THE EU CULTIVATED MEAT OPPORTUNITY

AUGUST 2024

SYSTEMIQ

Summary

- **We need to transition towards a better food system that delivers on multiple outcomes** - nutrition & health, food security, climate, nature & jobs
- **Three key shifts are required to deliver this transition:** 1) reducing over consumption of carbon-intensive foods, 2) shifting agricultural practices, and 3) reducing food waste
- **Under BAU trajectory, meat consumption is expected to grow 30% to 2050 from today, but our food systems are at capacity** - we have already crossed six of nine planetary boundaries, and we cannot continue to feed a growing population while respecting these boundaries
- **Alternative proteins offer one solution to meet growing meat consumption while operating within the planetary boundaries** – but they need to reach taste, texture and price parity to become a viable mass market solution
- **Cultivated products (CM) have the potential to help unlock this broader alternative protein market** – cultivated fat and muscle cells added to a plant-based matrix (hybrid products) can have an outsized impact on taste & texture, with meat & seafood gaining most traction
- **There is still significant uncertainty on whether a CM market will emerge** – the global CM market could reach up to €170-510bn by 2050, if regulatory and political hurdles are overcome, and price & performance parity with meat is met by 2035-40
- **The EU has potential for €15-80bn in new domestic and export markets along the CM value chain** – driven by opportunities to produce CM products for local consumption, some higher-end CM exports, and key input markets (e.g., specialised culture inputs like growth factors, equipment manufacturing in select markets); building on a strong ecosystem of CM companies & research and capabilities in related biotech, pharma & manufacturing
- **There are material economic benefits for the EU, with potential for CM to contribute a total of €20-85bn to EU GDP (up to 0.5% total GDP) and 25-90k new jobs to the economy,** alongside material environmental and food security benefits
- **The EU Commission and national gov'ts have a critical role to play in unlocking the CM market**, including creating a supportive regulatory and policy environment – which requires a material shift in current industrial strategy – and helping to close critical funding gaps (particularly R&D); both of which are critical to send the right signals to private actors and unlock private capital flows

CONTEXT: FUTURE FOOD SYSTEM & KEY SHIFTS NEEDED

SYSTEMIQ

We need a “better” food system that delivers on multiple outcomes

Climate

Food system emissions aligned with a 1.5˚C Paris agreement, with food system sequestering carbon

Jobs & Livelihoods

Farmers & supply chain workers supported, with new jobs created in alt. proteins and other non-animal food sources

Security & Resilience

Food supply chains more resilient to external shocks, with local, seasonal production (where appropriate) helping to reduce reliance on imports

Nature

Significant land returned to nature; agriculture is more nature-friendly; system is within sustainable limits for water withdrawals in 2050

Nutrition & health

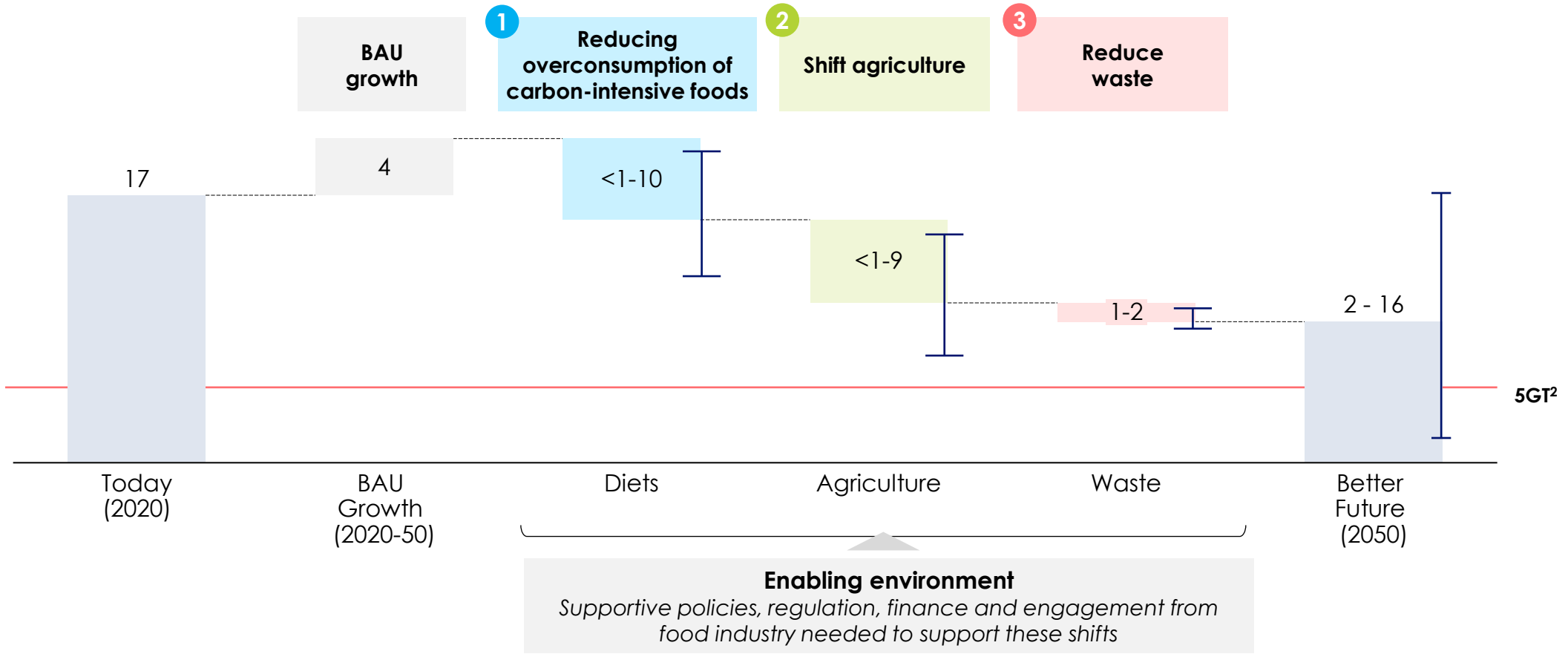
Global population have easy access to affordable healthy & sustainable food, and food security and diet-related diseases in decline

SYSTEMIQ

Three key shifts will be needed to deliver these outcomes

Estimated GHG emissions of the global food system[1]

Gt CO2e / year, 2020-50

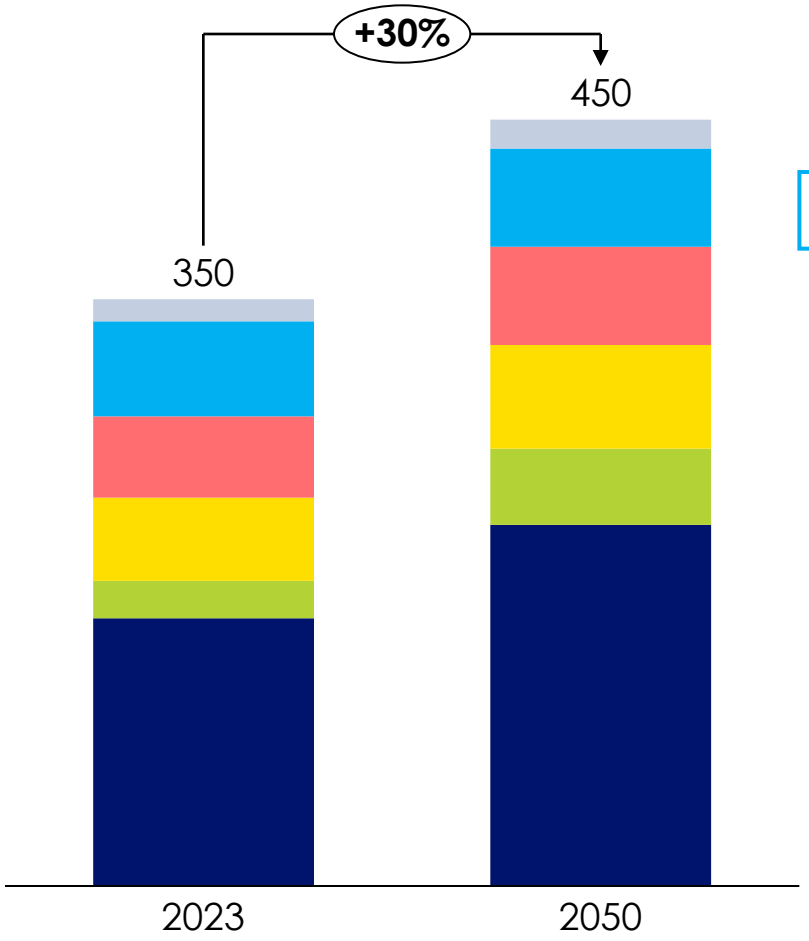


Sources & Notes: Systemiq analysis for PlantWorks; integrated system model based on FAO consumption data, USDA nutrition metrics, and Joseph Poore (2023 - unpublished) impact intensity factors. 1. Analysis based on total food system, full LCA of emissions; compared to 2010 emissions at 15GT; total numbers do not add up due to rounding of mitigation potentials of the interventions, and because of different mitigation potentials per scenario. 2. 5 GT defined by EAT as food limit planetary boundary to stay inside 1.5c scenario, assuming food system becomes net carbon sequester, inclusion/exclusion of off farm emissions will impact boundary level.

SYSTEMIQ

Under BAU trajectory, meat consumption will continue to grow significantly

'Current Course' Scenario – meat consumption by region[1]
(m tonnes)



	Current meat consumption *Kg per capita 2023*	Population growth[3] *% 2023-50*	Meat consumption growth[4] *% 2023-50*
Middle East	30	+32%	+1%
Europe[2]	115	-6%	+10%
North America	120	+12%	+7%
Latin America	80	+13%	+9%
Africa	15	+76%	+15%
Asia Pacific	35	+11%	+22%

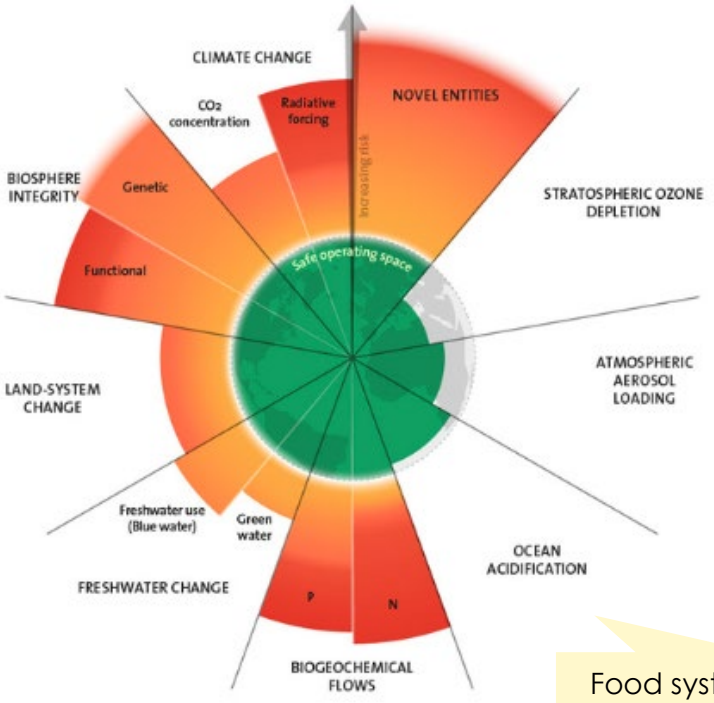
Europeans currently consume 7-8x more meat than required by the EAT Lancet planetary health diet[5] and this is set to **continue growing** on a per capita basis

Sources & Notes: 1. Systemiq analysis using FAOSTAT 2020 consumption data and Business-As-Usual Scenario growth to 2050; 2. EU and rest of Europe combined; 3. World Bank population data (2023); 4. Based on per capita meat consumption. 5. Eat Lancet (2019) Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems

SYSTEMIQ

But our food systems are at capacity

Six of the nine planetary boundaries have been crossed already[1]…



Food system is a key driver of these transgressions, e.g., **34%** GHG emissions[2], **70%** fresh water use[3], **90%** deforestation[4]

… we cannot feed the world's growing population and stay within planetary boundaries without shifts[5]

~7 bn

Status quo
Feeding the global population, but crossing multiple planetary boundaries (2005 baseline)

~3 bn

Respecting planetary boundaries
Under current agricultural practices and respecting these boundaries, our food system could only feed 3.4 bn a balanced diet

