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The Novel Food Market

Key Trends & Considerations

Six key trends are shaping **consumer behaviours in food consumption**

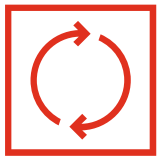
1

Demographic shifts and greater **diversity** in **diets**

- **Dispersion of diets** as a result of globalization and migration.
- New diets with **low meat use**, with **flexitarians gaining popularity.**

2

Increase in **sustainable** and **purpose-led** alternatives



- Increase public consciousness on **sustainability.**
- Grocers expected to source and partner with **more responsible Brands.**

3

Bifurcation between **healthy** foods and **indulgence**

- Greater concern on **health impacts of dietary choices.**

4

Premium specialty food vs **low cost** for basic food

- High demand for **both price deals** and **premium goods.**
- **Rise in private label** with niched products for both ends.

5

Greater need for **convenience** and **time savings**

- Dietary changes come with **faster and easier to prepare foods.**
- Emergence of **dark kitchens** and consolidation of **delivery apps.**

6

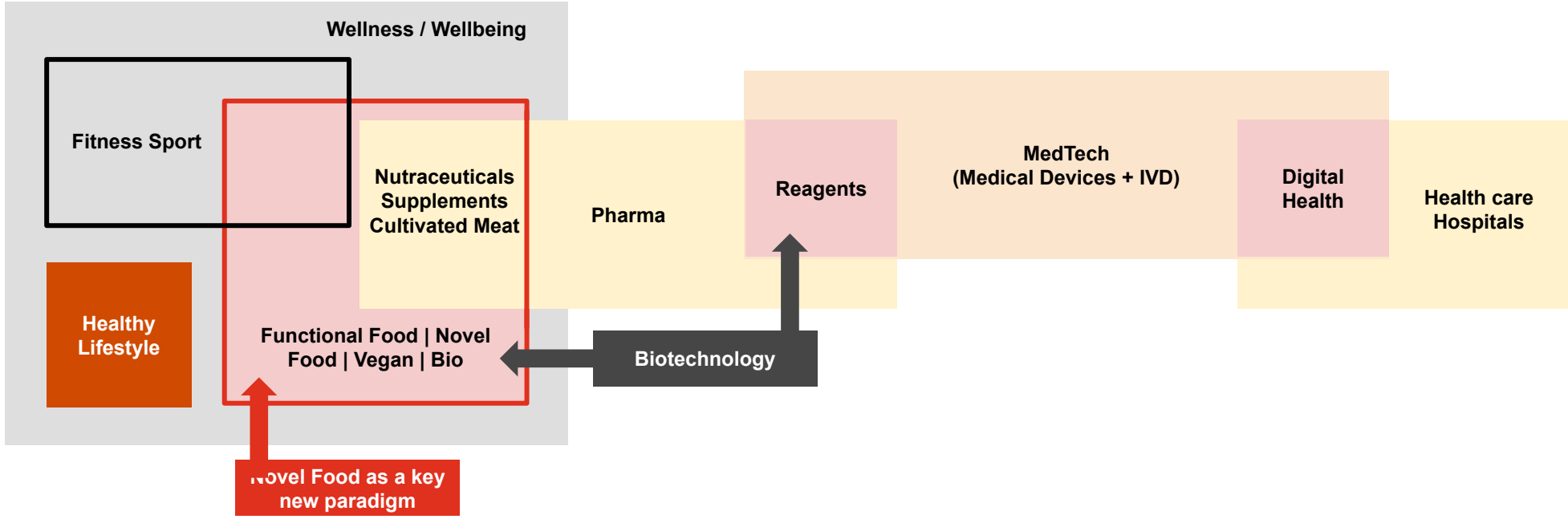
Growing importance of food **safety** and **traceability**

- High level of **transparency** demanded by consumers and governments, with **blockchain solutions** gaining traction.

Source: PwC Analysis

Over the years **the concept of diet has changed**, moving from the original meaning of deprivation in order to contain weight to the idea of a **balanced life** for the improvement of the **general wellness of people**

The health chain



The protection of **physical** and **mental wellbeing** is becoming increasingly important.
In a context in which the sensitivity towards overall health and, in turn, food choices is growing, an **adequate diet is the goal to reach.**

The result is **an extension of the health chain**, traditionally limited to ex-post curative, clinical and hospital interventions, by making it encroach on an area that **extends from diet to the whole of lifestyles.** In this context, **Novel Food** emerges as a **key paradigm** of **new diets.**

Source: PwC Analysis

Alternative proteins represent a viable solution to some of the most important **challenges** caused by **meat & dairy production & consumption**; among the most critical: increasing **population**, environment **pollution** and animal **welfare**

Challenges to face

- **Increasing population,** which would result in not meeting the needs of the population with the current production processes.
- **Environmental impact,** such as greenhouse gas emissions, water and land use; with the current production, the SDGs* will be impossible to reach.
- **Animal Welfare,** regarding slaughtering and treatment of animals especially in industrialized farming.
- **Excess meat consumption,** which has significant effects on human health and the economy.
- **Protein and energy intake,** which is necessary to meet the nutritional needs of the population.
- **Antibiotics use,** to avoid livestock epidemics which will cause antibiotic resistance in humans resulting in major health risks.

