Good Food Institute APAC

The landscape of alternative proteins: global & regional perspectives

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ASEAN-ASSET, Bangkok, Thailand
14th Nov, 2023

Good Food Institute APAC

Agenda

1. **GFI introduction & three pillars of alternative proteins**
2. State of the science and industry
   - 2.1 Global landscape
   - 2.2 APAC landscape

Good Food Institute

*We are a **force multiplier**, bringing the expertise of our 200+ staff across our six regions to the rest of the world*

GFI is an **international network of nonprofit think tanks** developing the roadmap for a sustainable, secure, and just protein supply.

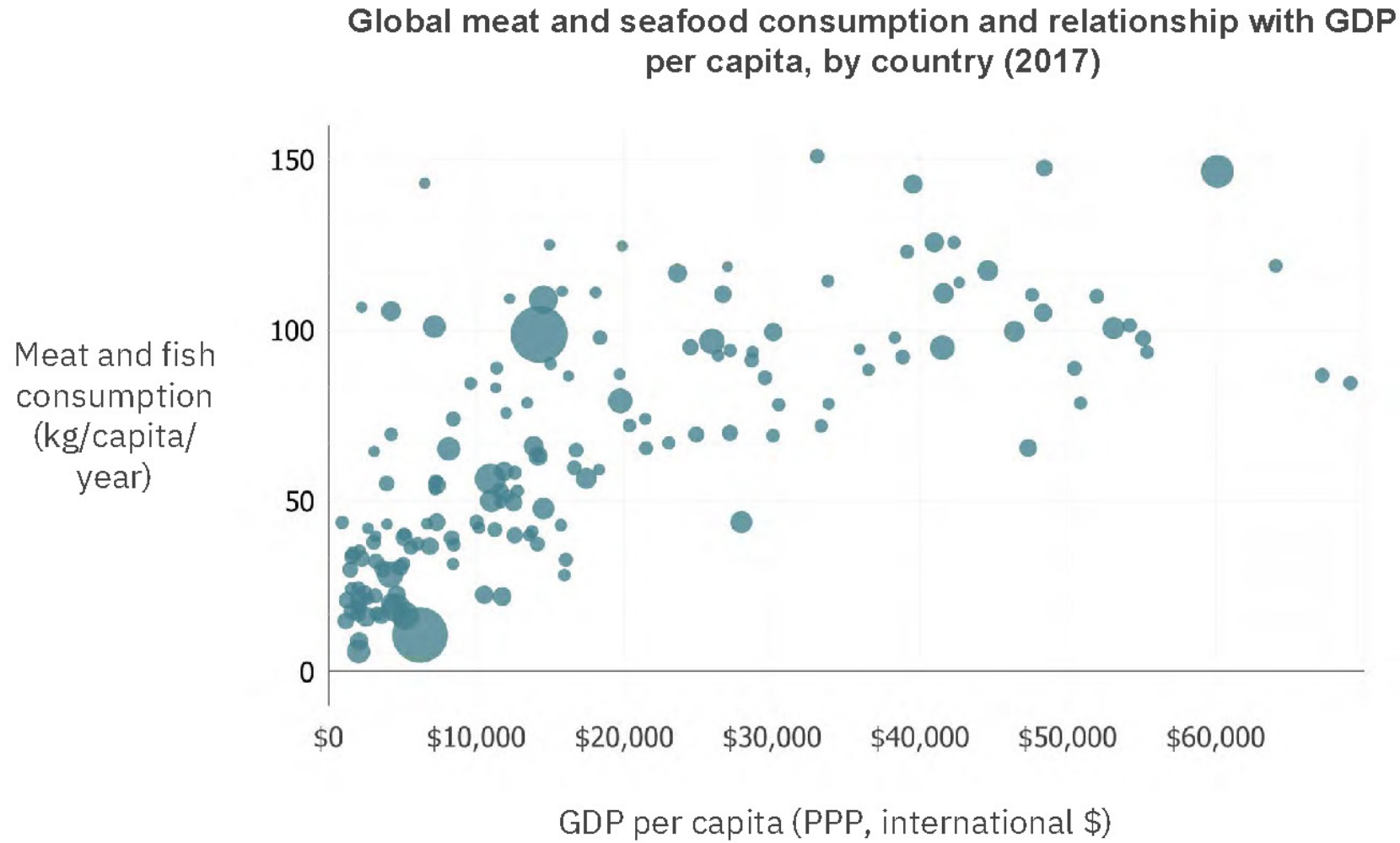
Our work spans three areas:

Science and Tech
Advance foundational, open-access research across alternative proteins

Corporate Engagement
Partner with companies and investors to unlock funds, innovation, and scale

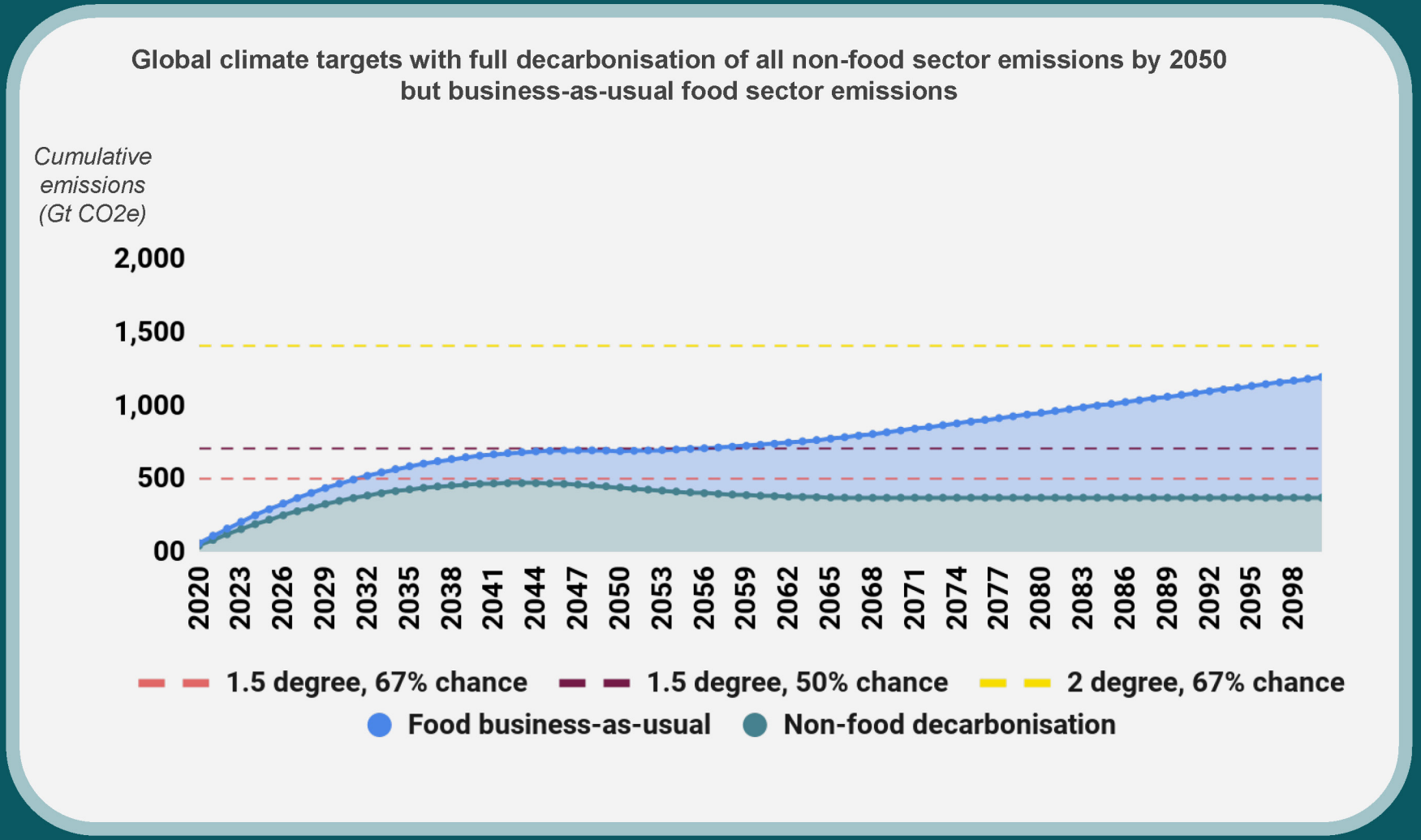
Policy
Work with policy actors to secure support for R&D and ensure regulatory clarity

As countries get richer, they eat more meat



Source: FAO, retrieved from Our World in Data (2022)

The world cannot decarbonise without alternative proteins



Even if fossil fuel emissions were immediately halted, current trends in global food systems would prevent the achievement of the 1.5°C target and, by the end of the century, threaten the achievement of the 2°C target. Meeting the 1.5°C target requires rapid and ambitious changes to food systems as well as to all non-food sectors.

