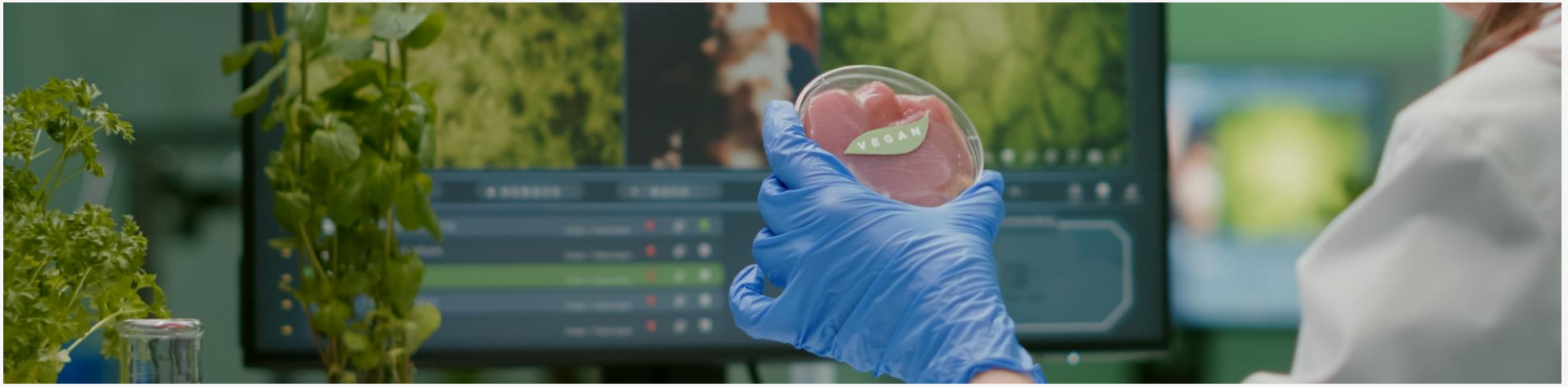
Special Report

Cultivated Meat Industry: Current Status & Way Forward



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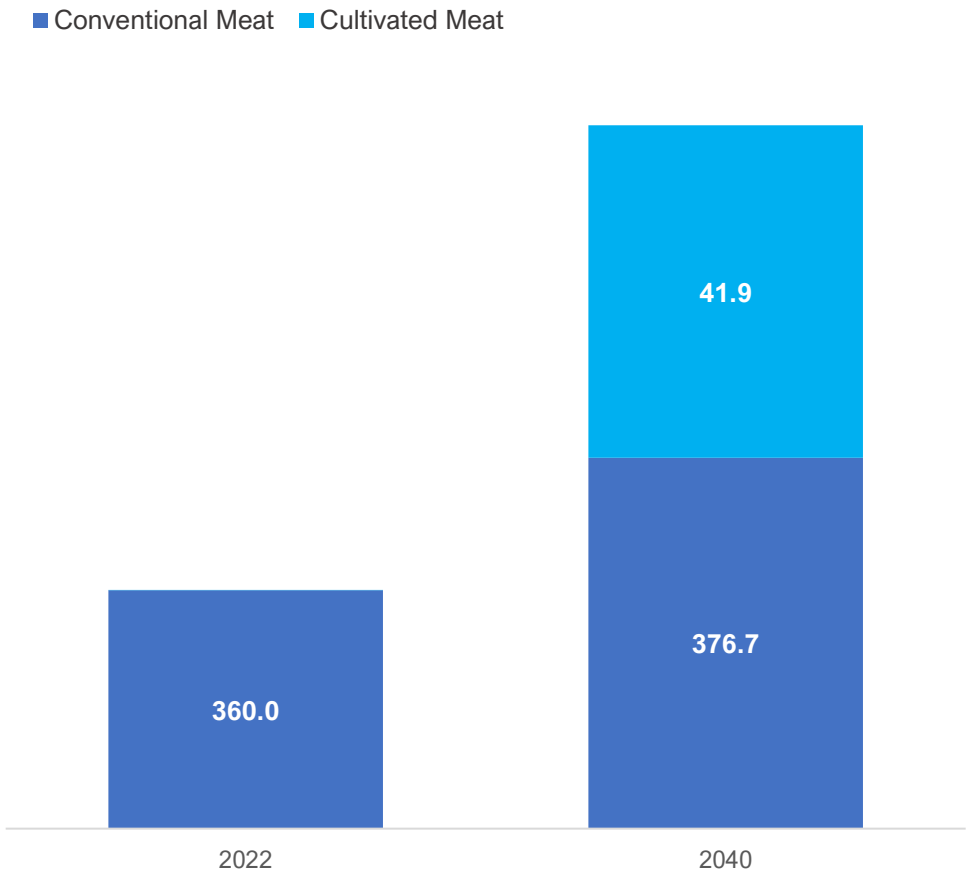
April 2024

