



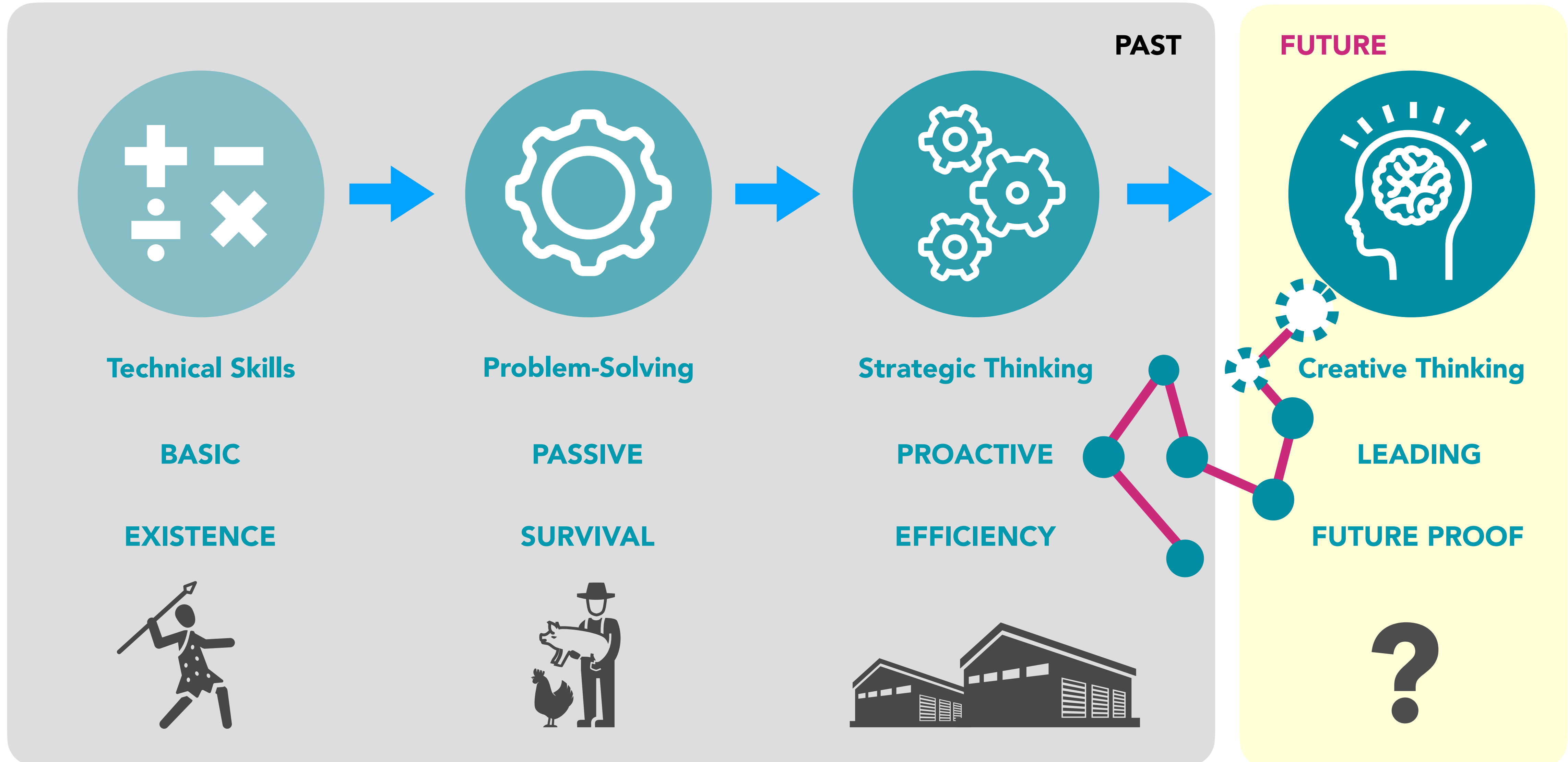
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novel cell cultivation technology

HKUL TEACHING BY DESIGN 2020
for the UN Sustainable Development Growth

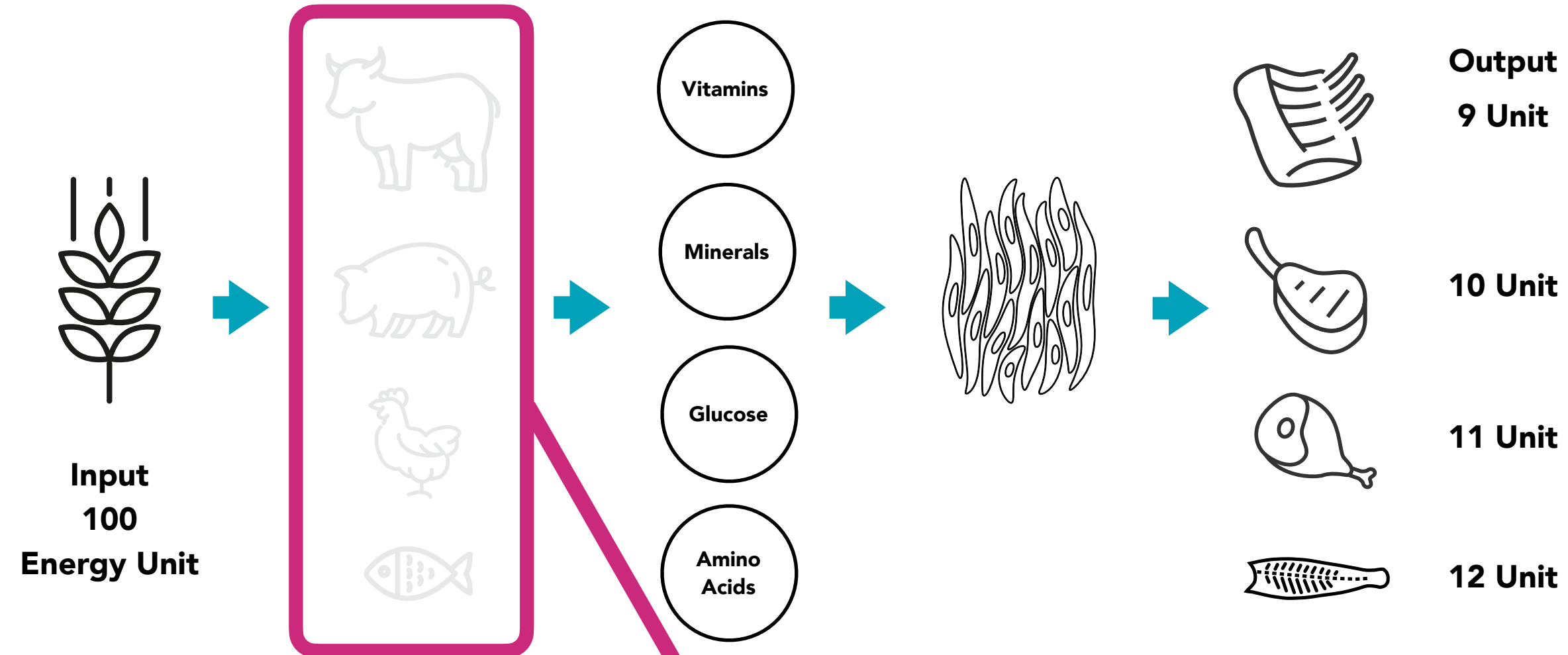
7 November 2020

DESIGN THINKING FOR INNOVATIONS



PROBLEMS TO SOLVE & THE CONCEPT OF CULTIVATED MEAT

Cause: Inefficient animal protein production mechanism



Result: Inefficient use of huge amount of natural resources used by animal agriculture