Alternative proteins as current solutions

- Companies have been focusing on looking for **new products to replace conventional produced meat**, **dairy, eggs and seafood** to address these challenges.
- **Alternative proteins are now becoming very popular** and they differ depending on the **production process.**
- They can be divided into **4 types of proteins**:

- Plant-Based
- Cell-Based
- Fermentation-Based (Microorganism)
- Other types (i.e. insect-based)

Source: PwC Analysis; Note: (*) United Nations' Sustainable Development Goals

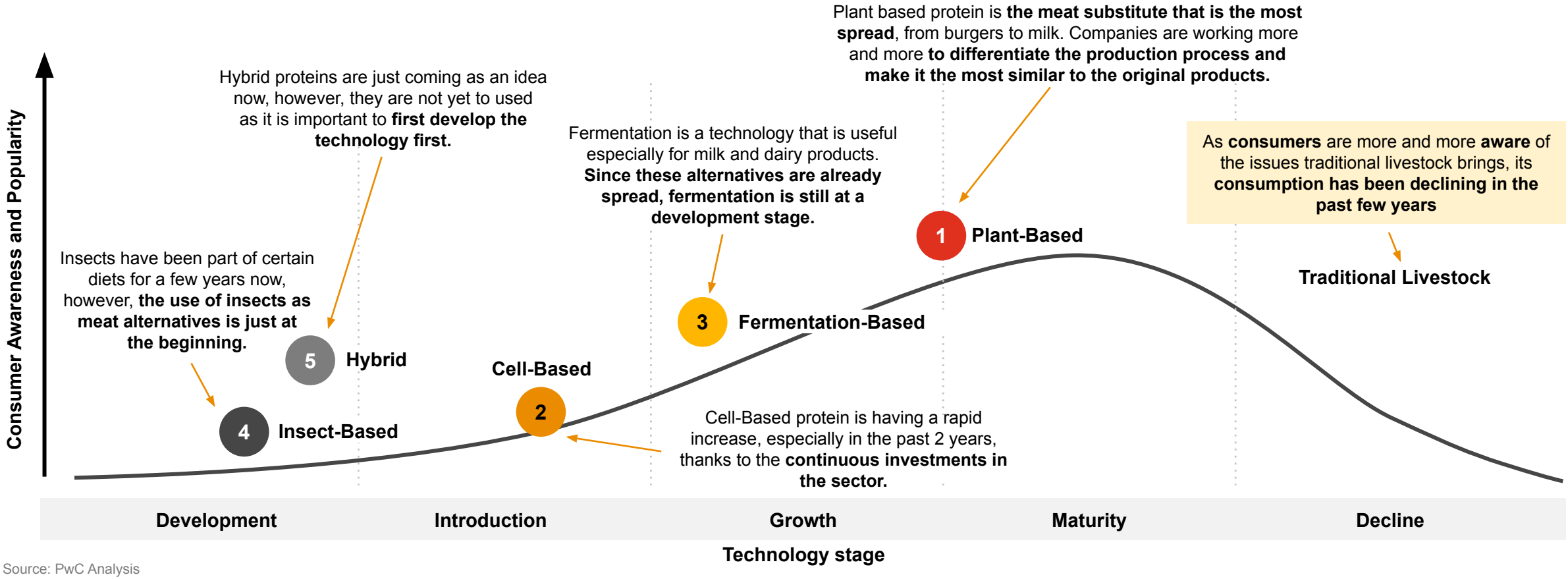
Novel Food types can be mainly clustered into **5 technologies/variants**: (i) **plant-based**, (ii) **animal cell-based**, (iii) **fermentation-based** (iv) insects-based and (v) **hybrid meat**

1	2	3	4	5
Plant-based	**Animal cell-based**	**Fermentation-based**	**Insect-based**	**Hybrid**
Meat Eggs Dairy	Meat Eggs Dairy	Meat Eggs Dairy	Meat	Meat

Source: PwC Analysis

As of today, most **Novel Foods** types are still in their **"development phase"**, in terms of both (i) **technological stage** and (ii) **consumer awareness**

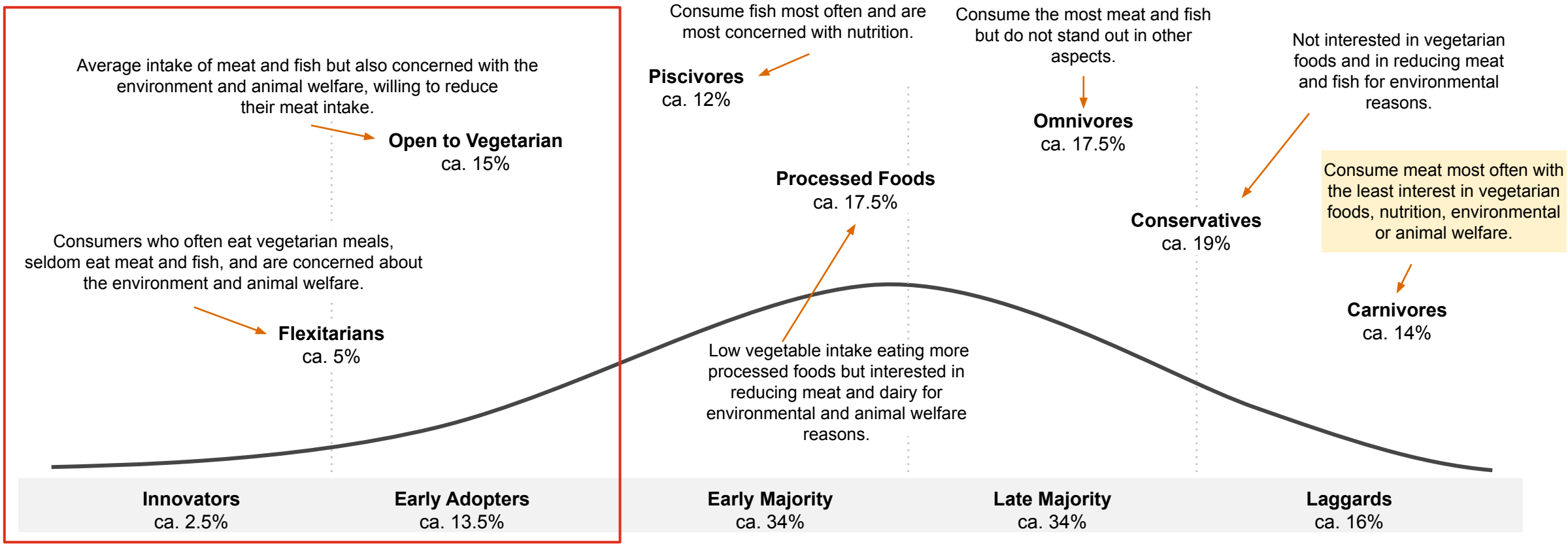
Market Development Phases of Novel Food types



