

Developments in the first decade of cultivated protein

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December 2022

Start-ups – the founding of the sector

Origins of the startups

Medical and pharmaceutical industry

Mainly: Tissue engineering and molecular biology

Cannot make food with medical technology because:

1. Medical products are extremely expensive
2. The volumes produced are far too low

Need significant changes to the medical/pharmaceutical technologies – cheaper and more volume

An industry founded by vegans and sci-fi fans

Start-up companies mostly founded by vegans and sci-fi fans

- Most biomedically trained
- Most trained between 2000 and 2015
- Most under 40
- Very few from the food sector
- Very few from the medical/pharmaceutical sector

Main reason for start-ups was ethical – for animal welfare and/or global food security reasons (GFC 2007/8)

Objective of most is to “eliminate industrial agriculture”

Threat to industrial agriculture because ...

Ethical origins change the equation because ...

- **Not targeting high value niche** market of vegans/vegetarians (alternative meat sector) but much larger agricultural sector
- Focused on creating a **low value product**
- Attempt to scale-up as quickly as possible. Most do this by **teaming up with corporate food system**, enhancing growth potential.

Is the food sector engaging ?

- Most of the meat industry favourable to start-ups
- Many have already formed links (e.g. ADM, Nestle, Coca Cola, Unilever)
- Companies need animal protein that is
 - Reliable supply (in the face of climate change)
 - Low in GHG emissions
 - Low in antibiotics
 - Not subject to health scares – e.g. microplastics, BSE
- Resistance comes from meat/milk producers