~10 bn

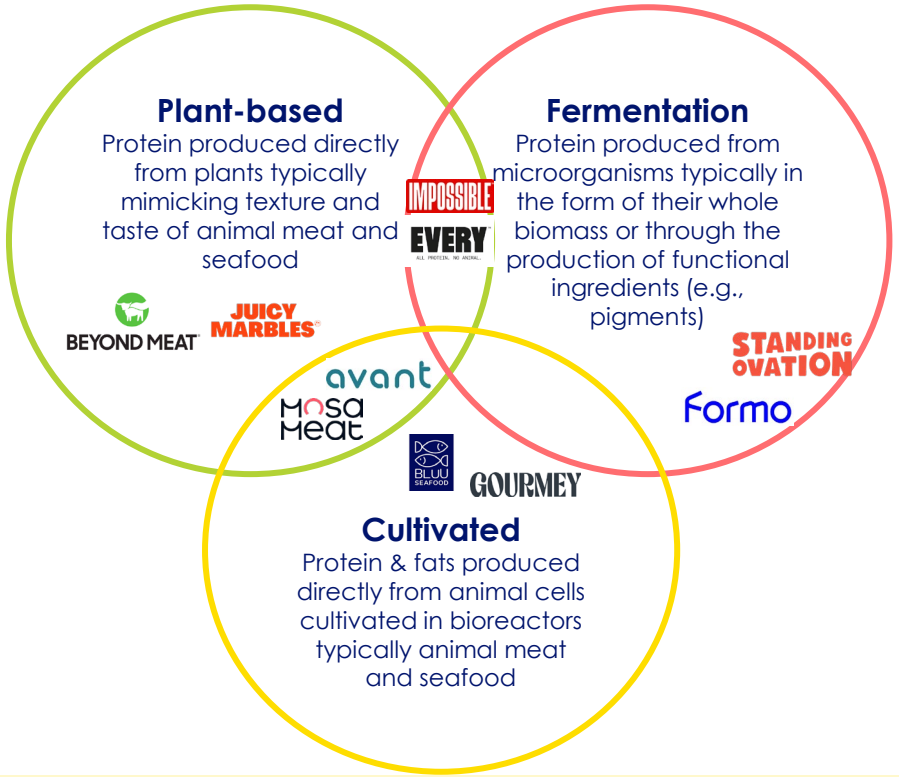
Respecting planetary boundaries & shifts
Shifting diets, agricultural practises and reducing food waste would enable our food system to feed >10bn people within planetary boundaries

Sources & Notes: 1. Richardson et al. (2023), Earth beyond six of nine planetary boundaries; 2. Crippa et al. (2021), Food systems are responsible for a third of global anthropogenic GHG emissions; 3. OECD; 4. FAO; 5. Gerten et al. (2020), Feeding ten billion people is possible within four terrestrial planetary boundaries; balanced diet defined as 2,355 kcal per capita per day including animal product consumption.

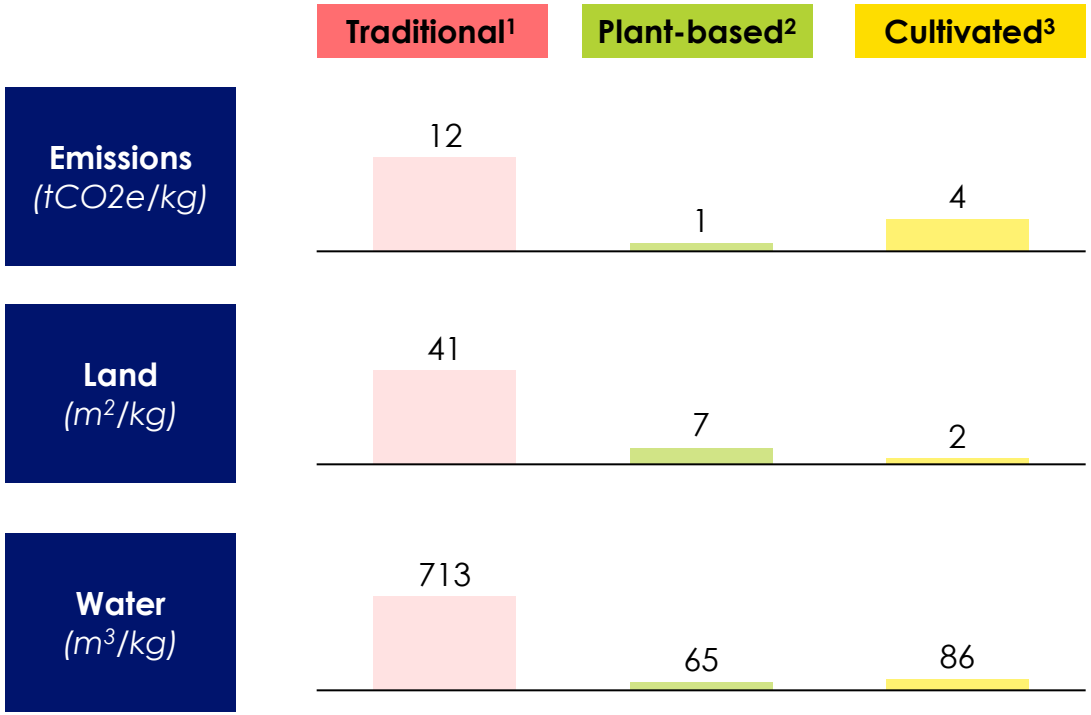
SYSTEMIQ

Alternative proteins are a critical lever to meet this growing demand, while staying within the safe operating limits of the planetary boundaries

Alternative proteins offer potential to meet growing demand for meat…



… with significantly lower environmental footprints



But alternative proteins need to meet taste, texture and price parity with meat to become a mass market solution

Sources & Notes: 1. Poore (2023) unpublished data, based on a consumption weighted average of pork, red meat, poultry and fish; 2. Blue Horizon (2020) Environmental impacts of animal and plant-based food, assumes renewable energy being used for Scope 1 & 2 emissions; 3. Sinke et al (2023) Ex-ante life cycle assessment of commercial-scale cultivated meat production in 2030; assumes renewable energy used for scope 1 and 2 (at the facility), and scope 3 is based on the global average energy mix.

SYSTEMIQ

Cultivated meat offers a promising solution for reaching taste & texture parity

Cultivated meat is still nascent, however it has the potential to bring us closer to reaching taste and texture parity with traditional meat and seafood products, if some key technology, regulatory & investment hurdles can be overcome

	Meat	Seafood	Dairy
Status	***Nascent market, but range of products in development*** *across species and formats; chicken products first to market in US & SG*	***Earlier stage – started emerging more recently*** *and research further behind; range of products in development across species*	***Limited – small number of products in development****, using both cow and human mammary cells*
Outlook	**High potential,** if technology, policy and investment barriers can be overcome	**High potential,** if barriers can be overcome; higher price points in some regions will help	**Low potential** – alternatives gaining more traction (e.g., precision fermentation)
Product types	• **Hybrid products (5-20% CM)** – cultivated fat or muscle cells, integrated into plant-based matrix, share of cells will increase over time) • **Cultivated products (80%+ CM)** – will typically be novelty or premium products (e.g., foie gras); alternative methods used to create structure, e.g., bio-printing on scaffolds		• **Milk harvested directly** from mammary cells grown in bioreactors
Example companies	Mosa Meat – Beef Vital Meat – Chicken Cubiq Foods – Fats Gourmey – Foie gras Vow – Quail meat	Bluu Seafood – Salmon & trout Upstream Foods – Salmon fat Fishway – Fish fat & protein Mermade – Scallops	opalia – Cow milk Wilk – Cow milk, yoghurt Biomilq – Human milk

Cultivated meat & seafood the focus of this analysis; products on the market expected to mostly be hybrid initially, but share of CM in products will likely increase over time

SYSTEMIQ

EUROPE'S OPPORTUNITY FOR CULTIVATED MEAT

SYSTEMIQ

What we've done

- Given the potential role cultivated meat could play in the future food system, Systemiq have collaborated with GFI Europe to better understand what the future cultivated meat market could look like and the benefits this could bring to Europe

- To support this, Systemiq have developed an analytical model with three core components:
  1. **Global CM demand & market size** predicts the range of possible futures for a cultivated meat market, based on different assumptions around regulatory, policy & technology developments, using an S-curve approach to define potential adoption rates
  2. **EU and country role:** integrates a perspective on the role the EU and select individual countries could play across the CM value chain, i.e. the share of domestic and export markets for CM products and key input markets (e.g., cell culture media, bioreactors)
  3. **Benefits:** determines the impact and benefits of these different market scenarios at the EU economic level (e.g., GVA, jobs, trade)*, in addition to its environmental benefits

- This analysis is based upon a series of assumptions across the three components collated through two key sets of sources:
  - **Interviews with >35 experts** in the CM space across a range of stakeholder groups (e.g., CM companies, scientists, NGOs, etc)
  - **Scientific papers & industry reports** – log of key sources in the appendix (slide 32)

- Our analytical model will be published alongside this presentation to allow further interpretation of the results and assumptions used, and further details on our approach can be found in the Appendix

**Our analysis focuses on CM only. It does not quantify the impact on related sectors including plant-based proteins, agriculture and meat processing – further details on slide 24*

SYSTEMIQ

Different scenarios exist for cultivated meat by 2050

Current course & speed	Low ambition: CM remains a niche market	Medium ambition: CM & bioeconomy gain momentum	High ambition: CM scales to mass market
• **BAU scenario extrapolating near-term capacity expansions** • Regulatory and political hurdles remain, with few new regulatory approvals granted • Prevents capacity build out and further cost reductions meaning prices stay prohibitively high • Very limited uptake of CM in plant-based (PB) products	• **CM becomes a niche ingredient used in a limited set of PB and high-end products** • Price and performance parity tipping point not met until **2045** • Wider regulatory approvals remain **5+** years out, slowing R&D, scale-up & cost reductions • CM remains expensive, limiting uptake to **0.2%** meat consumption by 2050 – as both an ingredient in PB products (10-20% of product), and some high-end categories (e.g., foie gras, premium seafood)	• **CM gains momentum with tipping point accelerated by traction in broader bioeconomy** • Price tipping point met in **2040** – commoditization of key input supply chains as part of broader bioeconomy sector growth helps bring down costs • Wider-scale regulatory approvals occur within **5** years • CM adoption reaches **3%** by 2050, as an ingredient in PB products and as a replacement for premium products	• **CM becomes a part of mass market diets globally** • Price tipping point met in **2035**, with CM becoming cost effective to include in PB products at high proportions • Regulatory approvals **happen efficiently** across key regions, building off existing frameworks (e.g., Singapore) • CM adoption reaches **9%** by 2050 – forming a core ingredient for PB mass market products, and increasing presence of standalone CM products on the market

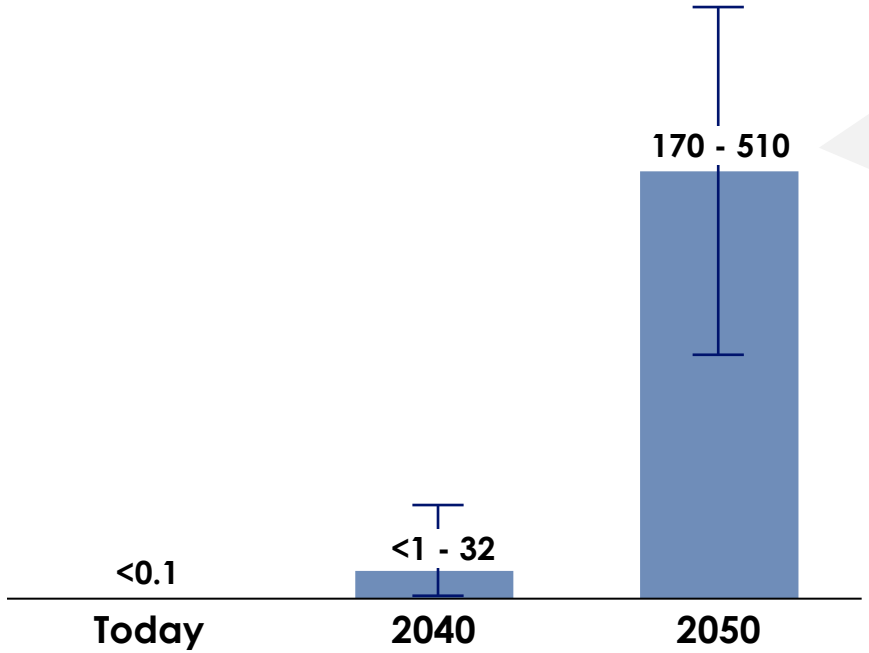
Opportunities very limited under current course and low ambition scenarios, the rest of the presentation focuses on the opportunity for the EU if they unlock a material CM market (i.e. shows the outcomes of the medium and high ambition scenarios)

SYSTEMIQ

Global cultivated meat market has potential to reach €500bn by 2050…

Global CM market size[1]