Result: Enormous environmental impact and health risks






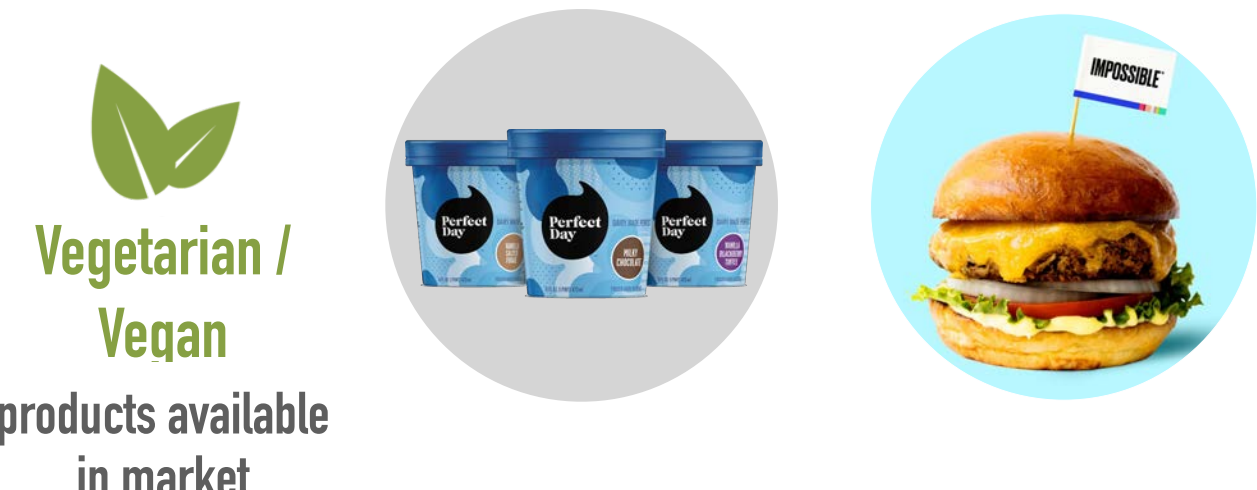

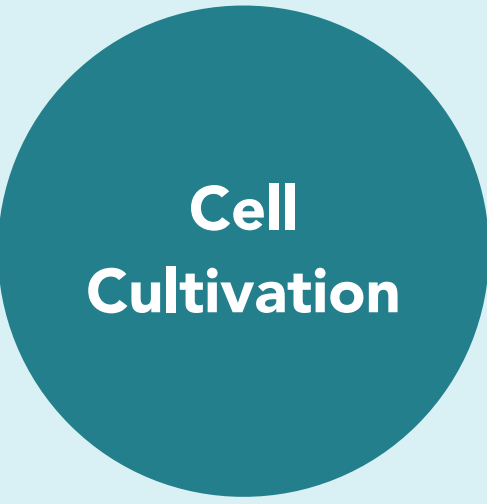

A pink-bordered box containing eight icons representing environmental and health risks:

- Sewage discharge
- Waste disposal
- Global greenhouse gas (15%)
- Micro plastic
- Inedible parts
- Antibiotics residue
- Superbug
- Radioactive contamination