Cultivated Meat Market – Potential Market Size

Fueled by growing demand for sustainable and ethical food choices, cultivated meat products are projected to capture 10% share in the global meat market by 2040

Projected Rise of Cultivated Meat Market | Million Metric Tons



The anticipated market size of **~42 million metric tons** for cultivated meat products by 2040 is driven by the following factors:

- **Increasing Demand for Meat**

  The UN's Food and Agriculture Organization (FAO) has estimated the global meat market would grow **~26%** from 360 million metric tons in 2022 to 455 million metric tons by 2050.

- **Environmental Sustainability**

  Conventional meat production is resource-intensive, requiring substantial amounts of land, water, and feed. About **14.5%** of all human-induced GHG emissions are attributable to livestock farming, as per UN's FAO 2013 data.

- **Animal Welfare**

  A 2023 Euromonitor survey indicated that **~36%** of global consumers prefer to buy meat from brands with strong animal welfare commitments.

- **Health and Nutritional Security**

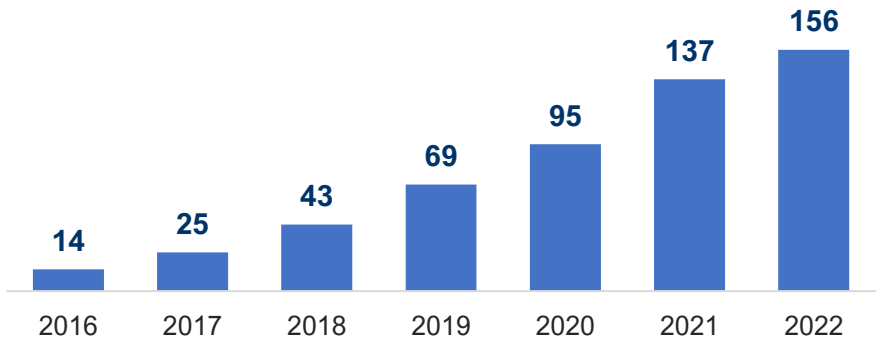
  The regular administration of antibiotics to livestock for preventing disease and enhancing growth has led to the emergence of antibiotic-resistant bacteria, significantly endangering human health.

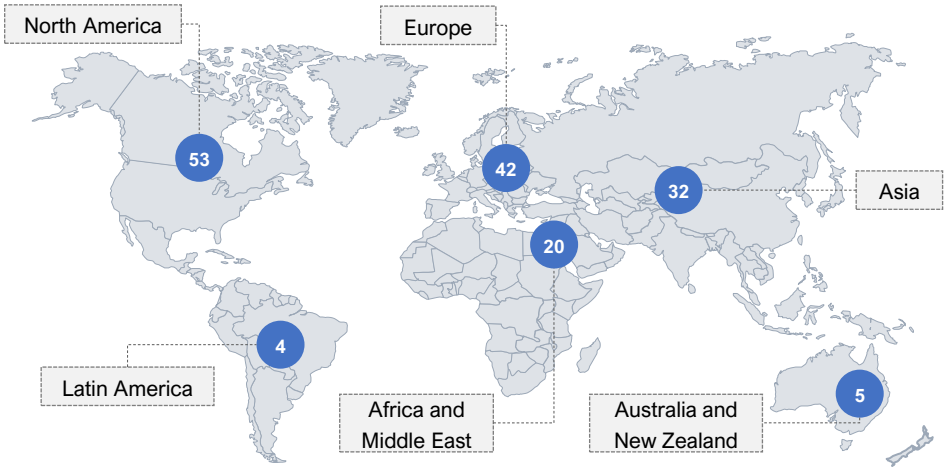
Source: *Secondary Research, Industry Analysis*