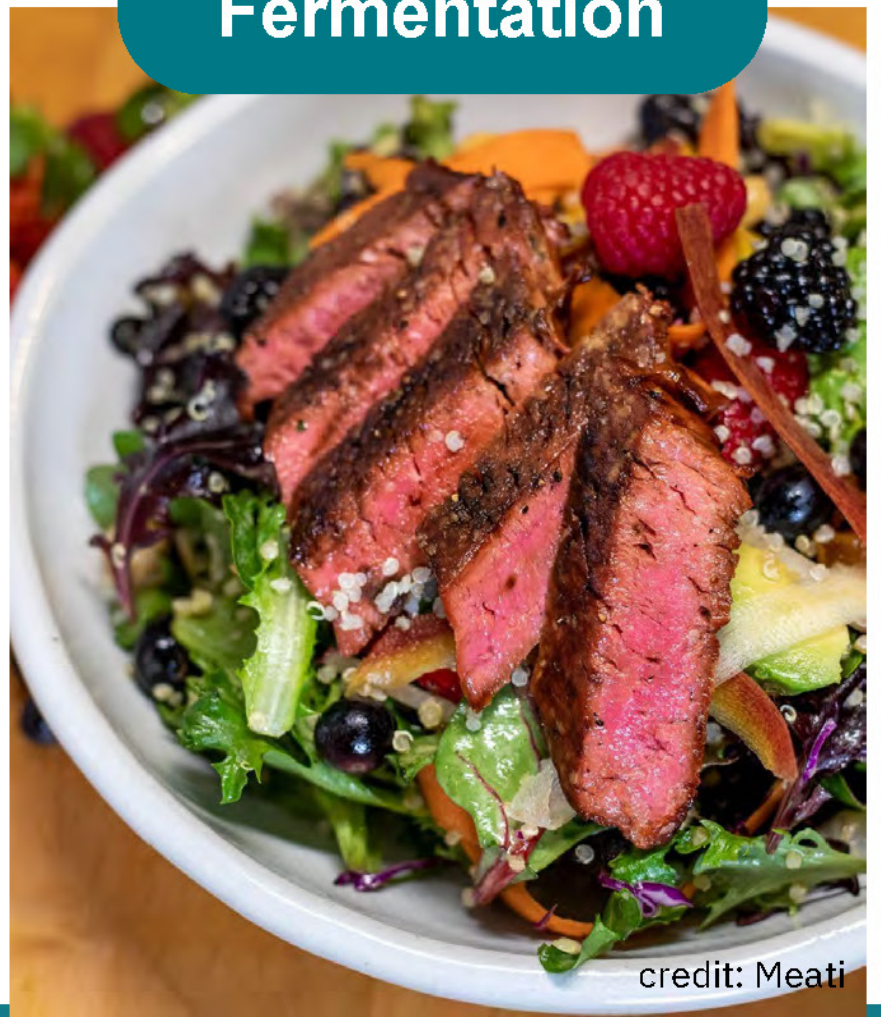
Clark, M. A. et al. (2020)

Source: GFI analysis based on supplementary data files from Clark, M. A. et al. (2020)

Protein diversification

Plant-based

Fermentation



Cultivated

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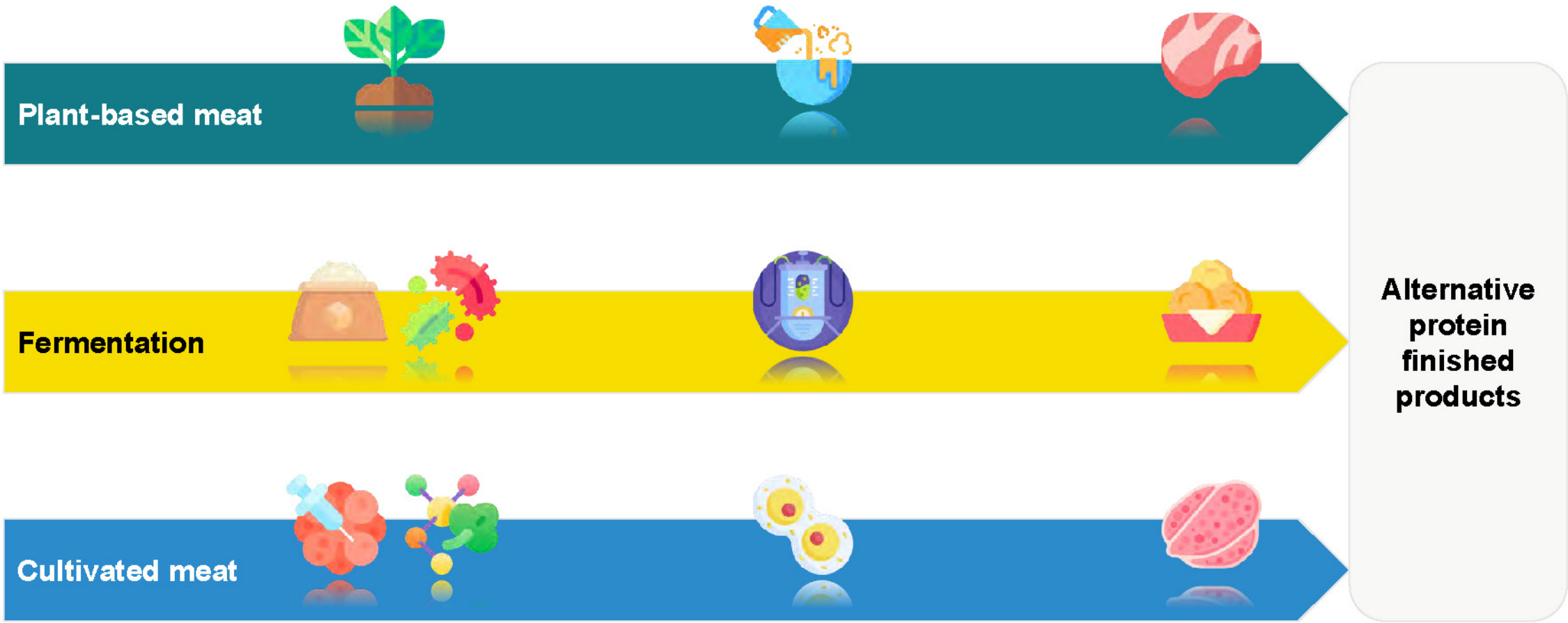
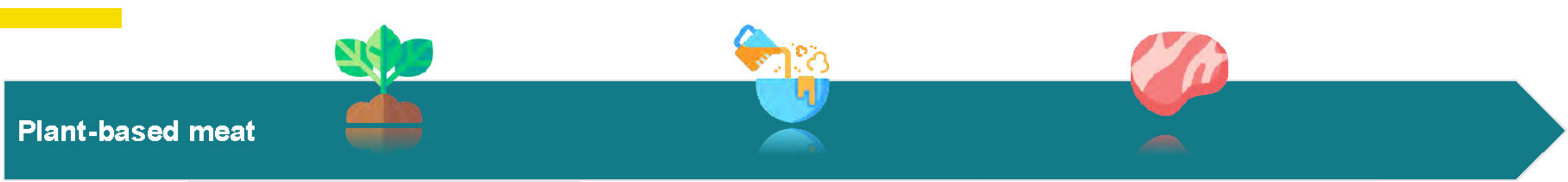
Alternative proteins: technology development stages



Plant-based meat: technology development trends



CROP DIVERSIFICATION	INGREDIENT OPTIMISATION	PRODUCT OPTIMISATION
Industry R&D efforts into **crop diversifications**:	**Alternative fat:** PrimeLock+, OlePBM, omega-3 encapsulation	**Novel texturisation methods:** new extrusion design, 3D printing, fiber spinning.
Enhancing **production scale** for plant proteins:	**Clean label binders:** citrus fiber, protein-based hydrogel.	**Nutrition:** 2022 literature review of 43 studies shows PBM health benefits.
Sidestream valorisation continues to gain traction.		