Source: PwC Analysis

As an **innovative product, Novel Food** is **targeted** to a type of consumer that is **willing to try new foods**, therefore prone to change, such as **flexitarians** and consumers **open to being vegetarian**

Consumer Adoption Curve of Novel Foods



Source: PwC Analysis

Among meat protein substitutes, **plant-based alternatives** are the **most developed** in terms of **production process**, **customer acceptance** and **market dimensions**

Overview

- **Plant-based**, includes all those products, even processed, **totally composed by one or more plant sources** and **no animal derived ingredients.**
- Plant-based alternatives can provide **the same or even more nutrients and protein** compared to meat and dairy products.
- Plant-based products have been shown to be a **better option for the planet**: (i) reduce reliance on **resource-intensive production processes,** (ii) produce lower **greenhouse gas emissions,** (iii) require **less water and land use** compared to conventional meat production.

Customer Base

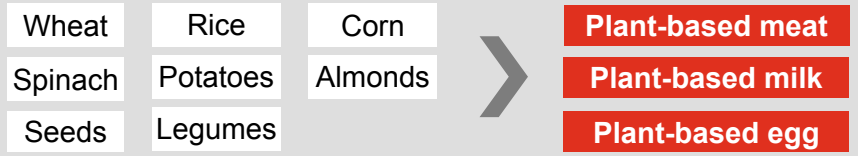
Consumer targets can be divided between:

1. People with **higher income:** they can afford **higher quality food** and are **willing** to **pay more** for **higher quality** products.
2. **Generation Z** consumers **and Millennials** who **appreciate fresh, healthy food** and are **open to trying** new products.
3. **Parents of young children** who care about making healthy, quality, home-cooked meals.

Source: PwC Analysis, Good Food Institute Reports

Technology & Production

- **Plant-based foods** are generally made of **fruits, vegetables, legumes, grains, nuts** and **seeds.**
- The category comprehend **derived processed counterparts** such as breads, pasta and **derived ingredients** such as oleaginous seed–derived oils, sugars, and some herbs and spices.



Market & Investments

- **Global dollar sales** of plant-based meat grew **17% in 2021 to $5.6 billion**, and **global dollar sales of plant-based milk grew 14% to $17.8 billion**, with milk accounting for the most popular plant-based product in the world.
- **Plant-based meat, egg, and dairy companies raised $1.9 billion in 2021**, bringing **total investments in such companies since 1980 to $6.4 billion.**
- With momentum growing for the entire alternative protein sector and total alternative protein investments increasing by 60% in 2021, **investors are diversifying their allocations** among alternative protein segments, with both fermentation and cultivated meat companies seeing large increases in investment in 2021.

Cultivated meat eliminates the need to raise and farm animals for food, its **cellular composition and structure** is very **similar** to that of **animal tissues;** the hardest challenge is to mimic the texture and the taste

Overview

- Cultivated meat is a **genuine animal meat that is produced by cultivating animal cells directly, without the need of slaughtering animals.**
- Cultivated meat is made of the same cell types arranged in the same or similar structure as animal tissues, thus **replicating the sensory and nutritional profiles of conventional meat.**
- In the **next decade,** companies **may also start producing eggs and dairy** alternatives through this process, however, as of today cultured meat is the main focus.

Technology & Production

The techniques used to grow synthetic meat are in part borrowed from those of **regenerative medicine**, and the production process involves **three main components**:

Starter Cells | **Scaffold & growth medium** | **Bioreactor**

Thanks to the advancements made in the **technology,** the **desired output** is a product that is exactly the same as the current types of meat consumed (e.g. beef, pork, chicken). **Real meat** with **the exact appearance of traditional products.**

Customer Base

- The main targets are **omnivores and flexitarians**, since cell-based meat still holds as a **product that comes from an animal and would go against most of the principles vegetarians and vegans** stand up for;
- It may however happen in the future that **vegans and vegetarians may be attracted by the product,** since it doesn't need slaughtering of animals.
- According to several surveys, many **potential consumers are interested in trying the product**, or at least getting to know more about its benefits.