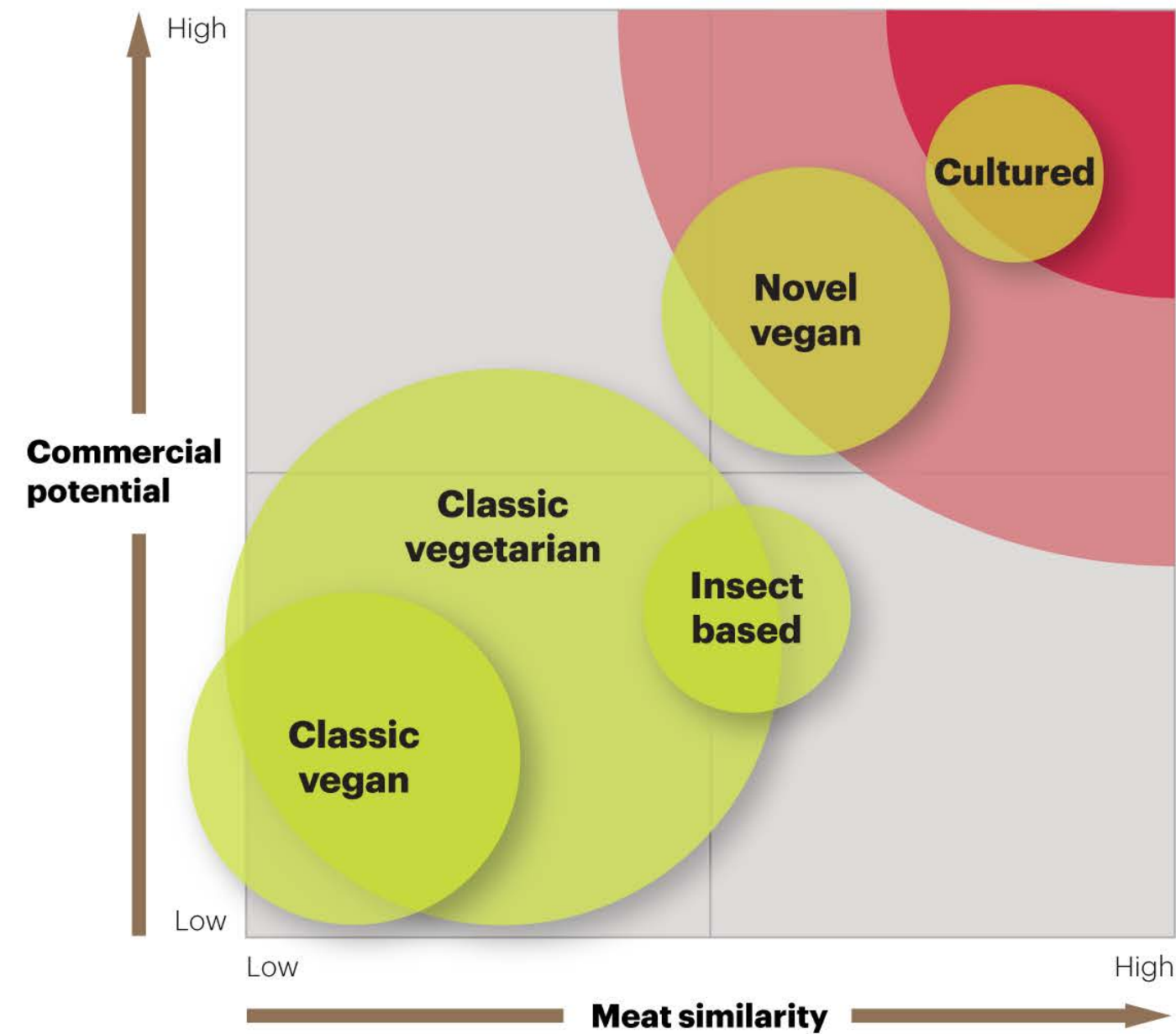
Imminent need for innovations



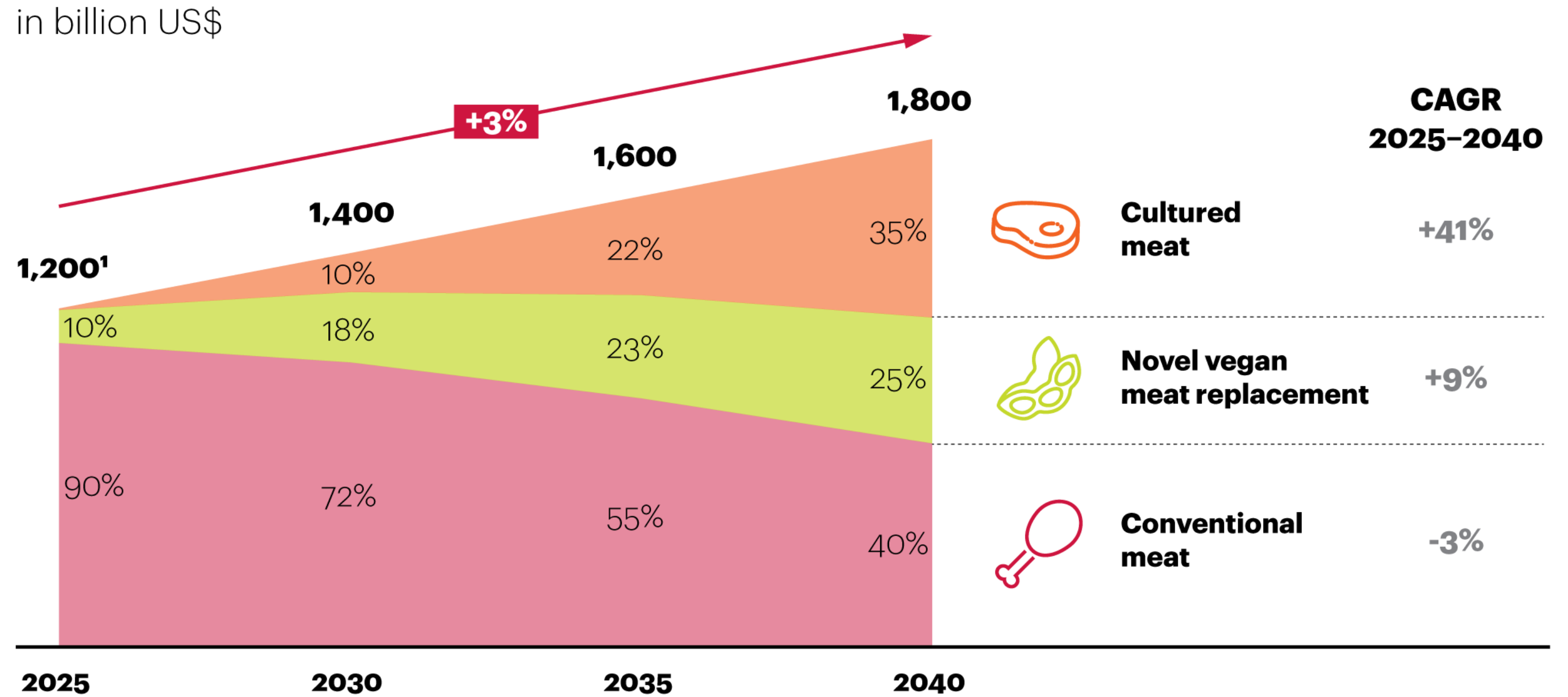
ALTERNATIVES TO CONVENTIONAL MEAT - TECHNOLOGY OVERVIEW

Likeness	Category	Examples	Core Technology	Value Proposition
 <p>Texture</p>	 <p>Plant-Based</p>	 <p>Vegetarian / Vegan products available in market</p>	<ul style="list-style-type: none"> Plant material properties 	<ul style="list-style-type: none"> Mimic texture of meat by processing plant materials to create mouthfeel Mimic taste of meat by incorporating flavouring
 <p>Texture Flavour</p>	 <p>Recombinant Fermentation</p>	 <p>Vegetarian / Vegan products available in market</p>	<ul style="list-style-type: none"> Low cost large-scale manufacturing of individual protein Single protein per production line Established industrial method used for production of biologics, e.g. insulin and vaccine 	<ul style="list-style-type: none"> Modified solution of Plant-Based options Introduce the character defining protein of animal product using recombinant method Example, adding recombinant casein to plant-based drink as alternative to dairy
 <p>Texture Flavour Nutrition</p>	 <p>Cell Cultivation</p>	<p>NOT yet in market</p> 	<ul style="list-style-type: none"> Low cost large-scale manufacturing of cells in entirety (multiple proteins) Scaffolding (as in tissue engineering) 	<ul style="list-style-type: none"> Improve efficiency of conversion of natural resources into animal protein by directly feeding the animal cells which proliferate in vitro Identical nutritional profile as conventional meat

CULTIVATED MEAT MARKET POTENTIAL



- Bubble size = Funding up to 2018
- = "Generation 1" corridor
- = "Generation 0" corridor



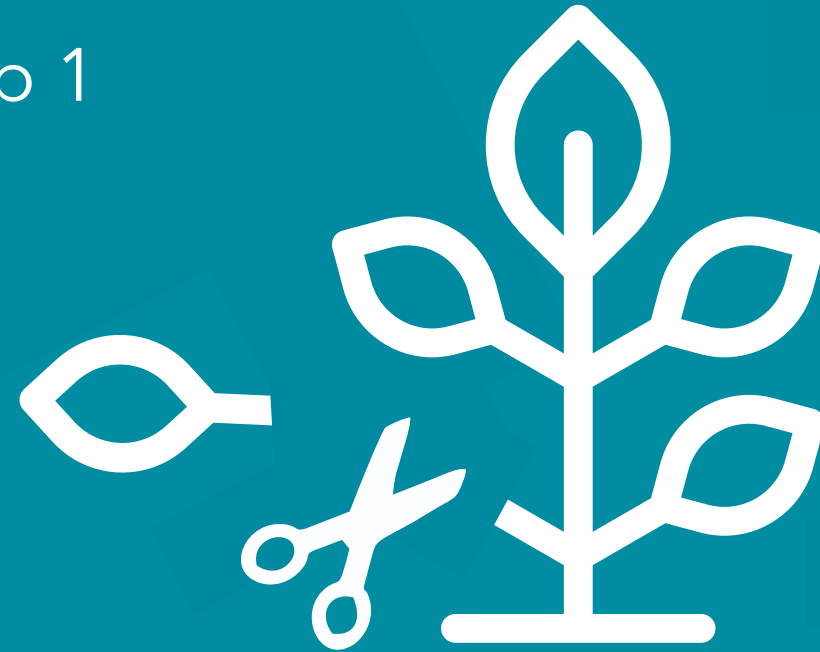
¹ Numbers are rounded to hundred billions.
Sources: United Nations, World Bank, Expert interviews; A.T. Kearney analysis

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MEAT CULTIVATION IN A NUT SHELL