Source: 2022 Plant-based meat state of the industry report

Fermentation: technology development trends

Fermentation

TARGET SELECTION & DESIGN	FEEDSTOCK	BIOPROCESS DEVELOPMENT
Using **AI/ML** to find novel functional proteins for food and strain design	**Waste conversion:** Lignocellulosic cellulosic biomass	**Process monitoring and control:** ML control processes
Egg white, dairy, iron-binding proteins precision fermentation improvement	**Sidestream:** date, molasses, potato scratch processing water	**Improvement in cultivation mode**
Alternative fat productions via microalgae and oleaginous yeast	**Gas fermentation:** patents from Solar Foods & Air Protein	**Downstream processing:** fungal biomass, proteins, lipid extractions

Source: 2022 Fermentation state of the industry report

Cultivated meat: technology development stages

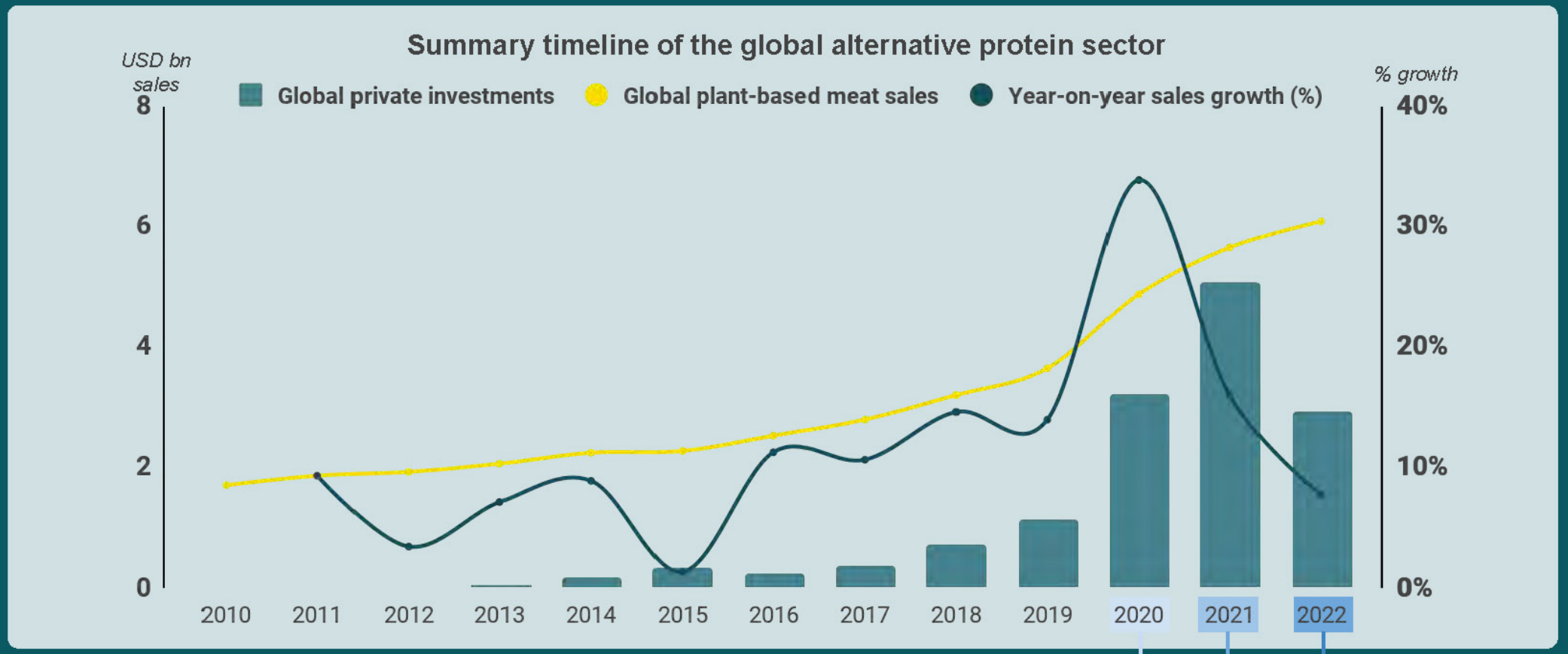
CELL LINE DEVELOPMENT	CULTURE MEDIA OPTIMISATION	TISSUE FORMATION	REGULATORY APPROVAL
Immortalised cell line from Atlantic mackerel muscle	**Albumin** is identified as the key cost driver for media in new GFI report	Using micro CT scans to program **3D printing of the yellow croaker cells**	**FDA** greenlights UPSIDE Foods and GOOD Meat cultivated chicken
	Albumin isolation from various plant seeds show promising alternatives		
	Believer Meats x HUJI: Comprehensive research article on cultivated meat production with chicken cell lines in a stirred-tank bioreactor		

Source: 2022 Cultivated-meat state of the industry report , FDA inventory of completed pre-market consultations for human food made with celtured animal cells

Industry collaboration

Source: [2022 GFI state of the industry report]

The global alternative protein sector has made huge progress



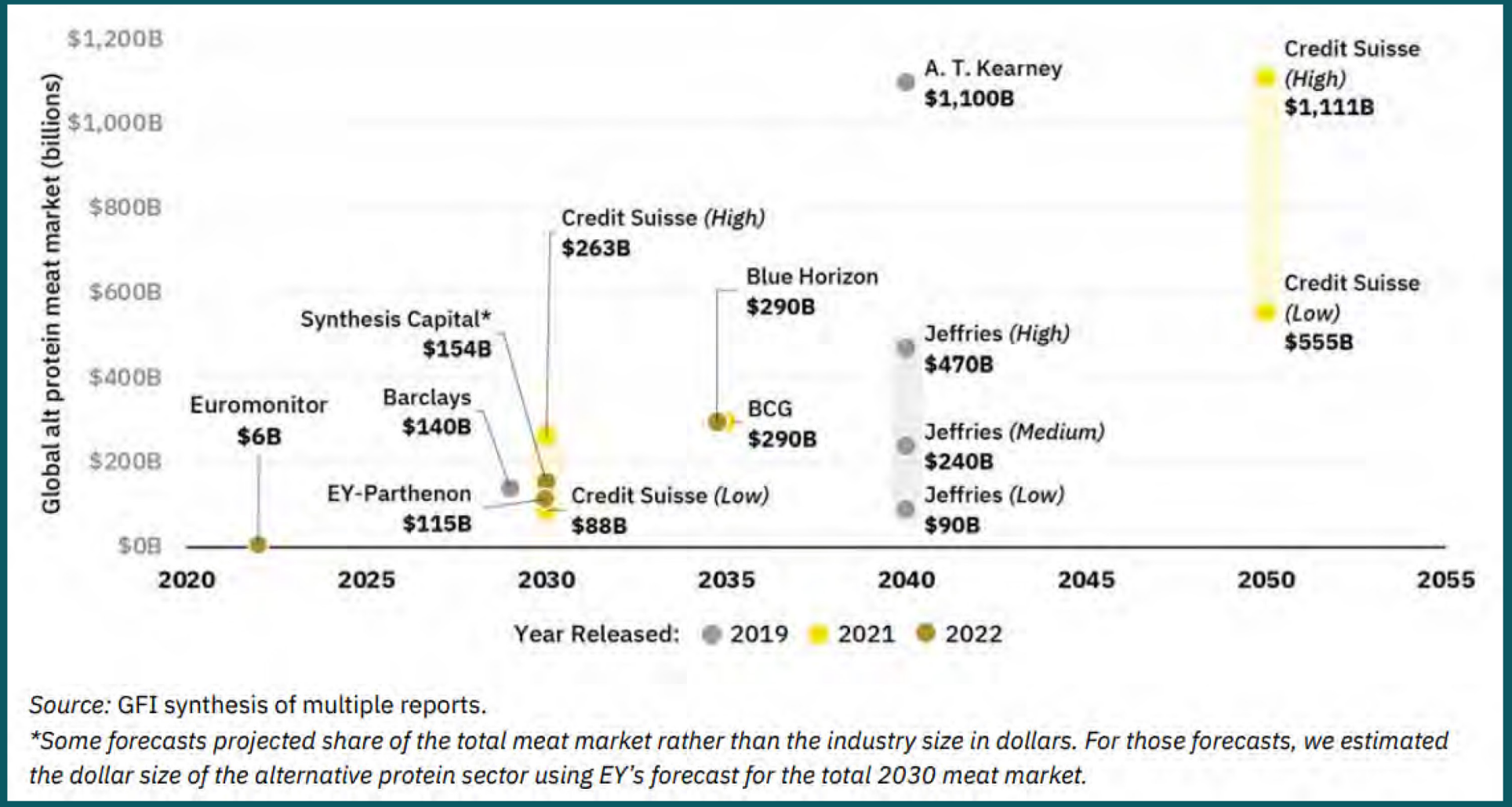
More private capital is invested in the year of 2020 than in the entire sector's history