Market & Investments

In 20 years, 35% of global meat consumption will come from cultivated meat products

+41%
CAGR 2025-2040

Enthusiasm is **building** among investors, who have several options for accessing the alternative meat market, including pureplay producers, distributors and servers, large multi-nationals, investment funds such as Agronomics and Cult Foods, an investment platforms.

Source: PwC Analysis

Fermentation products are a **completely animal-free alternative** to traditional proteins; the substantial benefit they provide regards the **possibility of being incorporated** into **plant-based** or **cultured meat products** to improve taste and texture

Overview

- **Fermentation** in the alternative protein industry refers to the cultivation of **microbial organisms** for the purpose of processing a food product or food ingredient that can be a **source of protein.**
- Fermentation is used in three main ways:
    1. **traditional fermentation**
    2. **biomass fermentation**
    3. **precision fermentation**

Technology & Production

Technology value chain for fermentation includes:

1. **Feedstock**
2. **Strain development**
3. **Fermentation bioprocess**
4. **Formulation and manufacturing**
5. **Target selection and design**

Customer Base

- Products derived by microorganism fermentation such as ice cream and yogurt will be a **valid alternative for lactose intolerant people.**
- **Vegan people** will greatly appreciate **proteins derived from fermentation** since they **do not contain any element of animal origin.**
- **Outputs of fermentation** will likely be **included in plant-based and cultivated-meat products** thus contributing to most of the end products included in the alternative proteins ecosystem reaching the broadest customer base.

Market & Investments

- Global investment in fermentation-based alternative proteins reached **587 $M in 2020** growing with a **CAGR** of **97% since 2013.**
- The majority of investments (59%) have targeted **precision fermentation.**
- **Venture capitals, accelerators/incubators** are the most active investors in term of number of deals for what concern dilutive types of investments; non-dilutive investments saw **grants** as the preferred funding method by number of deals.

$5M → **$587M**

Annual investments in 2013 — *Annual investments in 2020*

Source: PwC Analysis

Insects already belong to the diet of a third of the world population; they **hold the promise of solving some** of the most urgent **global challenges** such as climate change and growing food demand

Overview

- The term **entomophagy** refers to the consumption of insects.
- The practice constitutes a further alternative to the intake of proteins from farmed animals.
- Consuming insects would bring several **benefits** to natural resources consumption and to the environment such as l**ower water** and **land use** and **lower greenhouse emissions,** meanwhile **contributing to solve the problem of increasing food demand.**

Technology & Production

- The production process is very complex and involves three main stages:

1. **Harvesting phase:** occurs during **different life stages**, depending on the breed being grown.
2. **Blanching phase:** is a pre-treatment used to reduce microbial counts and deactivate the degradative enzymes that cause food poisoning and spoilage.
3. **Drying methods.**

Customer Base

- According to the Food Agriculture Organization (FAO), **edible insects belong to the diet of 2 billion people**, almost a third of the world's population.
- More broadly, flour derived from insects is already commercialized ad used in many countries to create **additives** to be included in **processed food.**
- **In near future**, insects will be the one of the first choices of people who pay particular attention to the **nutritional values of aliments.**

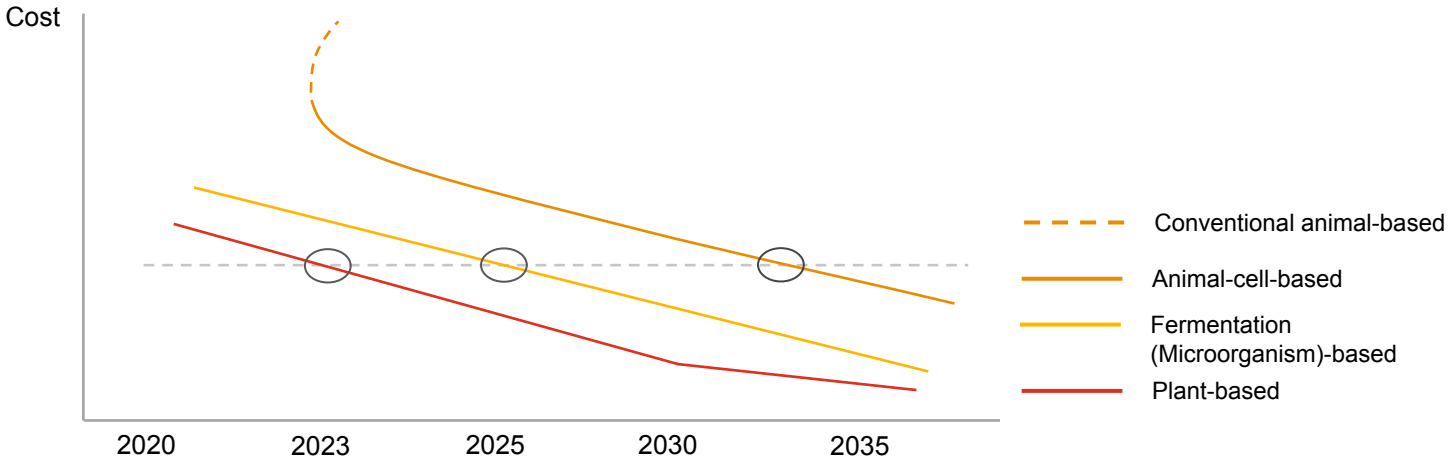
Market & Investments

- The market for insect is worth **US$ 1.2 billion in 2021.**
- **Global market size is expected to grow with a CAGR of 30% from 2022 to 2026.**
- **Asia Pacific dominate the market** with a share of **40%.**
- **North America and Europe** follow with comparable sizes: **29% vs 22%.**
- At present, the **highest market share is represented by whole insects** (close to a 1/4th of the products on the market).

