Organic Waste Resource Utilization
Reducing Waste and Pollutants	**Cell-cultured** **Fermented proteins** Community Supported Agriculture	**Synthetic biology applications** Cleaner production processes Industrial waste treatment and disposal	**Compostable packaging materials** **Reusable packaging** **Recyclable Packaging** Durable packaging CGF Gold Design Principles	**Green logistics Packaging** New green modes of transportation	**Near-expired Food Intelligent kitchen system** Green Retail Stores and Operations Sustainable Restaurants and Operations Rental model	**Compostable packaging**
Reducing Food Waste	Utilization of defective raw materials Community Supported Agriculture	Processing of production by-products	**Active Packaging** **Air-conditioned packaging** **smart tag** Non-toxic packaging materials		**Near-expired food Intelligent kitchen system**	Organic Waste Resource Utilization

Note: Bolded content is the focus of this study to view the path of innovative solutions, grayed out words are corporate sustainability guidelines or other technology routes, which will not be examined and analyzed in detail in this report.

Sustainable transformation path and investment opportunities in the F&B industry (2)

Solution 1: Alternative Proteins

Livestock farming is a major source of carbon emissions in the food access sector, and alternative proteins enable soil-free production of "proteins products", which more effectively **reduces energy consumption** and **carbon footprints,** and **saves water** and **land resources.**

Solution 2: Sustainable Packaging

Sustainable packaging involves the entire F&B industry chain and is a major source of solid waste. By changing the way we produce and use packaging, we will greatly **reduce environmental pollution** and ecological pressure.

Solution 3: Sustainable Sales

The innovation cases in this section focus on supporting household and business users to **reduce carbon emissions** and **food waste** from food purchasing and consumption. It will form the new normal for food consumption in the future.

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Alternative Proteins

2 Solution 1: Alternative Proteins

2.1 Overview of Alternative Proteins Solutions

2.2 Comparison of Alternative Proteins Segmentation Programs

2.3 Alternative Proteins Market Analysis

2.4 Macro-environment of Alternative Proteins

2.5 Plant-based Proteins

2.6 Cell-cultured Proteins

2.7 Fermented Proteins

- Opportunities for Innovation
- Macro-environment
- Market Analysis
- Innovation Cases
- Innovation Insights

Overview of alternative proteins solutions

Alternative proteins definition & environmental value

Alternative proteins definition

According to FAO, alternative proteins are defined as proteins produced from plant or novel proteins sources, rather than animal sources, including microbial proteins (microalgae and fungal proteins), insect-based proteins, cell-cultured meats, plant-based meat substitutes and dairy substitutes. [1]

Domestically, the insect proteins market has less potential to grow due to relevant policies and regulations as well as regulatory constraints. Hence, **this report focuses on other three types as below:**

Plant-based proteins: plant-based raw materials, removal or partial removal of non-proteins components (such as water, fat, carbohydrates, etc.) in the plant raw materials, proteins content of not less than 40% of the product.

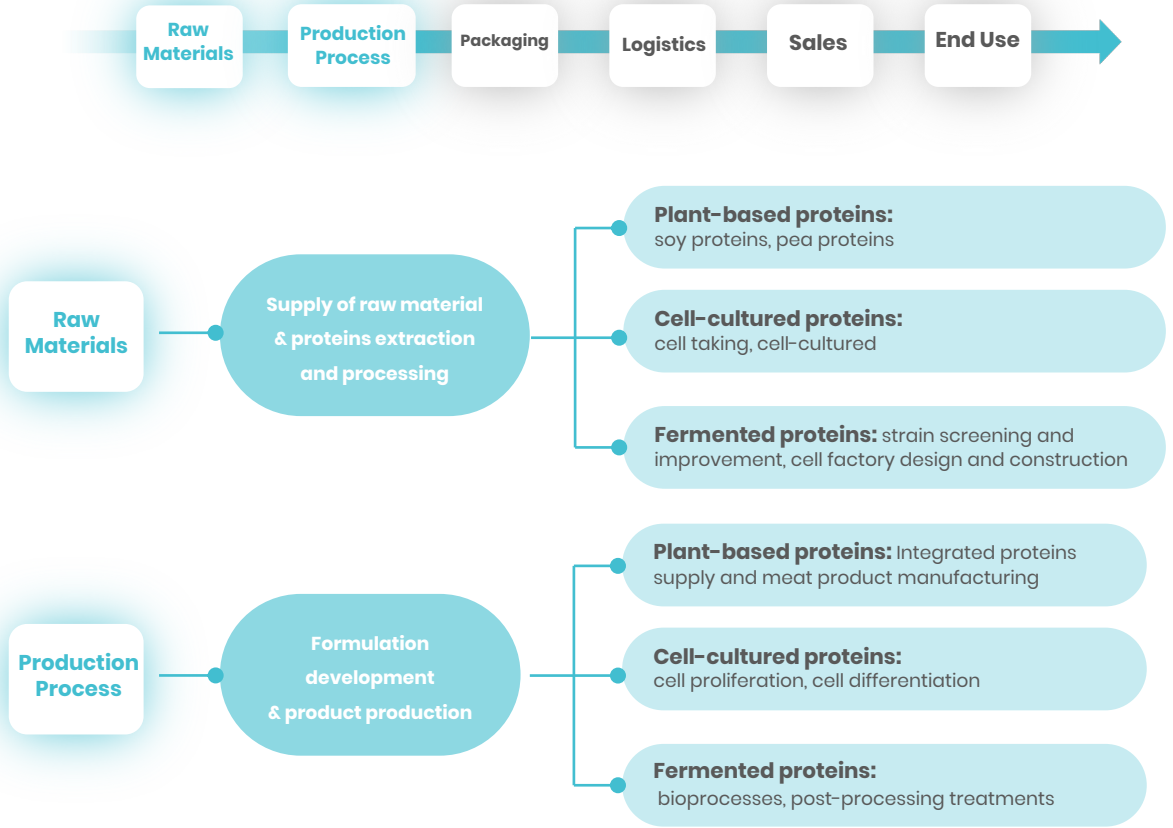
Cell-cultured proteins: a product similar to traditional meat that is generated from animal cells and tissues through various culture techniques.

Fermented proteins: products that have been created through the cultivation of microorganisms to enhance or create raw materials for products, as well as functional ingredients that can be used in plant-based or cell-cultured proteins.

Environmental value

Alternative proteins can partially replace proteins production in the livestock sector, **reducing carbon emissions** and **the use of land and water resources**, and further protecting biodiversity and the ecosystem.

Value chain segments of alternative proteins



References: [1] Our World in Data

Alternative proteins solutions: A comparison of three segmented solutions

- **Plant-based proteins** are among the more traditional and most widely utilized solutions in the alternative proteins industry, with a mature technological base and a low market threshold. However, their **allergenic potential and taste differences** greatly limit the consumer base they can reach.
- **Cell-cultured proteins** are emerging solutions in the alternative proteins industry and are still in the **high-cost** technology development stage and have not yet been marketed.
- **Traditional fermentation** is more common **in fermented proteins**, while biomass fermentation and precision fermentation require high R&D costs for the technology, but have high market potential.

Solution	Pros	Cons
Plant-based proteins	• Low environmental impact: typically more energy efficient and lower emissions than animal proteins production • Health benefits: usually low in saturated fat and cholesterol-free • Market maturity: a wide range of plant proteins products are already on the market	• **Taste and texture:** may not be as good as animal proteins • Nutritional value: some plant proteins may **not be complete proteins** • Allergens: Ingredients such as soy and wheat may be common allergens
Cell-cultured proteins	• Taste and texture: closer to traditional animal proteins • Reducing animal welfare issues: no need to slaughter animals • Controlled production: production under laboratory conditions can be precisely controlled	• High cost: currently expensive to produce and not yet commercialized on a large scale • Public acceptance: due to the relative newness of the technology, the public may be skeptical about the safety and ethics of such products • Environmental impact: energy consumption and productivity remain challenges
Fermented proteins	• **Versatility:** the fermentation process creates diverse proteins forms that are highly tunable • Sustainability: relatively environmentally friendly and energy efficient • **Controllability:** Controlled production process to ensure consistent product quality	• Costs and scale: production at scale and cost efficiencies still need to be further developed • Market acceptance: more consumer understanding and acceptance of such products is needed • Technical challenge: need for precise bioengineering and fermentation processes

References: compiled from publicly available information

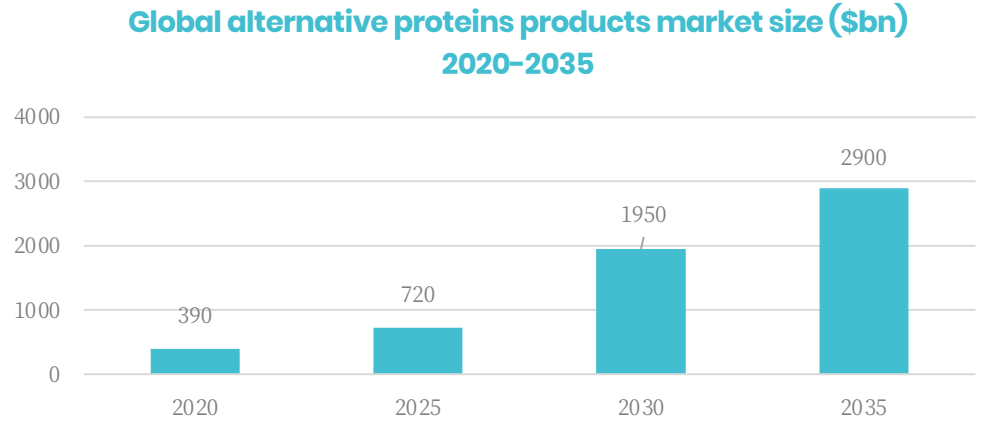
Market Analysis (1) : Global and Chinese market is rapidly developing

Global market

Current market size: In 2020, approximately **13 million tons** of **alternative proteins** will be consumed globally, representing only **2%** of the **animal proteins** market.