Year-on-year sales rise by 16 percent in 2021 after record 34 percent growth in 2020

Private investment drops as capital markets wane, but governments triple y-o-y funding

Source: Private investments based on GFI analysis of Pitchbook data. Sales based on Euromonitor data.

Global alternative protein forecast



Source: GFI synthesis of multiple reports.

**Some forecasts projected share of the total meat market rather than the industry size in dollars. For those forecasts, we estimated the dollar size of the alternative protein sector using EY's forecast for the total 2030 meat market.*

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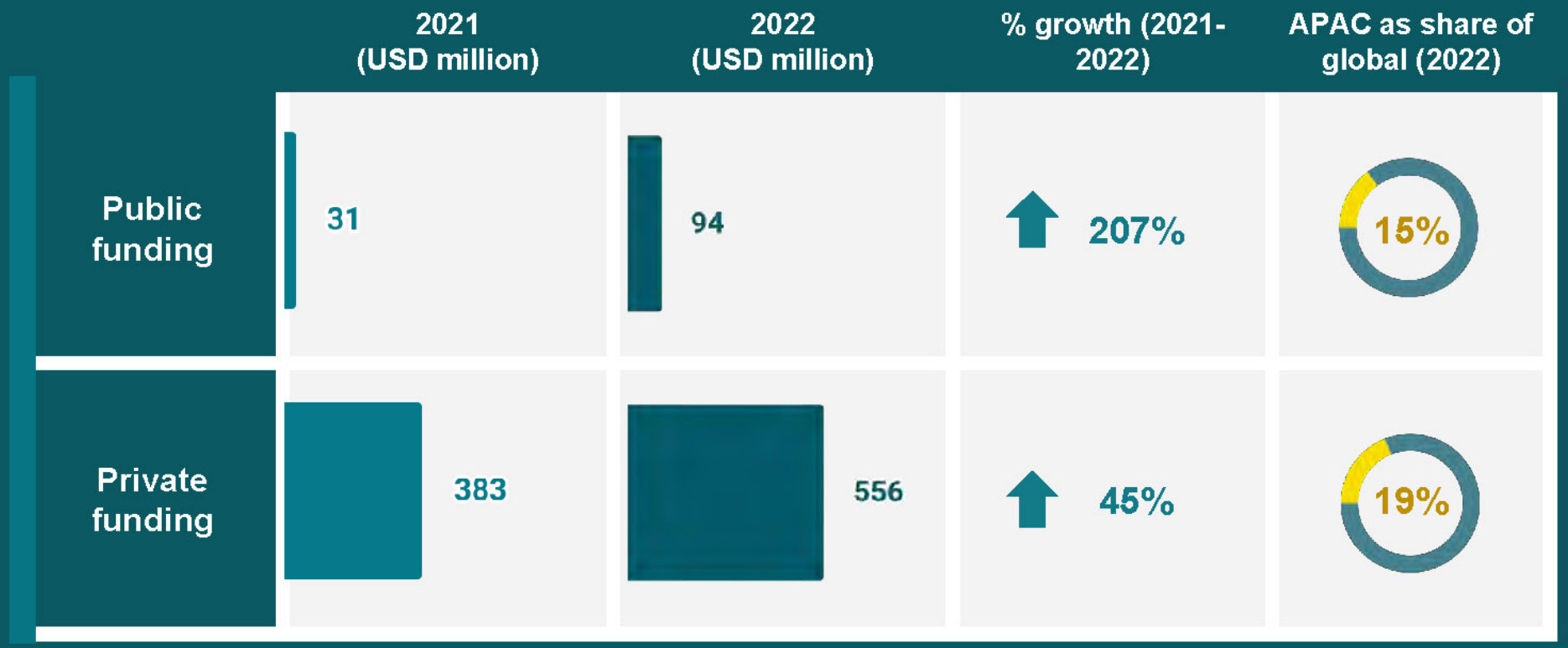
State of APAC's alternative protein sector



To date:

- **400+** sector research publications
- **20+** sector-dedicated shared facilities
- **200+** startups
- **15+** plant-based brands launched by major incumbents

All-time and 2022 sector private investment *(2010 to Q1-2 2023)*

COUNTRIES / REGIONS

AUSTRALIA / NEW ZEALAND

$399M

$151M

SINGAPORE

$320M

$170M

MAINLAND CHINA

$221M

$152M

SOUTH KOREA

$132M

$48M

HONG KONG SAR

$76M

N/A

JAPAN

$71M

$28M

OTHER[2]