Source: PwC Analysis

Alternative proteins could soon **match** animal protein in **taste, texture, and price**, fuelling widespread **adoption**, which would allow consumers to have their favourite dishes in a more **healthier** and **sustainable** version

Timing of cost parity for alternative protein with realistic taste and texture



- ***Plant-based*** *burgers are on the* ***verge of achieving parity****, and could do so within the next two years.*
- ***Plant-based chicken*** *pieces are* ***unlikely to achieve parity before 2023****. They're already similar in taste and texture, but they'll have to* ***lower their prices*** *to compete with mass-produced chicken.*
- ***Microorganism and animal-cell-based goods*** *will* ***first achieve price parity with more expensive animal products like meat****, whereas eggs and dairy will take longer.*

Source: PwC Analysis, US Department of Agriculture, Euromonitor, Good Food Institute, BCG Analysis, OECD and FAO Data and Agricultural Outlook 2021-2030

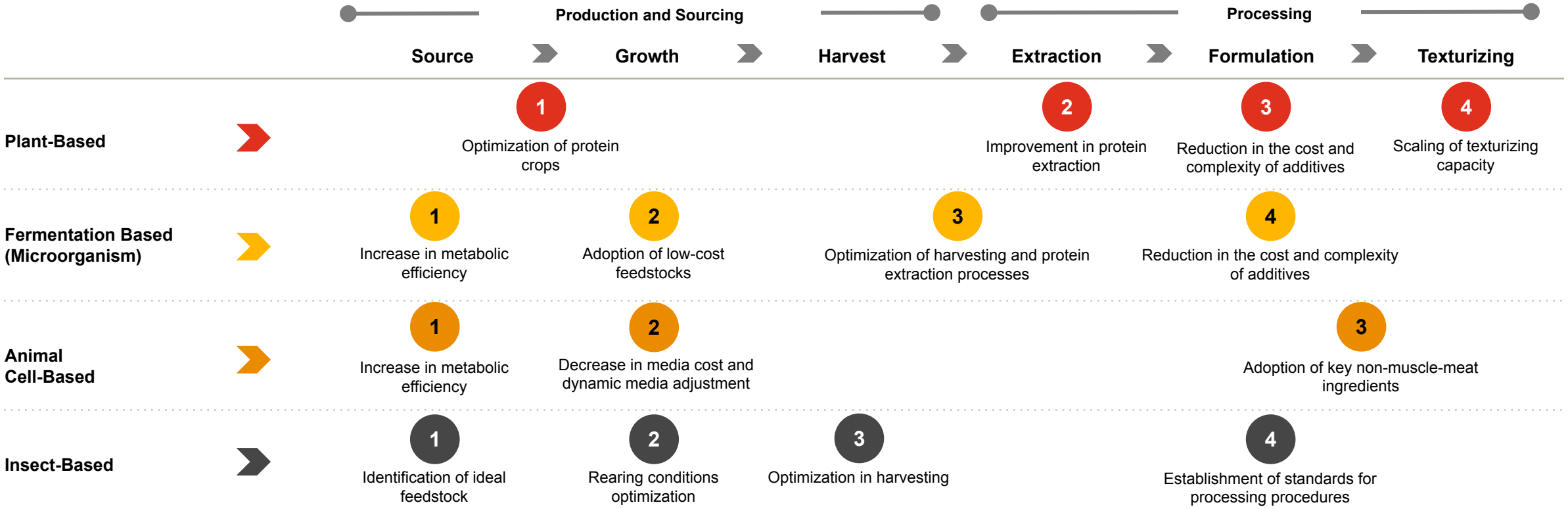
Challenges

Alternative proteins have to face **three main challenges** to reach parity with conventional animal-based proteins:

- **Taste:** to **accurately mimic the flavor**—and smell – of meat, fish, dairy, and eggs.
- **Texture:** to have the same **appearance and feel** as animal proteins. Meat's fibrous structure has a big influence on how it tastes. When cooked, alternative eggs and dairy must perform similarly to actual eggs and dairy; eggs alone have up to 70 uses, and substitutes must be able to be used in all of them.
- **Price:** despite not being the bargain option yet, if **substantial groups of people are going to buy alternative proteins on a regular basis, the price can become comparable** to or lower than the price of protein from animals raised in non-organic settings, and in a situation to be able to apply economies of scale.
- **Reaching parity will allow** people around the world **to make 90% of the most appreciated dishes** with alternative proteins (e.g. Lasagna, Pizza, Sandwich, Sushi, Alfajor).

