

2023



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Friedman School of
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**FOOD AND NUTRITION
INNOVATION INSTITUTE**

Boston Foodtech

A multi-billion-dollar industry cluster offering tech-based goods and services to businesses and consumers across the food supply chain



† includes acquisitions, IPOs, and SPACs
* food & beverage industry = primary market
** food & beverage industry = primary or key market

Boston Foodtech 2023

The 2023 Boston Foodtech report is being presented in collaboration with:

David Goodtree, CEO, FoodGraph and (former) Entrepreneurship Advisor of the Tufts Food & Nutrition Innovation Institute

David first raised the idea with Tufts that Boston is a world-class foodtech cluster worthy of deeper research. He defined the research methodology used in this report, supervised the first-round of research, and shared valuable insights throughout the effort. David's contribution to the project is beyond measure. We wish him and FoodGraph, a Boston foodtech startup, every success with the company's exciting new platform of US food products data and applications.



Lauren Abda, CEO, Branchfood, and Council Member, Tufts Food & Nutrition Innovation Institute; Carole Sioufi, COO, Branchfood.

Lauren and Carole both contributed critical input, ideas, and connections that informed the list of companies that are the foundation of this report as well as generous amounts of time sourcing and editing content, and guiding student research. Branchfood has served as a convening voice and platform for food innovators and entrepreneurs since 2013 and we deeply appreciate their collaboration and insights.



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Executive Summary

The Boston foodtech industry is a thriving and large economic cluster, serving customers across the breadth of the supply chain with global impact. The cluster is the product of several technology verticals, centralized in Boston, but spread out across Greater Boston and other regions of Massachusetts. The companies in this cluster are applying their expertise to one of the most essential systems in the world- food.

By any measure, the size of the cluster and its successes are extraordinary, due in part to the well recognized individual successes of biotech, robotics, and AI. This report brings the Boston foodtech cluster into clear view and demonstrates the power of systems change when technologies are applied in combination to real world challenges.

Boston Foodtech by the numbers:

- 138 foodtech companies, 125 with Massachusetts HQ.
- 13,655 employees globally, nearly 5,000 in Massachusetts.
- \$8.3b capital raised between 2019 and 2022.
- 16 successful exits between 2019 and 2022 (including acquisitions, IPOs, and SPACs) by "Primary Market" companies.

This world-class cluster is seeded by Boston's strong ecosystems in related industries, especially biotech, robotics, software, and data science. At the foundation of these ecosystems, Boston's research universities produce highly trained talent and breakthrough intellectual property that lead to new ventures and a labor pool that is always replenishing.



Executive Summary

Foodtech is a recent term with many definitions. We define foodtech as:

The application of software, hardware, and/or hard sciences to deliver value anywhere in the food supply chain, from farm to consumption.

The Boston foodtech cluster is also notable because it shows strength across the breadth of the supply chain in:

- Agriculture & Food Processing
- CPG, Wholesale, & Retail
- Restaurant & Food Service
- Home & Work
- R&D & Entrepreneurship

To represent the cluster's structure, we developed an original taxonomy, comprised of the 5 sectors above plus 15 sub-sectors. We believe this classification system can also be applied to understanding foodtech clusters in any geography.

This report is the first geographically focused foodtech study in the US. Other US-based studies have explored foodtech in specific technology areas, such as agtech, but no other studies we found describe foodtech in one geography, such as Chicago, NYC, or Silicon Valley.

By looking at foodtech in one metro area and across the supply chain, this research demonstrates that talent and IP in related sectors (like biotech and robotics) result in novel innovations, promote company formations, and foster a larger, more expert talent base.



Executive Summary

Our research methodology qualified companies using strict inclusion criteria.

Geographically, for a company or organization to be included, it had to have a specific type of presence in Massachusetts, defined by either its global headquarters, US headquarters, or a clearly identified R&D or office location in Massachusetts.

To qualify companies and organizations as “foodtech”, we used their website description of market(s) served, screening for food and beverage sectors (e.g. agriculture, CPG, retail) or applications.

We classify companies as either “primary market” or “multi-market”.

- “Primary market” companies self-identify food & beverage as their primary or only market.
- “Multi-market” companies self-identify food & beverage as one of its top markets.

We named this study “Boston” because it’s the hub of the regional economy.