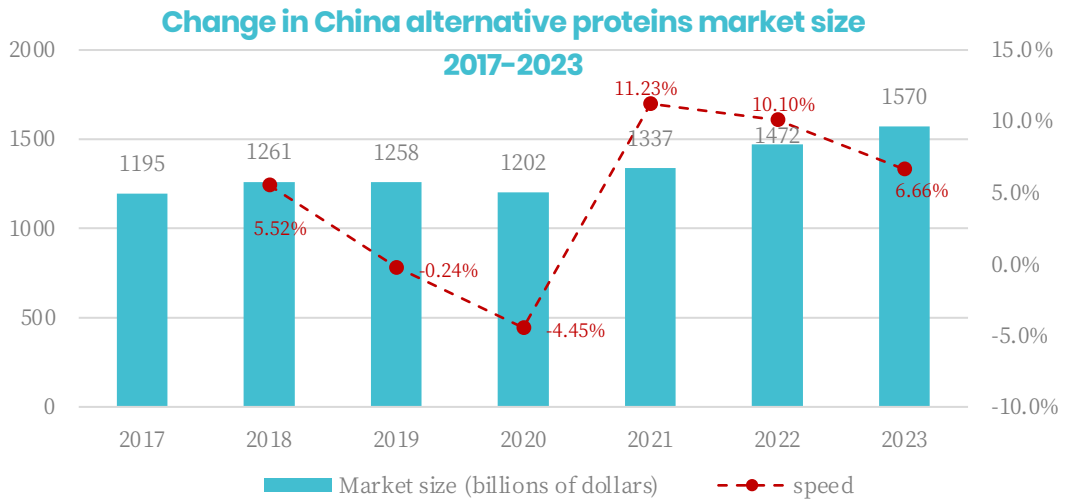
Future market expectations: by 2035, the market for alternative proteins will grow to **seven** times its current size[1] :

- Alternative proteins consumption: 97 million tons
- Market share: 11% (total proteins market)
- **Market size: $290 billion ($3 per kilogram)**



Chinese market

Market trend: According to the data, the growth rate of China's alternative proteins market size shows a downward and then upward trend. Growth rate of 11.23% in 2021, the fastest in recent years.
Current market size: $157 Billion alternative proteins market by 2023, **maintaining 6.6% growth rate.**
Future growth expectation: The future annual growth rate is expected to remain **above 5.89%**, and the market size will **reach 176.1 billion by 2025.**

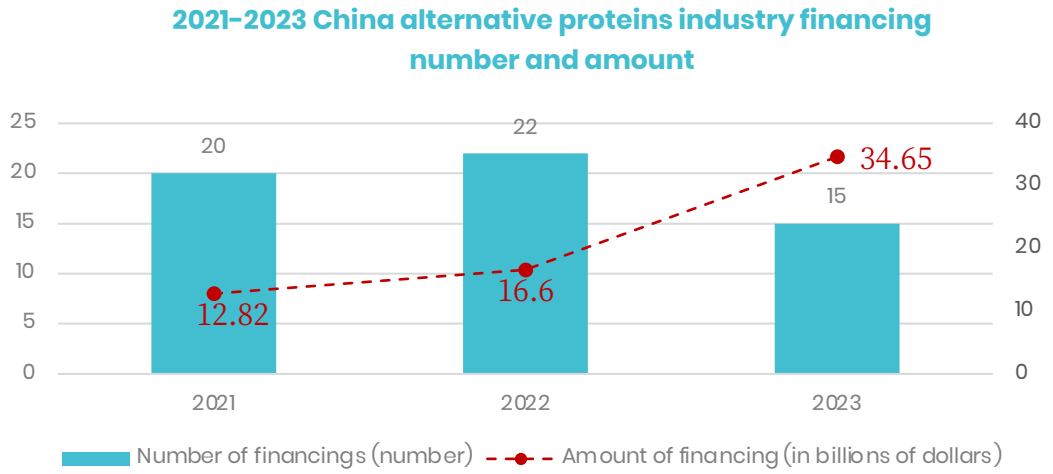


References: [1] *Food for Thought The proteins Transformation* BCG

Market Analysis (2): Domestic capital has been widespread, and synthetic biology financing is most popular

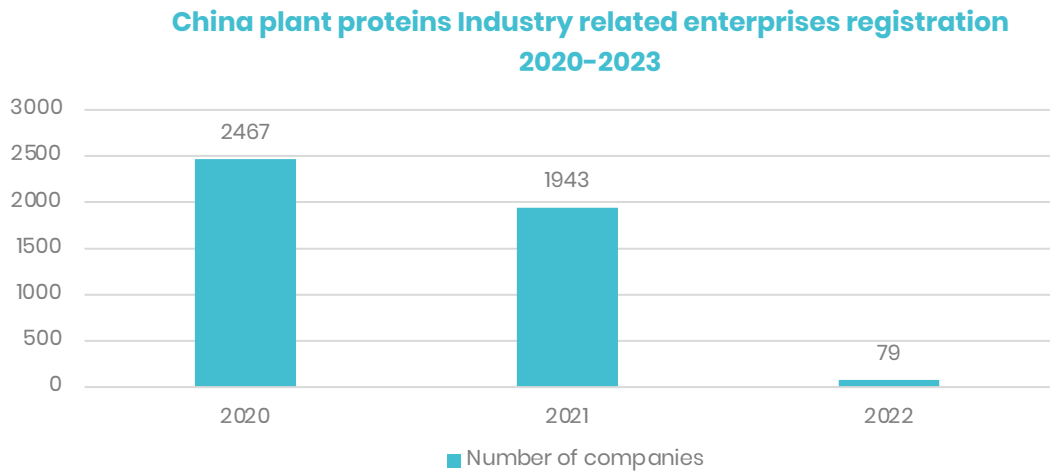
Financing trends

Number of financings: 2021-2022: more than **20 financings per year** 2023: the number of financings decreases to 15, and capital enters a cooling-off period.
Financing amount: gradual growth in recent years, with the total financing amount **doubling to $3.4 billion** in 2023 compared to 2022.
Financing direction: financing is mainly concentrated on headline companies, focusing on plant-based products and synthetic biology technology. In 2023, **synthetic biology and cell-cultured** technology gained capital favor and financing amount rose.



Market competition

The domestic alternative proteins market is still expanding, but there are currently many competitors within the market and the number of entrants is decreasing.
Take the most representative plant proteins in the alternative proteins industry as an example: In **2020**, the number of registrations of companies related to the plant proteins industry in China **reached the highest peak** in recent years, while the number of registrations declined steeply from 2021 to 2022.



References: compiled from publicly available information

Macro-environment: Rapid technology development, but facing challenges such as policy uncertainty

Policy factors

Opportunity **The Chinese government is under pressure to reduce agricultural emissions**: from 2000-2019, agricultural CO_2 emissions grew from 48 million tons to 101 million tons. To ensure food security and reduce carbon emissions, the Chinese government promotes a series of policies favoring Alternative proteins.

Risks According to the Scientific Consensus on Plant-Based Foods (2022 Edition), **genetically modified hemoglobin products** cannot be sold in the Chinese market, which somewhat limits the development of plant proteins and synthetic biology. So far, China has not issued clear policy requirements for cell-cultured meat and synthetic biology products.

Economic factors

Opportunity Alternative proteins are receiving widespread attention from ESG and impact capital. Globally, venture capital groups **invested $1.05 billion** in alternative proteins producers in the first half of 2022. From 2019 to 2021, China's plant-based food startup brands amassed **a total of 48 funding rounds** totaling more than **$1.2 billion**; after 2021, the overall number of funding rounds declined, but the average amount rose.

Risks Globalized trade tensions, which have an impact on the supply chain, lead to fluctuations in the cost of key raw materials for alternative proteins, such as price stability of plant proteins sources such as soybeans and peas. **Economic downturn** Increased consumer price sensitivity and lower consumer demand for plant proteins products.

Social and cultural factors

Opportunity The main consumers of alternative proteins are consumers aged 21-35 in **Tier 1 and new Tier 1 cities**, a segment that prefers plant-based products on a low-fat health and low-carbon level.

Risks **The Chinese diet is diverse,** and a single alternative proteins product does not offer a unified solution. **In terms of market acceptance,** consumers are generally concerned about the health risks associated with food additives and over-processing of Alternative proteins. China has a large number of alternatives to plant-based products, such as traditional proteins drinks like coconut milk and soy milk.

Technical factors

Opportunity The application of cutting-edge technologies such as **synthetic biology** provides effective solutions to several technical difficulties in the plant proteins industry.

Risks Despite the top number of alternative proteins patents filed by Chinese companies, the overall value is low, there are few incidents of technological achievements being transformed, and there is a **lack of overseas patent layouts.** There is a gap between laboratory innovations and market applications for the use of culture and fermentation base products.

References: *Toward Carbon Neutrality: Exploring the Emission Reduction Potential of China's Food and Land Use Systems*

Innovation Opportunities: Focus on structure, formulation design for end-product manufacturers

Suppliers of proteins raw materials

Supply of raw materials such as soybeans and peas for vegetable proteins products

The market is highly concentrated and the existing supply chain is relatively mature. Among them, the top five domestic manufacturers have occupied 60% of the soy proteins market share. In terms of pea proteins, the top five global manufacturers occupy 85% of the market share.

Suppliers of functional ingredients

Provision of functional ingredients such as flavor substances and flavors

Some of the functional ingredients are provided by fermented proteins companies, while others are developed by the end-product manufacturers themselves.

End-product manufacturers

Manufacturer of plant-based meat formulations and finished/ semi-finished products.
It is dominated by start-ups and traditional F&B companies.

Extraction and purification technology

Separation of proteins and other plant components by physical or chemical means to **obtain** highly pure **plant proteins**.

Structured technology

Physically or chemically altering the structure of plant proteins to more closely **resemble the texture of meat.**

Formulation and processing technology

Blending plant proteins with functional ingredients such as flavors, fats, and minerals to mimic the taste, appearance, and nutrition of meat.

Gene editing technology

Improving plants to **produce higher quality** or **higher yield proteins** through gene editing or traditional breeding methods.