Parity of alternative proteins can be reached by **developing and scaling up** existing technologies at **key steps** of the **value chain,** such as optimizing harvesting and improving protein extraction

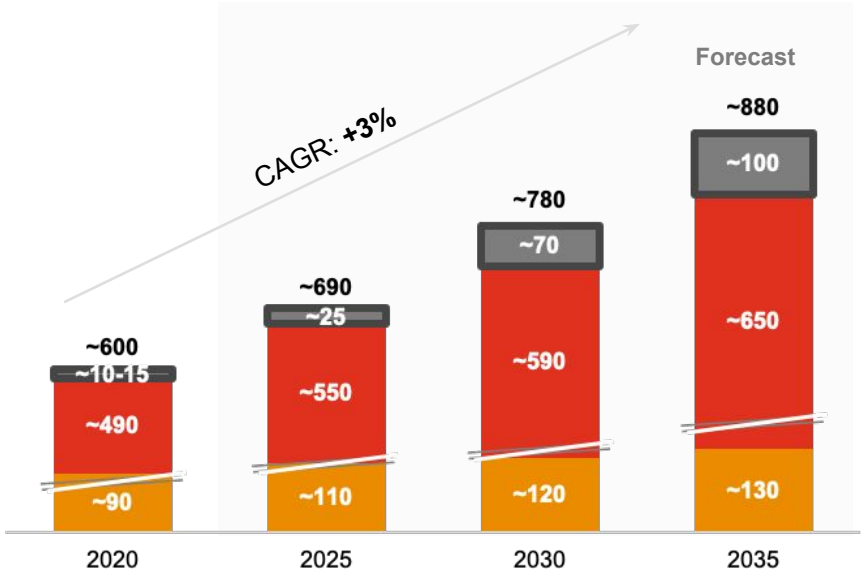
Alternative proteins value chain (Key areas of improvement by technology)



Source: PwC Analysis, US Department of Agriculture, Euromonitor, Good Food Institute, BCG Analysis, OECD and FAO Data and Agricultural Outlook 2021-2030

Alternative protein market is a **fast-growing market:** by **2035**, every tenth portion of protein is very likely to be alternative (**12% share)**, reaching a market amount of **ca. 100 million Tons consumed**

Global consumption of Protein Products
(Million Metric Tons, Expected Scenario)



2%	3%	8%	12%	**Market share of alternative proteins on Total**

Alternative Proteins

Alternatives that can be created by leveraging on current technology

Addressable Conventional Proteins

Non-Addressable Conventional Proteins

Include highly structured meat such as large cuts with bones

Market focus

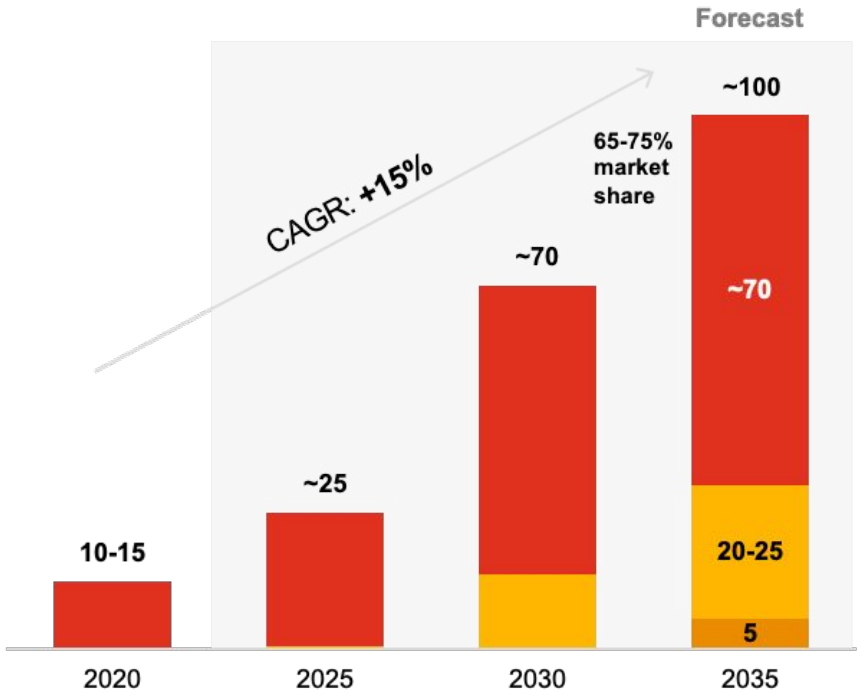
Key notes

- Alternative proteins include forms of animal protein for which like-for-like **alternatives can be created by leveraging on current technology.**
- The **global consumption of proteins** is expected to grow **by 2035** with a **CAGR of +3%** in the period 2020-2035 reaching **about 880 million metric tons consumed.**
- The share of alternative protein is expected to shift from the **current 2%** of the global protein market to **12%** moving from **10-15 million metric tons** a year as of today to **ca. 100 million metric tons** by **2035.**
- The market can be expected to reach a value of approximately **$290 billion in 2035.**
- Real revenues could be closer to **$10** per kilogram **for high-quality meat alternatives** but significantly **less for high-volume products like milk.**
- **By 2035**, the shift to plant-based beef, pork, chicken, and egg alternatives will **save more than 1 gigaton of CO2-e**, about as much as Japan current annual emissions.

Source: PwC Analysis, US Department of Agriculture, Euromonitor, Good Food Institute, BCG Analysis, OECD and FAO Data and Agricultural Outlook 2021-2030

Plant-based alternatives are expected to keep **dominating the market** but will show the lowest growth rates in the next decade; **animal-cell-based alternatives** are expected to accelerate the growth with a **CAGR '30-'35** of **116%**

Consumption of Alternative Proteins - by Protein Source
(Million Metric Tons, Expected Scenario)



	CAGR '20-'25	CAGR '25-'30	CAGR '30-'35
Total	**15%**	**22%**	**9%**
Plant-Based	15%	17%	6%
Microorganism-Based	55%	90%	10%
Animal Cell-Based	51%	67%	116%

Source: PwC Analysis, US Department of Agriculture, Euromonitor, Good Food Institute, BCG Analysis, OECD and FAO Data and Agricultural Outlook 2021-2030