Companies included in this report must list their headquarters, major office or R&D location in Massachusetts. We also use the term “Greater Boston,” as the collection of companies stretches geographically across Greater Boston and in a few instances, across the state. When referring to employees, we refer to Massachusetts as we are most interested in the total number of jobs in the Commonwealth.

See Appendix A for full details about the methodology for inclusion, data sources, and more.



Defining Foodtech

Foodtech

The term “foodtech” has gained prominence in the food & beverage industry, but its meaning varies widely. Some definitions limit the meaning to alternative proteins, or agtech, or eCommerce. We prefer to see foodtech broadly:

Foodtech is the application of software, hardware, and/or hard sciences to deliver value anywhere in the food supply chain, from farm to consumption.

Key to this definition is that a foodtech company has technology as part of its core value proposition. While most companies use technology, often in novel ways, their technology applications are not the basis of their goods or services. For example, we do not consider companies such as BJ’s Wholesale Club or Dunkin’ as foodtech companies, even though they are advanced users of technology (and are headquartered in Greater Boston).



**BOSTON
FOODTECH**
2023

Taxonomy

Our research found that in Greater Boston, foodtech companies span the entire supply chain. To develop a taxonomy, or company classification system, we studied 46 research reports (listed in Appendix B) from industry and financial analysts. In general, these taxonomies classify foodtech companies by technology type.

We chose instead to create a taxonomy that positions the markets served at the highest level. We believe that technologies, while enabling and exciting, are not the goal. Instead, the objective of tech is to serve market needs, so we believe that putting customers at the top is the best way to represent a cluster's breadth.

Using this approach of customers first, we identified 5 major sectors:



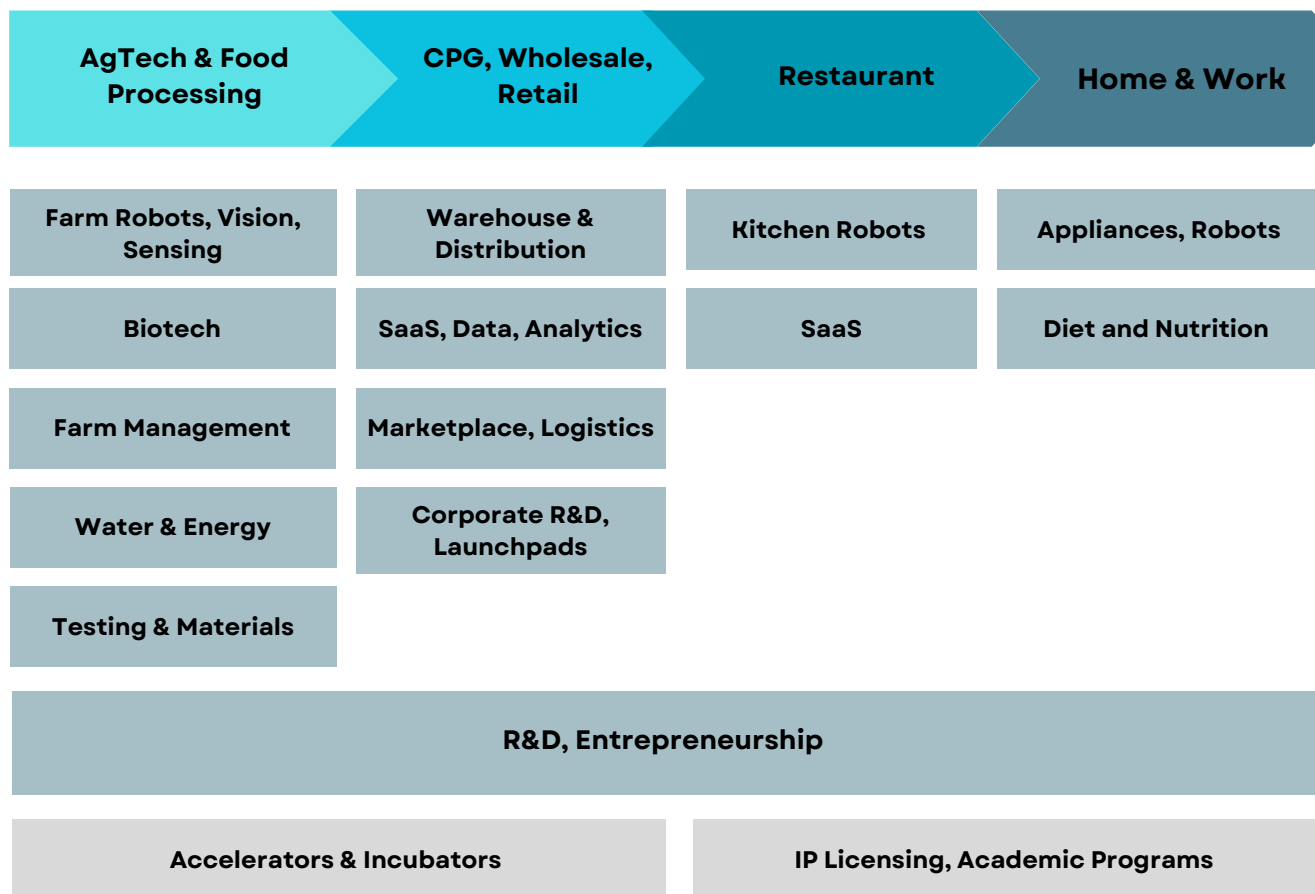
In the table above, the top row shows 4 primary markets that comprise the food supply chain, plus 1 market in the row below that enables the others. We chose this taxonomy because:

- Foodtech applications in each sub-sector are the drivers of success.
- Healthy clusters have a foundation of a robust R&D and entrepreneurship sector.

Taxonomy

We further identified 15 sub-sectors that represent the strengths of the Boston Foodtech cluster, as shown in the gray boxes in Figure #1.

FIGURE #1: SECTORS & SUB-SECTORS



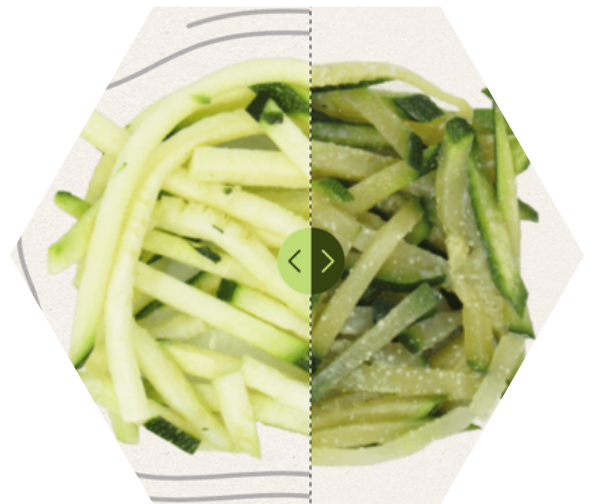
AgTech & Food Processing

Foodtech in this sector serves farmers, food processors, and others by providing technology applications to:

- Enhance food production efficiency
- Optimize manufacturing processes
- Increase food safety and traceability
- Develop novel ingredients
- Create new packaging solutions
- Formulate new products
- Use natural resources efficiently
- Prevent and manage food waste
- And other use cases

The Greater Boston cluster features these Agriculture & Food Processing sub-sectors:

Farm robots, vision, & sensing	Machines that augment human labor, enhance productivity in agriculture, and food processing.
Biotech	Crop enhancement, plant improvements, traditional breeding techniques, genetic engineering, microbial fermentation, cellular agriculture, precision nutrition, pathogen & pest management, flavor formulation.
Farm Management	Hardware and software systems for indoor & outdoor farm management.
Water and Energy	Irrigation technology, ag and food processing, water treatment, renewable ag energy, refrigeration, and power technologies.
Testing and Materials	Biological & chemical analysis, DNA testing, analytical equipment, novel packaging, and food safety.



Mori combats food waste and keeps food fresher through the application of a natural silk protein layer that prevents drying. The image above shows zucchini preserved with Mori and without. Mori's technology increases shelf life and reduces the need for single use plastic waste.

Mori was launched by university researchers and students from both Tufts University and MIT. Mori also received funding from the Massachusetts Clean Energy Center and received support and expertise from The Engine.

CPG, Wholesale & Retail

Foodtech in this sector serves brands, wholesalers, and retailers (physical and/or online) by providing technology applications to:

- Enable product development
- Manage inventory
- Enhance order fulfillment
- Optimize supply chains
- Automate processes
- Analyze consumer experience and needs
- Measure performance
- Refine marketing strategies
- Monitor performance and analyze consumer experience
- And other use cases

The Greater Boston cluster features these CPG, Wholesale, and Retail sub-sectors:

Warehouse & distribution robots	Automated picking, packing, and transporting boxes and pallets for order fulfillment, retailing, and inventory management.
SaaS, data, & analytics	Software, data and integration services to enable commerce, market research, customer insight, merchandising, productivity, and customer experience.
Marketplace and logistics	Platforms for buying and selling consumer products, and fulfilling and delivering orders.
Corporate R&D and launchpads	Product manufacturing and packaging innovations, go-to-market planning for new technology.