Cultivated Meat Market – Industry Proliferation

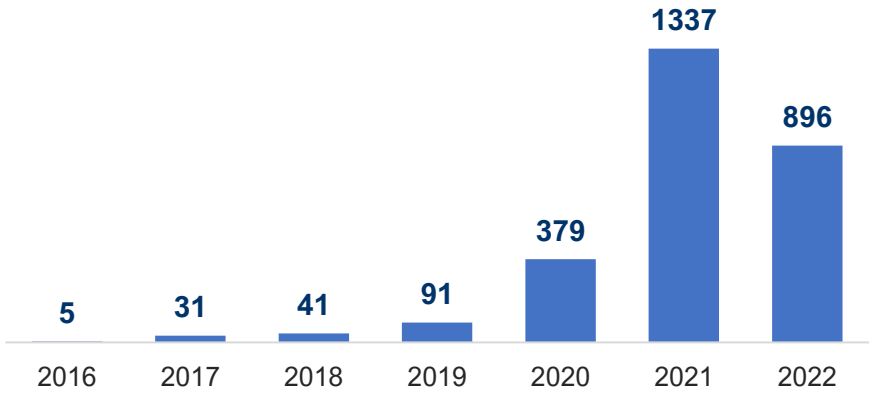
Due to the substantial market potential presented by the cultivated meat industry, a notable increase has been observed in the number of cultivated meat startups and the level of investments allocated to R&D endeavors

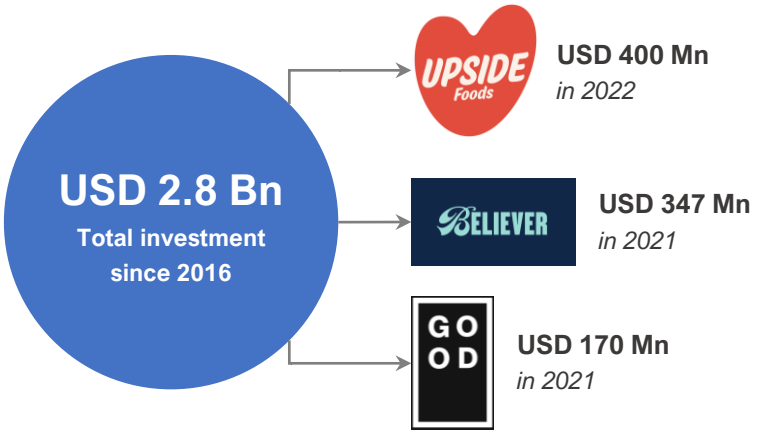
Total Publicly Announced Cultivated Meat Companies by Year Founded





Investments in Cultivated Meat Industry | USD Mn





Source: *Secondary Research, Industry Analysis*

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Advancements in R&D of Cultivated Meat Products

At R&D level, efforts are underway to develop ideal cell lines, optimize growth media, uncover scaling up technologies, and develop support scaffolds, aimed at creating realistic and cost-effective cultivated meat products

Cell Line Development

- Use of adipose-derived stem cells and fibroblasts to achieve diverse cell populations
- Investigation of CRISPR gene editing and metabolic engineering to develop cell lines that exhibit accelerated growth, enhanced maturation, and yield desired fat-to-muscle ratios

Alternate Growth Media

- Development of a cost-effective fetal bovine serum (FBS) alternative Plenty by Omeat
- Development of a nutrient-rich FBS replacement ClearX by Clear Meat
- Development of a serum-free meat cultivation method by Mosa Meat, eliminating the need for FBS

Bioreactor Technologies

- Exploration of perfusion bioreactors to facilitate continuous nutrient supply and waste removal for enhancing cell density and production efficiency
- Successful demonstration of a single airlift reactor to feed 75,000 people annually
- Usage of microfluidic bioreactors for co-culturing diverse cell types, potentially emulating intricate tissue structures