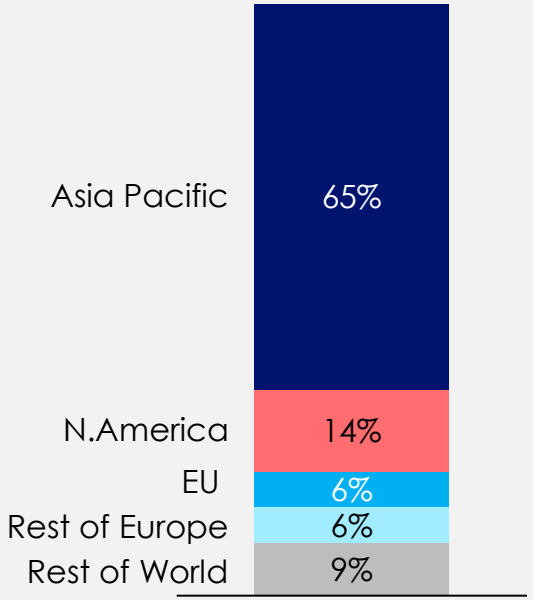
Revenues (€bn), ranges not true to scale



Global volumes ('000s MT)	<1	6 – 3,500	17,500 – 55,000

Primarily driven by APAC and Global North

Share of consumption by region (%, 2050)



- **Emergent global middle class** with increasing appetite for high protein/meat diets
- **Large & growing population in Asia** adding demand to a stretched agri sector
- Asia, North America and key non-EU countries (e.g., Switzerland/UK) further ahead in **regulatory & policy support for CM**
- **CM taste & price parity driving consumer acceptance** in key regions (as above)

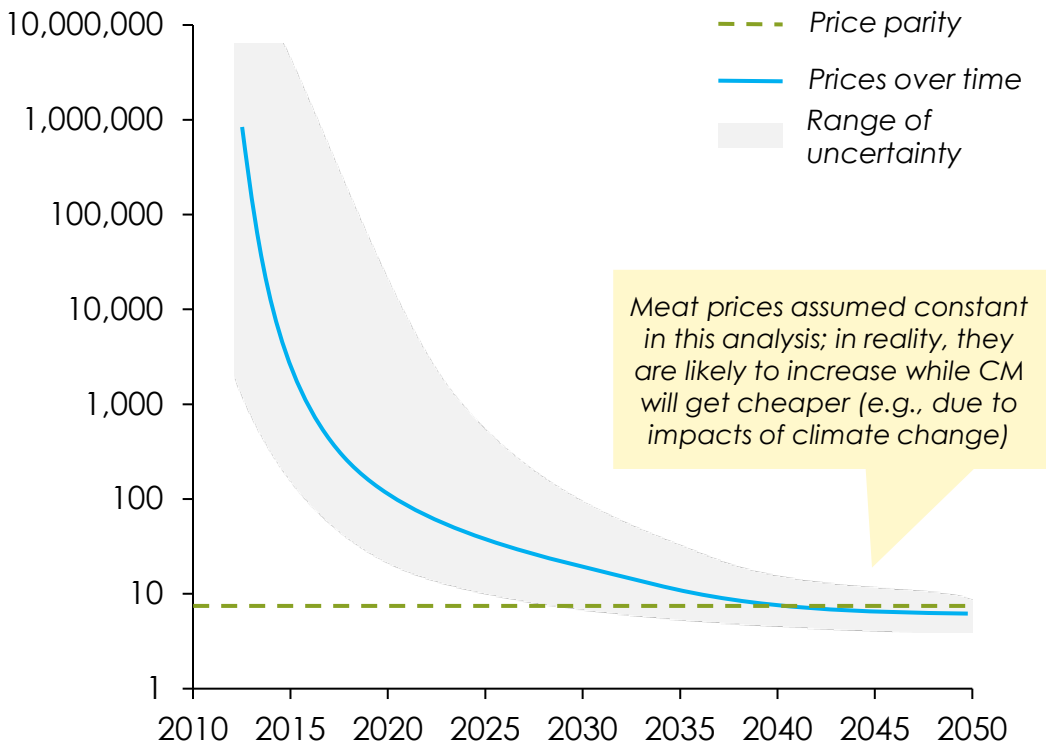
Sources & Notes: 1. Systemiq CM analysis; EU cultivated meat opportunity model based on FAO consumption data, Vergeer (2021) TEA of cultivated meat, Ark Biotech (2023) Cultivated meat's path to price parity TEA, McKinsey (2021) Cultivated meat: Out of the lab, into the frying pan, Eurostat Prodcom data; based on medium and high ambition scenarios only.

SYSTEMIQ

…but it requires a significant reduction in production costs

Production costs needs to come down to <€10/kg to reach price parity with meat[1]

(€/kg current prices, projection based on medium scenario)



Still material uncertainty around what developments in input market will emerge[2]

Inputs		Future cost (€/kg)[3]	Key developments needed to reach price parity
Cell culture inputs	**Specialised** *Recombinant proteins & growth factors*	0.9 - 3.5	• Increase media-use efficiency through cell engineering / new formulations • Identify new plant-based & fermentation sources • Pharma grade inputs replaced with food grade • Recycling media & valorising waste
	Bulk *Amino acids, vitamins, salt, glucose*	0.1 – 0.6	
Production infra	**Bioreactors**	0.1 – 0.3	• Scale-up of market for large (10-250k+ litre), low cost, fit-for-purpose bioreactors & perfusion reactors
	Processing equipment	0.2 – 0.6	• Specialised CM production equipment, including onsite storage facilities
	Buildings	0.1 – 0.2	• Ability to balance safety/sterility with costs
Other Opex	**Labour**	0.4 – 1.5	• Labour intensity of production reduced, but quality of roles and pay improves
	Utilities	0.2 – 1.9	• Facility energy needs are met with renewables • Requires build out of low-cost renewable energy
	Other	0.9 – 1.1	• Improvements in plant-based scaffold materials specific to CM production
	Total	6.1 – 6.5[4]	

Sources & Notes: 1. Historical prices calculated from market-prices or costs of production of individual CM products. Future price projections assume conversion to retail prices of meat products; based on Systemiq analysis of Systemiq analysis using McKinsey (2021), Good Seed Ventures (2021), USDA data for retail prices of meat products; 2. Given uncertainty of future processes and input costs, high and low ranges of future costs are taken from scenarios from academic sources that meet future price parity and where assumptions are not overly unrealistic; 3. Based on Vergeer (2021) TEA of cultivated meat; Ark Biotech (2023) Cultivated meat's path to price parity; 4. Totals are specific to manufacturing processes rather than totals of all specialized and bulk input costs.

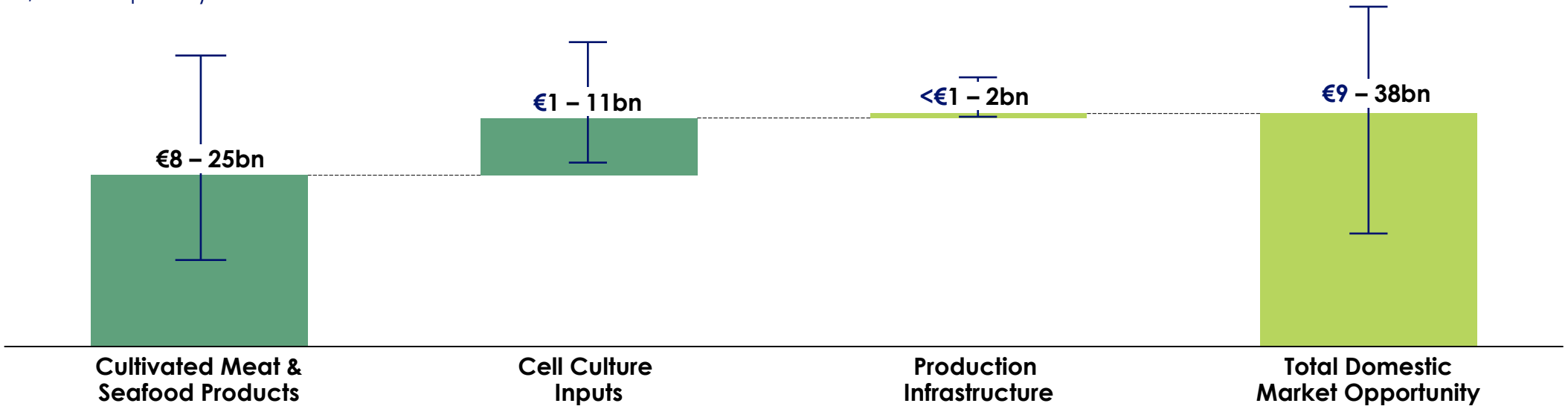
SYSTEMIQ

There is an opportunity for the EU to build a domestic CM market …

Estimates focus on physical product; additional opportunities will emerge from sale of IP to other producers

EU domestic market size by 2050[1]

(€bn, current prices)



Key drivers & assumptions:

- **EU could meet 70% of domestic cultivated meat demand**
- Colocation of production and consumption to result in 'sticky' EU demand for CM end products even if non-EU production is cheaper

- **EU could meet 85% of specialised cell culture inputs domestic demand**
- Can leverage strong existing biotech and pharma manufacturing capabilities to develop a cost competitive advantage vs import markets

- Largely **reliant on imports** from economies with lower-cost production method – EU to meet **55% of domestic demand**
- Some key geographies to support domestic bioreactor and processing markets (e.g., Germany & Spain)

Sources & Notes: 1. Systemiq CM analysis; EU cultivated meat opportunity model based on FAO consumption data, Vergeer (2021) TEA of cultivated meat, Ark Biotech (2023) Cultivated meat's path to price parity TEA, McKinsey (2021) Cultivated meat: Out of the lab, into the frying pan, Eurostat Prodcom data; based on current course and low ambition scenarios only; estimates based on EU's existing potential in relevant proxy markets (e.g., production infrastructure based on EU's machinery production), see page 38 for more details.

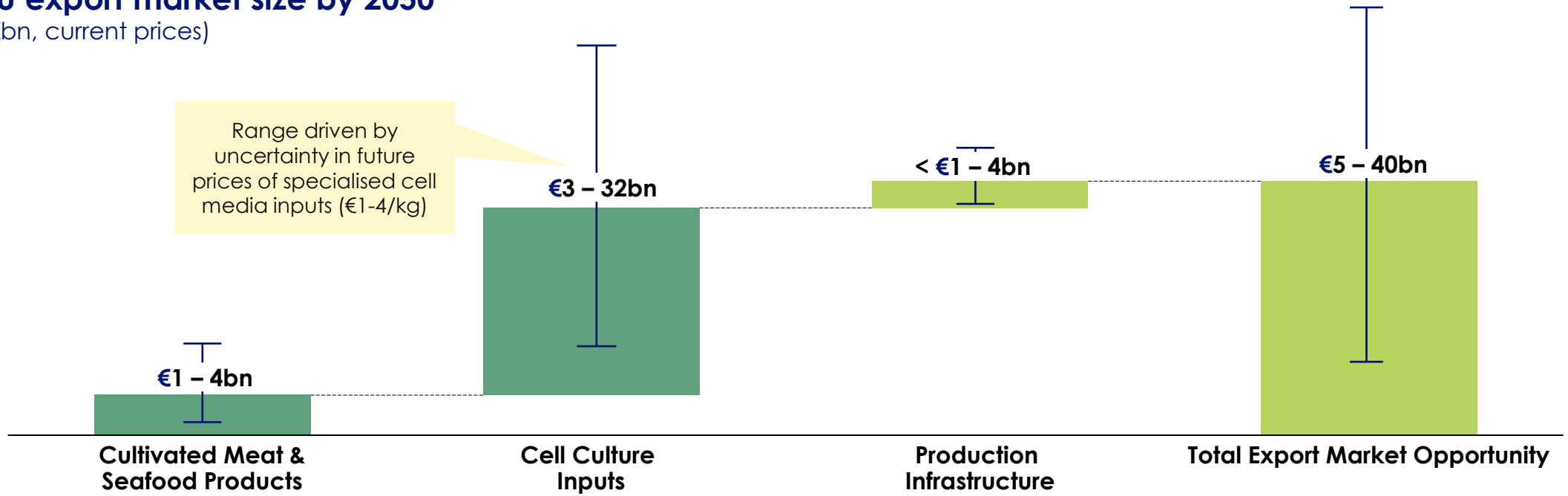
SYSTEMIQ

… and more select opportunities for export markets

Estimates focus on physical products, but additional opportunity from sale of IP to other producers

EU export market size by 2050[1]

(€bn, current prices)



Key drivers & assumptions:

- **EU could meet ~1% of global end product demand, in line with existing food product exports**
- Difficult to compete in end-product market with likely high production costs versus other economies

- **EU could meet ~20% of specialised cell culture inputs global demand** (vs ~15% of existing pharmaceutical exports)
- Well established export markets for pharmaceutical and life sciences sectors which can be built upon

- Relatively smaller opportunities for exporting bioreactor or processing equipment; EU likely to be less competitive vs lower production cost economies
- Some scope to export more **advanced / niche infrastructure**

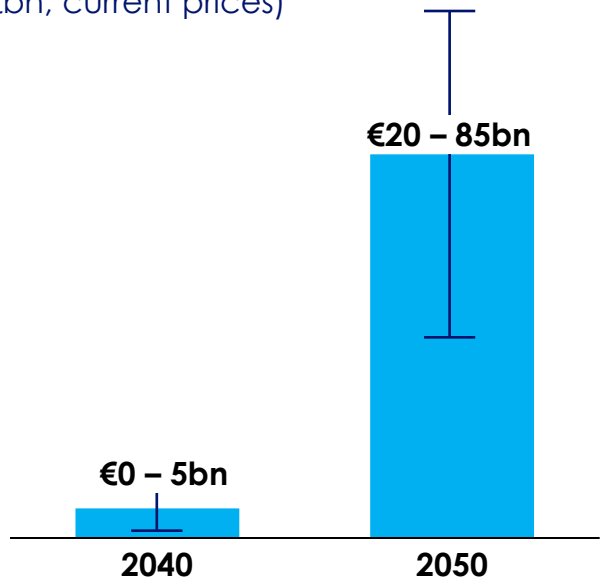
Sources & Notes: 1. Systemiq CM analysis; EU cultivated meat opportunity model based on FAO consumption data, Vergeer (2021) TEA of cultivated meat, Ark Biotech (2023) Cultivated meat's path to price parity TEA, McKinsey (2021) Cultivated meat: Out of the lab, into the frying pan, Eurostat Prodcom data; based on current course and low ambition scenarios only; estimates based on EU's existing potential in relevant proxy markets (e.g., production infrastructure based on EU's machinery production), see page 38 for more details.