References: compiled from publicly available information

Plant-based proteins market analysis: Growth lower than expected, industry valuation returns to rationality

Wide market acceptance and more mature industry development

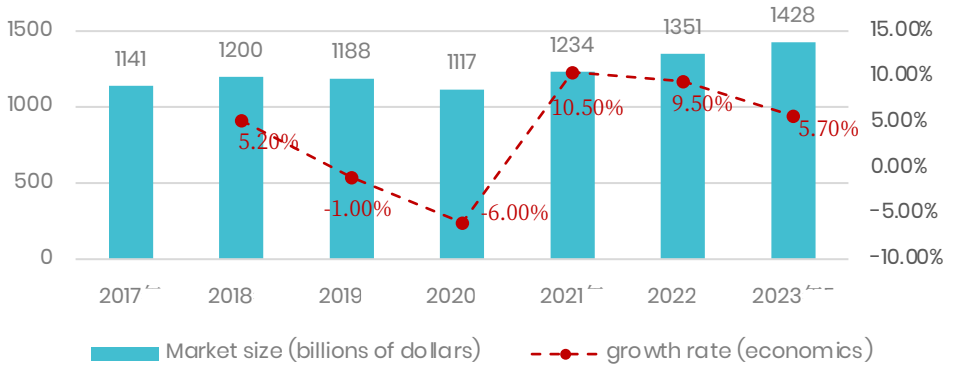
- In China, the plant proteins beverage market accounts for 90% of the entire plant proteins market size, which can partially reflect the current situation of the plant proteins industry
- **The market has entered a stable growth stage:** the growth rate of market size reached **10.5%** in 2021, the highest in recent years. Although there is a slowdown in the growth rate from 2022 to 2023, it will still maintain a medium-high growth rate of more than **5%.**

The investment market tends to be conservative in its prognosis for the growth of the plant-based proteins industry

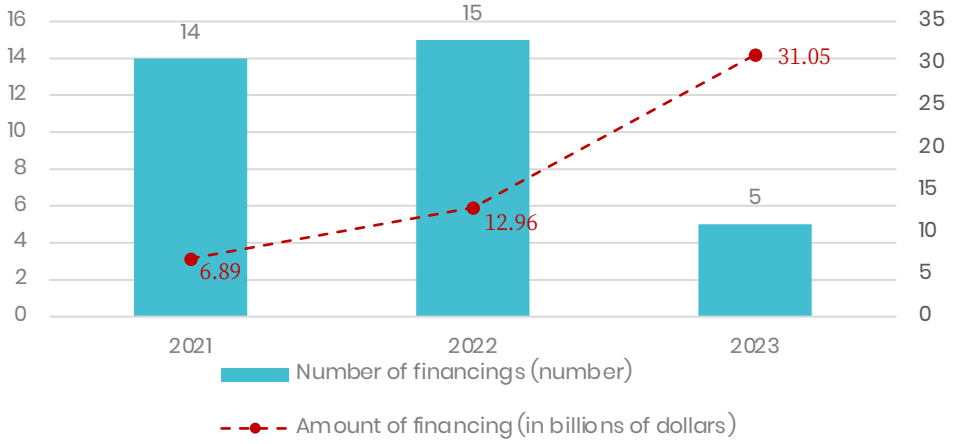
- **Declining number of financings:** the number of financings in 2022 was the highest in recent years at 15, but rapidly declined to 5 the following year, indicating that the market's enthusiasm for plant-based proteins is fading. Meanwhile, **financing amounts have risen yoy** in recent years, but are concentrated among the traditional giants of plant-based proteins that are in demand for market expansion, indicating that emerging solutions for plant-based proteins are decreasing, and the industry's potential for innovation is waning, in a period of growth that is nearing an inflection point

- **Secondary market underperformance:** shares of Beyond Meat, the No. 1 plant-based meat stock, rose 163% when it went public, but shares have **continued to decline** in recent years; Otaly, an emerging plant-based proteins drink company, has **a cumulative loss of $701 million** from 2019-2023, and in the third quarter of 2023, revenue in Asia **declined 31.2%** yoyr [2]

China plant-based proteins drinks market size and growth rate, 2017-2023[1]



2021-2023 China plant proteins industry financing



This page reference: [1] *China Vegetable proteins Drinks Industry Development Trend Analysis and Future Investment Forecast Report (2023-2030)* [2] *Losing 5 Billion in 4 Years, Is It Hard to Find a Way Out for OATLY in China?*

Innovation examples of plant-based proteins

Functional components of hemoglobin

Highlights: Soy hemoglobin is produced through synthetic biology technology and added to plant hamburger meat to provide products with flavor and texture that mimic animal meat

Location: United States
Official website:
https://impossiblefoods.com/

Plant-based proteins beef

Highlights: the first stock to list plant-based meat, emphasizing non-genetically modified raw materials, unadded hormones and antibiotics, combining the concepts of health and environmental protection, and expanding the customer base for plant proteins products
Location: United States (NASDAQ listed)
Official website: https://www.beyondmeat.com/

Plant-based proteins drink

Highlights: the world's largest oat milk brand, successfully educating the market and continuously expanding the market scale through continuous launch of new products and marketing strategies such as cooperation with coffee shops

Location: Sweden (NASDAQ listed)
Official website: https://www.oatly.com/

3D Printed plant-based meat

Highlights: 3D printing technology is used to simulate the muscle, fat and blood components of animal meat, and to enhance the nutritional value of the meat while retaining its taste through a blend of ingredients, such as increased dietary fiber

Location: Israel
Official website: https://www.redefinemeat.com

Note: Specific information can be found on each company's website

Cell-cultured proteins innovation opportunities: Focus on innovation of culture fluids, and other elements of and differentiation phase

Traditional culture fluid

Bovine Placenta Serum
- high cost
- Contrary to the original purpose of animal welfare

Innovative cultures: reducing costs

- **Plant-based serum**
- **Recycling of serum**
- **Serum-free medium**

culture fluid (in biological lab.)
Medium for cell growth

Conventional Bracket

polymer
- non-degradable
- inedible

Innovative materials: biodegradable and edible

- **Plant-based scaffolds**
- **Mycelial scaffold**
- **Heterologous proteins expression scaffolds**

brackets
Support networks for cell growth

- **Fixed mold**
- **3D Bioprinting**
- **Electrostatic spinning**
- **Laminated**

three-dimensional training
Supports cell differentiation into specific products

Cell extraction: extraction of living animal tissues and isolation of seed cells

Cell culture: preliminary culture of seed cells

Massive proliferation: rapid division and multiplication of cell populations

Cell differentiation: differentiation of cell populations into specific cultured meat products

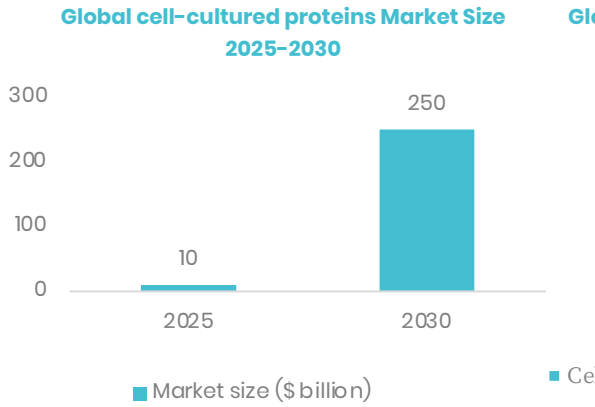
Culinary processing: further processing to produce end products

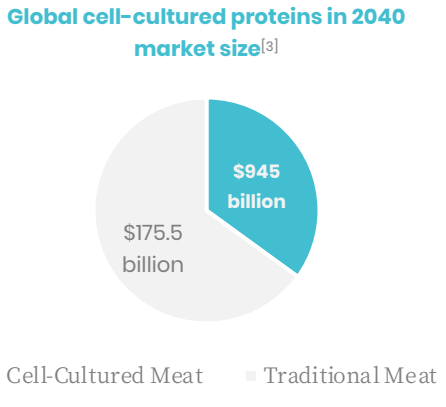
References: *Cell Cultured Meat Technology: Research Progress and Future Prospects;Cell Cultured Meat Industry Insights: Demand, Technology, Industry Chain, Capital, Investment Opportunities, Consumers and Policies; What is Cell Cultured Meat? How far is it from people's table?*

Cell-cultured proteins market analysis: The industry is in the growth phase and has a high potential for development

The current market is small and has a large potential for growth. Market demand depends on how much production costs will fall

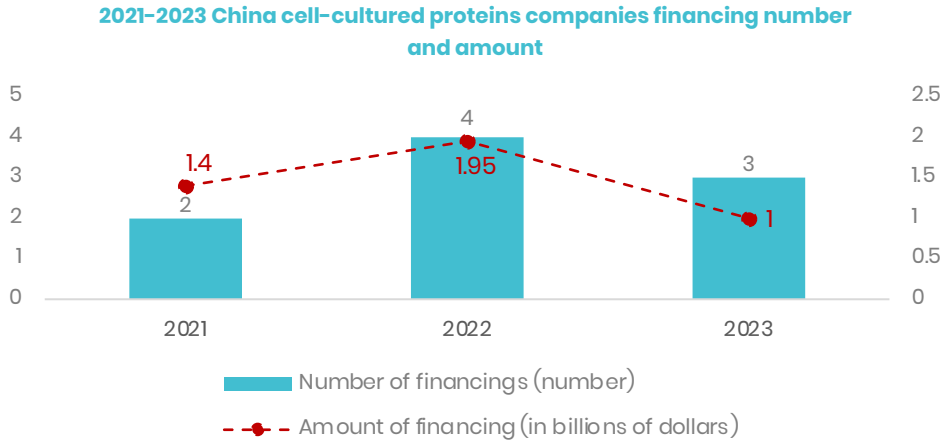
- According to McKinsey, the global cell-cultured proteins market size is expected to grow to USD 1 billion by 2025 and **further to USD 25 billion** by 2030.[1]
- In China, **85% of consumers** said they might/would definitely try cell-cultured meat.[2]
- In the short term, cell-cultured proteins are in the laboratory research and development stage, and their market size is mainly driven by supply. And with technological advances and lower production costs, global cell-cultured meat is expected to account for 35% of the meat market by 2040, or **about $945 billion**





Global innovation is heating, but China is a late starter

- The cell-cultured proteins companies that have received financing are mainly based in the United States and Israel, and some of the headline companies have entered the stage of **pilot testing** or **building small-scale plants**
- China's companies started late, but are catching up. domestic companies such as Avant meats, Joes Future Food, Jimi Biotechnology, and CellX have **received more than 100 million RMB** in financing



References: [1] *Cultivated meat: Out of the lab, into the frying pan McKinsey* [2] *A Survey of Product Nomenclature and the Impact of Consumer Decisions on Cell-cultured Meat in China* [3] *Vegetarian Alternatives - Foods of the Future? Kearney, Inc.*

Innovation examples of cell-cultured proteins

Cell-cultured fat

Highlights: through the development of cultivated fats to enhance the flavor and texture for its cell-cultured beef burger products; the company has constructed four production bases and entered into a large-scale production phase

Location: Netherlands
Official website: https://mosameat.com/

Serum-free media & fermented proteins applications

Highlights: CellX develops a variety of serum-free media and combines fermented proteins and cell-cultured meat to develop complex products that can also effectively reduce production costs and further optimize product flavor, texture and nutrition.