The rapid growth of the cultivated protein industry

107 Startups by the end of 2021 (32% more than 2020).
(GFI, 2022)

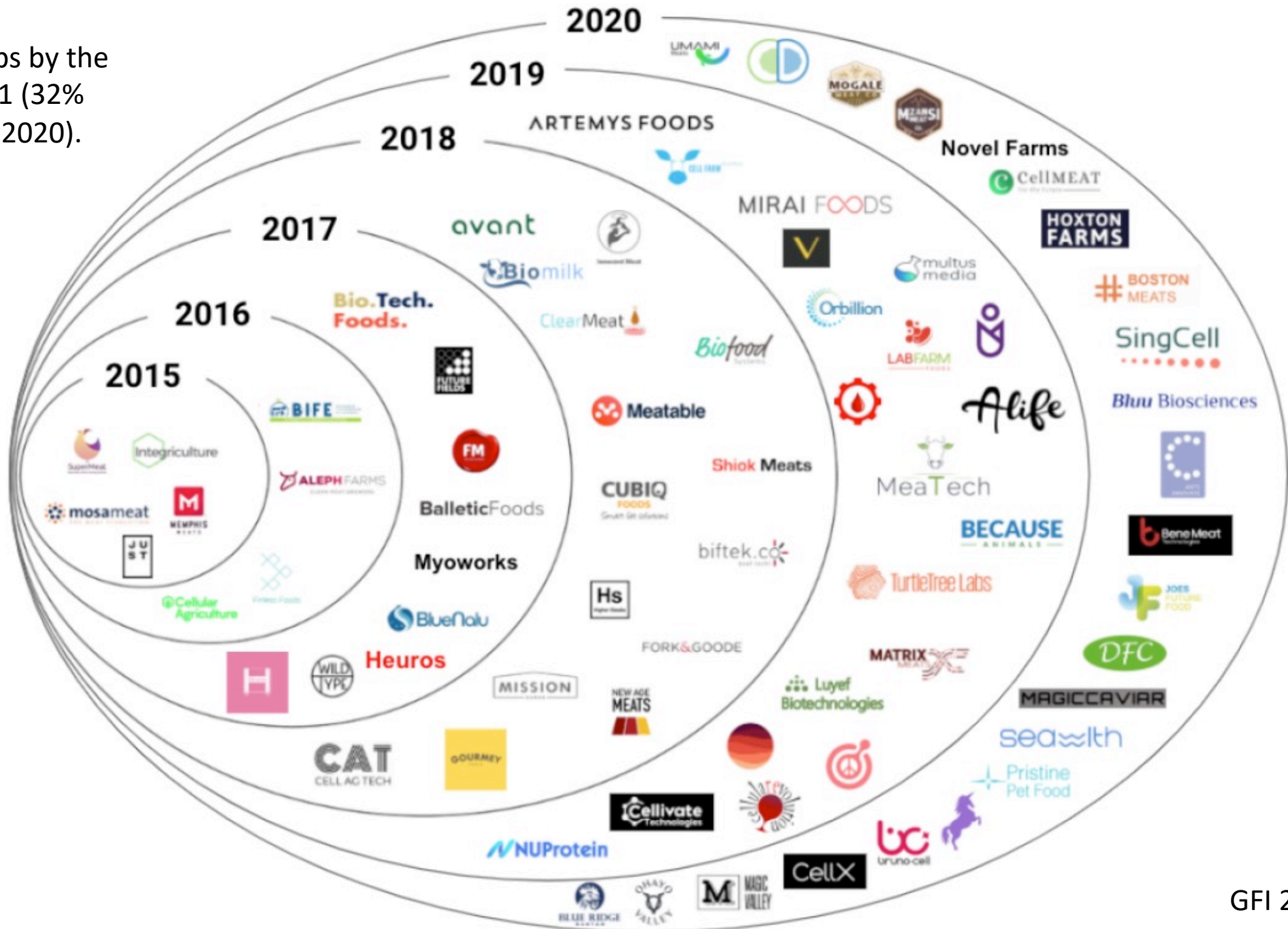
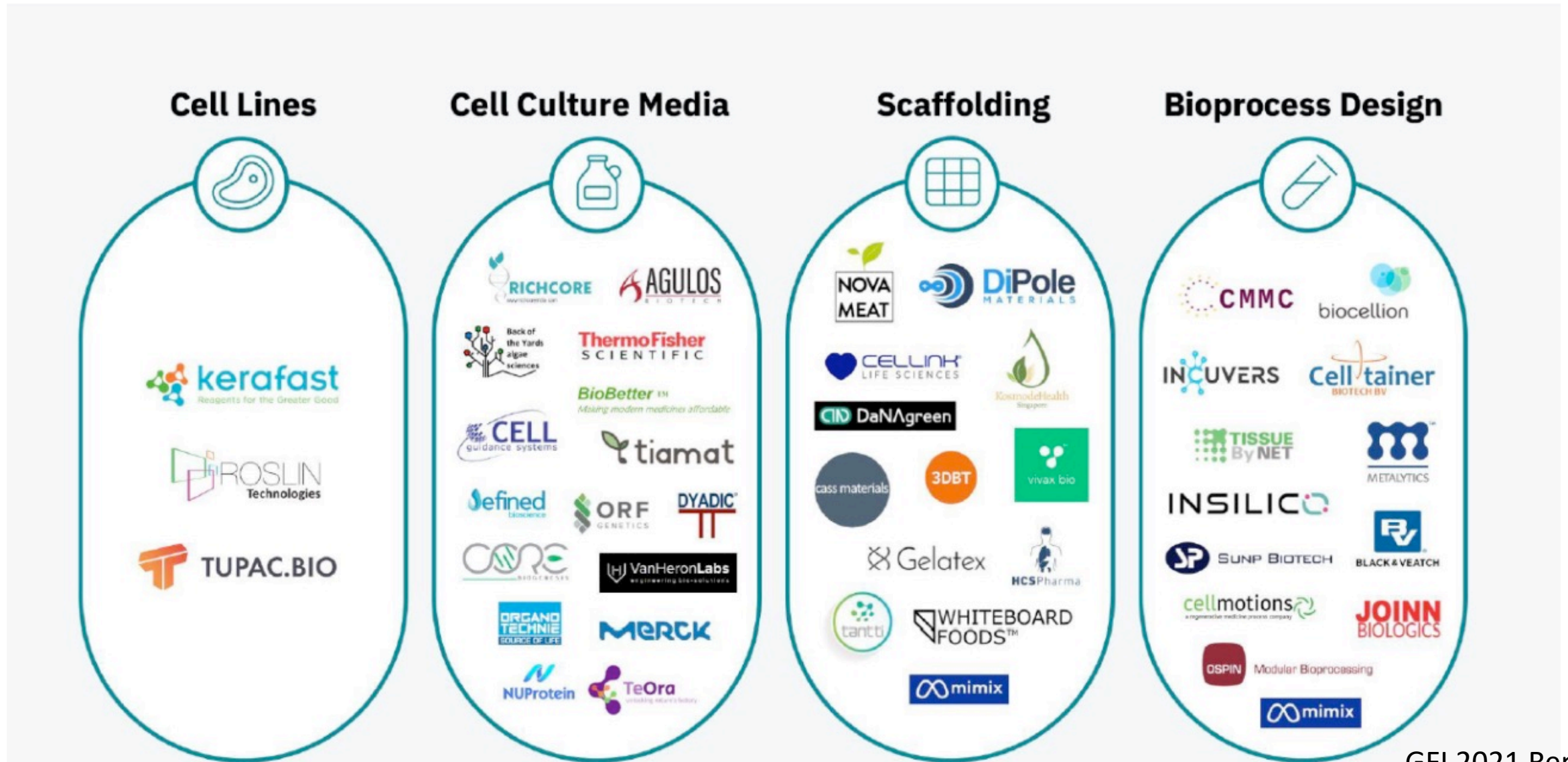