SYSTEMIQ

Developing CM would create economic opportunities for Europe…

GVA

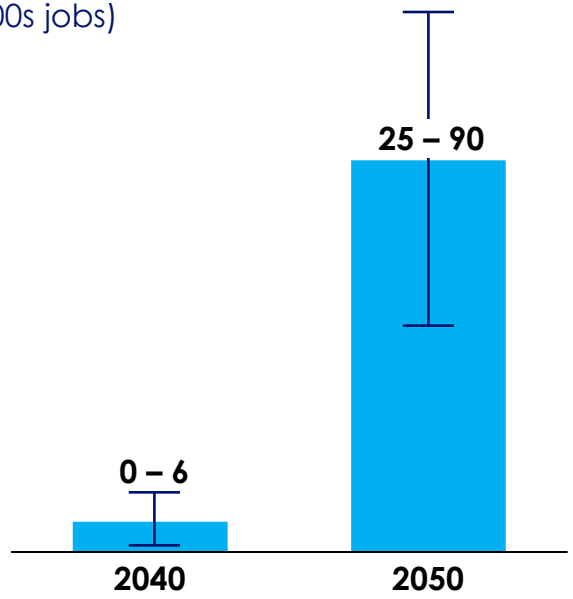
Total annual gross GVA contribution[1]
(€bn, current prices)



- Up to **€85bn** annual contribution to EU economy by 2050 – **0.4% total EU GDP**
- **~30%** driven directly by the CM sector, and **~70%** indirectly through suppliers and induced spending in the economy

Jobs

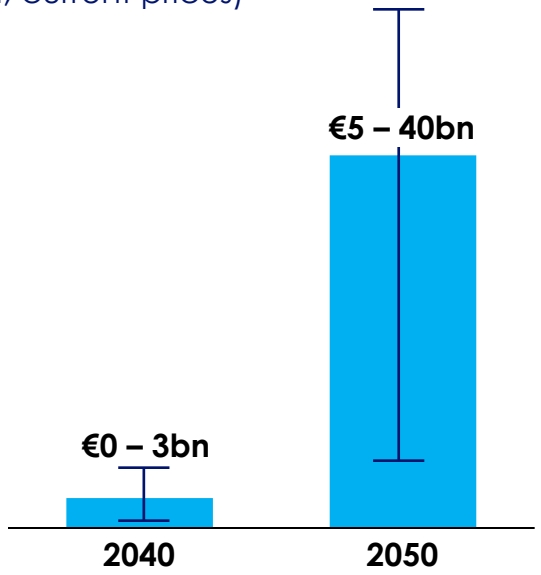
Total gross job creation[1]
('000s jobs)



- Up to **90,000 jobs** created directly in CM production, with estimates suggesting for every job created in CM another job will be created elsewhere in the economy
- Jobs expected to be well paid with workers earning an average of €95,000 annually[2]

Trade

Annual gross market value of exports
(€bn, current prices)



- Up to **€40bn** in trade opportunities created, largely driven by EU becoming a leader in specialized cell culture inputs
- For context, total exported processed agriculture products from EU represented **€84bn** in 2023[3]

Sources & Notes: Systemiq CM analysis; based on medium and high ambition scenarios only – further details of approach slide 38; all based on the gross impact of CM and its value chain, they do not consider the net impact with agriculture. 1. Use GVA and job multipliers for 2030 UK CM sector from Oxford Economics (2021) The socio-economic impact of cultivated meat in the UK; 2. Garrison et al (2022) How much will large-scale production of cell-cultured meat cost?, conversion used 1 EUR = 1.08 USD; 3. Eurostat Prodcom data.

SYSTEMIQ

… in addition to critical environmental and health benefits…

Environment

Global mitigation potential 2050 versus BAU scenario

	Cultivated products[1,2]		Plant-based[2,3,4]		Total mitigation potential (% 2050 food system[5])
GHG emissions	0.1-0.4 Gt	+	2.2-3.1 Gt	=	2.4 – 3.5 (12 – 17%)
Land use	70-200 m Ha	+	800-1200 m Ha	=	870 – 1400 (22 – 33%)
Water use	10-35 m m^3	+	135-190 m m^3	=	145 – 225 (4 – 7%)

As a key unlock for plant-based adoption, environmental benefits of CM extend beyond direct impact

Health & Nutrition

- **Nutritional benefits still being tested** – initial results suggest on par or better than traditional meat, ongoing research to develop healthier fats with lower risks of cholesterol & colon cancer[6]
- **Reduced zoonotic & AMR risks** – ~65% of all antibiotic use in Europe is in animals, contributing to the growth and spread of antibiotic resistance[7]
- **Potentially reduced risk from bio-accumulation of toxins** (esp. relevant for seafood) – Eat Just's cultivated chicken demonstrated cleaner microbiological content[8]; but Upside faced some challenges with heavy metal levels that they are working to address (despite FDA approval)[9]
- **Increased food security** – under current course, meat production likely get more expensive over time (e.g., with climate change, pressure on water/land-use); CM will help reduce reliance on imports and feed production

Sources & Notes: Totals may not sum due to rounding. Systemiq analysis comparing the environmental impacts of cultivated and plant-based products versus conventional meat and seafood equivalents for medium & high scenarios; 1. Sinke et al (2023) Ex-ante life cycle assessment of commercial-scale cultivated meat production in 2030 emissions factors; 2. Poore (2023) unpublished data; 3. GFI (2023) Environmental benefits of alternative proteins; 4. Blue Horizon (2020) Environmental impacts of animal and plant-based food; 5. PlantWorks integrated food systems model (2023); 6. Vegconomist (2021); 7. Van Boeckel et al (2015) Global trends in antimicrobial use in food animals; 8. Food manufacturing (2023); 9. Upside Foods (2024)

SYSTEMIQ

…and spillover benefits for other sectors

Broader bio-economy

- **Developments in cultivated meat will help unlock the broader bioeconomy by bringing down production costs,** increased knowledge of cellular agriculture
- **Potential for valorising waste products from CM production process as input to the bioeconomy** – e.g., poly-lactic acid from culture media can be used to produce bioplastics[1]
- **Potential for functional animal-based ingredients as input to the bioeconomy** – e.g., marine protein peptides for the cosmeceutical functional ingredient market to promote anti-aging[2]

Pharmaceuticals & life sciences

- **Common supply chain components between CM and biopharma will help bring costs down** – e.g., lower cost culture media & growth factors will help reduce R&D costs, and overall production costs
- **Developments in cell line engineering & growth factors will support new applications** – e.g., therapeutic applications for growth factors, vaccine development for animal agriculture applications, etc

Agriculture

- **Growth opportunities for arable farmers** – e.g., CM will support uptake of PB alternative proteins which will rely on growth of key crops to meet demand for PB inputs, crop byproducts used as inputs for CM growth media
- **Some new opportunities for animal farmers** – e.g., supplying animal cells for developing new cell lines, animal byproducts used for CM (e.g., hydrolysed collagen derived from connective tissue, and gelatine provides a structure for muscle cells to attach and grow)
- **As well as potential diversification opportunities** – feasibility still to be tested, but longer-term there may be opportunities for small-scale onsite cultivated meat production[3]

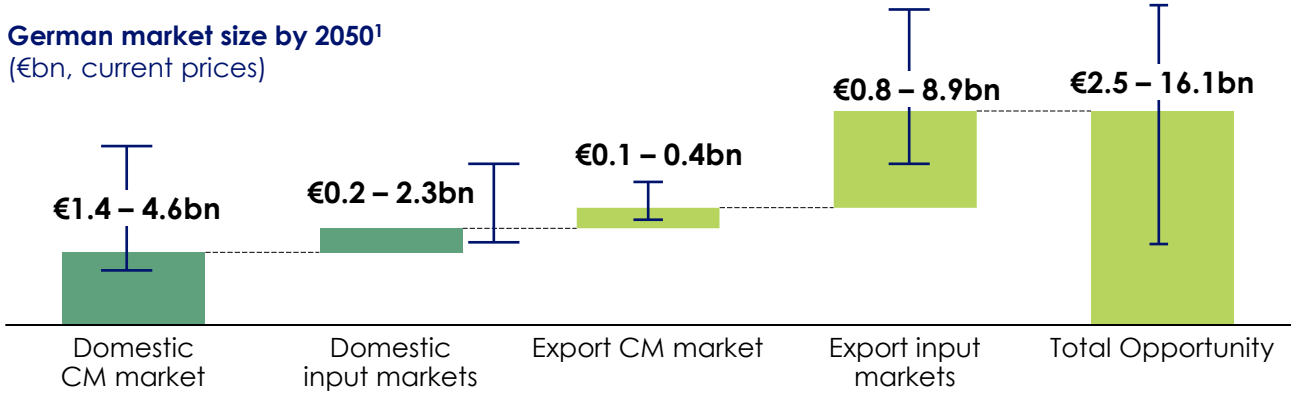
Sources & Notes: 1. GFI, Cultivated Meat Co-product Valorization; 2. Avant Meats website 3. Royal Agricultural University (2024), Culture Clash? What cultured meat could mean for UK farming.

What this could look like at the country level: GERMANY

Germany has the potential to develop up to a **€16bn market** by 2050 building **on a strong biotech R&D landscape** with increasing focus on cellular agriculture**, highly advanced pharma manufacturing companies** looking to become CM value chain suppliers, and **investment from progressive food players** looking to expand their alternative protein portfolio

Opportunity & key benefits

German market size by 2050[1]
(€bn, current prices)



€3 – 17bn GVA annually *(0.1-0.4% total[4])*

5 – 15k Jobs

Key drivers

Leading biotech research and innovation

- **Leading biotech nation** after the US[2] across scientific research and innovation, with notable 'Bioregion' innovation hubs
- Capabilities are already being leveraged with GEA Group investing in scaling AP production incl. CM

Strong pharma manufacturing sector

- **One of largest pharma manufacturers globally with revenue surpassing €50bn**[2]
- Established pharma players incl. Merck and Eppendorf are aiming to become B2B suppliers for CM value chain machinery and inputs

Forward-looking traditional meat & ag. sector

- **PHW Group, In Family and other meat & ag. companies invested in CM** domestically and internationally
- Established players are looking to evolve into protein companies, and can accelerate CM market

Key considerations:

- **Develop CM specific innovation hubs:** Current CM ecosystem is still limited. Germany has potential to accelerate market growth by leveraging its existing biotech ecosystem to drive innovation. CM and/ or cell. ag. specific innovation hubs will attract early-stage entrepreneurs and foster collaboration between start-ups, academia and industry.
- **Champion CM at EU-level:** Given that Germany recognizes the potential of CM in its transition to alternative proteins[3], it is well-positioned to champion the sector within the EU. By taking a leading role, Germany can help accelerate CM market growth across Europe and advance the regulatory approval process.

Sources & Notes: 1. Systemiq CM analysis, based on medium and high ambition scenarios only; 2. Germany Trade and Invest (GTAI) 3. German Government to boost alternative proteins with €38m, Food Navigator 4. Calculations based on total GVA €3,772bn in '23 from World Bank data, 1 EUR = 1.08 USD.