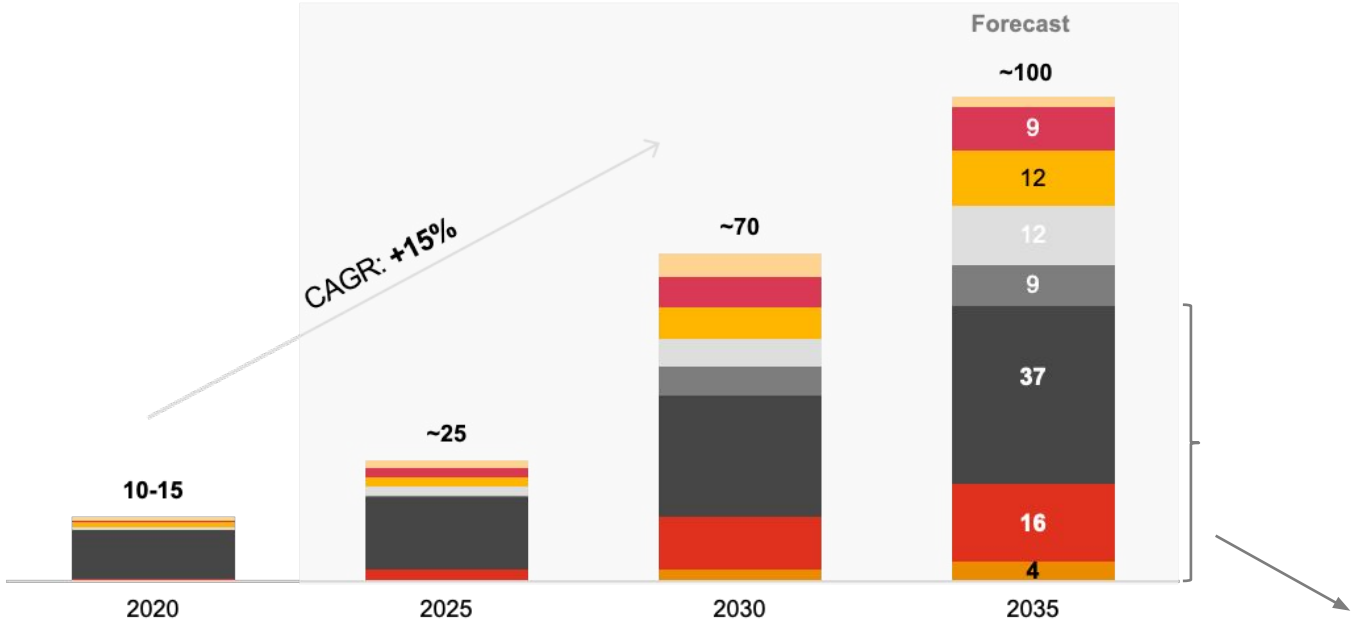
Key notes

- Volumes of alternative proteins consumed are expected to grow with a **CAGR of 15%** in the period 2020-2035.
- **Plant-based alternatives** are expected to be **the most relevant category,** accounting for ca. **70%** of the total volumes consumed in **2035.**
- Proteins based on **microorganisms** will likely reach parity by 2025 and will be the **fastest growing** in the period **2025-2030.**
- **Animal-cell-based protein** are expected to reach parity in 2030 and then accelerating growth in the period **2030-2035** with a **CAGR of 116%.**

*The above estimates of the **market size** take into account alternative proteins only in relation to **human consumption**. The numbers **do not consider** the possibility of using alternative proteins as a basis for **animal feed.** Replacing the fishmeal and bone meal used as feed in aquaculture and other types of animal farming could contribute significantly to the growth of the market.*

Milk & **Dairy** alternatives are expected to be worth **more than 55%** of the **total** alternative protein **market, overperforming** until **2030** and then **in line** with **market average;** by **2035 Chicken** & **Seafood** show the **highest growth** rate

Consumption of Alternative Proteins - by Product Type
(Million Metric Tons, Expected Scenario)



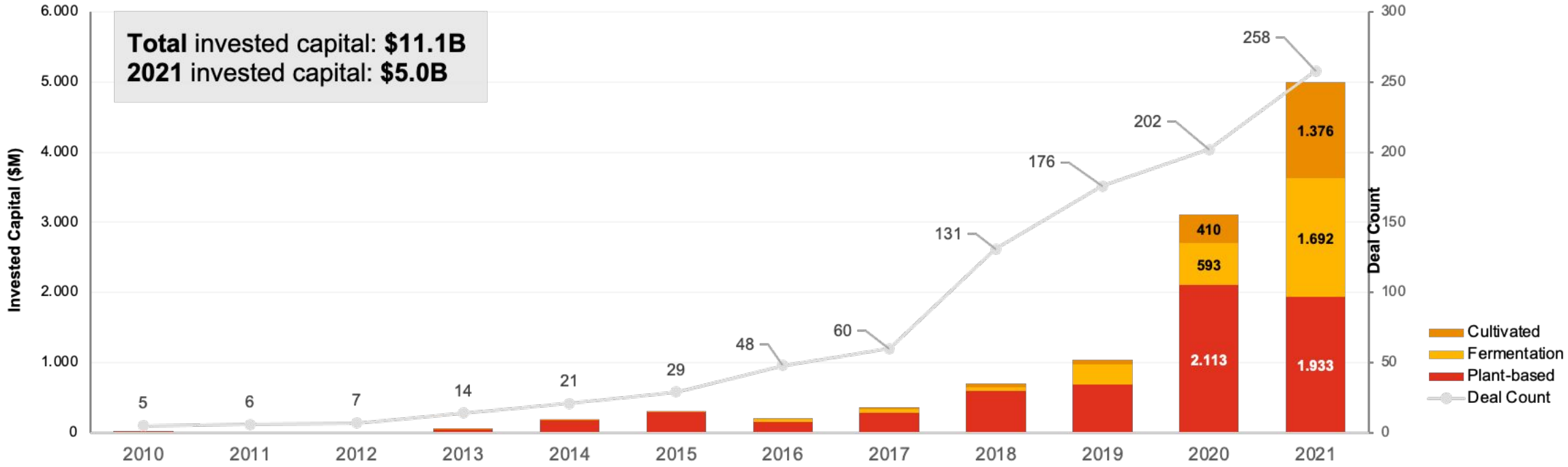
	CAGR ’20-’25	CAGR ’25-’30	CAGR ’30-’35
Total	**15%**	**22%**	**9%**
Beef	22%	23%	5%
Pork	28%	30%	7%
Chicken	20%	25%	12%
Seafood	23%	27%	15%
Eggs	72%	79%	8%
Milk	8%	11%	8%
Fresh-dairy	34%	37%	8%
Cheese	43%	54%	13%