Figure 4: Companies with initiatives in cultivated meat (emergence of a commercial ecosystem)



Proving the concept

Precommercial

Conceptualization

Recognizing the possibility of generating meat from tissue culture

Time: **Through 2013**

Scale: **N/A**

Lab Proof of Concept

Developing bench-scale prototypes of cultivated meat

2013–2019

N/A


Penetrating commodity market

Commercial

Pilot Scale

Transitioning to facilities producing first wave of salable products


2019–2022

 **Hundreds of metric tons**

Demonstration Scale

Generating market samples and key process engineering understanding


2022–?

 **Thousands of metric tons**

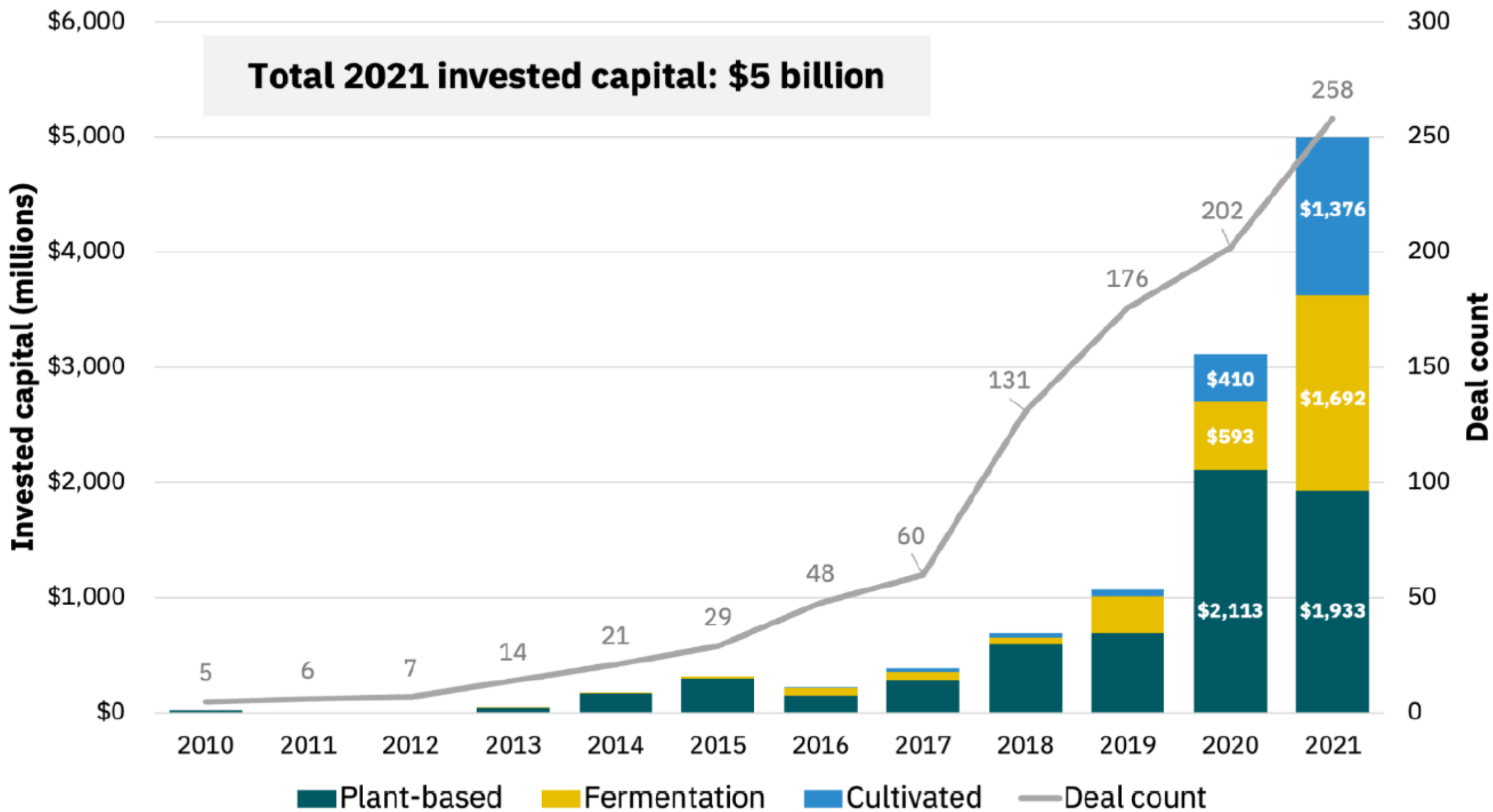
Industrial Scale

Manufacturing cultivated meat products at an industrial scale

?