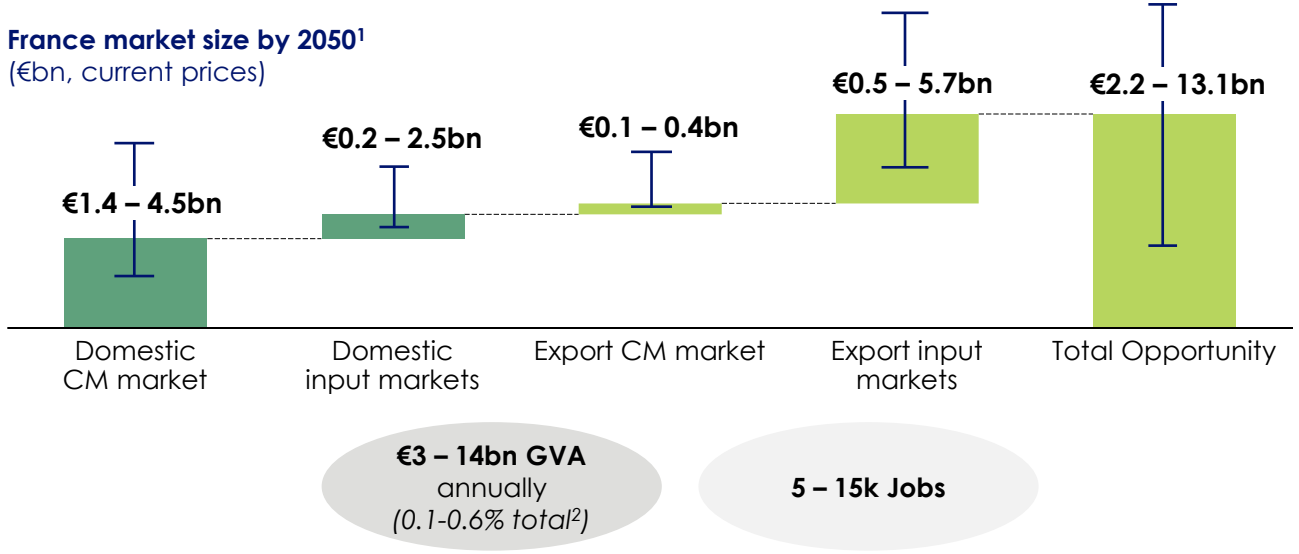
SYSTEMIQ

What this could look like at the country level: FRANCE

France has the potential to develop a **€13bn market** by 2050 building on **biotech expertise** driven by strong research capabilities and gov't support , a **mature domestic start-up ecosystem** with supportive policies as well as a **rich culinary heritage** with global recognition

Opportunity & key benefits

France market size by 2050[1]
(€bn, current prices)



€3 – 14bn GVA annually *(0.1-0.6% total[2])*

5 – 15k Jobs

Key drivers

Biotechnology expertise

- **Strong biotech scientific research capability backed by €7.5bn[3] in public funding to make France a bio-pharma leader**
- Existing biotechnology research capabilities can be leveraged to advance cellular agriculture research

Start-up ecosystem

- **In top 20[4] countries worldwide for entrepreneurs,** with supportive government policy, and physical infrastructure
- Mature start-up ecosystem makes France well-placed for early-stage CM companies that require significant capital and bricks & mortar investment

Culinary heritage

- **Rich culinary heritage with a distinct cuisine and historically strong agri-food sector**
- Food companies like Danone and Lactalis have introduced French food to global markets, and CM companies could follow suit

Key considerations:

Reframe the political & cultural narrative: CM has received pushback domestically (despite first regulatory filing from Gourmey), especially from agri-food sector. Established agri players should be engaged in conversations, with CM framed as a complement, not a disruption, to traditional agriculture; role for gov't to support farmers to capitalize on CM opportunities

Mobilize research capabilities: Open access scientific research on CM has been restricted in France to date and there is an opportunity for France to develop an advantage if it can mobilize research resources and funding to build an ecosystem of CM-focused research

Activate biotech & innovation ecosystem: France's existing biotech hubs and incubators for shared facilities can be leveraged to develop the next generation of CM entrepreneurs. Natural synergies with other cellular agriculture industries like pharmaceuticals and cosmetics have potential to help scale capacity and funding

Sources & Notes: 1. Systemiq CM analysis, based on medium and high ambition scenarios only; 2. Calculations based on total GVA €2313bn in '22 from INSEE data; 3. McKinsey; 4. Global Entrepreneurship Monitor, 2021/2022 Global Report.

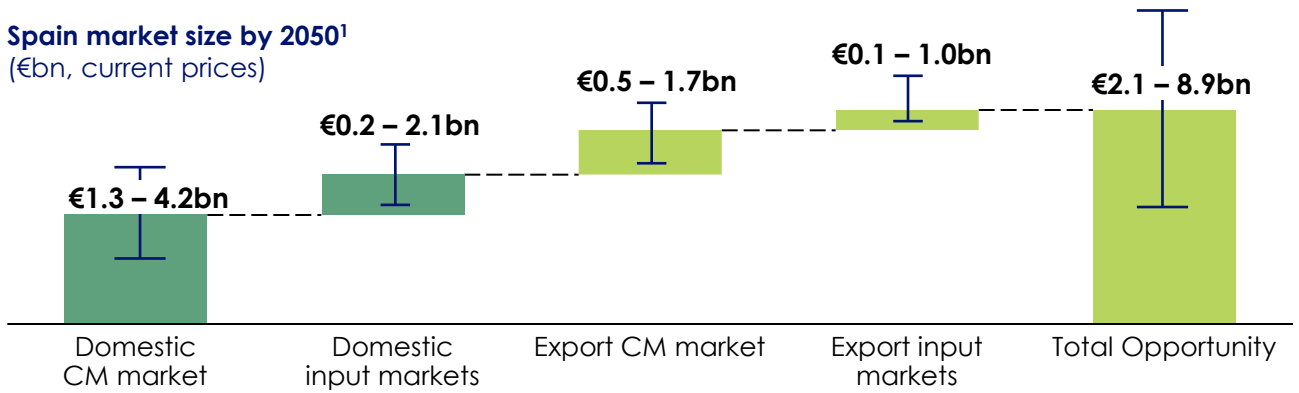
SYSTEMIQ

What this could look like at the country level: SPAIN

Spain has the potential to develop up to a **€9bn market** by 2050 building **on strong pharmaceutical manufacturing** driven by vaccine production, an **export oriented agri-food sector** with processing and trade infrastructure, as well as increasing **engagement from traditional meat players**

Opportunity & key benefits

Spain market size by 2050[1]
(€bn, current prices)



€3 – 10bn GVA annually *(0.2-0.8% total[4])*

6 – 18k Jobs

Key drivers

Growing pharmaceutical sector

- **Pharma. manufacturing grew by 53%**[2] in '22 due to COVID vaccine production, leading to public and private investment momentum
- Capabilities can be leveraged to produce specialized inputs and machinery for the CM value chain

Strong agri-food capabilities

- **7th largest exporter**[2] **of agri-food globally**
- Existing processing and export infrastructure can be leveraged to produce and export CM at scale

Engagement from traditional meat players

- **Leading domestic players like Aldelis, Argal and Martínez Somalo have invested in CM R&D** in Spain
- Support from traditional actors could accelerate CM ecosystem growth

Key considerations:

- **Government support:** Spanish government has remained mostly neutral to stay out of any CM related debates occurring in other EU countries. Spanish CM market has signs of traction and government support could accelerate the domestic market, and potentially attract CM startups from other countries.
- **Meat consumption and public health:** Spain faces major public health concerns linked to red meat consumption, as it consumes the highest amount of meat in the EU per capita[3]. CM can tap into this large consumer base as a healthier, lower-cholesterol option.
- **Accelerate cell ag. research:** Spain has the pharma. capabilities to produce CM, but scaling the sector requires cell ag. and biotech innovation. Intellectual property (IP) capabilities will have to either be imported or developed domestically.

Sources & Notes: 1. Systemiq CM analysis, based on medium and high ambition scenarios only; 2. Spanish Institute for Foreign Trade; 3. Politco using FAO data; 4. Calculations based on total GVA €1333bn in '23 from World Bank data, conversion 1 EUR = 1.08 USD from XE, July '24

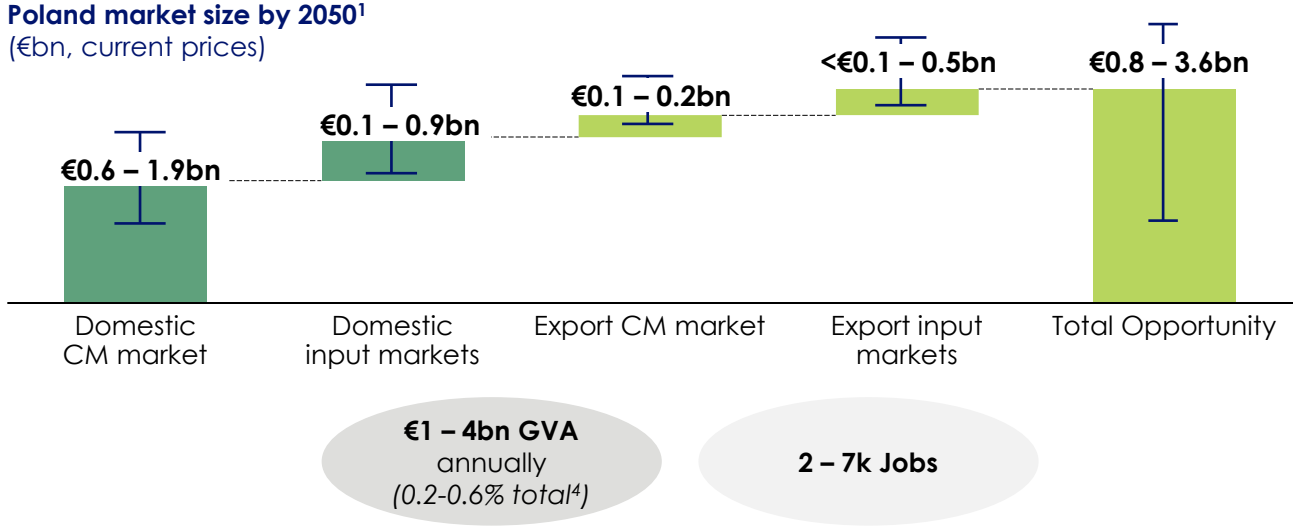
SYSTEMIQ

What this could look like at the country level: POLAND

Poland has the potential to develop a **€4bn market** by 2050 building **on strong pharmaceutical capabilities** driven by production of generics, and **existing manufacturing capabilities** with a strong competitive advantage due to lower production costs in the EU region

Opportunity & key benefits

Poland market size by 2050[1]
(€bn, current prices)



€1 – 4bn GVA annually *(0.2-0.6% total[4])*

2 – 7k Jobs

Key drivers

Strong pharmaceutical sector

- **Pharma manufacturing contributes to 1.7%[2]** of Poland's GDP
- Existing pharmaceutical capabilities especially in generics and biosimilars that can be leveraged to produce bulk inputs in the CM value chain

Manufacturing capabilities

- **5th largest manufacturing country within EU[3]**
- Growing manufacturing sector can be well positioned to produce machinery and other equipment required to produce CM due to lower products costs (e.g., labor, land)

Key considerations:

- **Material government support:** Poland has yet to develop cohesive sustainable protein strategy which will be crucial to the development of the CM market, signaling gov't interest in alternative proteins. Additionally, government initiatives like tax incentives, engagement with AP sector and support for research into Poland's role in the CM value chain will be key to catalyzing private sector investment.
- **Engaging agri-food players**: Poland possesses a strong agri-food sector that should be engaged to ensure support and buy-in to the CM market as a complement to traditional production.
- **Biotechnology capabilities:** Poland is well placed to build on existing pharmaceutical manufacturing capabilities to develop specialized inputs for CM. The gov't also shows increasing focus on attracting biotechnology companies through tax incentives[3], aiming to capitalize on EU-wide post-pandemic pharma sovereignty focus.

Sources & Notes: 1. Systemiq CM analysis, based on medium and high ambition scenarios only; 2. European Medical Journal; 3. International Trading Association 4. Calculations based on total GVA €678bn in 2023 from World Bank data, conversion 1 EUR = 1.08 USD from XE, July '24.