$11M

$7M

Key

All-time investment

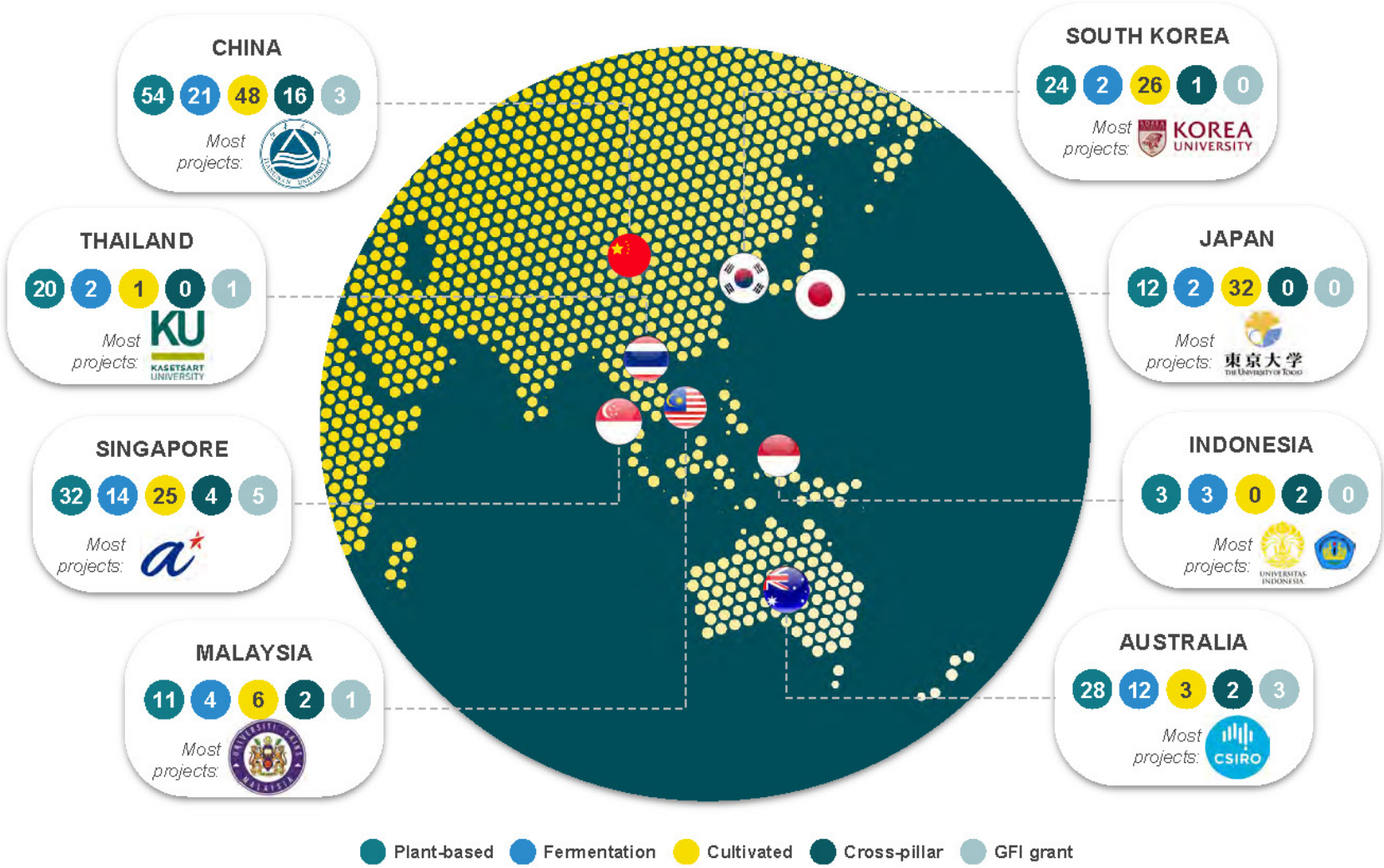
2022 only

Source: [1] Analysis of Pitchbook data. Note data only includes deals with disclosed amounts and is only a partial view of 2023 (up to Q2); [2] Includes other countries for which investment data exists, in this case Indonesia and the Philippines.

Sector research publications

There have been 400+ alternative protein-related research publications in APAC since 2020.[1] About a third of these were in Q1-2 2023. **China** has carried out the most research for each pillar. **Singapore** has three of the region's five most active research centres, followed by **Australia.**

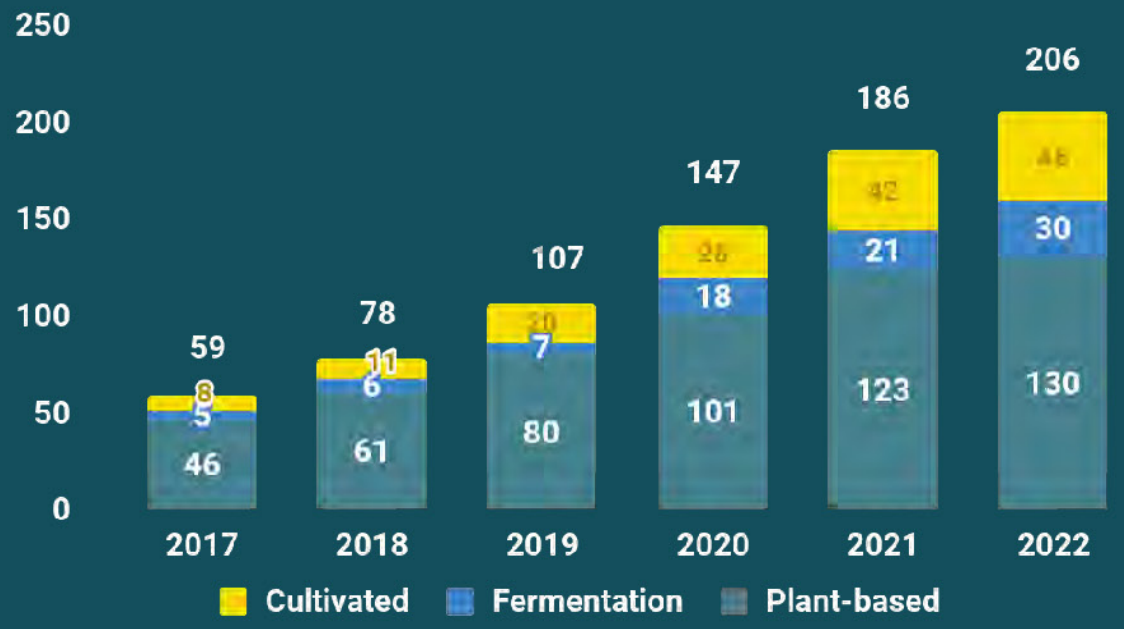
Most active research centres	# projects
Agency for Science, Technology and Research SINGAPORE	45
CSIRO Australia's National Science Agency	16
KOREA UNIVERSITY	15
NUS National University of Singapore	15
NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE	12



Source: [1] Based on targeted word search across multiple publication search engines. May omit capture publications outside of this targeted word search and industry R&D publications. For China, only 2022-23 publications are included.

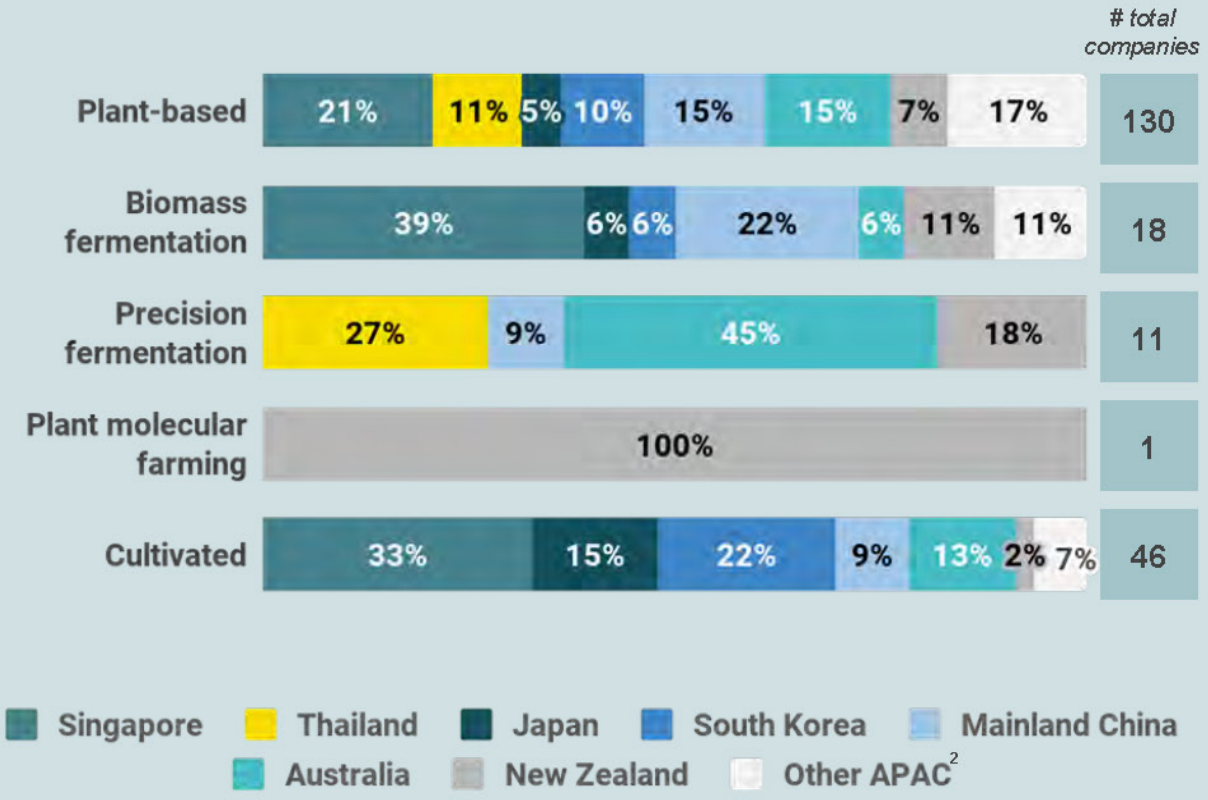
APAC is home to 200+ startups

Cumulative number of APAC startups by alternative protein pillar



Source: [1] GFI company database as of Q2 2023. Excludes alternative protein brands launched by corporates.