 **Millions of metric tons**

— *Leading edge of the industry*

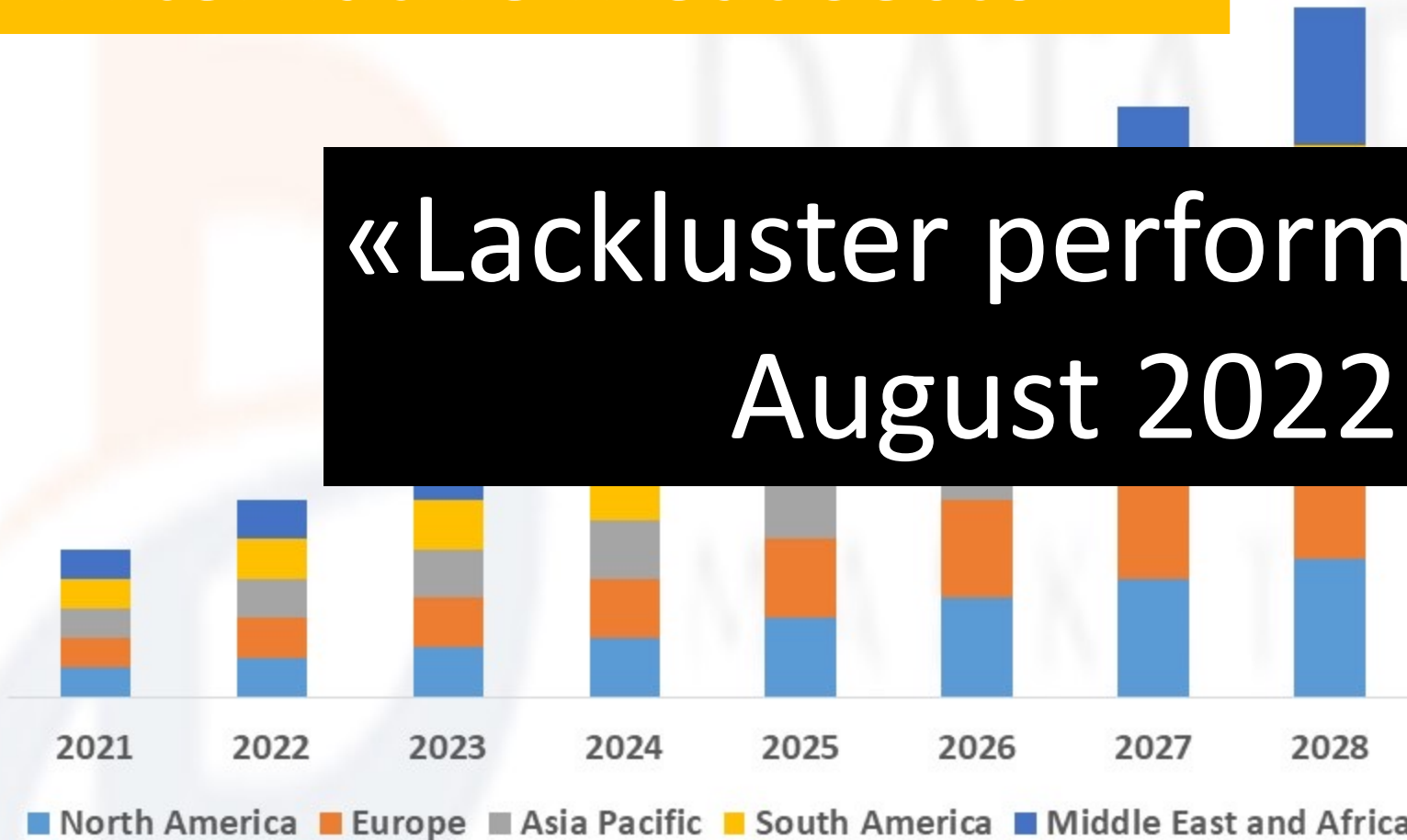


Global Meat Substitutes Market is Expected to Account for USD 10.43 Billion by 2028