SYSTEMIQ

Key considerations & uncertainties

- **This analysis demonstrates there is an opportunity for the cultivated meat sector** to play a material role in the EU economy
- **However, the market is still early-stage and significant uncertainty remains on whether CM will become mass market at all –** regulatory, political & technology developments over the next 2-3 years will materially shape its trajectory helping to reduce some uncertainty
- **In light of this, we had to make some fundamental assumptions around how the market will emerge in our model, in particular**
  - Cultivated products will reach price parity with meat & seafood over the next 10-20 years, but exact route not yet known
  - Once price and performance parity is met consumers will rapidly adopt CM products
  - GVA & jobs impacts of CM sector for the EU will be similar to the UK – limited data availability meant using GVA and job multipliers from the UK CM market[1] and other relevant sectors (e.g., biotech, manufacturing) as proxies
- **If CM does become mass market by 2050, it will have implications for agriculture and meat processing industries** – in higher ambition scenarios, CM volumes of 17-55 mn tons could support 35-55% meat consumption when in hybrid forms with a plant-based matrix
- **Quantifying the impact on farmers and meat supply chain workers will be a critical part of understanding the broader impact of cultivated meat moving forward** (not in scope of this analysis)
- **This is a key research gap that needs to be filled, but it is a complex topic** – CM is not a simple 1:1 replacement for meat (given emergence of hybrid products), and other structural factors and pressures that farmers are facing will feed into this as well (e.g., climate change, declining farmer populations, farm consolidation & intensification)
- **In the meantime, it will be critical for governments and philanthropies to support a just transition**, including support for shifting practices, ensuring they can benefit from emerging opportunities, and support for re-training / diversification to other sectors if chosen

Sources: 1. The socio-economic impact of cultivated meat in the UK, Oxford Economics (2021)

WHAT IS REQUIRED TO UNLOCK THIS OPPORTUNITY

SYSTEMIQ

Four key unlocks required

Policy & regulation

- **Regulatory approvals for CM products in key regions,** enabling a range of products on the market pre-2030
- **Collaborative & transparent approval processes**
- Significant step-up in **policy support and R&D funding** for CM

Costs & technology

<€10/kg
of CM produced
to be competitive

- Developments in **cell line & process engineering** to enhance yields & reduce costs
- **Food grade cell culture media** to scale to industrial levels
- **CM-specific bioreactors & equipment** – 1.6bn litres bioreactor capacity needed for 1% global market penetration[1]

Investment

Up to
€55bn
annually
2024-50[2]

- Public funding channelled into **R&D and large-scale infrastructure projects**
- **Shared access R&D sites** for start-ups to trial go-to-market volumes
- **Proof of concept of new de-risking funding models for CM** (e.g., blended, LT offtake agreements)
- As market becomes more material, **just transition support** for farmers & meat supply chain workers

Societal acceptance

- Products to meet **performance & price parity**
- **Consumers widely accept CM from a cultural perspective,** as both a safe & natural food
- Commonly **accepted nomenclature for CM products** in key regions

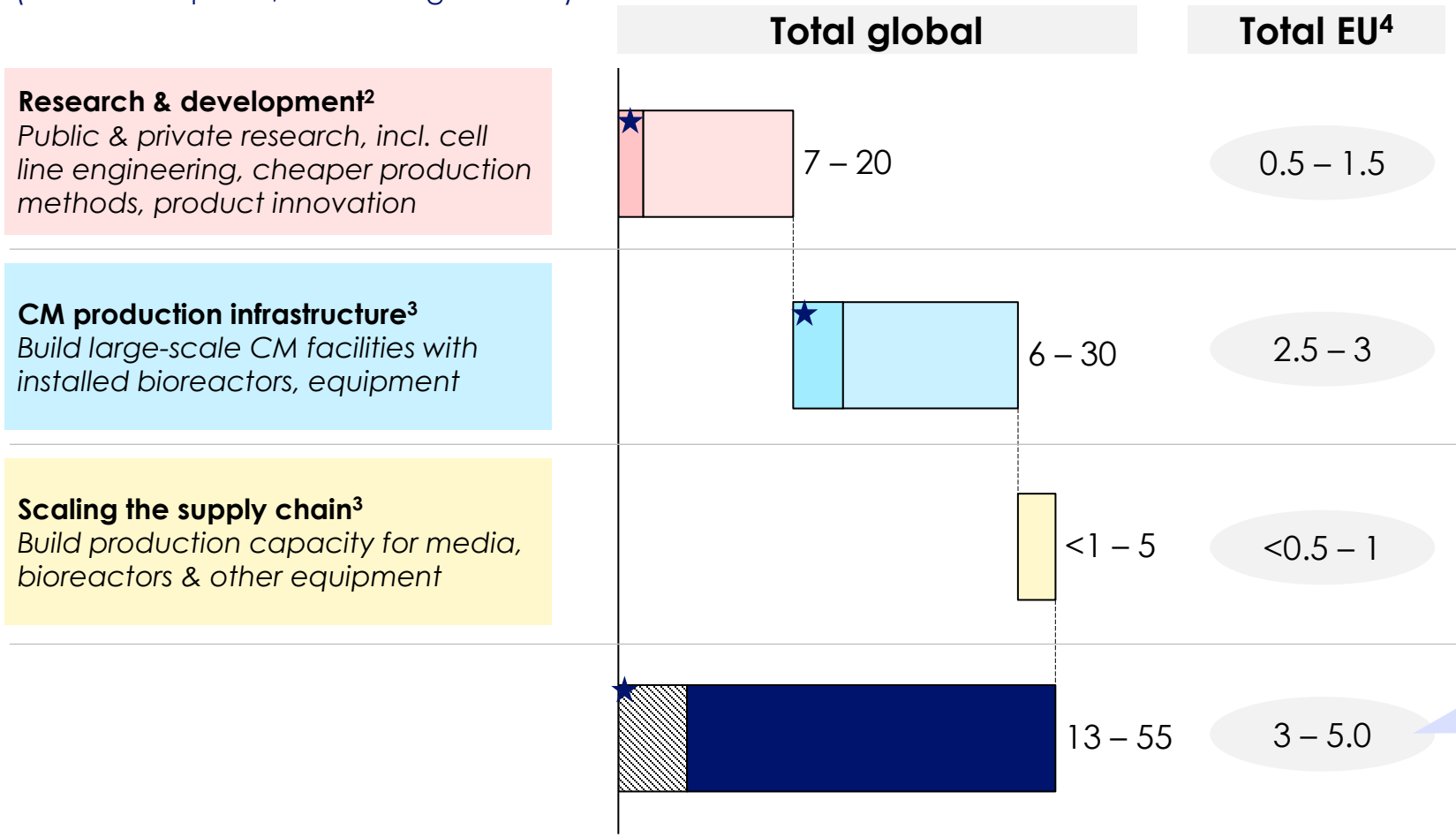
Sources & Notes: 1. Ark Biotech (2021) Bioreactor Gap; 2. Systemiq analysis – see next slide for details

SYSTEMIQ

€500mn public funding required annually in the EU to unlock this opportunity

Total investment (public & private) required to scale CM market[1]

(€bn current prices, annual avg. 2024-50)



Potential public financing models that governments can use:

- Research grants
- R&D subsidies & tax credits
- Venture funding

- Blended de-risking finance (e.g., guarantees, first loss capital)
- Public-private partnerships
- Long-term offtake agreements

- Blended de-risking finance (e.g., guarantees, first loss capital)
- Long-term offtake agreements

~€0.5bn public funding required in the EU *annually (~€5bn public globally) – 60% for de-risking infrastructure build out, and 40% for R&D*

Sources & Notes: 1. Systemiq CM analysis, based on medium and high ambition scenarios only; 2. Based on share of projected sector revenues spent on R&D for similar sectors from Damodaran dataset (2021), plus public R&D investment estimates from GINA (2021) Protein Diversity; 3 . Based on share of projected sector revenues spent on capital expenditures from Damodaran dataset (2021), plus public commercialisation investment estimates from GINA (2021) Protein Diversity. 4. Total EU investment required; the EU's share of global investments calculated directly from market sizes for production infrastructure, with public share of global public funding for commercialisation based on EU's share of production infrastructure markets (calculated by the model). Share of public investment for R&D determined using the EU's total contribution to global R&D spend from 'European Commission (2022) The 2022 EU Industrial R&D investment scorecard'.

SYSTEMIQ

Key takeaways

- **Cultivated meat is an important solution for meeting growing global meat consumption**, while feeding a growing population and respecting planetary boundaries, by helping to unlock the broader alternative protein market

- **Potential for a global cultivated meat market of up to €170-510bn by 2050,** if price and performance parity with traditional meat (but significant uncertainty still remains)

- **€15-80bn in domestic and export opportunities for the EU along the value chain by 2050**, if it chooses to play a leading role in the cultivated meat sector

- **This could bring €20-85bn in GDP and 25-90k new jobs to the EU economy,** as well as material environmental, food security & health benefits

- **The EU needs to create a supportive policy & regulatory environment and help fill key funding gaps (~€0.5bn / year)** to send the right signals to unlock this opportunity and ensure private capital starts to flow

Sources & Notes: Systemiq CM analysis, based on medium and high ambition scenarios only.

APPENDIX

SYSTEMIQ

ANALYTICAL APPROACH & KEY ASSUMPTIONS

SYSTEMIQ

Key principles for the modelling exercise

1. **Cultivated meat sector will follow an s-curve of adoption** – material growth in adoption (i.e. a tipping point) will only occur once price and performance parity with traditional meat is met

2. **Developed a high-level model to avoid 'black box' issues and a multitude of assumptions** – given limited data availability on the cultivated meat sector, we have kept scope and granularity high-level e.g., global production costs/prices, global view on when tipping points occur

3. **Global scenarios for what the future market could look like** – for each scenario, price and performance parity tipping points will occur on different timelines, and for each we will need to define what it will take to come true

Key inputs to the analysis

	Key sources
CM Market Sizes	• McKinsey (2021) Cultivated meat: out of the lab and into the frying pan • BG IRIS (2021) Fermentation, mycoprotein, cellular agriculture • BCG & Blue Horizon (2021) Food for Thought: The Protein Transformation • FOLU (2021) Positive Tipping Points for Food and Land Use Systems Transformation • Systemiq (2023) The Breakthrough Effect • Eurostat & PRODCOM datasets
Costs & Production	• Vergeer (2021) TEA of cultivated meat • Ark Biotech (2023) Cultivated meat's path to price parity • Humbird (2021) Scale-up economics for cultured meat • Garrison et al (2022) How much will large-scale production of cell-cultured meat cost?
Economic Benefits	• Oxford Economics (2021) The socio-economic impact of cultivated meat in the UK • EFPIA (2016) The economic footprint of selected pharmaceutical companies in Europe • MTA (2024) The true impact of British manufacturing • Fuentes-Saguar et al (2021) The Role of Bioeconomy Sectors and Natural Resources in EU Economies • Vergeer (2021) TEA of cultivated meat
Environmental benefits	• Sinke et al (2023) Ex-ante life cycle assessment of commercial-scale cultivated meat production in 2030 emissions factors • Blue Horizon (2020) Environmental impacts of animal and plant-based food • Poore & Nemecek (2018) Reducing food's environmental impacts through producers and consumers • Poore (2023) unpublished data

SYSTEMIQ

Analytical approach

1 Global CM demand & market size

- Developed **global 's-curves' for adoption** of CM between 2020-50 for future scenarios based on:
  - Timelines to reach **tipping points for price & performance parity**
  - **Peak adoption in 2050** - built bottom-up from regional adoption rates
- Estimated what prices are required to reach price parity, and how production costs will come down over time based on techno-economic analyses conducted for CM – based on analysis of key inputs & how their costs change with scale-up (e.g., cell culture media, bioreactors)

2 The EU & country roles

- Established a **view of high potential opportunities for the EU and individual countries (Germany, France, Spain, Poland)** to develop a view on domestic production / consumption markets, and competitive advantages in key input markets including for export (e.g., specialised cell culture media inputs)
- Identified the key **levers and estimated investments required to scale-up the market and realise the domestic and export opportunities**, including R&D investment and regulatory reform