Share of APAC startups by country/region and alternative protein pillar



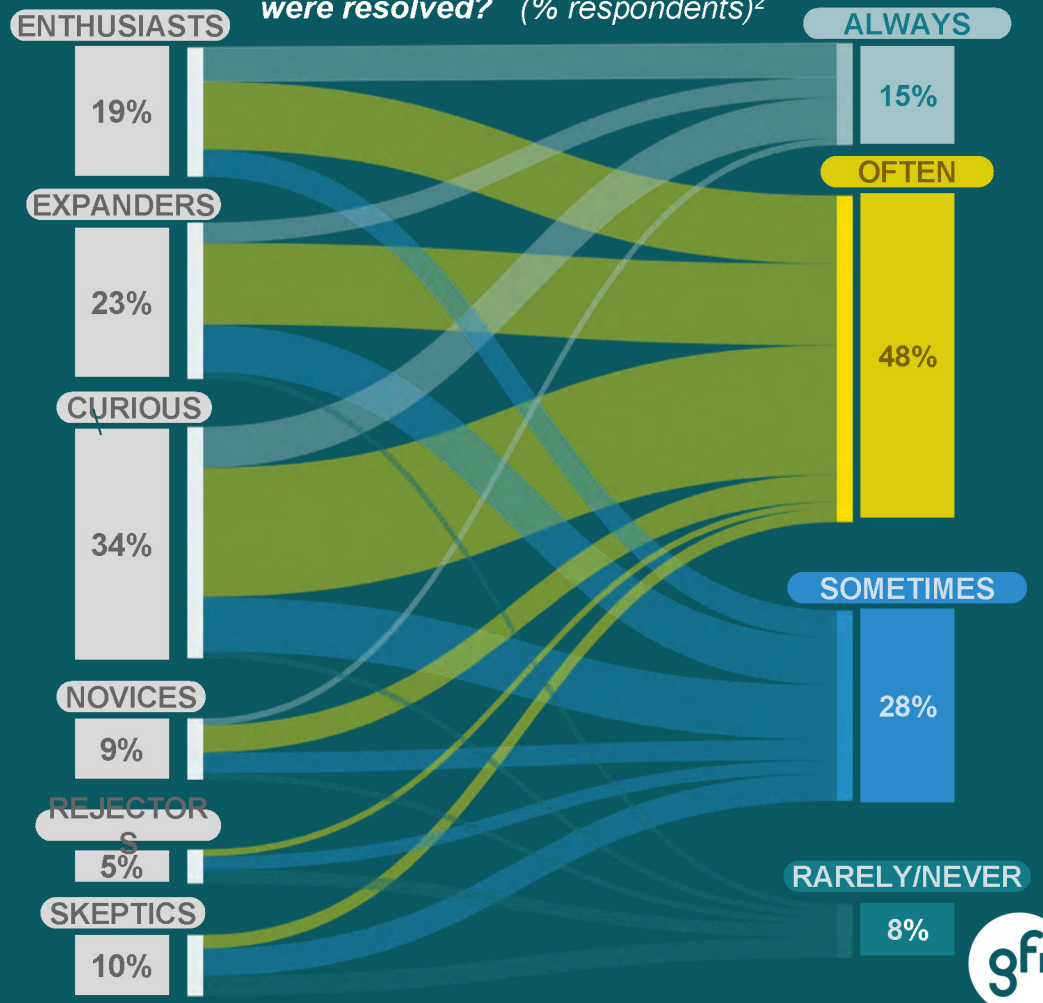
Source: [2] Groups together other APAC countries/regions with less than ten alternative protein startups as listed in GFI APAC's database (Hong Kong SAR, Taiwan, Indonesia, Vietnam, Malaysia, Philippines)

If barriers are resolved, consumption can significantly increase

What would make you eat more plant-based meat products? *(Rank up to 3)[1]*

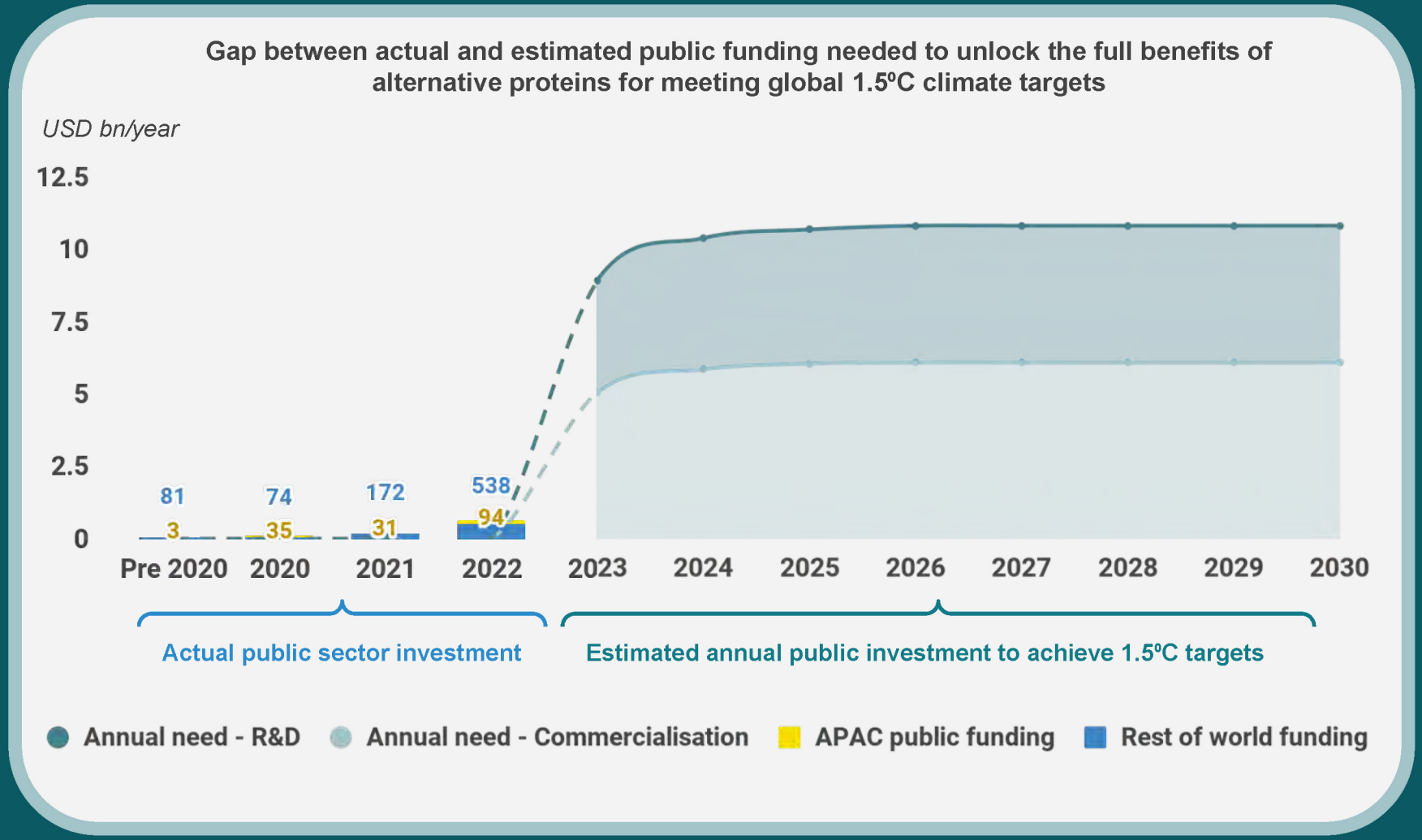
	Skeptics	Rejectors	Novices	Curious	Expanders	Enthusiasts	Average
Was more affordable	54%	39%	45%	52%	43%	39%	47%
Was more nutritious	39%	35%	46%	44%	37%	39%	41%
Tasted better	40%	39%	38%	35%	31%	30%	34%
Tasted more like meat	30%	29%	26%	28%	27%	26%	28%
Is more available when shopping	18%	17%	22%	32%	26%	28%	27%
Had more variety	21%	19%	19%	19%	26%	31%	23%
Was less processed	20%	26%	15%	16%	22%	22%	19%

How often would you choose plant-based meat if all your concerns were resolved? *(% respondents)[2]*