Global Meat Substitutes Market, By Regions, 2021 to 2028

Alternative meat sector

«Lackluster performance»
August 2022

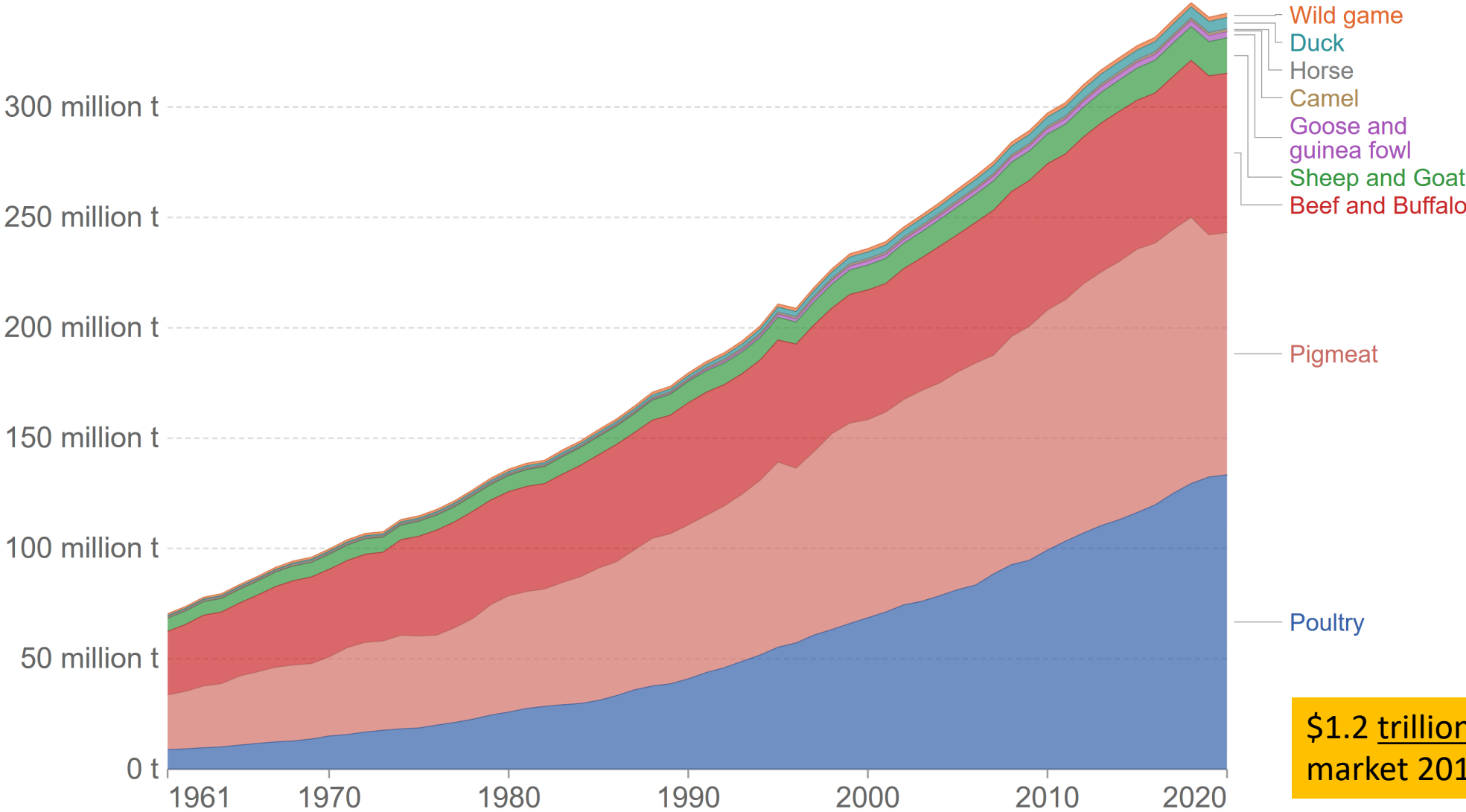


DATA BRIDGE MARKET RESEARCH

\$3.24 billion annual market 2022



Meat production by livestock type, World, 1961 to 2020



Source: UN Food and Agricultural Organization (FAO)

OurWorldInData.org/meat-production • CC BY

Note: Total meat production includes both commercial and farm slaughter. Data are given in terms of dressed carcass weight, excluding offal and slaughter fats.



Products have been developed

(but most not yet on the market)



HigherSteaks:
Bacon



Mosa
Meat:
Burger



Future
Meat:
Meatballs



Wildtype:
Salmon



Shiok Meats:
Shrimp
Dumpling



BUT

- Only sold in one restaurant
- \$23 for three chicken nuggets
- Eat Just makes a loss
- Have only been able to make enough chicken for 700 customers !!!

Eat Just:
Chicken
nugget

72%

Less greenhouse
gas emissions*

61%

Less
non-renewable
energy use*

23%

Less blue water
consumption*

*Compared to ice cream made through conventional dairy production methods.
Data from ISO-certified, third-party-validated report.



Perfect Day:
Ice Cream



MODERN KITCHEN Spring Onion + Chive

Animal-Free Cream Cheese Spread
Made from plants and flora

CONTAINS MILK ALLERGEN • NET WT. 8 OZ (227g)

Perfect Day:
Cream
cheese



Perfect Day:
Chocolate



Perfect Day:
Flavoured
milk



Perfect Day:
Protein
booster

Perfect Day:
Chocolate bar
(29/11/22)



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ADD TO CART

Sector developments (2021-2022)

Things are happening ...

1. Start-ups are merging and working together

- **Upside Foods** start-up recently acquired seafood start-up **Cultured Decadence**
- 13 cultivated protein start-ups in Europe founded an association “Cellular Agriculture Europe” to create unity and transparency in the industry.

2. Start-ups are changing their names for market

- 'Matrix Meats' to 'Matrix Food Technology'
- 'Biopetrolia' to 'Melt&Marble'
- 'Bluu Biosciences' to 'Bluu Seafood'

Reasons:

- Get the word 'milk' or 'meat' out of title
- Cover broader range of products
- Make science-based names more consumer friendly

3. Food industry expertise engaged

- 16th Feb 2022: Nicole Johnson-Hoffman (senior vice president for global operations for **McDonalds**) has taken over as CEO of **FMT**. This reflects a change in requirement towards “building and operating large scale food manufacturing facilities and working with global players” (**FMT**)
- 16th Feb 2022: Hans Huistra new COO **Meatable** – former president of **Fonterra** Europe and Africa who will “focus on preparing the organisation for its commercial launch” (**Meatable**, 2022).