Similar to Hydroponics

Step 1



Start with a small cutting from a plant

Step 2



Place cutting in a nutrient-rich environment that allows it to grow

Step 3

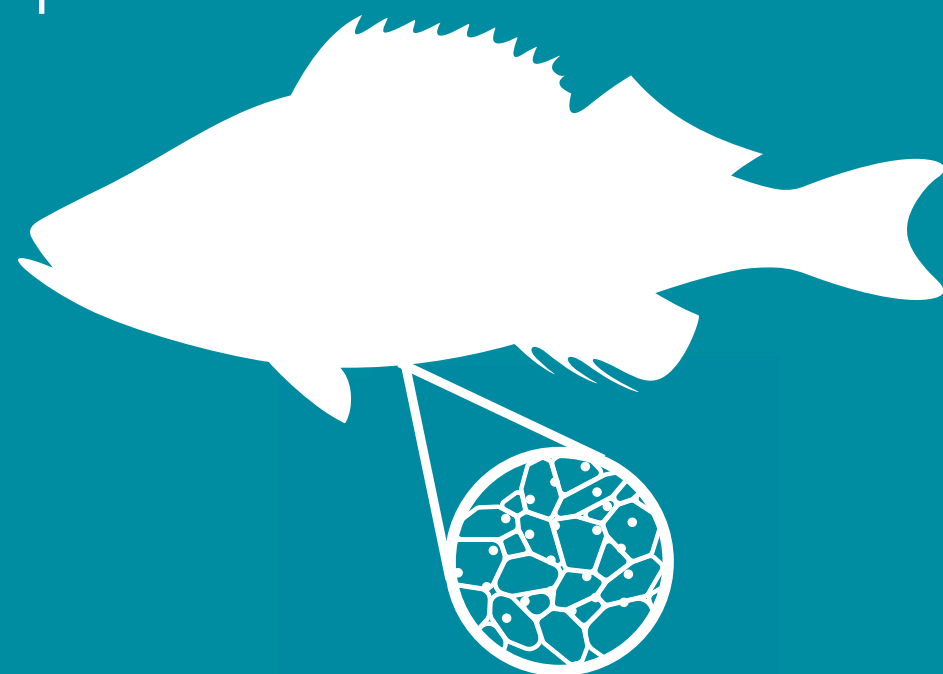


Enjoy your vegetables
Bon appétit

Credit: Mattson & The Good Food Institute

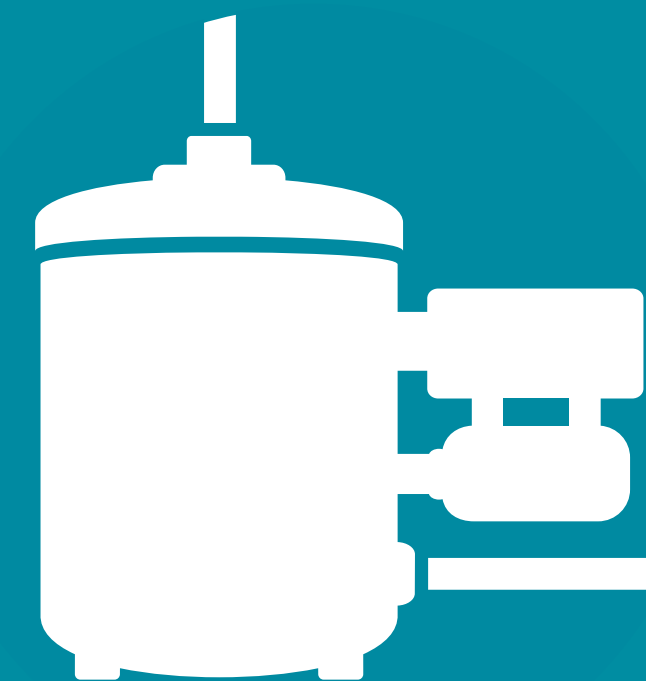
Meat Cultivation

Step 1



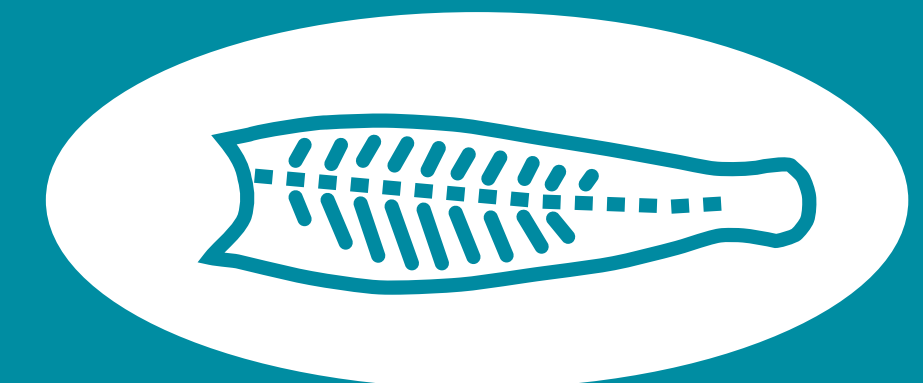
Start with a small sample of cells from a fish

Step 2



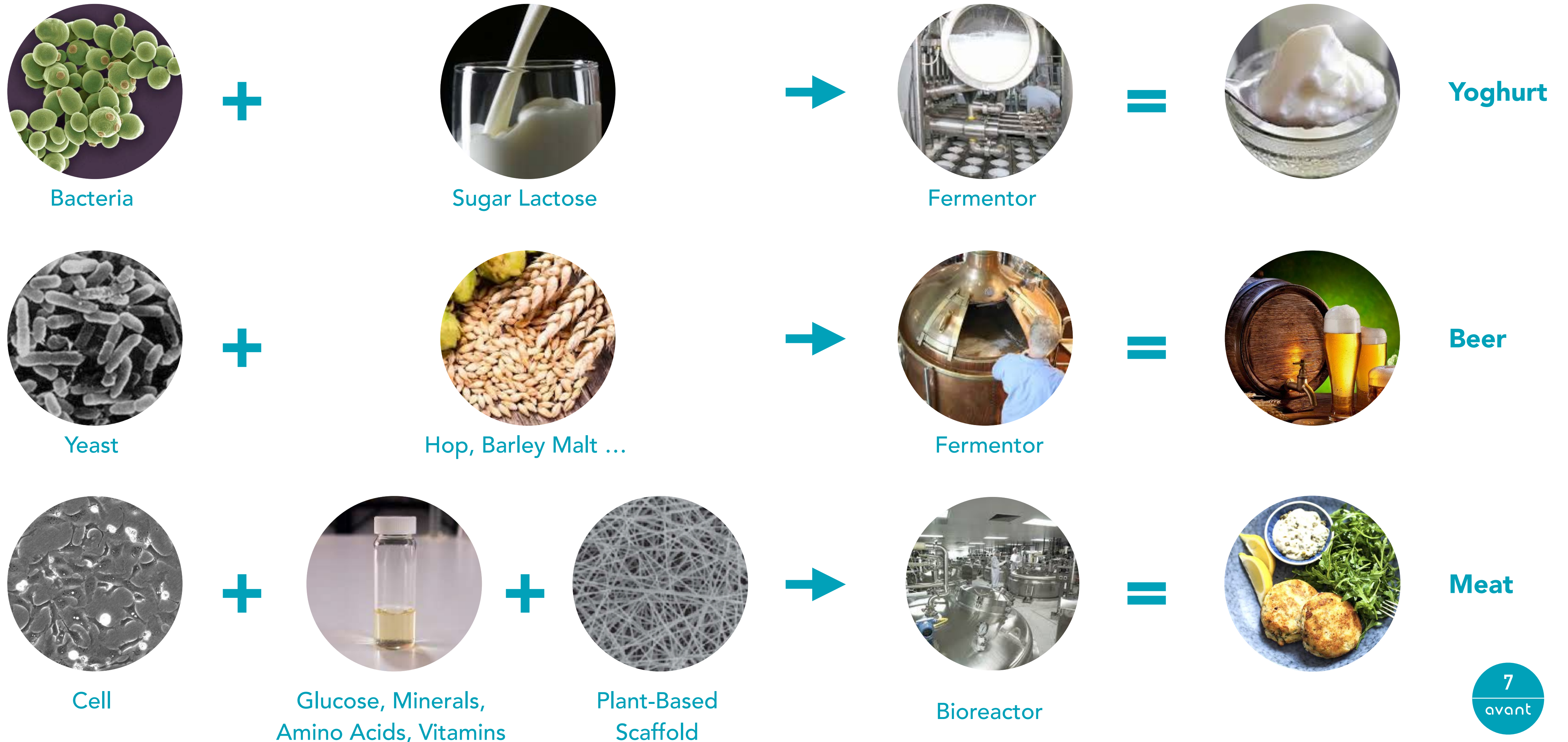
Place cutting in a nutrient-rich environment that allows it to grow