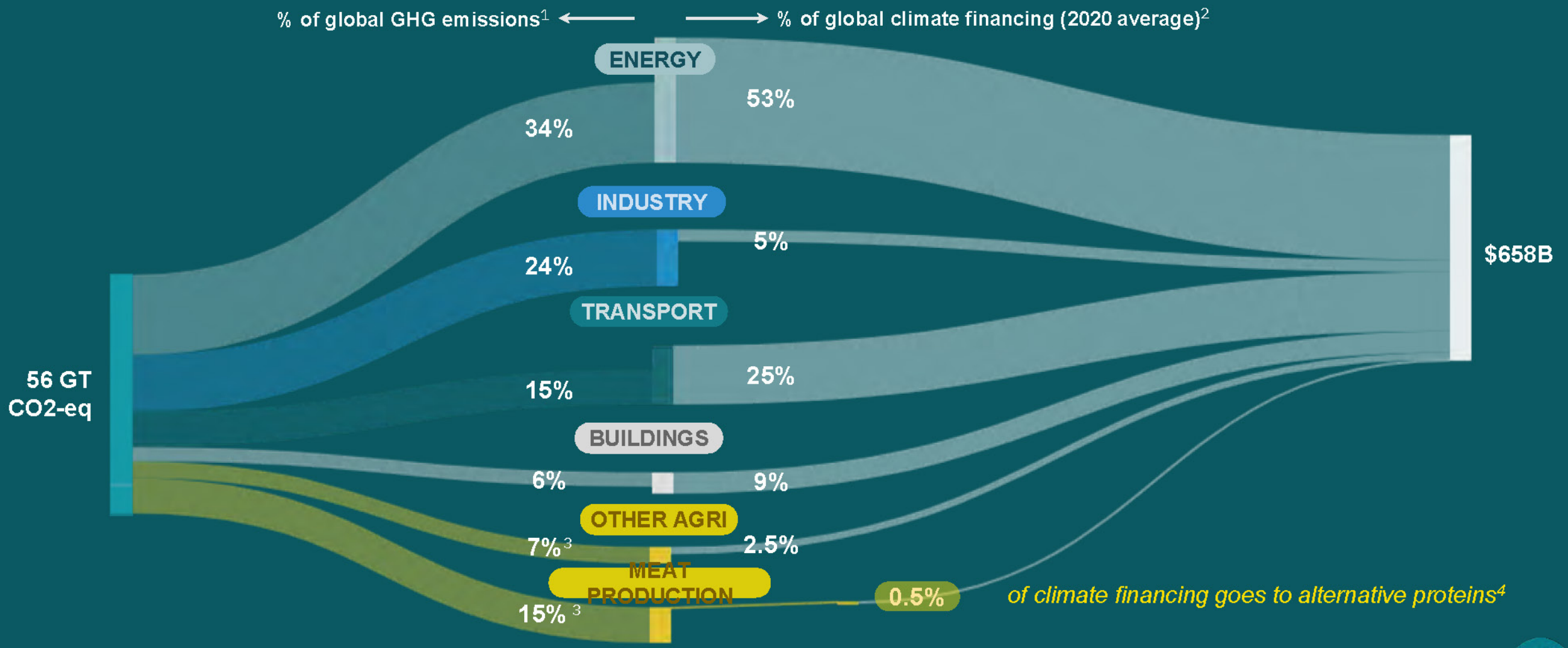
Source: [1] All respondents (n=5,971) except those who said they would not eat any, or unlikely to try (n=279); [2] All respondents (n=5,971)

To get consumers on board & stay within 1.5 degrees limit, $10.1B is needed in annual public funds



Source: [1] Based on estimates in the Global Innovation Needs Assessments (GINA) on protein diversity, with amendments made to the 2020 starting year forecast to account for the funding shortfall in the years 2021-22 as per the estimated need. A growth rate is applied to assume gradual increase of funding. Dotted line indicates transition to level of estimated funding needs.

Alternative proteins are underfunded as a climate solution



Source: [1] Based on IPCC for all sectors; meat production share from Poore and Nemecek (2021). [2] Based on most recent sector-specific datasets from Climate Policy Initiative. Financing for "other" and "unknown" categories are excluded. Waste-related/ICT categories are grouped under "Industry". [3] Figures are lower-bound estimates–high-end estimates for AFOLU is 37 percent, and meat production 17 percent. [4] Figures for alternative proteins from GFI analysis of policy and Pitchbook data.

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Thank you!