Source: PwC Analysis, US Department of Agriculture, Euromonitor, Good Food Institute, BCG Analysis, OECD and FAO Data and Agricultural Outlook 2021-2030

Dairy Alternatives

In recent years, the M&A market and funds' **investments** have **skyrocketed**, reaching **$5B** invested in **2021** in plant-based companies; **cultivated** and **fermentation** alternative proteins are the ones growing the most

Annual investments in Alternative Protein companies
($M, 2010-2021)



Source: PwC Analysis, Good Food Institute; Note: Invested capital includes accelerator and incubator funding, angel funding, seed funding, equity and product crowdfunding, early-stage venture capital, late-stage venture capital, private equity growth/expansion, capitalization, corporate venture, joint venture, convertible debt, and general debt completed deals; insect-based investments data is yet to be available

Protein alternatives that will appear in the market will constantly change; **33 million Italians** expect that among new foods, **plant-based meals** with a meaty flavor and **algae-based** foods will be the most popular

Future of Food in Italy

- **Italians in 10 years will see food profoundly different**. New lifestyles, technological innovation and climate change will be the drivers of change.
- People will be **ready to eat sustainably,** and certainly more **innovative** foods.
- **Many companies** are now **operating in the food tech sector** that are **investing** significantly in **new foods** and in particular in **next generation nutrients.**
- The latter category - which includes all alternative ingredients such as plant-based meat, insect-based and mushroom-based products - **invested over €6B in 2020 alone**, driven by the exponential **growth of the alternative protein sector**, which has recorded investments of over **€2.4B in the last year, growing** at an average **growth rate** of **+81% since 2018.**

33 millions
of people in Italy are ready to see changes in the food we eat today by the end of 2030.

Factors that will change food in the next 10 years

*("Which factors will drive the change in foods' production we'll eat in 10 years time?", % of respondents, multiple choice)**

- **35%** Climate Change
- **32%** Changing Lifestyles
- **27%** Use of new raw materials
- **26%** New Technologies
- **26%** Unavailability of raw materials due to climate change

New foods that will be popular in the next 10 years

*("Which new foods will appear on the table?", % of respondents multiple choice)**

- **33%** Plant-based with meaty flavor
- **28%** Algae-based
- **26%** Insect-based
- **23%** Seed-based with high protein
- **22%** Cultivated Meat

Source: PwC Analysis; Just Eat, Rapporto Coop 2021, Nomisma; Note: (*) According to a Coop Survey run in August 2021 among 1500 Italians aged 18-75

The **change** in consumers' preferences in eating meat has brought the main players in the market to find **solutions** to **avoid disruption**, among them **M&A** and **Joint Ventures** are the most common ones

The Meat Industry Changes

- In the last decade, there has been an undeniable **shift in consumers' preferences** when it comes to eating meat.
- This is partly due to the **wide availability of meat replacement** options combined with **growing awareness** of their health benefits and lower impact on the environment compared to conventional meat.
- Meat replacements and cultured meat **could overtake the conventional meat market.**
- Conventional meat will make up just **40%** of all **global meat supply by 2040,** compared to **90% in 2025.**
- For this **reason**, **conventional meat** producers are either **investing** significant amount of **capital in meat alternative companies** or expanding their **portfolio** so they can **avoid disruption.**

Main Trends

Diversification: meat producers are entering also in aquaculture production, plant-based food production and are starting to communicate themselves broadly as "protein" companies.

M&A: meat giants and diary processors are taking over full or partial ownership of alternative protein firms.

Joint ventures: traditional animal protein producers are entering into joint agreements with plant-based protein producer to create innovative alternative protein hubs.

	2025	2030	2035	2040	CAGR '25-'40
Global Meat Market Value	$1.2 Trillion	$1.4 Trillion	$1.6 Trillion	$1.8 Trillion	50%
Conventional Meat	90%	72%	55%	40%	-3%
Conventional Novel Food	10%	18%	23%	25%	9%
Cultured Meat	<1%	10%	22%	35%	41%

Source: PwC analysis; AT Kearney Analysis, Good Food Institute, FAO

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