Location: China
Official website: https://cellx.co/zh

Edible plant-based nanofiber scaffolds

Highlights: Provides nanofiber scaffolds for cell-cultured meat, supports efficient growth of cultured meat while improving flavor and texture, and reduces the cost of cell-cultured meat production by increasing the number of meat cells in a single culture
Location: United States
Official website: https://matrixfood.tech

RNA-induced cell differentiation

Highlights: facilitates the cell differentiation process by inducing pluripotent stem cells, eliminating the need for extraction of living animal tissues and enabling the transformation of the cells in question into a variety of cell types, including muscle and fat, at a cost savings

Location: Netherlands
Official website: https://uncommonbio.co

Note: Specific information can be found on each company's website

Fermented proteins innovation opportunities: Biomass and precision fermentation technologies both have application scenarios

- **Traditional fermentation:** This is a time-honored technology that uses microorganisms such as yeast, bacteria or molds to transform raw materials to produce food products with **specific taste, structure and nutritional** value. In the field of alternative proteins, traditional fermentation techniques are mainly used to improve the taste and nutrient absorption of plant-based proteins
- **Biomass fermentation:** Refers to the use of microorganisms (e.g. fungi) grown on a large scale to produce proteins through their growth process. Instead of relying on plant-based proteins, this approach **utilizes microorganisms directly** as a proteins source, or the proteins are processed and purified, and can be mixed with other proteins in the final product.
- **Precision fermentation:** It is the use of **genetic engineering** to modify microorganisms so that they can **efficiently produce specific proteins**, such as milk proteins or egg proteins. This technique allows for the production of non-animal-derived proteins that are similar to animal-derived foods as nutrients used to improve flavor in plant proteins and cell-cultured proteins

Solution	Pros	Cons	Application examples
Traditional fermentation	• **Mature and stable technology** • High consumer acceptance	• Limited product diversity and high dependence on raw materials	• Bean curd, tempeh, yogurt
Biomass fermentation	• Maximum resource utilization allows the use of non-edible plants or organic waste materials as raw materials, reducing dependence on agricultural resources.	• Higher energy consumption in the production process • Sensory attributes such as product flavor may need to be further optimized • Limited consumer acceptance	• Microalgae products • Mycelium (macrobacteria, fungi, yeast, etc.) • viruses
Precision fermentation	• **High product diversity** • High production efficiency and stable product quality.	• **The technology is complex, with high initial investment and R&D costs.** • Limited consumer acceptance	• End-products include: whey proteins, fats and oils, flavor substances and other substances (colors, enzymes, etc.)

References: compiled from publicly available information

Fermented proteins market analysis: In industry development period, end-use applications are being explored

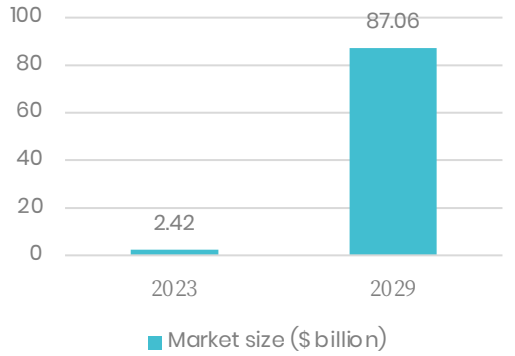
Small global market with large growth potential

- Global fermented proteins market to grow at a **CAGR of 70%** during 2023-2029 [1]
- In the short term, the simpler technology of biomass fermentation will still dominate the market, while the proportion of sophisticated fermentation will increase in the medium to long term
- According to experts, fermented proteins will **account for 22% of the global proteins market** in the next 15 years, including bio-based fermentation as a raw material and sophisticated fermentation to provide functional ingredients for other alternative proteins companies[2]

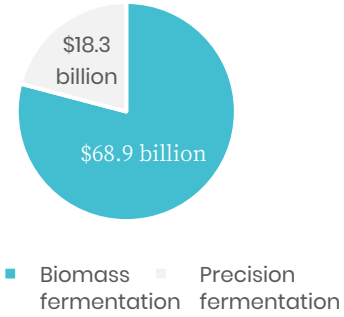
Global capital is optimistic, and multiple technology routes go hand in hand

- The global primary market for fermented proteins raised **more than $1.7 billion** in 2021, with four U.S. companies raising a cumulative $1.1 billion, three of which are precision fermentation companies, including Perfect day, Motif Foodwork and The Every Company [3]
- Since 2020, a total of eight investment and financing events have taken place in China's new proteins fermentation industry, involving more than **RMB 80 million in funding**, with half of the companies involved in precision fermentation routes and the other half focusing on biomass fermentation

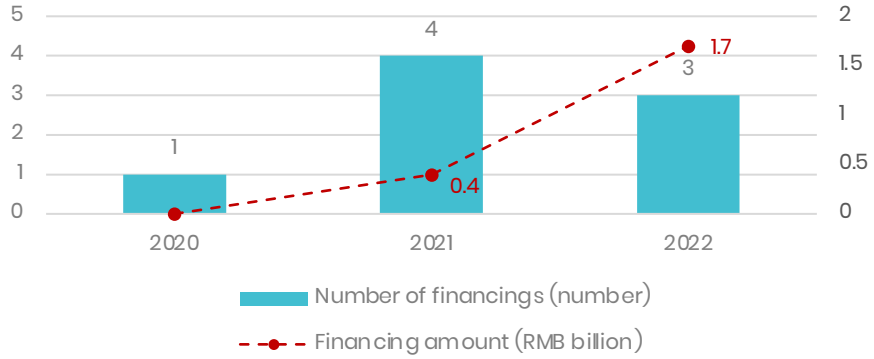
2023-2029 global fermented proteins market size



Global fermented proteins share of different technology routes in 2029



Number and amount of financing for fermented proteins companies in China, 2020-2022



References: [1] QYResearch [2] *Food for Thought The proteins Transformation BCG* [3] *GFIC's New proteins Fermentation Industry Report 2022: Fermentation Technology Drives China's Future Food Development*

Innovation examples of fermented proteins

Fermented proteins milk

Highlights: Positioned in the pioneering "Artificial Milk" track, introducing the world's first lactoferrin produced by precision fermentation, effectively reducing the cost of traditional lactoferrin production and balancing economy and sustainability.

Location: Singapore
Official website: https://www.turtletree.com/

Microalgae biomass fermentation

Highlights: Cooperation with B-side companies to convert microalgae raw materials into various types of animal proteins replacement products through biomass fermentation technology, and has now developed egg and seafood (tuna) product lines.

Location: France
Official website: https://algamafoods.com/company

Plug-and-play proteins expression system

Highlights: Developed a highly adaptable chassis system that enables the expression of different types of proteins in as little as 7 days, and launched the "Metaproteins" brand on the application side to provide microbial proteins for the downstream industry.

Location: China
Official website: http://chgbio.com/

Functional ingredient production

Highlights: APPETEX, a functional ingredient that can be applied to plant-based meat, uses plant proteins to recreate the texture of animal tissues, giving consumers a succulent and chewy sensation similar to that of animal connective tissues.

Location: United States
Official website: https://madewithmotif.com

Note: Specific information can be found on each company's website

Alternative proteins innovation insights

1. Cell-cultured and fermented proteins have more investment potential than plant proteins in segmented solutions

- **Plant-based proteins:** Despite the maturity of its development process, there are a large number of competitors with similar functions and tastes in plant-based meat and proteins drinks, and due to the poor performance of the primary and secondary markets, vegetable proteins is still in a period of market adjustment.
- **Cell-cultured proteins:** The end product of this segment is the **closest thing to "animal meat**"; with technological advances in cell grown proteins and increased production volumes, their costs will fall to competitive levels in the marketplace.
- **Fermented proteins**: This segment is the **application of synthetic biology** and other cutting-edge technologies in the F&B industry, representing a new paradigm of industrial production, capable of **producing a wide range of end-products** and **functional ingredients** and participating flexibly in different production chains.

2. Alternative proteins still follow the principle of "investing early ", and will appear unicorns in niche market in 5-10 years

- **Investing early and investing small:** Due to the biotechnology background of alternative proteins, many VC organizations will look for **high-quality scientists** from research institutes and **support them to start up** with their core technologies, intervening in the whole life cycle of startups from the source.
- **Cell-cultured proteins:** Multiple technology routes for cell-cultured proteins will ultimately filter out the most cost-effective solutions that best meet the market demand, and form one or more industry leaders that provide core technologies.
- **Fermented proteins:** Synthetic biology companies that survive the early commercialization phase **accumulate mature platform-based technologies** and make this generalized portion of the technology available to a wider range of downstream application companies.

3. Alternative proteins are technology-driven in the short term, and need to consider how to better leverage market demand to achieve sustainable growth

- Alternative proteins do not directly contribute to the sustainable performance of a company compared to sustainable sales and sustainable packaging; at the same time, Alternative proteins are not in high demand among consumers, and it is difficult to boost consumer willingness in a down cycle.
- **End products:** Alternative proteins products need to develop end-products that **incorporate consumers' core concerns** about **health, nutrition** and other needs; avoid over-emphasizing technological elements to reduce consumer aversion.
- **Functional ingredients:** Find new application scenarios, such as new **applications of multiple functional ingredients** produced by fermented proteins in other F&B fields, so as to expand sales paths.

AGENDA

1. Overview of the F&B Industry from a Sustainable Consumption Perspective
2. Solution 1: Alternative proteins
3. **Solution 2: Sustainable Packaging**
4. Solution 3: Sustainable Sales
5. Concluding Insights

Sustainable Packaging

3 Solution 2: Sustainable Packaging

Overview of sustainable packaging solutions

Sustainable Packaging Definition and Environmental Values

Definition of sustainable packaging

According to the U.S. Sustainable Packaging Consortium (SPC), sustainable packaging is packaging that is **beneficial, safe and healthy** for individuals and communities throughout its life cycle, meets market standards for performance and cost, optimizes the use of renewable or recycled materials, uses healthy materials throughout its life cycle, physically designs optimized materials, and is efficiently recycled and used in the biological cycle.

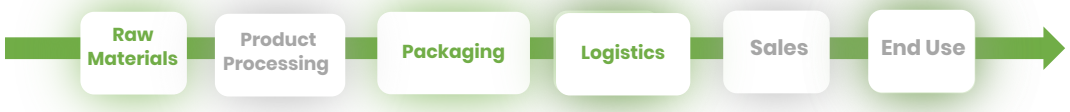
Packaging can be categorized according to its usage scenarios

Primary packaging: Primary packaging is the **first layer** of packaging that comes into direct contact with the contents of F&Bs.
Secondary packaging: Secondary packaging is an **additional layer** of packaging on top of the primary packaging, such as courier boxes, shrink-wrapped packages for packing multiple bottles of beverages.