Step 3



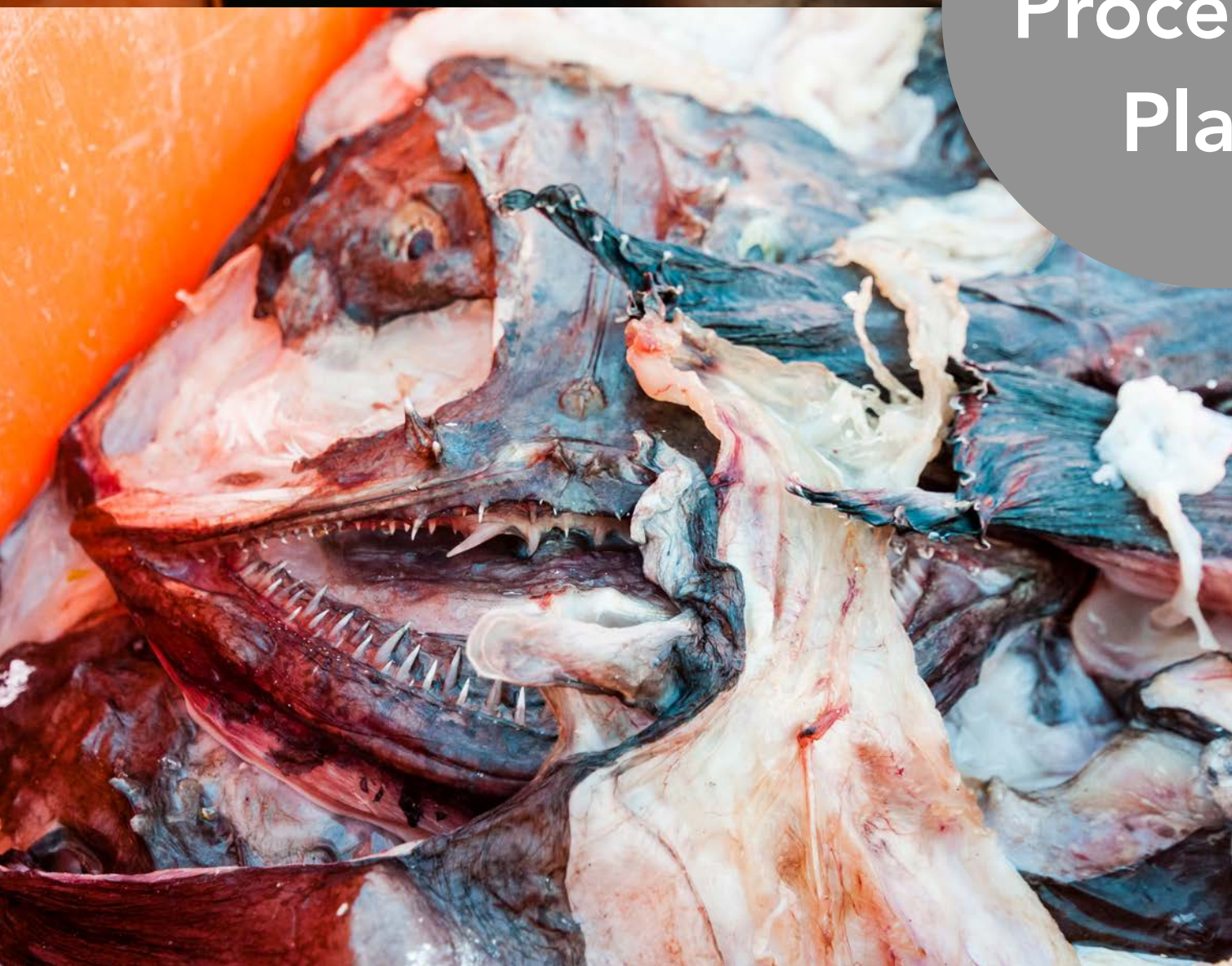
Enjoy your fish fillet
Bon appétit

SIMILAR BIOPROCESSES IN FOOD & BEVERAGE PRODUCTION





Fish
Processing
Plant



current
2020



avant

from
2022



PROBLEMS WITH CONVENTIONALLY PRODUCED FISH



Pollution



Congested & Filthy
Fish Farming and
Antibiotics Abuse

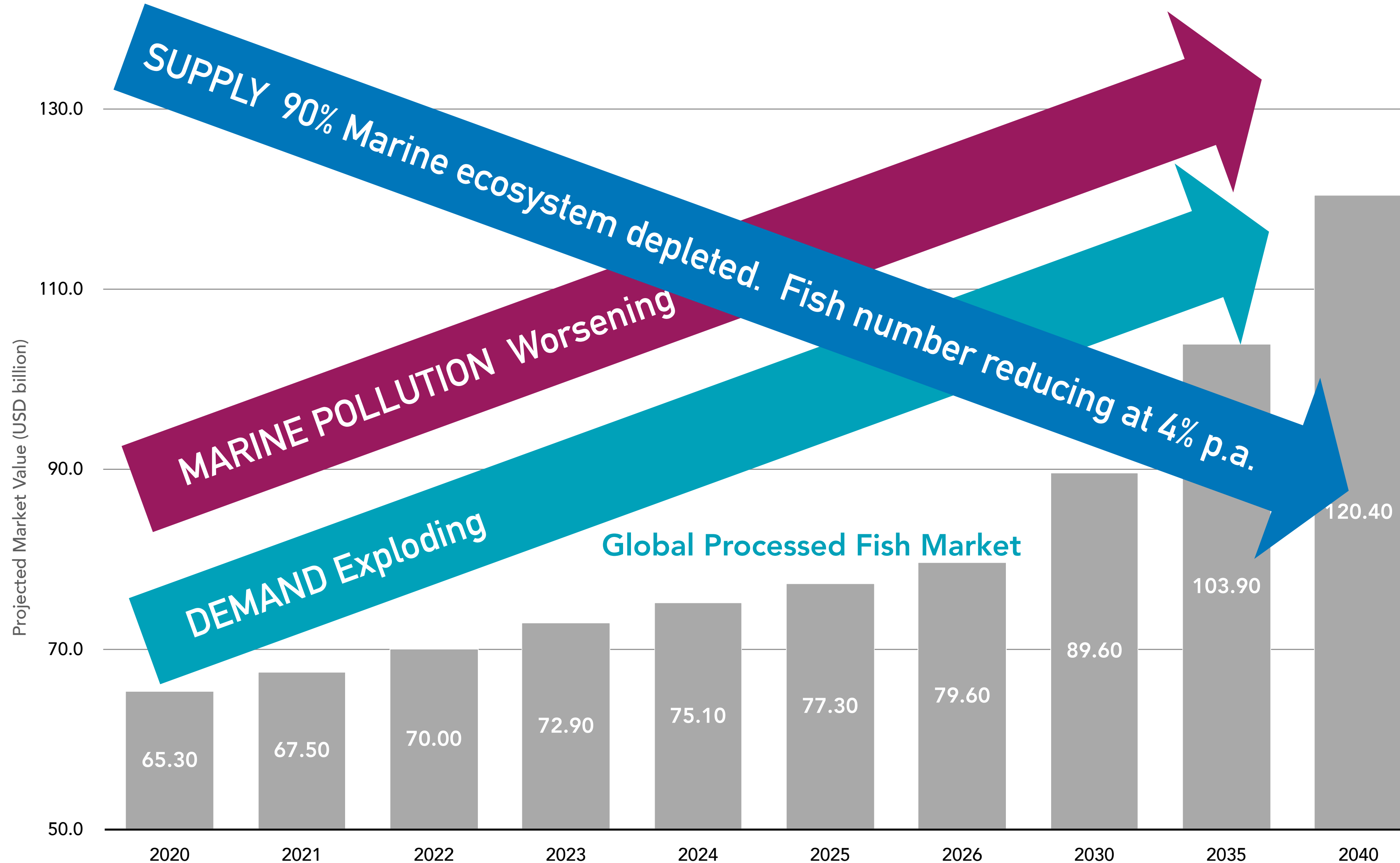


Fish Diseases &
Parasites



Microplastics

PROBLEMS WITH CONVENTIONAL FISHING & FISH FARMING



Fish Consumption:

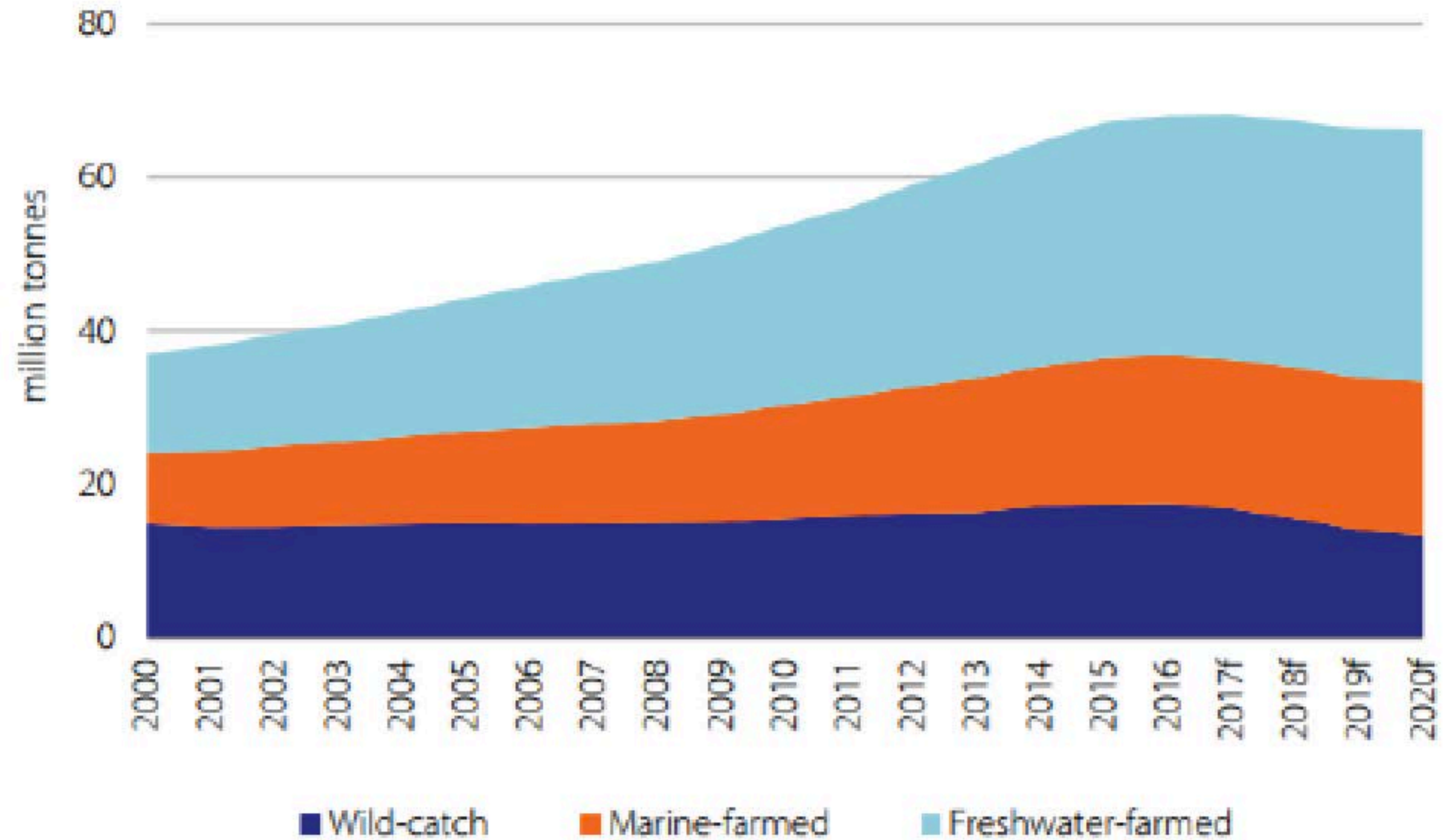
- 66% Asia
- 35% China
- 10% Europe
- 7% Latin America
- 5% North America
- 12% Rest of the World