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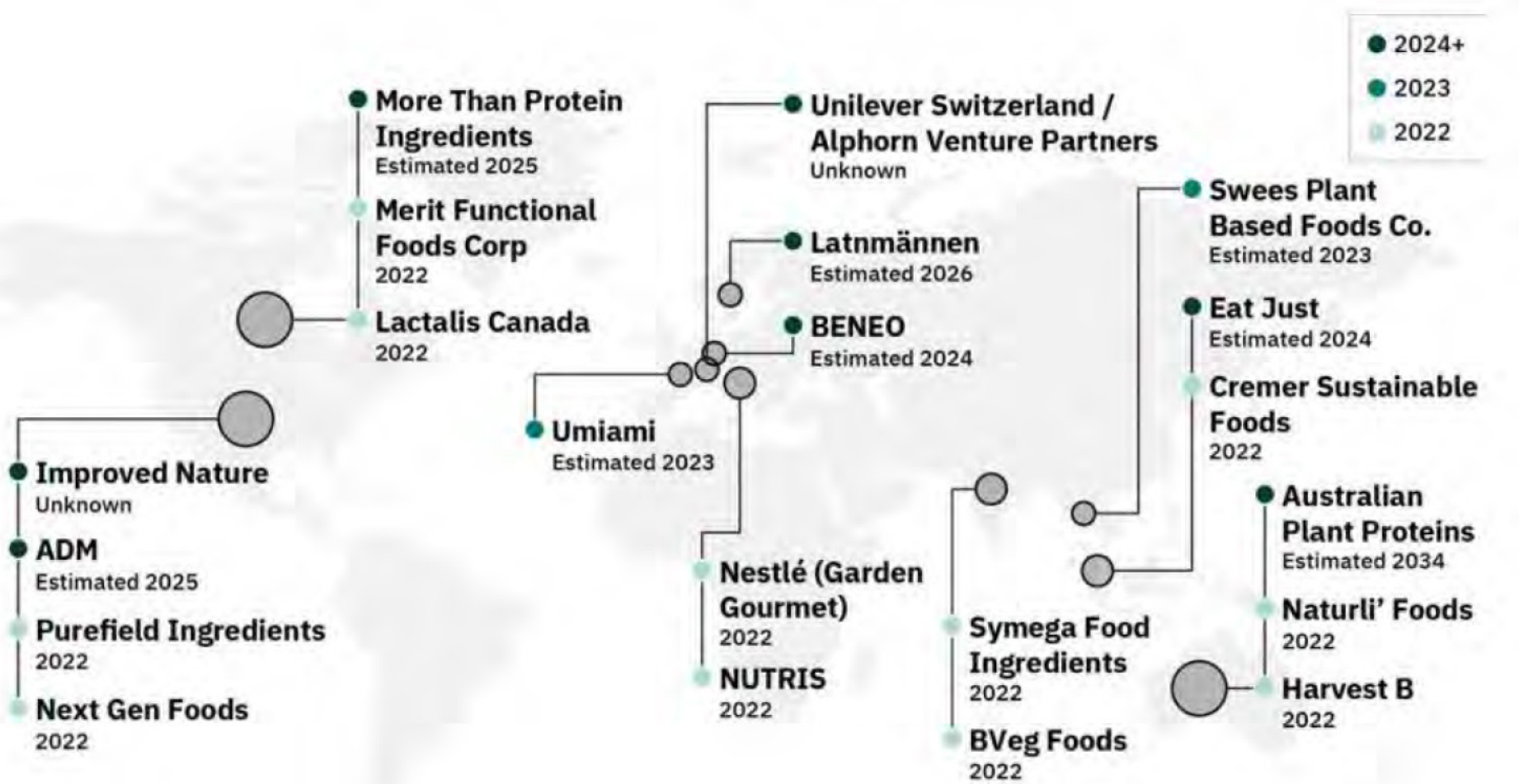
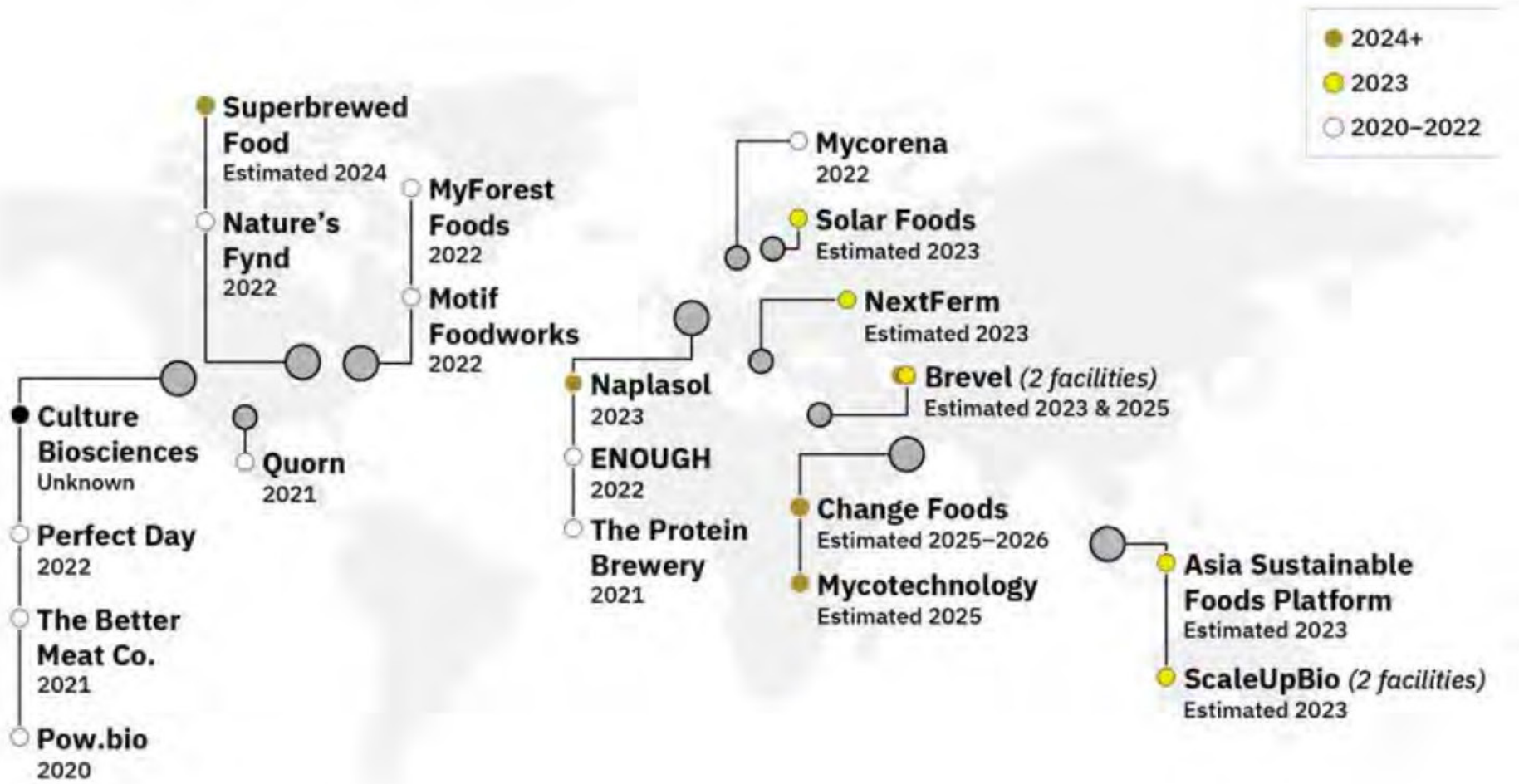
Appendix 1: Facilities

Plant-based meat: facilities



Source: 2022 Plant-based meat state of the industry report

Fermentation: facilities



Source: 2022 Fermentation state of the industry report

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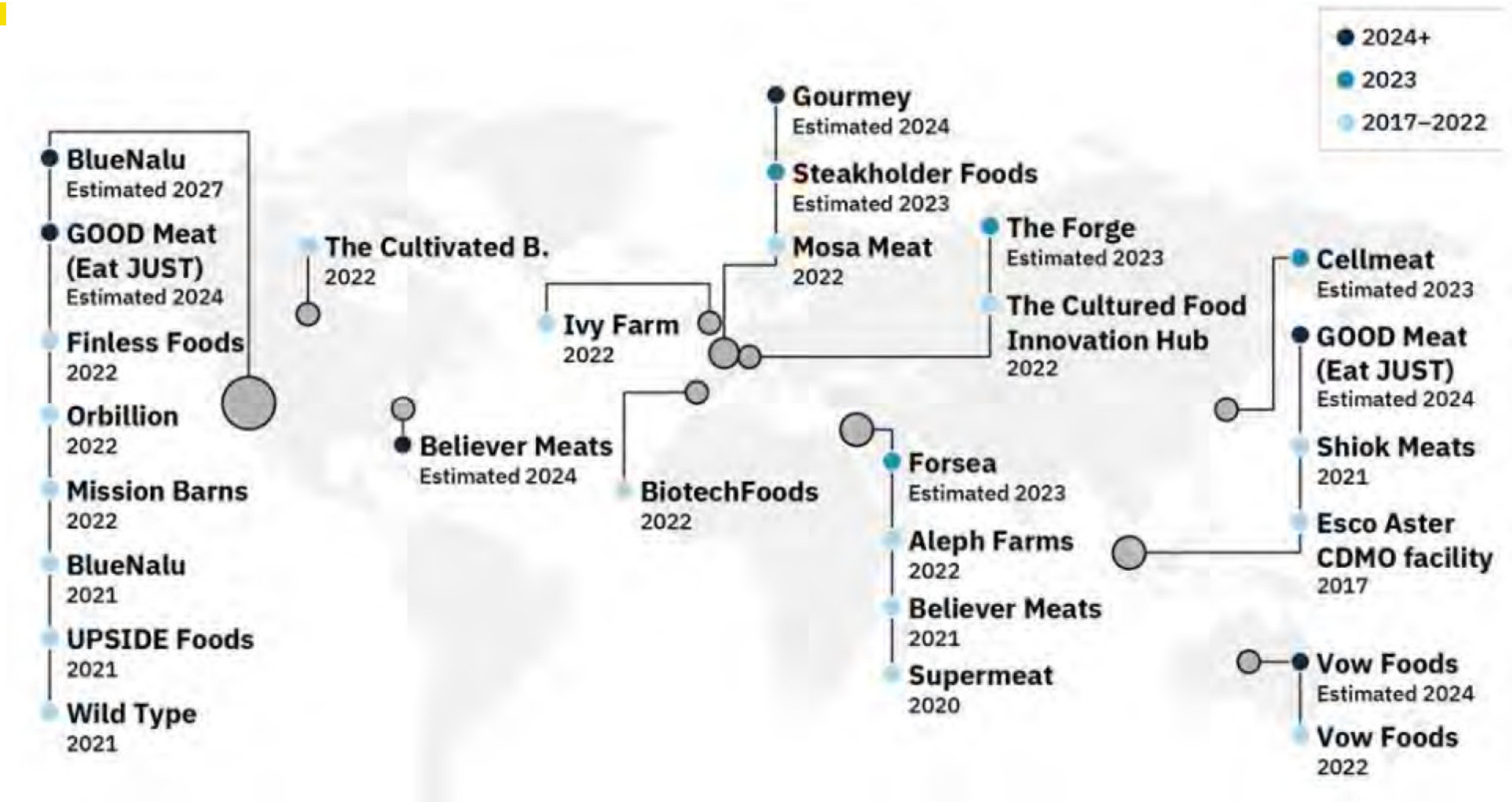

Source: 2022 Cultivated-meat state of the industry report

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Appendix 2: Interconnection of AP pillars

Connections between alternative protein pillars