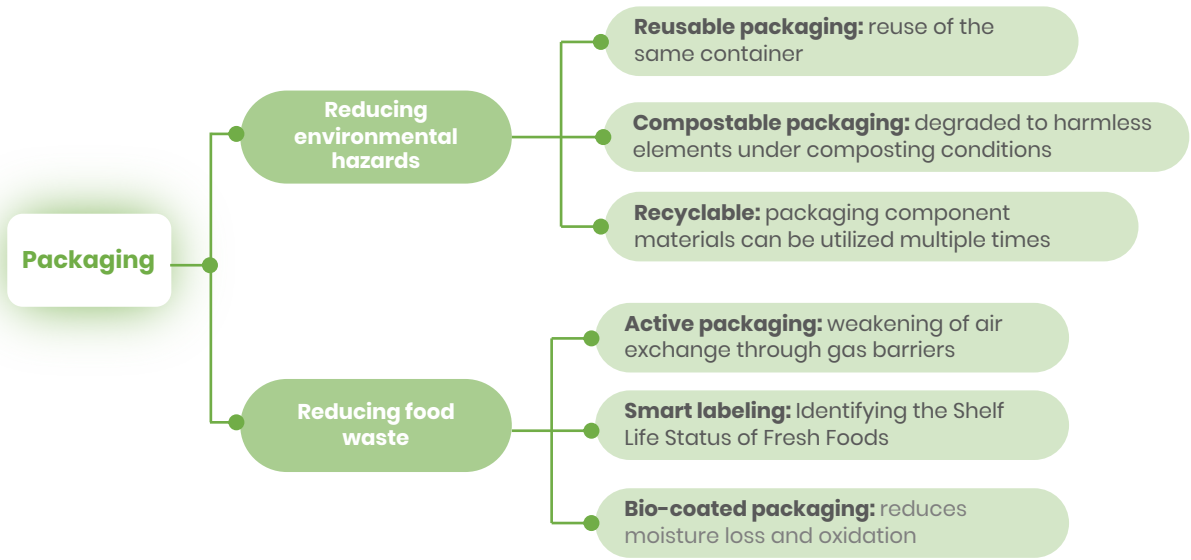
Environmental value

Reducing energy consumption and carbon emissions: Reducing resource use in the packaging production chain.
Reducing solid waste pollution: Reducing the flow of non-biodegradable plastics into the soil and oceans, which generates negative environmental pollution.
Reducing food waste: Extending food shelf life and reduce food loss during transportation and distribution.

Industry value chain involved in sustainable packaging

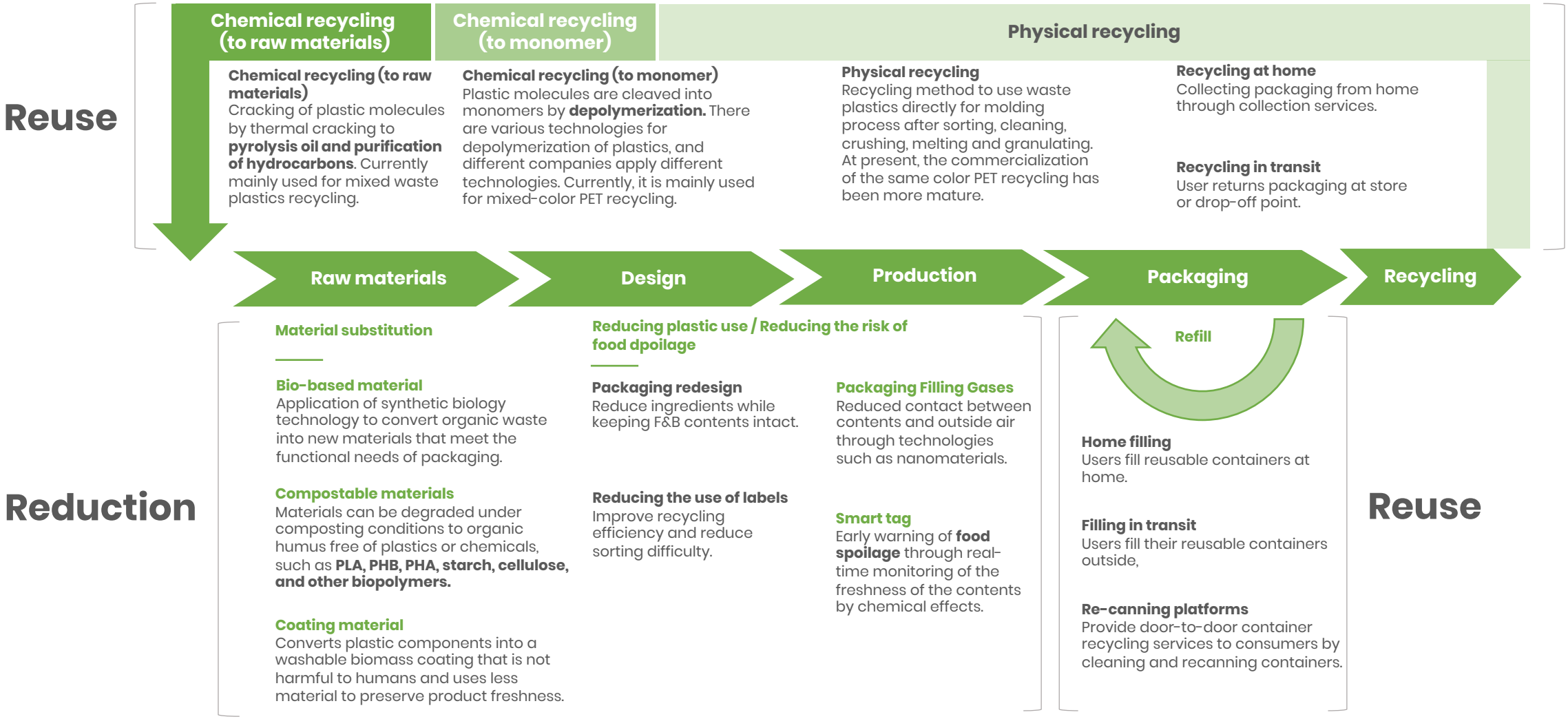


F&B Industry Value Chain



References: [1] https://www.ecoembesthecircularcampus.com/norma-une-en-134322001-envases-y-embalajes/
[2] https://www.goodstartpackaging.com/biodegradable-vs-compostable-what-is-the-difference/#:~:text=The%20main%20difference%20between%20the,composting%20facilities%20to%20do%20so.
20between%20the,composting%20facilities%20to%20do%20so. [3] https://www.domino-printing.com/zh/blog/2017/123packing

Innovation opportunities: Addressing the need for plastic and carbon reduction through material substitution and systemic change



Market analysis: Industry-side demand continues to grow, startups gain extensive attention from venture capitals

Global demand for sustainable packaging continues to grow, with food application scenarios and plastic innovations palying an important role

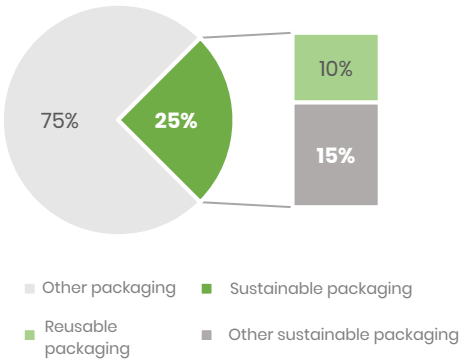
- Global sustainable packaging will double its market size by leaps and bounds from 2022-2031, **increasing its share** of the global packaging market **to 30.6%**, and the compound annual growth rate of sustainable packaging is significantly higher than that of plain packaging.
- As of 2021, China's food packaging market size **reached 722.5 billion RMB**, accounting for about **60%** of the proportion of the entire packaging[3] ; and **plastic** packaging accounted for **50.4**% of the food packaging, and plastics have a low cost, light weight and good airtightness and other characteristics, so that it can be widely used in food, pharmaceuticals, daily chemical and other fields; the existing alternatives instead of generating additional environmental costs such as carbon emissions.

Sustainable packaging has gained global capital

The chart on the right lists some of the sustainable packaging companies that **have received financing** recently and whose growth prospects have been recognized by VCs. Although domestic financing is currently focused only on recycled secondary packaging, along with the tightening of ESG disclosure requirements on the industry side, the **sustainable transformation** of multiple types of primary packaging will also receive wider attention.

Global packaging and sustainable packaging market[1]

2020 global packaging industry product structure[2]



Financing for part of sustainable packaging companies 2019-2024

Brand	Financing Lifecycle	Year	Amount	Investors
Banbrew	Series A	2024	$7.19 M	Led by Blume Ventures
Notpla	Series A	2021	$13.3 M	Lead investor: Horizons Ventures
Sway	seed round	2021	$2.5 M	Led by Valor Siren Ventures
TIPA	B round	2019	$25 M	Led by GreenSoil Investments, Inc.
	C round	2022	$70 M	Lead investor: LeadMillennium Food-tech
Footprint	Listing (SPAC)	2021	$1.6 Bn	-
Shanghai HongYan Returnable Transit Packagings Co.,Ltd.	C round	2019	several hundred million dollars	Led by: China-U.S. Green Fund
	D round	2023	$200 million	Lead investor: Zhongguancun Science and Technology Leasing

References: [1] https://www.mordorintelligence.com/zh-CN/industry-reports/sustainable-packaging-market [2] *Roland Berger Sustainable Packaging for Consumer Goods* [3] *China Food Packaging Industry Panorama 2022*

Sustainable packaging macro-environment: Driven by both technological change and industry-side market demand

Policy factors

Opportunity

- **Global rules on plastic use are getting tougher**with Europe and the US having enacted a series of regulations limiting the production and waste of plastic packaging.
- **China has enacted a series of regulations to limit the use of plastic packaging**, and from 2021, the use of non-degradable plastic bags, disposable plastic tableware and other plastic products in the catering industry will be prohibited; by 2025, the intensity of consumption of non-degradable disposable plastic tableware in the field of catering takeaways in cities of prefectural level and above will be reduced by 30%.

Threat

- China's policy on sustainable packaging lacks details, which is unfavorable to the development of production-oriented enterprises.
- The product **evaluation system** and labelling system are **not yet perfect.**

Economic factors

Opportunity

- **ESG disclosure requirements tightened,** packaging received widespread attention as a key disclosure item related to "solid waste".
- **The world's leading F&B companies have developed sustainability strategies for sustainable packaging, with** reusability, renewability and compostability as key directions for the packaging transition.