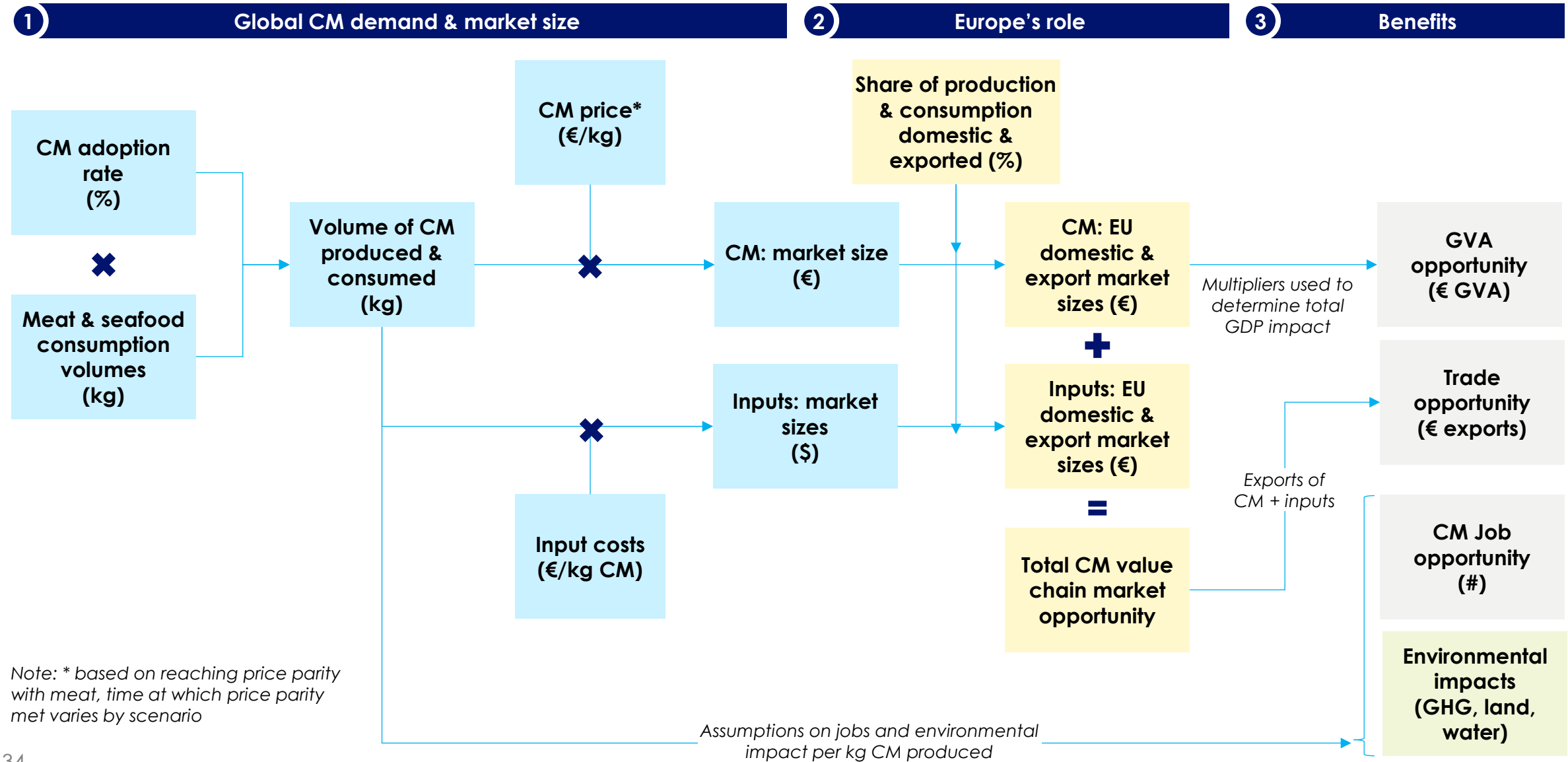
3 Benefits

- Quantified **gross economic upside** of developing CM and input markets by using **multipliers for GVA and employment/livelihoods** (e.g., GVA multiple for UK CM market is 3.7x)
- **Quantified net environmental benefits** - GHG emissions, land-use, & water-use relative to traditional meat

SYSTEMIQ

Analytical approach: key calculations

Replicated across all scenarios and for individual regions / countries



*Note: * based on reaching price parity with meat, time at which price parity met varies by scenario*

Four key scenarios considered

	Current course & speed	Low ambition: CM remains a niche market	Medium ambition: CM & bioeconomy gain momentum	High ambition: CM scales to mass market
Key assumptions:				
Price & performance tipping point	**N/A** Tipping point never reached, regulatory approvals stall further, CM remains niche, expensive product	**~2045** Wider regulatory approvals remain 5+ years out, slowing R&D, scale-up & cost reductions. Premium market meets price tipping point (<€10/kg) before mass market	**2040** Wider regulatory approvals occur within 5 years, premium products breakthrough in early 2030's, reducing key input costs for mass market tipping point	**2035** Regulation progresses efficiently, building on other market approaches (e.g., Singapore), and it becomes cost effective to include a high proportion of CM cells in alt. products
Market growth rates	Pre-tipping point: low growth phase, based on continuation of expected 2023-26 capacity additions[1] Post tipping point: exponential growth phase, based on uptake patterns of other food groups (e.g., rape seed oil, eggs)[2]			
Adoption rates 2050	Total AP adoption[3]: **2%** CM adoption[4]: **0%** Assumes proportions of CM in alternatives are negligible	Total AP adoption: **6%** CM adoption: **0.2%** Assumes alternatives contain up to 15% of CM cells by 2050	Total AP adoption: **37%** CM adoption: **3%** Assumes alternatives contain up to 20% of CM cells by 2050	Total AP adoption: **56%** CM adoption: **9%** Assumes alternatives contain Up to 30% of CM cells by 2050
2050 Global Market Results:				
CM Volume (mn tonnes)	**<1**	**<1**	**20**	**55**
CM Market Size (€bn)	**<1**	**5**	**170**	**510**

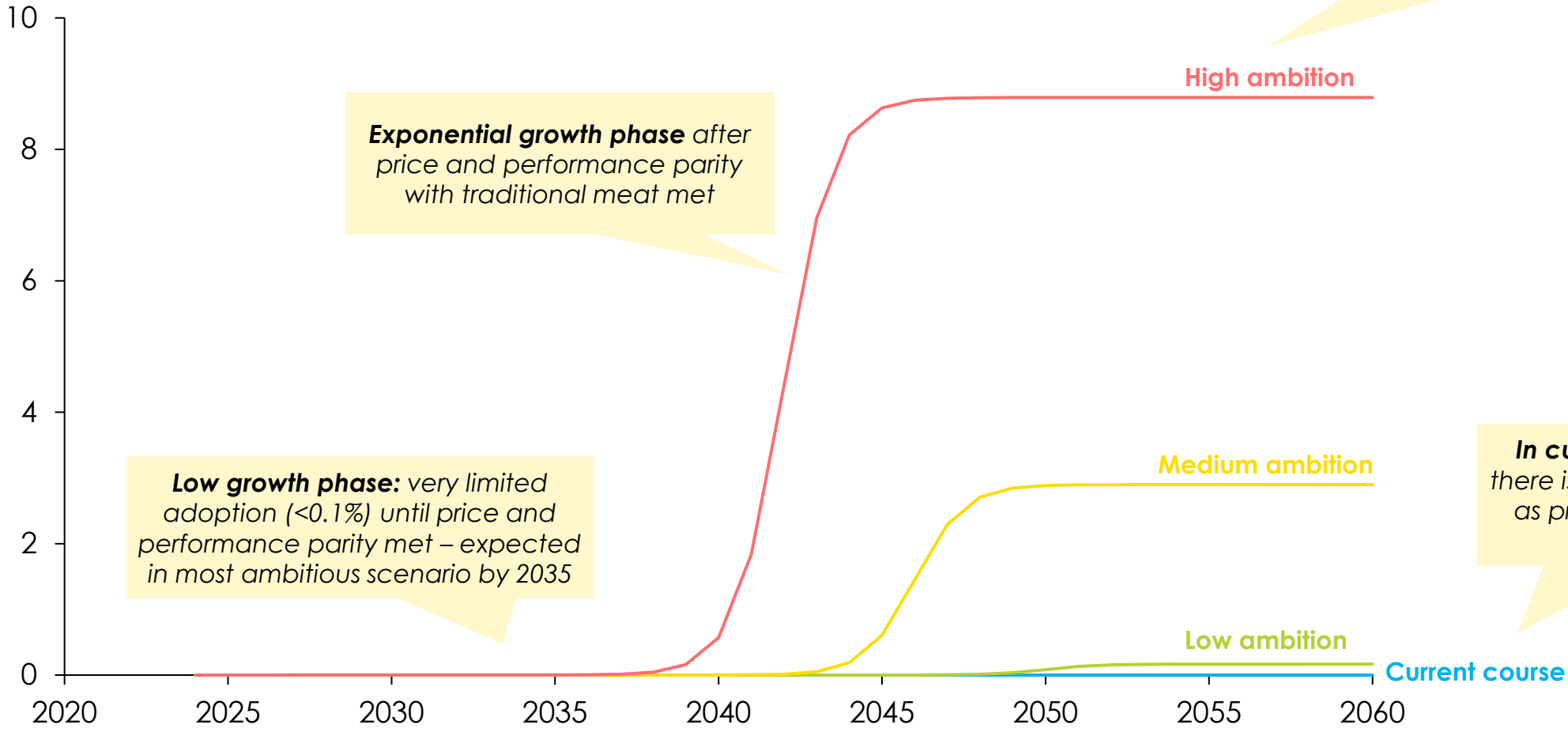
Sources & Notes: Assumptions developed & refined through a series of expert interviews. 1. Based on GFI (2023), Trends in cultivated meat scale-up and bioprocessing; 2. FAOSTAT data; 3. Global adoption of meat/seafood alternatives, primarily plant-based products (some of which will become hybrid with 10-20% share of CM cells) and small proportion of majority CM products; current rates calculated taking averages of existing adoption rate scenarios from multiple papers: BCG (2021) The Benefits of Plant-based Meats; Credit Suisse (2021) The Global Food System: Identifying Sustainable Solutions; Bloomberg (2021) Plant-based foods poised for explosive growth; 4. CM adoption reflects that CM will predominantly be part of hybrid products, where they form a proportion of the final products (rest will typically be plant-based) – the share of CM cells in hybrid products will vary over time and by scenario.

SYSTEMIQ

Global adoption S-curve defined for each scenario

Share of meat and seafood consumption from cultivated meat

(% meat & seafood consumption)



Growth plateaus around a maximum adoption rate of ~9%; *based on assumption that consumers will still choose to eat some traditional meat, and other forms of AP have a role*

Exponential growth phase *after price and performance parity with traditional meat met*

Low growth phase: *very limited adoption (<0.1%) until price and performance parity met – expected in most ambitious scenario by 2035*

In current course & speed, *there is no exponential growth as price and performance parity never met*

Sources & Notes: Systemiq CM analysis; s-curve adoption rate by scenario.

SYSTEMIQ

Regional market assessment & global market breakdown

Region	# companies in CM value chain	Regulatory status	Public funding landscape	Overall assessment	Breakdown of global market (2050)	
					CM	*Meat & seafood*
North America	**54**	**CM products in market** Shorter process, with amenability to innovation, though CM banned in some states	**US** invested **$10M** in a national cell ag. centre in '23, but CM requires more public funding to accelerate the market	**High potential** - lower regulatory barriers, and high private investment but lack of public funding and lower consumer acceptance present barriers to growth	**13%**	**11%**
APAC	**45**	**CM products in market** More efficient processes; SG invested in upskilling, enabling gov't to accelerate CM opportunities	**SG** remains a global leader with **$200M+** since '21 into CM R&D. **China**, **Japan** and **South Korea** are also starting to invest in CM	**High potential** - APAC has the makings of mature CM market due to both strong government support and private investment and high levels of consumer acceptance	**64%**	**52%**
EU	**30**	**1 dossier submitted; Italy banned CM** Lengthy process and strict GM food regulation presents barrier to entry	**EU** allocated **$7M** towards CM in '23, and **NL** & **Germany** pledged **$60M+** and **$40M** towards AP sector in '23. CM requires greater and dedicated funding	**Medium potential** - high consumer willingness and an ecosystem of emerging companies, but faces regulatory hurdles and requires more public funding	**7%**	**7%**
Middle East	**19**	**CM products granted approval to sell** Shorter process with amenability to innovation, Israel approved first CM beef	**Israel** remains a regional frontrunner having invested **$30M+** in CM R&D since '21 and upskilling. **UAE** and **Qatar** are regional players but still lag	**Medium potential** - very high consumer acceptance. Israel stands out in the region due to high levels of private and public investment while other countries lag	**3%**	**3%**
Rest of Europe[1]	**17**	**Companies filed for regulatory approval** Lengthy process but amenability to innovation and planned reforms of novel food regulation to accelerate market entry	**UK** granted **$30M** to various CM R&D programs in '23 demonstrating CM as an emerging priority for the country	**High potential** - lower regulatory barriers, and high private investment, but lack of public funding and lower consumer acceptance present barriers to growth	**6%**	**4%**
Latin America	**6**	**No dossiers submitted** Limited market and regulation development	No significant investment	**Low potential** - Limited progress. Brazil planning to develop regulation around CM	**3%**	**11%**
Africa	**3**			**Low potential** - Limited progress	**3%**	**11%**

Sources & Note: 1. Rest of Europe includes non-EU countries (e.g., UK, Switzerland) 2. Figure refers to UK consumers. Source(s): GFI State of the Industry Report (2023); Innovation Israel; Food Navigator; Perception of cultured "meat" by Italian, Portuguese and Spanish consumers, Lui et al. 2023; US and UK Consumer Adoption of Cultivated Meat: A Segmentation Study, Szejda et. al (2021); Food Navigator Cultivated meat in the Middle East: Low consumer awareness, but huge interest once informed – GOOD Meat; Food Frontier