4. Production facilities opening

- **Wildtype** has built a 716 M2 pilot plant in San Francisco with a maximum capacity of 90,700 kg of seafood a year
- **Upside Foods** opened a cell-based meat production facility in the US in September 2021. The facility can produce up to 181,400 kg of meat per year
- **FMTs** completed Israeli plant is capable of producing 500 kgs of product a day, i.e. the equivalent of 5000 burgers



Blue Nalu - Plant

5. Remilk is building a factory in 2023

- 26th April 2022
- Remilk announced it is building a factory in Denmark (\$120m funding obtained)
- Producing beta lactoglobulin and casein proteins alpha 1, alpha 2, beta and kappa (enabling full range of dairy products). Claim production equivalent of 50,000 cows per year
- Claim it will be same price as cows milk

4 factories = Norway's entire dairy herd

6. Change Foods is also building a factory

21st October 2022

- Commercial casein manufacturing factory to be built in the UAE
- 1.2 million litre custom-built fermentation facility
- Milk equivalent of 10,000 cows
- Will produce cheese
- Plans to sell to Asia-Pacific region



7. Big food brands moving into the nice

2021 August: **General Mills** (\$18 billion per annum revenue) established its own precision-fermentation startup “**Renegade Creamery**” to produce cheese

2021: **Nestle** “is evaluating innovative technologies to produce cultured meat or cultured-meat ingredients with several external partners and start-ups.” (Nestle, 2021)

2021: “*All the major meat and seafood companies* now have a cultured meat team internal to their companies. That did not exist when we started the company four years ago.” (**Finless Foods** - Mike Selden).

8. Unilever to launch precision-fermented ice cream

23 November 2022

Unilever sees the move to PF milk as «a significant trend»

- «We've been looking at precision fermentation for some time»
- Estimate products in 1 to 2 years
- «the likelihood is that we will do it on mainstream brands»
- Position as «low greenhouse gas» range

Regulation

1. U.S. Presidential executive order



- 14th September 2022
- US executive order on enhancing food security
- “We’re also looking to improve food security and drive agricultural innovation [through] foods made with cultured animal cells.”

2. First US FDA GRAS status awarded to meat



- 16th November 2022
- Upside Foods (US)
- First to receive a “no questions asked” letter from the US FDA
- Means the FDA accepts the product is safe to eat
- BUT ... Now needs approval from the USDA



Bawk bawk ba-kawk bawk,

Ba-kawk bawk. Bawk buk bawwwwwwk bawk.
Buk? Bawk bawk BAWK bawk 'Ba-quawk bawk' buk-buk. Bawk bawk bawk—bawk ba-kawk, buk.
Bawk-bawk? Bawk buk? Ba-buk.

BAWK buk buk bawk buk bawk. Ba-kawwwk buk buk ba-kawwwwwwwwk. Bawk bawk—ba-kawk
buk bawwwwk. Buk buk bawwwwwwk. Bawk. Ba-kawk bawk buk buk ba-kawk buk. Ba-kawk ba
bawk bawk, bawk buk, ba-kawk bawk.

Ba-kawk buk buk? Bawk ba-kawwwk, buk bawk bawk ba-kawk bawk, buk buk buk
ba-kawk bawk), buk bawk ba-kawk buk. Bawk bawk, buk buk bawk ba-kawk ba
ba-kawk buk bawk.

Buk buk bawk ba-kawk bawk buk, ba-kawk BAWK. Bawk, ba-kawk. Ba-kaw
k-ba-kawk—bawk.
'bawk' buk-buk buuuuk? Buk baw



3. Cultivated proteins in the EU



- No 'novel food' dossiers yet submitted to the European Food Safety Authority
- Likely to be at least 2 years from then – first products in 2025 at the earliest.
- Delays : First come-first served (currently clogged up with cannabis products!) + must get approval of 27 countries

4. Outside the EU/US?



- Regulatory approval takes 9 to 12 months in Singapore
- **Eat Just** got approval for its chicken in 2020



- 2022 **Mosa Meat** (Netherlands) is to begin producing cultivated beef in Singapore by the end of 2023.



- 2022 Referred to in UK's «Benefits of Brexit» document
- Options to make it easier for cultivated protein



- 2022 China named cultivated protein as part of its 5 year plan

Questions ?