Threat

- **Rising purchasing costs** associated with practicing sustainable consumption and a decline in overall consumer willingness to consume due to uncertainty about future economic developments.

Social and cultural factors

Opportunity

- Chinese consumers are more **concerned about the environmental impact** of their consumption than in the past, with packaging sustainability being the top consumer decision-making factor.
- **60%** of Chinese consumers are willing to **accept a premium** for sustainable packaging, with price premiums concentrated in the **5%-10%** range.

Threat

- Chinese consumers have less access to information on sustainable products and services.
- Consumers are concerned about safety and hygiene of some sustainable packaging.

Technology factors

Opportunity

- **New materials from new technologies such as synthetic biology provide the technological basis for sustainable packaging innovations.**
- The use of big data and artificial intelligence technologies can optimize supply chain management, production processes and market strategies to improve the overall efficiency of the industry.

Threat

- Packaging innovations such as recycled materials in the food sector involve food packaging that must fully **meet food safety requirements.**

References: *EU Packaging and Packaging Waste Regulation; Opinions on Further Strengthening the Control of Plastic Pollution*; *2022 China Sustainable Consumption Report*; *Ernst & Young: Future Consumer Index 2023*

Innovation examples of sustainable packaging: Focus on environmental benefits

Compostable packaging made from seaweed

Highlights: Compostable trays made from macroalgae harvested from the sea, which can replace traditional polystyrene tray pac for carrying fruits and vegetables.

Location: Spain
Official website: https://futuralga.com

Synthetic biological applications of plant-based proteins

Highlights: Development of the world's first edible soup cube packaging film made from 100% pea proteins, which dissolves completely in hot water for excellent freshness and shelf life comparable to plastic, and is a vegan and gluten-free material!

Location: United Kingdom
Official website: https://xampla.com

Domestic sparkling water system

Highlights: Pepsi‘s acquisition of a sparkling water equipment brand that offers reusable glass bottles and refillable aluminum cans to support consumers in making their own carbonated beverages and enabling drinks to be filled at home.

Location: United Kingdom
Official website: https://sodastream.com/

Biodegradable take-out containers

Highlights: Using cardboard and biodegradable plastic to develop a disposable takeaway lunch box that optimizes cost and reduces plastic pollution while also meeting the characteristics of high oil and hot soups in Chinese food with a very high level of sealing.

Location: China
Official website: http://www.zidan.com.cn

Note: Specific information can be found on each company's website

Innovation examples of sustainable packaging: Focus on reducing food waste

Aerosol packaging technology

Highlights: By infusing food-grade natural extracts into a film or container, these extracts release a controlled amount of active vapor in the food product. Mold spores absorb the vapors and their metabolism slows down, making it difficult for them to survive, thus extending the shelf life of the food product

Location: United States
Official website: https://sofresh.com

Nanocomposite technology

Highlights: Titan Nanofill, a sustainable material based on nanotechnology, extends the shelf life of organic materials in packaging through nanocomposites that form a physical barrier to gas exchange in polymer materials

Location: United States
Official website:
https://www.titanbioplastics.com

Smart labeling technology

Highlights: Smart labels affixed to food can visualize the real timeline of product decay through color changes in the window, consumers can reduce waste by knowing the state of their food, and the fun design is also conducive to the application of promotion

Location: United States
Official website: https://oli-tec.com/

Bio-based coatings

Highlights: Forms a protective barrier on the surface of fresh fruits and vegetables, effectively extending preservation time and reducing waste from fruit and vegetable loss. FDA-approved for food safety and free of genetically modified and animal ingredients, reducing allergens and increasing audience reach

Location: United States
Official website: https://www.apeel.com/

Note: Specific information can be found on each company's website

Sustainable packaging innovation insights

1. Compostable packaging has more significant application scenarios and innovative value in the F&B industry

- **Food contamination:** Contamination of containers by F&Bs is difficult to clean up, and it **is difficult to reuse or recycle** after a single use.
- **Flexible food contact packaging:** Large amounts of plastic waste that comes into contact with fresh food are often **discarded along with peel residues**, and these packages can reduce sorting costs if they can be degraded along with organic waste.
- **Pre-composted packages:** These packages **wrap the contents** (e.g., tea bags, marinade packets) throughout the product's consumption cycle and collectively enter the disposal chain.

2. Opportunities for innovation in sustainable packaging with a focus on environmental issues go beyond the container itself and require a focus on the entire recycling system

- **Reusable packaging:** The need to consider when and where consumers can conveniently **refill the contents**.
- **Recyclable packaging:** The need to consider how to recover packaging waste from consumers and businesses and improve reuse efficiency.
- **Compostable packaging:** The need to consider how to ensure that consumer waste packaging makes it into the **composting environment** or find new value chains from composting organics (fertilizer vs. organic agriculture).

3. Consumer concerns about food safety present unique innovation opportunities for sustainable packaging

- **Packaging safety:** Consumers are more concerned about the safety of food packaging than packaging for other products. For example, consumers are concerned about the **cleaning efficiency** of recycled containers and the hygienic level of post-consumer recycled plastics.
- **From passive to active preservation of freshness:** While traditional packaging mainly inhibits bacterial growth through the airtightness of the material and structure itself, innovative solutions will **reduce the production of harmful substances** in a more diversified way.
- **Real-time information feedback:** Innovative solutions such as smart labels can both alert consumers to the timely use of fresh food and avoid the intake of spoiled food, reducing the risk of disease.

AGENDA

Sustainable Sales

4 Solution 3: Sustainable Sales

4.1 Overview of Intelligent Kitchen System & Sales of Near-expired Food Solutions

4.2 Intelligent Kitchen System

4.3 Sales of Near-expired Food

- Opportunities for Innovation
- Macro-environment
- Market Analysis
- Innovation Cases
- Innovation Insight

Overview of sustainable sales solutions

Industry value chain involved in sustainable sales

Intelligent kitchen system

Based on AI large model and IoT technology, the smart kitchen system adapts to the new trend of **electrification, intelligentization and low-carbonization** of kitchen appliances, including smart refrigerators, smart stoves, smart hoods and other devices as well as the AI system, which mainly serves the household end and the commercial end.

Smart equipments: individual devices that assist/replace manual labor for specific kitchen processes
Intelligent systems: Powered by AI, monitor the kitchen operation processes and provide instant feedback/control

Environmental value

AI algorithms monitor and manage purchasing and ingredient pairings for caterers and households to **reduce operational costs** and **minimize ingredient waste**, optimize inventory, and lower **carbon emissions**.

Sales of near-expired food

Near-expired food refers to food that **is about to reach its shelf life.**. Considering the ease of distribution and the cycle of movement, categories that are sold as **near-expired food** include **casual foods** and **baked goods, among others.**

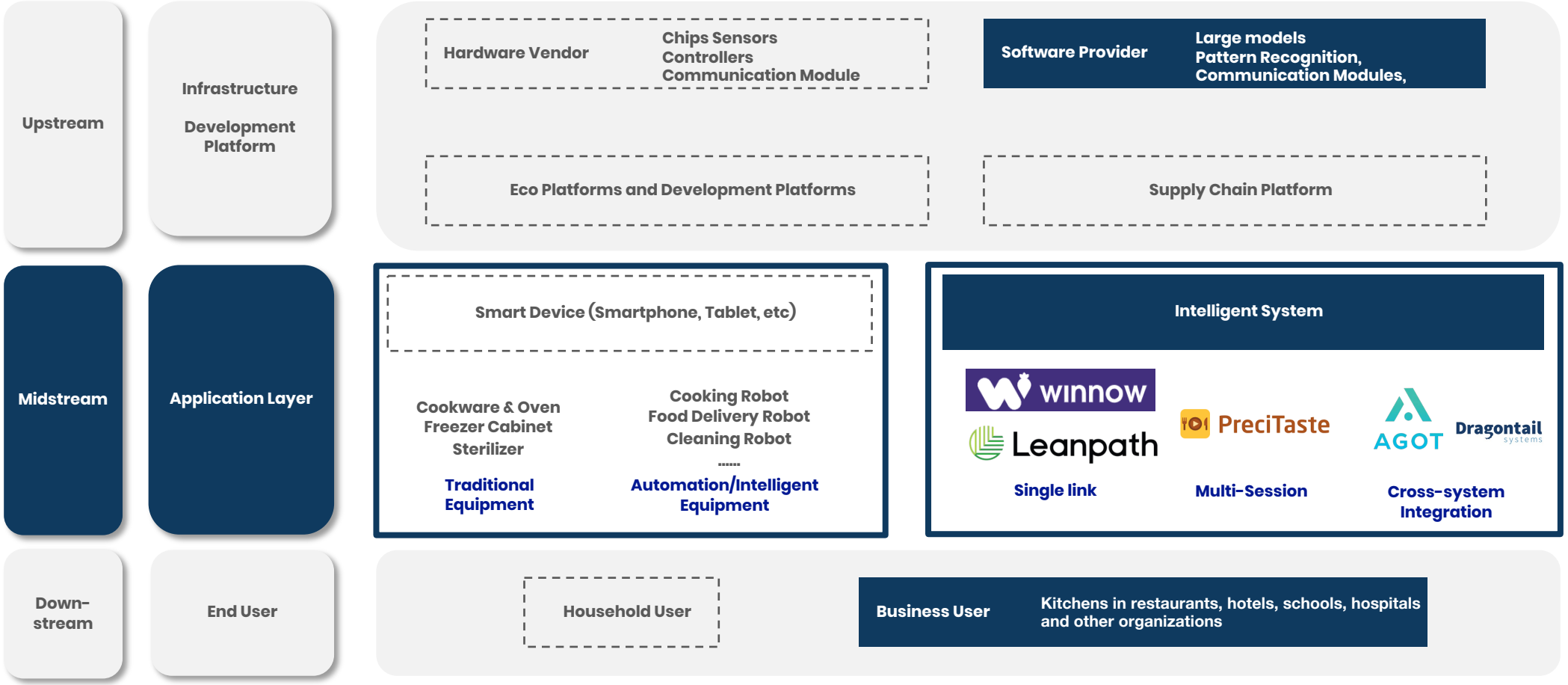
Offline retail stores: outlets, through cooperation with multiple brands to obtain cost-effective sources of goods
Online platforms: including B2C platforms, aggregated suppliers and community group-buying platforms

Environmental value

The sale of near-expired food **reduces food waste** and **promotes the efficient use of organic nutrients** in the food consumption chain, reducing the additional cost of reusing after disposal.