Scaffolds for Growth and Support

- Development of scaffolds using composite hydrogels of alginate and gelatin to mimic meat's natural architecture
- Use of soy protein isolate (SPI) in 3D printing edible scaffolds for intricate meat structures
- Use of soy protein amyloid fibril scaffolds
- Development of composite scaffolds consisting of soy protein and cellulose nanofibrils
- Use of decellularized spinach leaves as a scaffold for cultivating bovine muscle cells (BSCs)
- Investigation of engineered protein scaffolds from dextran to regulate BCS differentiation
- Development of 3D edible scaffolds with soy conglycinin amyloid fibrils and chitosan
- Development of animal-free scaffolds from brown algae for steak-like cultivated meat
- Development of pea protein isolate scaffolds for BSC cultivation
- Use of 3D printed prolamin scaffolds for cultivating meat from muscle stem cells
- Fabrication of glutenin into films for muscle-like textured cultivated meat
- Development of novel edible scaffolds using proanthocyanidins and dialdehyde chitosan crosslinked with yeast proteins

Source: *Secondary Research, Industry Analysis*

Commercial Milestones by Meat Cultivators Since January 2023: A Snapshot

The cultivated meat industry has seen two companies secure full product approvals since January 2023, and over 10 companies have claimed successful development of meat products

Regulatory Milestones

Aleph Farms

In January 2024, Israel's Ministry of Health approved Aleph Farms to debut its first Aleph Cuts product "the Petit Steak"

UPSIDE Foods

Upside Foods secured USDA approval for its cultivated chicken in June 2023

Development of New Products

3DBT

In February 2023, **3D Bio-Tissues** announced the development of the "world's first" 100% cultivated pork steak.

MIRAI FOODS

In February 2023, **Mirai Foods** cultivated the "first thick cultivated steak" using its proprietary fibration technology platform.

FORK&GOOD

In March 2023, **Fork & Good** showcased its cultivated ground pork product in dumplings and tacos.

TissenBioFarm

In March 2023, **TissenBioFarm** introduced a 10 kg cultivated meat prototype at the inauguration of the North Gyeongsang Cellular Agriculture Industry Support Center, South Korea.

极廩

In March 2023, **Jimi Biotech** claimed to have developed China's first 100% cultivated chicken, made without using plant scaffolding.

MAGIC VALLEY

In March 2023, **Magic Valley** unveiled the successful development of a cultivated premium pork product, showcased in filled dumplings.

Re=Meat

In July 2023, **Re:Meat** introduced the first cell-cultured Swedish meatball, cultivated using its patent-pending serum-free technology.

Steakholder FOODS

In April 2023, **Steakholder Foods** 3D bioprinted the "world's first" whole fillet cultivated fish.

MEATABLE

In May 2023, **Meatable** revealed its capability to cultivate high-quality pork meat in just eight days.

MEWERY growing meat with love

Mewery successfully developed a cultivated pork prototype using its proprietary microalgae-based growth medium in February 2023. Furthermore, it developed the "first-ever" cultivated burger made with pork and microalgae cells in June 2023.

myriameat

In December 2023, **MyriaMeat** claimed to successfully cultivate 100% "real meat" from stem cells.

Source: *Secondary Research, Industry Analysis*

Developments in Commercial Space: Since January 2023 (1/3)

The industry has observed significant activity in terms of commercial partnerships, primarily centered on R&D initiatives, growth media procurement, and expansion of production capabilities

In December 2023, **Multus** and **New Wave Biotech** collaborated to scale the production of cultivated meat more quickly and effectively using the latest in AI technology. New Wave's software would help Multus create virtual experimentation on thousands of processes, leveraging real-life data for continual improvements. The AI eliminates unviable processes, accelerates R&D, lowers development costs, and ultimately improves costs.

In December 2023, **BSF Enterprise** and **CellRev** formed a JV, **Cultivated Meat Technologies Limited**, to mass produce cultivated meat. The JV would merge CellRev's continuous bioprocessing expertise for faster, cheaper, and sustainable muscle cell production with 3DBT's leading knowhow in forming meat tissue and its City-Mix™ animal-free cell culture supplement. City-Mix™ is currently employed in cultivating skin, muscle, and fat cells for use in lab-grown meat production.