What will need to happen for each scenario to come true

	Current course & speed	Low ambition: CM remains a niche market	Medium ambition: CM & bioeconomy gain momentum	High ambition: CM scales to mass market
Policy & regulation	• **Anti-CM movement in EU and US gains traction**, with major lobby, labelling challenges and regulatory stalls (e.g., in EU, US)	• **Regulatory approvals take 5+ years** to come through at significant scale in key markets (e.g., EU, US, Asia) • Policy support continues on current trajectory with some, but insufficient funding for R&D	• **Significant regulatory approvals in 3-5 years** in key markets • Policy support for CM and public R&D funding ramps up, helping to unlock key developments	• **Regulatory approvals ramp up rapidly in next 3 years,** with key markets approving wide range of products near-term • Significant step-up in policy support & R&D funding for CM
Costs & technology	• R&D stalls and production costs level off at current levels	• **Production costs come down to <€10/kg CM by 2045, but initial cost reductions slow to materialise** • Culture media prices come down using food grade inputs and new sources for recombinant proteins • Bioreactor capacity & prices remain challenging in the near-term	• **Production costs come down to <€10/kg CM by 2040** • Culture media prices come down with cheaper inputs, and cell line engineering improve media & bioreactor efficiencies • Bioreactor prices come down more quickly, as supply chain scaled up	• **Production costs come down to <€10/kg CM by 2035** • Cell line engineering rapidly improve media use & cell density • Bioreactors & equipment capacity rapidly scaled-up, bringing down costs
Investment	• **Private investments dries up** as regulatory hurdles remain	• **Private investment continues slowly**, but challenges securing scale-up investment remain	• **Investment levels remain slow to 2030**, but once regulatory approvals come through more scale-up funding flows in	• **Material private investment enables rapid scale-up** of production facilities, supporting cost declines • New funding models (e.g., blended, LT offtake agreements) used to help de-risk investments near-term
Consumer acceptance	• **Sizeable share of consumers adopt anti-CM** stance due to health & farmer livelihood concerns	• **Gov't / media support increases transparency** on true health, environmental considerations, etc • **Limited consumer willingness** to pay prices for premium products in select markets	• **Consumers accept CM as core part of PB products** once price and performance parity met, and select premium products	• **Consumers accept CM products as a cheaper and healthier alternative to industrial meat,** with rapid uptake in products after price and performance parity met

SYSTEMIQ

Value chain opportunities for the EU

Value chain	Relevant industry/ sector	The EU	Germany	Spain	Poland	France
Bulk cell media inputs	**Existing pharmaceutical** related production facilities commoditised basal media inputs	**Medium potential** Existing pharma. manufacturing capabilities can be leveraged; but difficult to compete with lower cost production economies in RoW	**Low potential** Difficult to compete with lower cost production economies in RoW, limited role in EU & domestic production	**Low potential** Difficult to compete with lower cost production economies in RoW, limited role in domestic production	**High potential** Existing pharma. manufacturing capabilities can be leveraged to produce lower cost inputs	**Medium-low potential** Gov's focus on domestic pharma manufacturing could encourage more production for domestic use
Specialised cell media inputs	**Biotechnology** related capabilities for specialized, high-value (e.g., growth factors)	**High potential** Mature biotech capabilities including high value, niche biopharma inputs	**High potential** Strong, existing capabilities in biopharma manufacturing	**High potential** Focus on Spain leading in biotech innovation and existing capabilities could be leveraged	**Low potential** Unlikely to compete with EU counterparts with more advanced biotech sectors	**High potential** Focus on France leading in biotech innovation and existing capabilities could be leveraged
Bioreactors	**Relatively basic engineering** for design; **Low-cost manufacturing** required for material scale-up	**Low potential** Difficult to compete with lower cost production economies	**High potential** Strong machinery manufacturing capabilities	**Medium -high potential** Capabilities are high in EU but could be difficult to compete against lower cost production economies in RoW	**Medium potential** Well placed within EU, may be difficult to compete with lower production economies in RoW	**Medium potential** Existing biopharma sector capabilities can be leveraged for niche/ advanced machinery
Processing & scaffold equipment		**Low potential** Difficult to compete with lower cost production economies	**High potential** Strong machinery manufacturing capabilities	**Medium potential** Existing agri-food sector capabilities can be leveraged for niche/ advanced machinery	**Medium potential** Well placed within EU, but difficult to compete with lower production economies in RoW	**Medium potential** Existing agri-food sector capabilities can be leveraged for niche/ advanced machinery
Buildings & infra	**Low-cost land & building infra** - near-term smaller share of costs, but increasing importance over time	**Low potential** Difficult to compete with lower cost production economies	**Medium potential** Existing storage and logistics infrastructure capabilities can be leveraged but large volumes could raise costs	**Medium potential** Existing storage and logistics infrastructure capabilities can be leveraged but large volumes could raise costs	**Medium potential** Well placed within EU, Infrastructure and building costs are low compared to EU counterparts	**Medium-low potential** Existing storage and logistics infrastructure capabilities can be leveraged but large volumes could raise costs
CM Production	**End-market food production** Higher costs due to skilled labour, and production at scale	**Medium potential** Difficult to compete with lower cost production economies in RoW; but role in domestic production	**Medium potential** Difficult to compete with lower cost production economies in RoW but role in EU & domestic production	**Medium potential** Difficult to compete with lower cost production economies in RoW but role in EU & domestic production	**Low potential** Lower production costs, but lack of private sector presence in market presents major barrier	**Medium potential** Difficult to compete with lower cost production economies in RoW but role in domestic production

Sources: Expert interviews; GFI State of the Industry Report (2023), Centre of Strategic and International Studies, Trading economics, Pharmaceuticals Industry Trends France 2022 Atradius, Drugs Shortage Sees France Restart Local Production and Target Antibiotics Use RFI, France's Attractiveness to the Pharmaceutical Industry SNECI, Eurostat, Spanish Foreign Trade Institute (ICEX), European Bank for Reconstruction and Development (EBRD) in Poland, Polish Investment & Trade Agency (PAIH) reports

Domestic & export market potential assumptions

Assessed market potential: High Med Low

Share of market captured (%)		Domestic					Export: intra-EU					Export: ROW				
	Proxy market	EU	Germany	Spain	Poland	France	EU	Germany	Spain	Poland	France	EU	Germany	Spain	Poland	France
Approach	• Analysed historical trade data for proxy markets (defined on slide 39) to define the high, medium, and low ambition archetypes for the proportion of the market that could be met domestically • Assigned countries/regions an ambition archetype according to their existing economic strengths & capabilities and future outlook						• Analysed historical data for proxy markets (defined on slide 39) to identify country/regions existing exports to the rest of the EU and rest of world (RoW) • Applied a multiple (e.g., +/- 7.5%) to the existing share of the export market captured in line with the country's future outlook for that specific market (e.g., Germany can build on its already strong manufacturing sector with the signalled continuation of government support)								
Bulk cell media inputs	Sugar & Vitamins production	60%	40%	40%	75%	60%	-	7%	1%	3%	6%	3%	0.6%	0.1%	0.1%	0.5%
Specialised cell media inputs	Pharmaceutical manufacturing	85%	85%	85%	65%	85%	-	7%	1%	0.4%	6%	19%	3%	0.4%	0.1%	3%
Bioreactors	Machinery production	55%	95%	95%	95%	90%	-	12%	1%	1%	3%	8%	5%	0.4%	0.4%	1%
Processing equipment	Machinery production	55%	95%	95%	95%	90%	-	12%	1%	1%	3%	8%	5%	0.4%	0.4%	1%
CM Products	Meat & fish products	70%	80%	80%	70%	70%	-	1%	1%	0.4%	1%	1%	<0.1%	0.3%	<0.1%	0.1%

Sources: Systemiq analysis of sectoral trade data from Eurostat / Prodcom production, import and export data

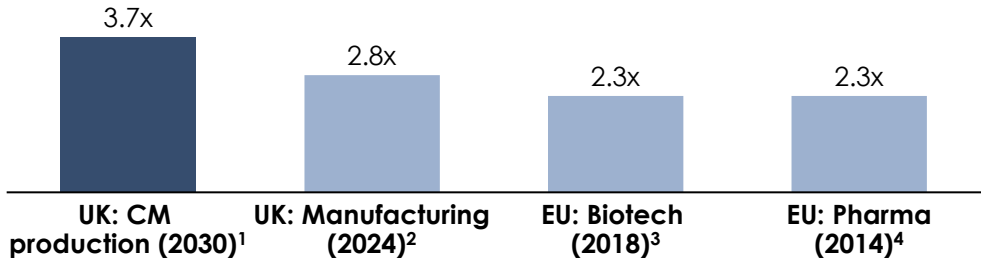
SYSTEMIQ

Key economic assumptions used

Economy

Output multipliers

Total GVA impact per direct € GVA



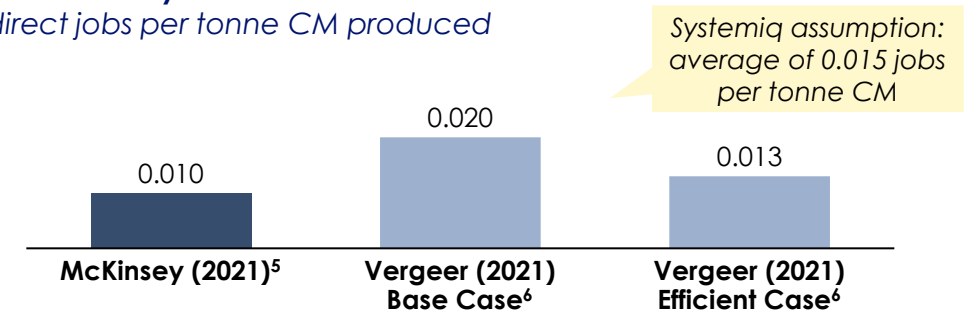
	UK: CM production (2030)[1]	UK: Manufacturing (2024)[2]	EU: Biotech (2018)[3]	EU: Pharma (2014)[4]
GVA Rate (% GVA/Rev)	**~35%**	**~30%**	**~45%**	**~50%**

- **Total GVA contribution** from CM value chain estimated based on: 1) Direct contribution from CM market, 2) Indirect & induced GVA, and 3) additional export opportunities
- Direct GVA contribution calculated from total CM market size using a **GVA rate of ~44%** - estimated based on Systemiq's cost analysis
- Indirect & induced impact calculated from direct GVA **3.7x multiplier** (based on UK CM 2030 estimates) to estimate total GDP impact that CM brings to EU economy
- Export opportunities were not factored into the UK CM multiplier, so these have been layered on top using a similar approach, with proxy markets used to identify GVA rates and multiplier assumptions:
  - CM exports – based on UK CM market
  - Cell culture exports – based on EU Biotech market
  - Production infrastructure – based on UK Manufacturing market

Jobs

Labour intensity

 # direct jobs per tonne CM produced



- **Total job creation** from CM value chain estimated based on: 1) direct job creation in CM production facilities, 2) indirect and induced jobs through the wider CM value chain and economy
- **Direct jobs** were estimated using an assumption of **0.015 jobs per tonne CM** produced, multiplied by total volumes of CM produced under the different scenarios
- **Indirect & induced** jobs calculated using **job multiplier of 2x** (based on UK CM 2030 estimates[1]) – i.e. for every job in CM, another job will be created elsewhere in the economy
- **Job potential may be slightly underestimated** as it does not reflect roles in CM companies outside production (e.g., marketing), and broader export opportunities for cell culture inputs and production infrastructure

Sources: 1. The Socioeconomic Impact of Cultivated Meat in the UK, Oxford Economics (2021); 2. MTA (2024) The true impact of British manufacturing; 3. Fuentes-Saguar et al (2021), The Role of Bioeconomy Sectors and Natural Resources in EU Economies; 4. EFPIA (2016) The economic footprint of selected pharmaceutical companies in Europe; 5. Cultivated meat: Out of the lab, into the fryingpan, McKinsey (2021); 6. Vergeer (2021) TEA of cultivated meat.

SYSTEMIQ

Investment analysis: analytical approach

1 Research & development

- Commercial funding calculated by taking the proportion of global end market revenues that are spent on research and development for sectors with similar characteristics to cultivated meat (using an average of chemicals, pharmaceuticals, healthcare, & food processing sectors)
- Additional public funding needed based on cultivated meat representing ~40% of the total public investment required for the total alternative protein transition, as estimated GINA (2021) Protein diversity
  - *EU's proportion of the global public spend taken as % of global R&D spending within industry (~17% - EU Commission (2022) The 2022 EU Industrial Investment Scorecard)*

2 Production infrastructure

- Calculated the global & EU market private sector spend required to install Bioreactors, Processing Equipment, and Buildings based on the high and low-cost ranges and adoption rates of medium and high ambition scenarios (2023-50)
- Additional public funding needed based on cultivated meat representing ~75% of the total public investment for commercialisation for the total alternative protein transition, as estimated GINA (2021) Protein diversity
  - *EU's proportion of the global public spend for commercialisation taken as % of global infrastructure market from the model (~11%)*

3 Scaling the supply chain

- Calculated global & EU market revenues for key supply chain inputs, (i) production infrastructure (Bioreactors, Processing Equipment, Buildings) and (ii) cell culture media (specialized and bulk inputs) based on the high and low-cost ranges and adoption rates of medium and high ambition scenarios (2023-50)
- Applied an estimate of the proportion of commercial revenues to be spent on capital expenditures to scale the supply chain, using the equivalent sectors as proxies – e.g., machinery used for production infrastructure, biotech for cell culture media

SYSTEMIQ