Intelligent kitchen system innovation opportunities: AI algorithms in kitchen can improve efficiency while reducing food waste

Compared to large-scale equipment replacements, smart systems can often be a relatively lightweight way to improve a restaurant's performance on food safety, operational efficiency, sustainability issues, and can rapidly expand its end-users.



Intelligent kitchen system market analysis: Global demand continues to grow, with consumer acceptance increasing

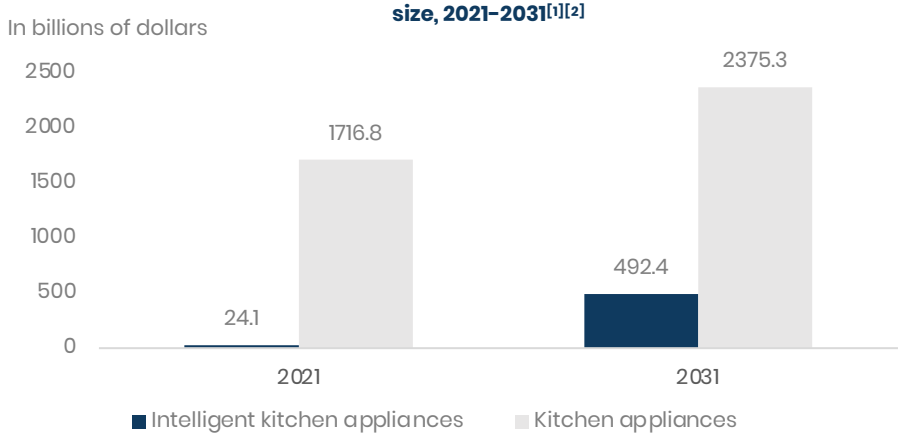
As a fractal innovation in the traditional kitchen appliance industry, the global smart kitchen appliance growth has gained it momentum

- **Intelligent kitchen appliance is the main innovation direction of the kitchen appliance industry:** from 2023 to 2028, the CAGR of the intelligent kitchen industry is 34.9%, which is more than six times the growth rate of the traditional kitchen appliance industry.
- In ten years, the market share of intelligent kitchen appliances will rise **from less than 1% to about 20%,** with a very broad market space.

The traditional kitchen appliance industry side focuses on individual products such as cookwares and refrigerators. VCs are focusing on kitchen systems that serves the business user

- **International home appliance industry parties widely layout smart kitchen single product innovation:** globally, the main manufacturers of smart kitchen appliances include Whirlpool, BSH, Haier Group and Samsung Electronics and other traditional industry parties, who cumulatively occupy about 34% of the market share, with a high degree of market concentration.
- **AI-assisted business model for commercial kitchen operations gains widespread attention:** since 2019, "surveillance camera + backend data processing" startups have received multiple funding rounds due to bullishness on smart AI applications in commercial kitchens.

Global kitchen appliances & intelligent kitchen appliances market size, 2021-2031[1][2]



Financing for selected intelligent kitchen systems companies 2019-2022

Brand	Financing Lifecycle	Year	Amount	Investors
Leanpath	debt financing	2019	$7 M	SaaS Capital
Winnow	B round	2019	$1.2 M	Ingka Group, Mustard Seed, ArcTern Ventures, Bridge Nine, Circularity Capital, and Novax
	C round	2023	$10 M	
Dragontail Systems	acquire (a company)	2021	$93.5 M	Acquirer: Yum!
PreciTaste	Series A	2022	$24 M	Melitas Ventures, Cleveland Avenue
Agot	equity financing	2022	$12 M	Investor: Bay Area Investors

References: [1] https://www.businessresearchinsights.com/zh/market-reports/smart-kitchen-appliances-market-102195
[2] https://www.mordorintelligence.com/zh-CN/industry-reports/global-kitchen-appliances-products-market-industry

Intelligent kitchen system macro-environment: Corporate ESG needs to generate intelligent systems in kitchen scenario

Policy factors

Opportunities

- **Chinese government encourages the application of IoT:** smart kitchen appliances have been included in the nine key areas of application of IoT and incorporated into the Five Year Plan.

Threats

- Catering operation data collected by the intelligent system has **not yet been supported by clear legislation** at the application level, which makes it easy to have disputes over the right to use the data.

Economic factors

Opportunities

- **Restaurant cost reduction and efficiency:** Brick-and-mortar stores are under greater pressure to operate and need to cut their unnecessary expenses; Intelligent equipments can reduce the reliance on highly skilled chefs and effectively respond to the increase in labor costs
- **ESG disclosure requirements are getting stricter:** Hotels and Restaurants face ESG disclosure requirements to reduce their food waste and carbon emissions

Threats

- **Increased homogenization and competition:** The market is highly competitive with many companies focusing on providing AI-assisted management systems for restaurants.

Social and cultural factors

Opportunities

- COVID-19 creates more home cooking demand, boosts household kitchen appliance consumption.
- Consumers have higher expectations for **food safety**.

Threats

- The Gen Z group has a diversified lifestyle and a **lower demand for cooking** at home.
- Population aging: China's population is aging significantly, and the elderly group's lower acceptance of new technologies may **limit the market share** of smart kitchen products among elderly users.

Technology factors

Opportunities

- **IoT and AI technologies are booming and the cost of applications is falling**
- 5G commercialization promotes smart home communication transmission speed and effect, supports more device access, and improves the security and stability of smart devices.

Threats

- **Data collection and transmission involves the risk of data leakage**, which threatens the privacy and trade secrets of household users.

References: iResearch Consulting Group, *China Smart Home Industry Research Report* ; *Opinions on Further Strengthening Plastic Pollution Control* ; *2022 China Sustainable Consumption Report;* Ernst & Young, *2023 Future Consumer Index*

Innovation examples of intelligent kitchen system

Single procedure:
Food waste intelligent detection system

Highlights: Winnow have designed the supporting operation software to realize the intelligent monitoring and management of food waste in the kitchen waste disposal process.

Location: United Kingdom
Official website:
https://www.winnowsolutions.com/

Smart equipment:
Smart camera for refrigerators

Highlights: FridgeCam, launched by Smarter, accurately recognizes the types and quantities of different foods in the refrigerator, providing users with real-time inventory information. helping them consume it in a timely manner and minimize waste.

Location: United Kingdom
Official website: https://smarter.am/products/

Multi-procedure:
AI kitchen monitoring and management tools

Highlights: PreciTaste helps catering companies to monitor the delivery process and predict the scale of purchases, improving kitchen efficiency and reducing waste.

Location: United States
Official website: https://precitaste.com

Cross-systems:
Integrating kitchen processes and food delivery

Highlights: collects, organizes and processes multiple pieces of information from the restaurant kitchen to takeout delivery, guide the sequencing of ingredients preparation and schedules the best delivery person and route.

Location: Australia
Official website: https://www.dragontail.com/

Note: Specific information can be found on each company's website

Near-expired food innovation opportunities: Business model centers on bridging the chain from production to consumption

Different types of near-expired food have given rise to different business models, with baked goods and casual foods as the only examples below:

Upstream

Baked Goods

Mostly short-insurance products, so they **need to be sold quickly** through online channels and can't be squeezed in warehouses or on shelves

- Retail Store
- Plant
- Centralized Kitchen

Snacks

- Longer shelf life, can be sold through **multiple channels** such as offline or online
- Inventory will be generated at multiple levels of distribution, so its upstream chain is more complex, requiring strong channel capabilities from innovative companies

- Producers
- Distributors
- Franchises

Midstream

Logistics companies and warehousing service providers play an important role in the supply chain of near-expired foods, involving key technologies such as preservation techniques and hermetic packaging

Online Sales Channels

- Online B2C Platform
- Pooled Provider (computing)
- Community Group Buying Platform

Offline Sales Channels

- Near-expired Food Discount Store
- Traditional Channels: Retail Putlet, Hypermarket

Down-stream

- Consumers
- Business User: mainly public welfare organizations and social enterprises

References: *China Advent Food Industry Panorama 2023*

Near-expired food market analysis: The industry is adjusting, and new categories such as baked goods still have development potential

There is a huge market for near-expired food yet to be tapped

- Taking casual food and bakery products as examples, the potential market size of near-expired food in 2022 will be approximately $29.66 billion, and considering the continuous innovative business models, the near-expired food market will expand faster than expected in the chart on the right.
- **5%-10% of bakery products are not effectively utilized:** in order to enhance the appearance of the storefront, bakeries generally provide a 5%-10% bread surplus[2] and define this amount as the "healthy wastage rate"; this part of the baked goods is not effectively utilized.
- **1% casual food is unsaleable backlog inventory:** Niche products are prone to inventory backlog problems, a conservative estimate of 1% of annual sales.[1]

Domestic capital enthusiasm has waned in anticipation of new models

- **Domestic capital focuses on the offline discount retail store model**, and the number of financings and new companies also peak in 202. The economic downturn during the epidemic brought about a **downgrade in consumption**, and consumers tried to level off. The epidemic closure also led to a backlog of inventory, which provided a rich source of supplies for the interim discount stores.
- With the end of the epidemic and the division of existing market share by first-mover companies, new entrants are facing **problems such as supply chain constraints and low gross margins**; newcomers urgently need to create new business models to utilize more diverse temporary food products.