In December 2023, France's first cultivated meat startup **Vital Meat** announced a partnership with Europe's one of the largest cell culture media producers **Biowest** to scale the production of cultivated chicken. Biowest has developed a customized serum-free medium for Vital Meat's cultivated chicken platform that has allowed it to achieve successful pilot productions of cultivated chicken in 250-liter bioreactors.

In November 2023, **Magic Valley** announced plans to amplify its production capacity by expanding its operations to a state-of-the-art pilot facility at **Co-Labs**, an innovation hub and co-working laboratory. Magic Valley aims to scale up capacity to 3000-liter bioreactors and ramp up its production capacity to 150,000 kg of cultivated meat annually. The new facility would also enable Magic Valley to foster innovation and efficiency.

Source: *Secondary Research, Industry Analysis*

Developments in Commercial Space: Since January 2023 (2/3)

The industry has observed significant activity in terms of commercial partnerships, primarily centered on R&D initiatives, growth media procurement, and expansion of production capabilities

In November 2023, **Newform Foods** (previously Mzansi Meat) and the engineering giant **Project Assignments** announced their partnership to install a demonstration facility for cultivated meat products. Newform Foods aims to expand its business model by offering meat manufacturers, cultivated meat producers, and retailers end-to-end solutions for developing cultivated meat in their existing facilities.

In October 2023, South Korean biotech **SeaWith** and Icelandic molecular farming company **ORF Genetics** announced a partnership to accelerate cultivated meat production with plant-based growth factors. The collaboration would secure SeaWith a stable supply of ORF Genetics's animal-free growth factors to economically develop sustainable meat. SeaWith aims to introduce cultivated beef developed from the cells of Korean native Hanwoo breed, under the brand "Welldone," to the market by 2025.

In September 2023, **The Cultivated B** announced a partnership with biotech and biomaterials company **denovoMATRIX** to explore the possibilities of economically scaled up meat cultivation for commercial purposes. They plan to conduct a joint feasibility study using microcarriers to overcome the limitations of growing cells in suspension, with the end goal of establishing pilot-scale cell manufacturing that can be adopted as a standard to cultivate meat at scale successfully.

In July 2023, **Ivy Farm Technologies** and **Finnebrogue** announced the "world's first" partnership to develop and sell cultivated Wagyu beef burgers in the UK. The new venture aims to leverage Finnebrogue's award-winning Wagyu cattle and Ivy Farm's cultivated meat expertise to meet demand for Wagyu meat while also reducing the environmental impact of its production. The collaboration plans to address growing demand for meat with a sustainable alternative.

Source: *Secondary Research, Industry Analysis*

Developments in Commercial Space: Since January 2023 (3/3)

The industry has observed significant activity in terms of commercial partnerships, primarily centered on R&D initiatives, growth media procurement, and expansion of production capabilities

In July 2023, **Magic Valley** announced the signing of an MoU with **Biocellion SPC**, a software developer and computer modeling company for life sciences to research cell behavior in bioreactor tanks and advance bioreactor technology. The goal is to economically scale up the production of cultivated meat, reducing the cost of the end-product.

In May 2023, **Aleph Farms** announced a long-term agreement with **Thermo Fisher Scientific** to establish a supply chain for growth media and make the cultivated meat production cost-efficient. The agreement would allow Thermo Fisher Scientific to mass manufacture Aleph Farms' specific formulations for growth media and become an industry supplier, furthering Aleph Farms' mission to provide solutions that benefit the entire sector.

In April 2023, **ADM** and **Believer Meats** signed a non-exclusive MoU to broaden the protein ecosystem by collaborating on the development of new cultivated meat products to meet growing consumer demand. The companies aim to collaborate on cultivated meat production, leveraging ADM's ingredient resources and nutrition expertise to enhance Believer's proprietary cell-cultivated meat process.

In February 2023, **CellX** and **Tofflon** announced a strategic agreement partnership to build China's first pilot facility for cultivated meat production. CellX, leveraging its cell line development and serum-free media proficiency, coupled with Tofflon's advanced biological equipment and production capacity, plans to expand its suspension cell lines in thousand-liter bioreactors equipped with Tofflon's digital management systems at the pilot facility.