Each year 2.7 trillion fish are caught from the wild and 37-120 billion fish are killed on commercial farms

Sources: Euromonitor, A.T. Kearney analysis, USA Today

WORLD FISH & SEAFOOD SUPPLY PROSPECT

China Fisheries and Aquaculture Production Prospect



Source: China National Bureau of Statistics, OECD-FAO, Rabobank 2018

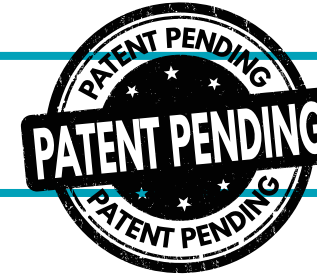
DOING WELL & DOING GOOD

SUSTAINABLE DEVELOPMENT GOALS

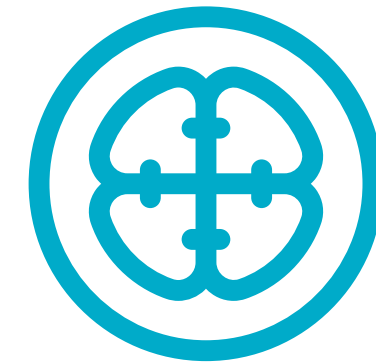


OUR CORE TECHNOLOGIES

Stem Cell Technology: Cell Line

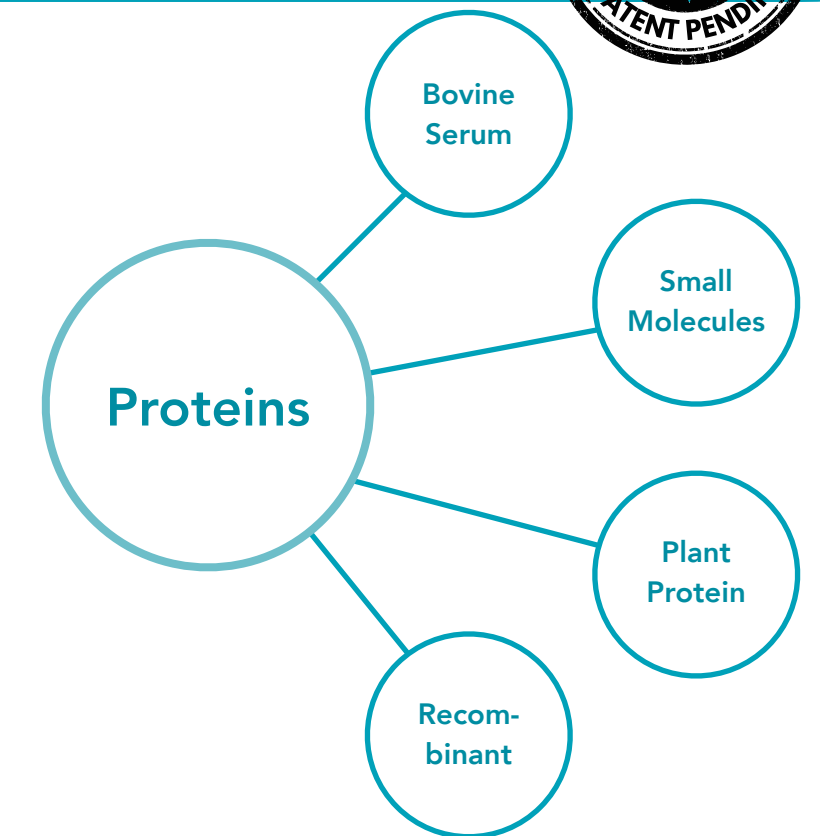
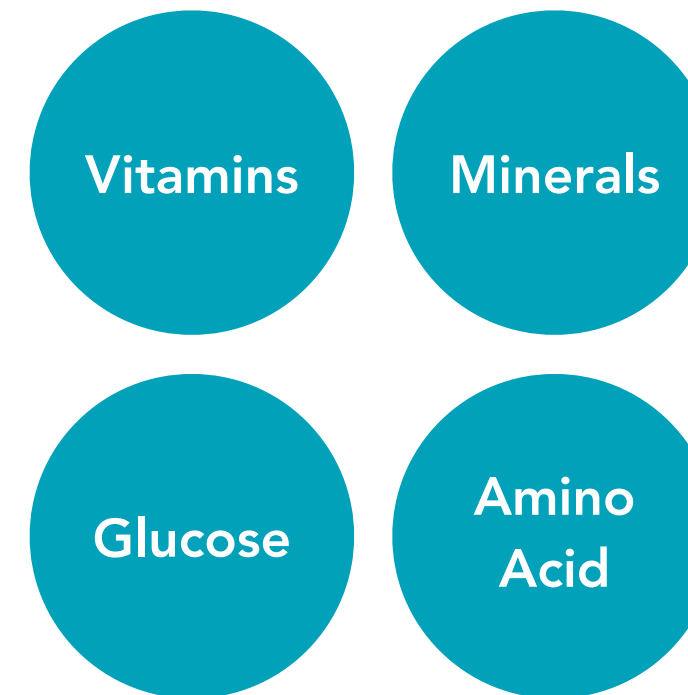
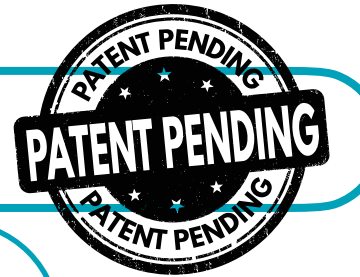


Primary Cells



Embryonic Stem Cells

Cell Culture Medium

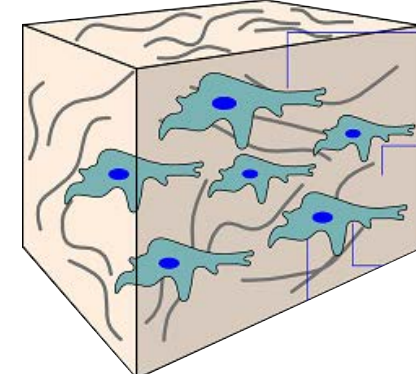


Tissue Engineering Technology: Scaffold

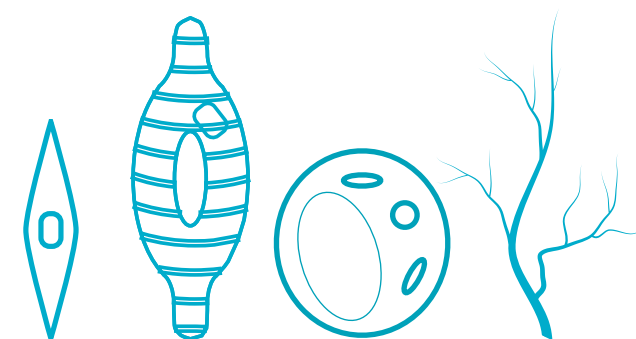
Secret Recipe



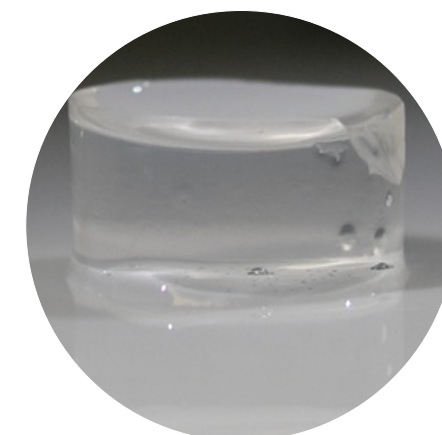
2D



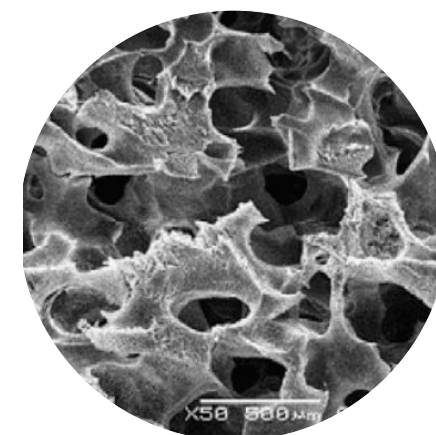
3D



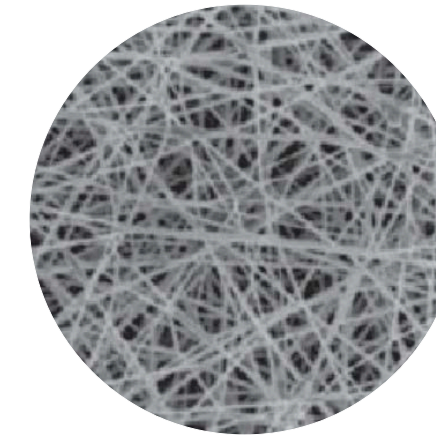
Cell Types



Hydrogel (Left-in / Degradable)