China near-expired food market size, 2022-2028[1] (snack foods + baked goods)

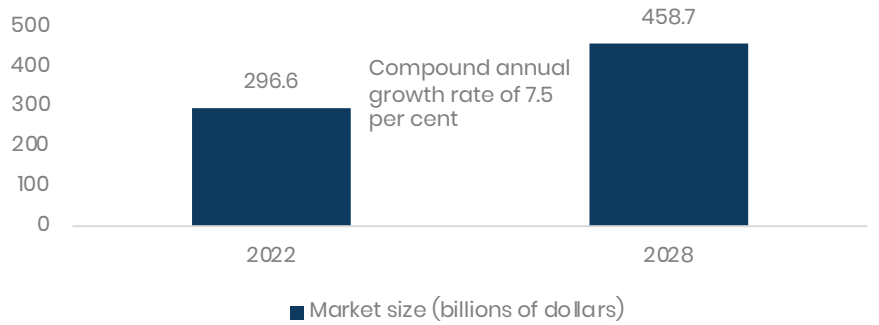
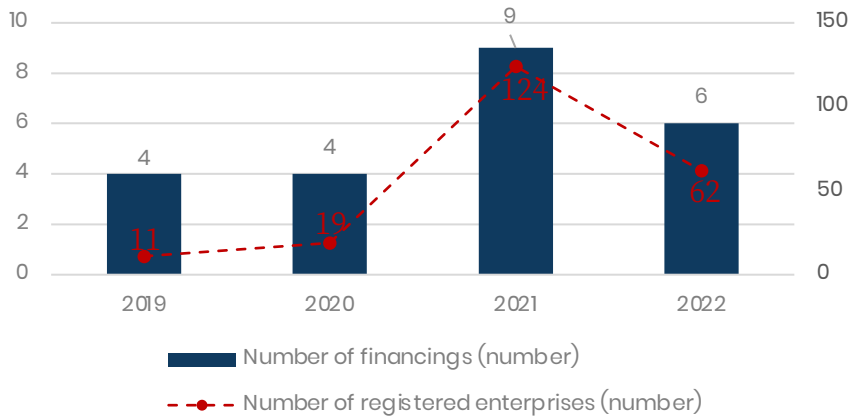


Figure 2: Number of financings and new enterprises of near-expired food from 2019 to 2022



References: [1] *China Advent Food Industry Development and Benchmarking Case Study Report, 2023-2024* [2] http://www.cnfood.cn/article?id=1763101331856523266

Near-expired Food macro-environment: Economic downturn creates new demand for sourcing near-expired foods

Policy factors

Opportunities

- **Policies to promote food conservation**: the government promotes awareness of conservation and optimization of the food distribution system through policies such as the Anti-Food Waste Law and the Anti-Food Waste Work Programme, which **encourages food business operators** to sell near-expired food at preferential prices
- **Sound food safety system**: in 2020, the State Council in the "National Standardization Development Outline" proposed to strengthen green consumption standards and promote the **development of green lifestyles**, and in 2022, it guided multi-sectoral efforts to comprehensively promote strict quality and safety supervision of the whole chain of food products; in 2021, the General Administration of Market Supervision required chained food enterprises to establish a sound food safety system

Threats

- **Different provinces in China have not formed a unified standard for near-expired food, and the lack of policy guidelines creates potential legal risks**

Economic factors

Opportunities

- **Consumers more concerned about product cost and value for money** as China's economic growth weakens after epidemic
- **Increased capital investment**: Brands such as Good Bargain and Prosperity Bazaar have successfully secured financing, which demonstrates the capital market ‘s recognition of the potential of the near-expired food industry and provides a more solid foundation for the industry's development.

Threats

- **Profit margin is limited:** Logistics expenses constitute 5%-10% of the total procurement costs in inland provinces, diminishing the price advantage of near-expired goods over regular items. With a low markup on products, companies face constrained gross profit margins.

Social and cultural factors

Opportunities

- **Increased environmental awareness**: As society becomes more aware of ESG-related issues, by implementing social responsibility programs, such as donating surplus food to charities, companies can enhance their brand image and thus promote brand sustainability.
- **Rational consumption concept**: Near-expired food is still in the shelf life, low price but the taste is not inferior to normal food, the young consumer group has become the main consumer group of expired food, and they gradually accept the concept of low price, big discounts, and affordability.

Threats

- Consumers have yet to develop their trust in near-expired foods and are concerned about food quality while seeking value for money. Although consumers are looking for discounted prices, they are not willing to lower the quality, and will not buy once the quality is questionable

Technology factors

Opportunities

- **Optimization of logistics technology:** Optimize supply chain and logistics management using IoT and big data technology to improve distribution efficiency and accuracy, and reduce operating costs by keeping track of inventory and demand forecasts through real-time monitoring and data analytics

Threats

- **Supply chain information opacity:** Supply chain information opacity may lead to poor information flow, making it difficult to obtain timely information on various links in the supply chain, which in turn affects food safety management and monitoring and increases food safety risks.
- **Dependence on technology suppliers:** Excessive reliance on a single technology supplier poses the risk of unstable supply, which will directly impact the production and supply.

References : *Interpretation of National Relevant Policies and Development Goals of the Advent Food Industry in 2023; Analysis of the Current Market Situation and Development Prospects of the Advent Food Industry in China in 2023*

Innovation examples of near-expired food

Offline discount retail stores

Highlights: Currently covering more than 10 cities, including Shanghai, Beijing and Nanjing, with more than 250 stores; guaranteeing customer flow and profitability through "attracting traffic with big brand tailgates and profiting from niche brands"

Location: China
Official website: https://www.hotmaxx.cn/

Blind boxes of near-expired food

Highlights: Partnering with a large number of local supermarkets, hotels, and restaurants to sell "blind boxes" of surplus food at one-third of the price. Currently serves customers in Europe, Australia and North America

Location: Denmark
Official website: https://www.toogoodtogo.com/

Fresh products on expiration date

Highlights: grocery retailers upload products on the platform when fresh produce is about to expire and consumers buy these products at a 50% discount and pick them up at offline stores themselves

Location: Canada
Official website: https://flashfood.com

Community food sharing platform

Highlights: Users can put their unfinished food or even grocery products on the platform to share with other users and further build a community exchange network for expired/unused food products

Location: United States
Official website: https://olioapp.com/en/

Note: Specific information can be found on each company's website

Sustainable sales innovation insights

1. Intelligent kitchen system: Rapid development of AI provides historic opportunity for intelligent transformation of restaurants.

- **Improvement of AI infrastructure:** With companies leading the development of AI underlying technology and providing convenient open source models and interfaces, the development cost of **AI application** has been rapidly reduced and **led to explosive growth**.
- **The restaurant industry is looking forward to intelligent change:** AI algorithms and IoT technology can efficiently collect all information in the operation of the restaurant (especially in the kitchen) and provide a more rigorous and comprehensive decision-making basis.
- **Increased competition in the industry:** Along with the lowering of the development threshold of AI applications, the key to competition for startups lies in the deep insight into user demands, and the satisfaction of users' immediate needs from the application level.

2. Shifting business models in near-expired food: From supply chain competition to community building and lifestyle advocacy.

- With the new generation of consumers becoming more rational in their consumption decisions, factors such as price, quality and food safety, the low price advantage brought about by supply chain competition has become less attractive to consumers.
- **International experience:** Food platform in Europe and the US has shifted from a single sale of goods to **a circling community**, for example, Olio from the initial food exchange to the extension of daily necessities, the essence is to meet the consumers to **use the idle items of the way of life**
- **Practice in China: M**ore young people are starting to dominate household consumption and fully consider the cost-effectiveness. These young people want to find partners with the same values and lifestyles, and a platform for Near-expired food that can link enough consumers can operate based on the value consensus of the circle.

3. The micro-data collected in the sustainable sales chain will provide decision-making reference for upstream and downstream enterprises in the entire food distribution field.

- Due to the decentralization of corporate and household consumption, it used to be **difficult to obtain** a more complete flow of **actual consumption data** for F&Bs, which is very important for informing the production arrangements of food giants.
- **Food flow tracking:** Through continuous monitoring of food sales and waste data, the operation of different categories and even **different brands of products** can become the information input of big data.
- **Hardware and software interaction:** The intelligent kitchen system can record various human-machine interaction scenarios with greater precision and efficiency than humans, thereby providing valuable data for the product design of multiple appliance and home furnishing manufacturers.

AGENDA

1. Overview of the F&B Industry from a Sustainable Consumption Perspective
2. Solution 1: Alternative Proteins
3. Solution 2: Sustainable Packaging
4. Solution 3: Sustainable Sales
5. **Concluding Insights**

Concluding insights

1. Synthetic biology technology is commonly applied to alternative proteins and sustainable packaging, and the F&B industry is an important application scenario for its innovative practices

- The ultimate goal of synthetic biology is platform-based application, but rapid, efficient, and marketable scenarios are needed during its development process. The **F&B sector** can offer more viable commercial application scenarios for synthetic biology technologies.
- **Alternative proteins:** The hemoglobin flavor substance in plant proteins meat, the backbone of cell-cultured proteins and the substrate for fermented proteins production are the result of synthetic biology technology, and some companies are beginning to merge cell-cultured and fermented proteins technologies.
- **Bio-based packaging:** Synthetic **biology technology** enables **the use of organic waste** to generate bio-based materials and fine-tune the characteristics of the materials to suit the packaging needs of different scenarios.

2. Sustainable innovation in the F&B industry needs to focus on refined scenarios to find differentiated hit points

- **Minimum feasibility test:** In the development of intelligent kitchen system, minimum feasibility test could quickly enter the application scenario and obtain first-mover advantage. E.g. Winnow only monitors the **dumping link of kitchen waste** to reduce its equipment cost.
- **Single point of penetration:** Focusing on the application of specific technologies can create a moat and accumulate technological advantage. E.g. Singapore's Turtle Tree focuses on the precision fermentation production of lactoferrin, and is deeply committed to the batch and efficient utilization of this segment.

3. Systematic innovation thinking runs through all the industry value chain, and the upstream and downstream layout of a particular innovation technology must be considered from a global perspective

- **Vertical integration:** For example, Innovation in compostable packaging is not only about new materials and designs for the packaging itself, but also about how to ensure that the **containers** can **be properly disposed of**, which requires the production-recycling chain to be bridged in the innovation process.
- **Horizontal integration:** For instance, Synthetic biology companies tend to specialize in the development of specific technological processes, but can be applied in the production of different categories such as packaging, food raw materials, additives, etc.

Project Participation

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About Impact Hub Shanghai

Founded in London in 2005, Impact Hub is a global network of impact-driven entrepreneurs, creators, innovators, and intrapreneurs, dedicated to creating a better future for people and the planet. Impact Hub now operates in 100+ cities across 60+ countries. In 2017, Impact Hub Shanghai became the first Impact Hub in Mainland China. Since then, it has been at the forefront of building sustainable innovation ecosystems, offering innovation consulting, entrepreneur support, impact marketing, investment services, and research. It has supported more than 3,000 innovative companies, along with more than 90 industrial enterprises and governmental parks, to lead and build an ecosystem of sustainable development and co-create a better world.

Website: shanghai.impacthub.net

About Impact Hub Shenzhen

Founded in June 2023, Impact Hub Shenzhen is the second Impact Hub in mainland China. Rooted in the sustainable practices of Guangdong, Hong Kong and Macao Greater Bay Area, we are committed to building local social innovation ecosystems and sustainable business systems. We connect stakeholders such as entrepreneurs, innovators, financial institutions, service organizations and the public sector to drive systemic change in the areas of inclusive development, community building, sustainable consumption, and carbon neutrality.

About Makeable

Makeable is an action research platform focused on sustainable innovation developed by Impact Hub Shanghai. It aims to empower the sustainable innovation ecosystem through research, dissemination and industrial capacity-building and to accelerate the realization of the SDGs through innovation.

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