Source: *Secondary Research, Industry Analysis*

PESTLE Analysis: Cultivated Meat Industry

Cultivated meat, positioned as a sustainable solution with regulatory and political hurdles, faces resistance from consumers with health and financial concerns, but boasts potential for growth with technological advancements

Political

- Cultivated meat presents itself as a potential solution to the food security and sustainability concerns raised by UN's FAO, WEF, the European Commission, and several national governments
- Several nations support the cultivated meat industry financially and through policy
- However, concerns continue to rise in 12 European nations regarding lab-grown meat's impact on traditional food production methods and potential public health risks

Economic

- Cultivated meat remains costlier than its traditional counterpart due to higher production costs and its current phase of early-stage development
- Cultivated meat is expected to achieve price parity with traditional meat through advancements in cell culture techniques, the development of more efficient bioreactors, and a shift to large-scale production facilities

Social

- While cultivated meat offers a more sustainable approach to meat production, its unfamiliar, lab-based origin could trigger consumer unease and hesitation
- Religious reservations among some consumers further complicate cultivated meat's adoption
- Social acceptance would heavily rely on consumer education, clear regulations, transparent labeling, and a gradual introduction

Technology

- The technological landscape for cultivated meat is rapidly evolving, with a heavy focus on cell line development, growth media development, bioreactors, and scaffolding technologies
- The industry is implementing AI to carry out virtual experimentation by leveraging real-life data to accelerate research and enhance production efficiency
- AI is being used to optimize process variables, enhancing cell growth and quality control

Legal

- Cultivated meat, as an emerging laboratory-based food product, is subject to rapidly evolving regulations pertaining to quality control, food safety, labeling, and other related aspects in various countries
- Singapore and the US have established frameworks, while countries like Canada, Israel, Japan, South Korea, and the European Union are actively developing their own regulations

Environment

- Cultivated meat offers considerable environmental advantages over conventional production, potentially reducing methane emissions, deforestation, biodiversity loss, water use, pollution, and antibiotic resistance while mitigating foodborne illness risk
- The cultivated meat industry could limit the climate impact of traditional meat by up to 92%, reduce air pollution by up to 94%, and use up to 90% less land

Source: *Secondary Research, Industry Analysis*

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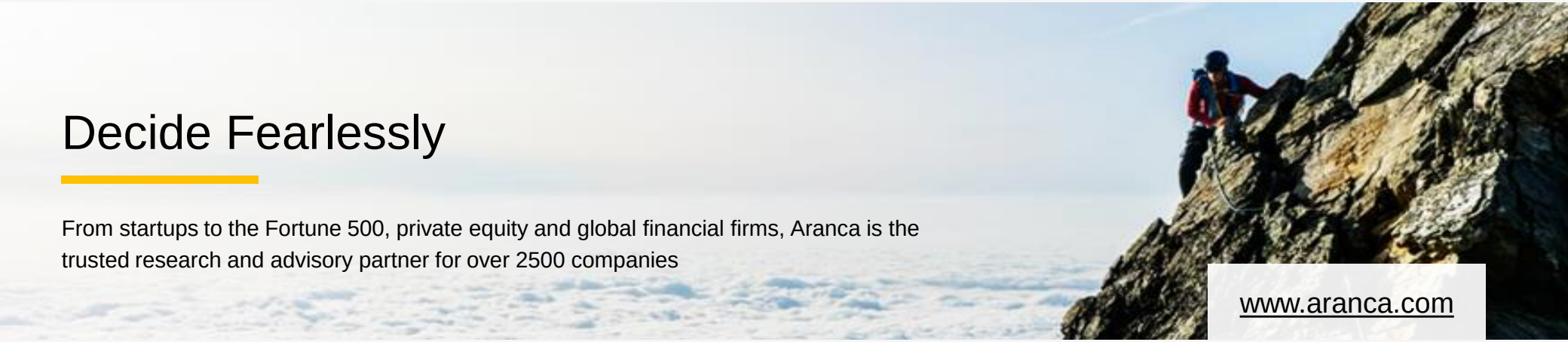

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