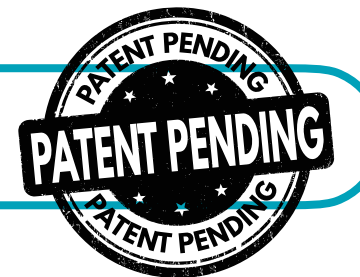


Bio-Printed (Left-in / Degradable)



Plant-Based (Left-in)

Scale Up Production



Bench Top Scale



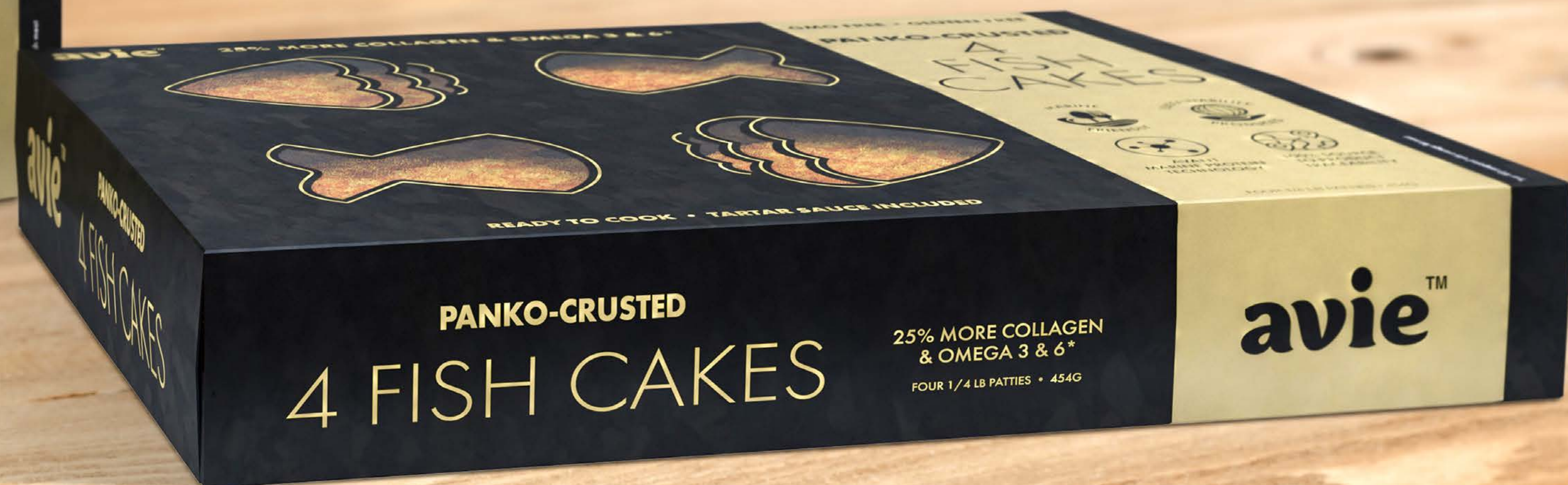
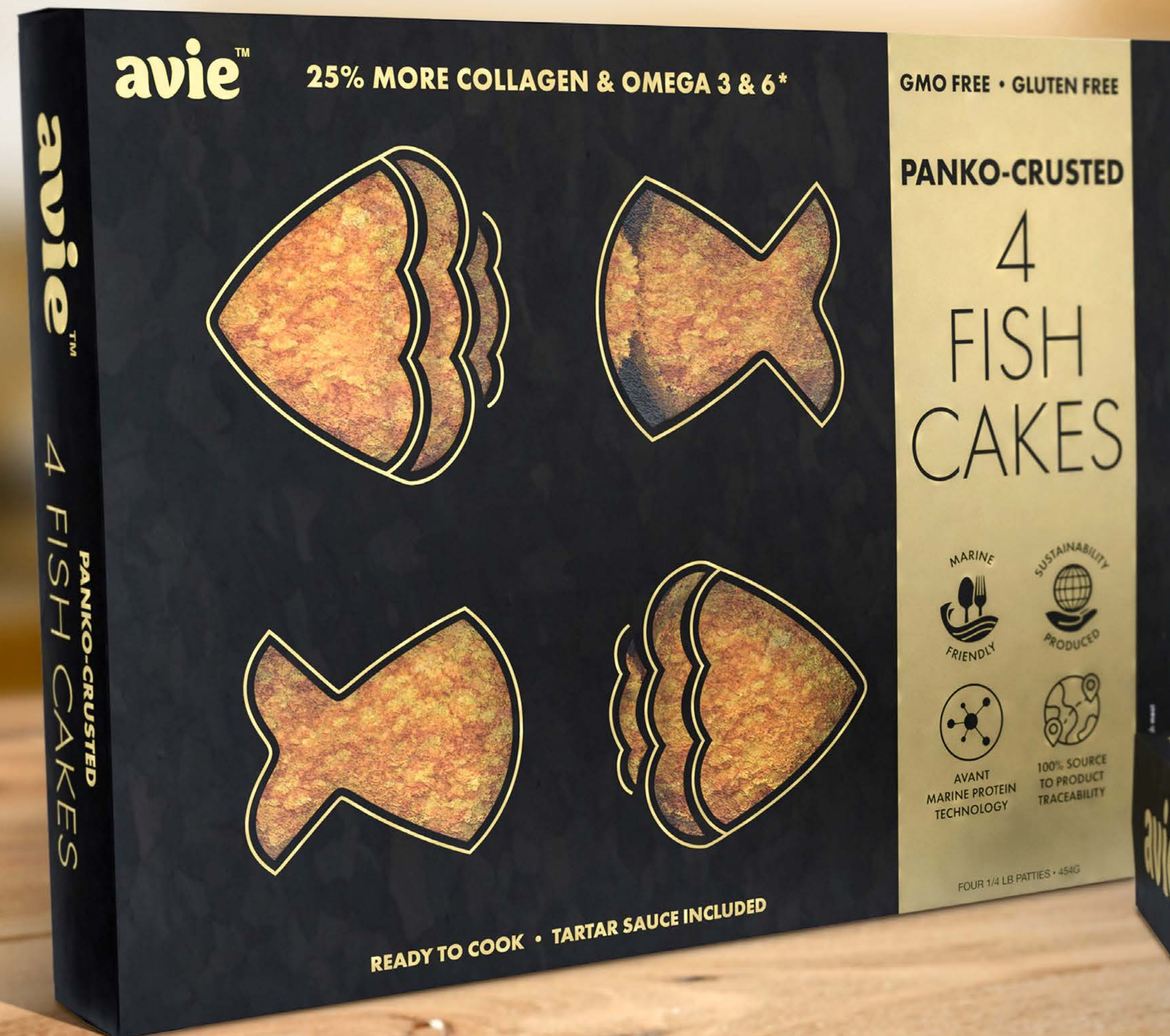
Industrial Scale

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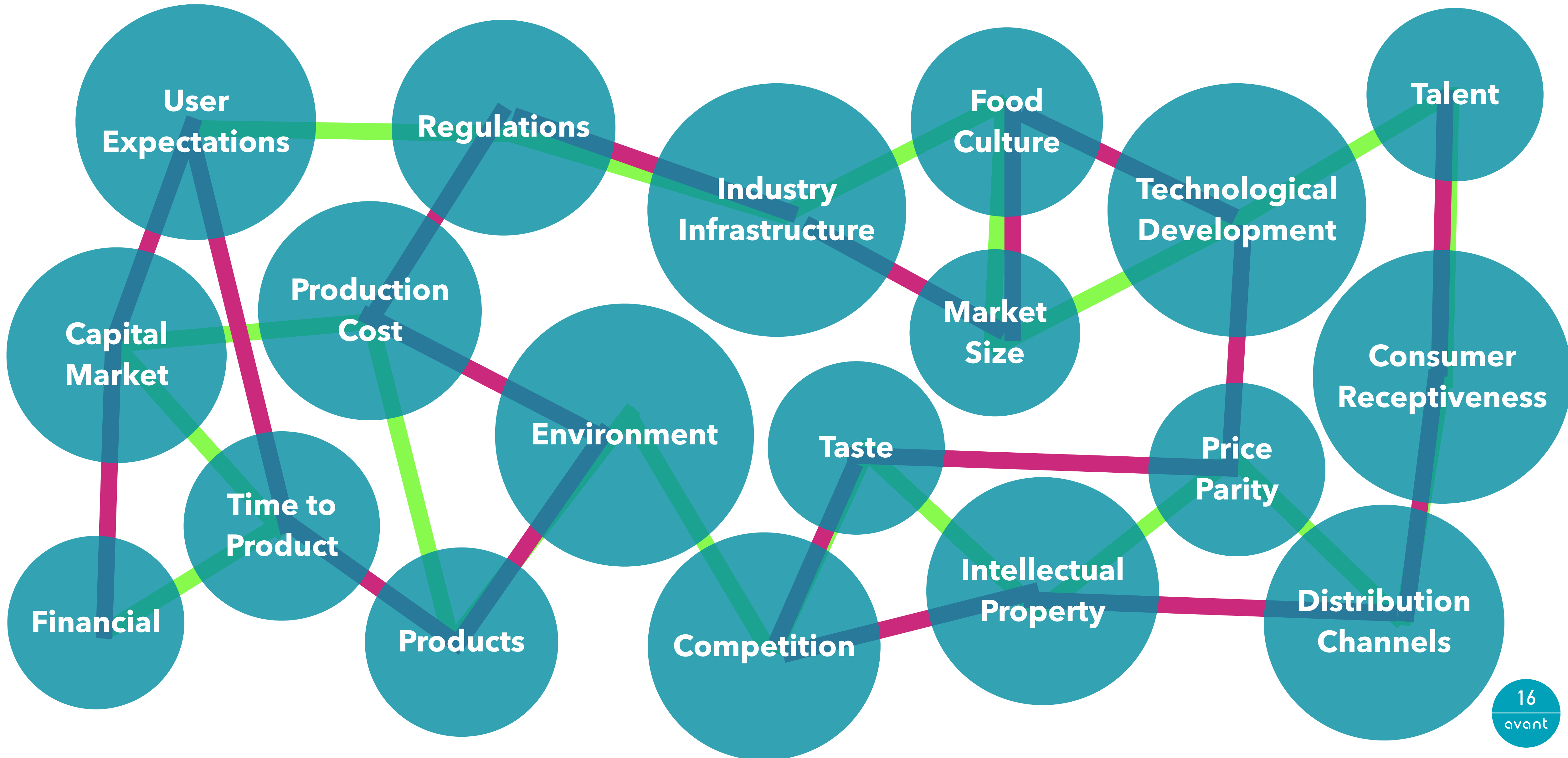
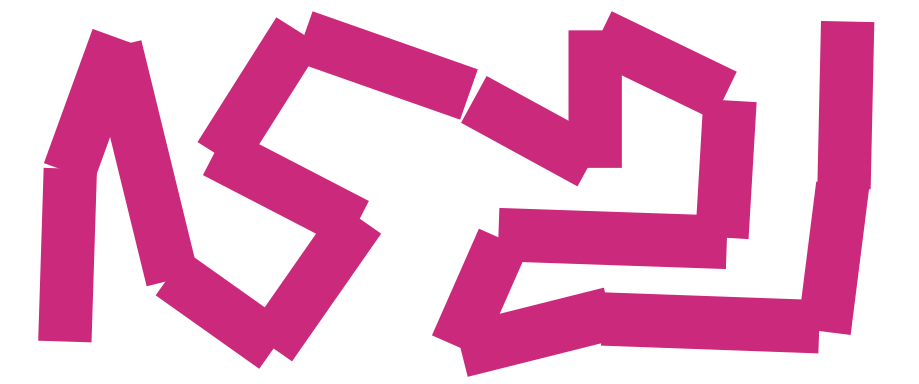
avie™

- ★ **Crusty and chunky**
- ★ **Made with pure fish proteins**
- ★ **GMO free & Gluten free**
- ★ **Contain 25% more Collagen & Omega 3 & 6**
- ★ **100% Source to Product Traceability**
- ★ **Marine Friendly and Sustainably Produced**





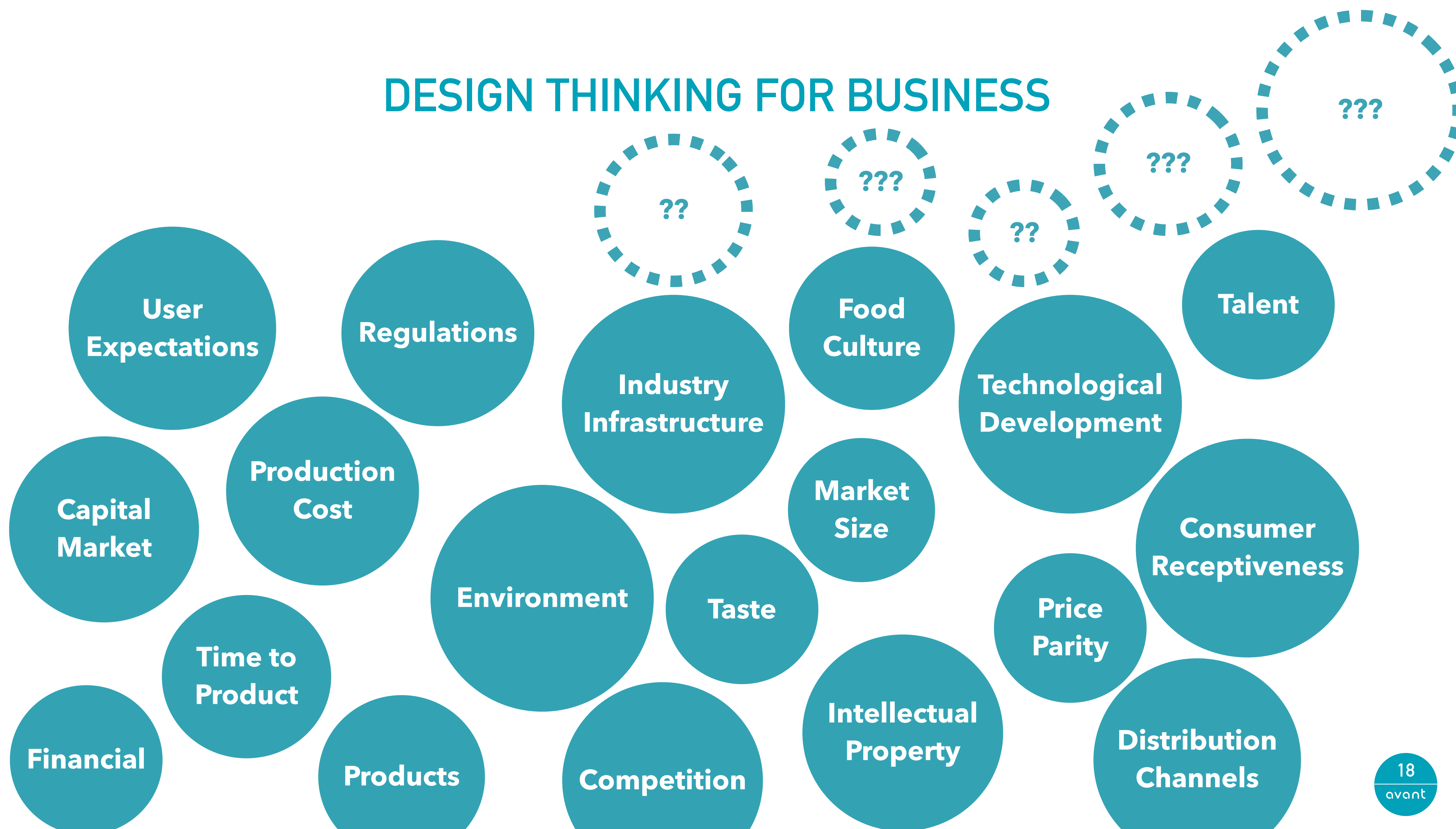
DESIGN THINKING FOR BUSINESS



CHALLENGES = OPPORTUNITIES



DESIGN THINKING FOR BUSINESS



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