All of Amazon's warehouse robots that drive the order fulfillment process are designed and manufactured in two locations in Greater Boston. This stronghold in Massachusetts began with a 2012 acquisition of Boston-based Kiva Systems, a pioneer in the warehouse robotics space.

Amazon Robotics has revolutionized how large warehouse order fulfillment is operationalized. The addition of Whole Foods to the Amazon portfolio expands Amazon Robotics' mandate to innovate in cold storage supply chain technology and automation of food handling, packing and inspection. Amazon Robotics announced the expansion of its operations in Massachusetts in October 2021 with the opening of a new 350,000 square foot facility in Westborough, MA.

Restaurant and Food Service

Foodtech in this sector serves restaurants and food service operators by providing technology applications to:

- Automate food preparation, cooking, and serving
- Streamline operations
- Lower costs
- Increase management efficiency
- Improve employee retention
- Enable digital ordering
- Improve customer experience
- Deliver innovative dining experiences
- And other use cases



The Greater Boston cluster features these Restaurant & Food Service sub-sectors:

Kitchen Robots	Food and beverage preparation machines for restaurants and hospitality.
Saas	Software for inventory control, labor management, ordering, payments, corporate sales, and customer loyalty.



Toast has a focus on hospitality, equipping restaurants with the technology to automate processes that save time and costs. Founded locally by Steve Fredette, Aman Narang, and Jonathan Grimm in 2012 in Cambridge, the company combines cloud-based software and restaurant-grade hardware into an all-in-one platform that is intended to improve operations, enhance the guest experience, and increase employee retention.

Toast is a major player in the restaurant management software market in North America, which is expected to grow at a CAGR of 14% or \$3b between 2020 and 2025. The company went public in 2021 with a market cap at almost \$20b, making it Boston's largest IPO valuation ever.

Home and Work

Foodtech in this sector serves the consumer market by providing technology applications to:

- Improve cooking processes
- Understand food products and ingredients
- Make personal food choices based on health and other preferences and requirements
- Plan meals and dining experiences
- And other use cases

The Greater Boston cluster features these Home & Work sub-sectors:

Appliances and Robots

Smart cooking and beverage preparation, automated storage, and allergen detection devices.

Diet and Nutrition

Meal planning, restaurant search, food ratings, personalized food and nutrition programs, software applications for weight management and disease prevention.



SharkNinja is a multi-billion-dollar consumer brand headquartered in Needham, Massachusetts. SharkNinja products are used in kitchens across the globe, providing affordable appliance options for the home chef. SharkNinja was born in 1994 under the leadership of Mark Rosenzweig and offers an array of products from blenders and smoothie mixers to air fryers, many of which have become social media darlings for healthy cooking and eating. SharkNinja employs over 800 Massachusetts residents and amplifies the Boston foodtech ecosystem by releasing innovative products, year after year.

R&D and Entrepreneurship

Foodtech in this sector serves entrepreneurs, students, researchers, and companies by providing technology resources, graduates, and community for:

- Technical and business education
- Community for connecting with researchers, entrepreneurs, and customers
- Catalogs of intellectual property to develop novel products and services
- Basic and applied research
- Collaboration and partnerships

The Greater Boston cluster features these R&D and Entrepreneurship sub-sectors:

Accelerators and Incubators

Startup launch, business plan development, test and production kitchens, labs and co-working spaces, mentorship, fundraising, community events, networking.

IP Licensing and Academic Programs

Innovation catalogs, applied education, interdisciplinary R&D, internships, industry sponsorships, and competitions.



Tufts University is an R-1 research institution with a growing portfolio of intellectual property in food system innovation. Included in this portfolio is Dr. David Kaplan and the Kaplan Lab at the School of Engineering, recently awarded a \$10 million grant by USDA to further the field of cultivated meat. The Silk Lab at Tufts, established and run by Dr. Fiorenzo Omenetto, is pioneering the application of edible silk technology for food preservation, and the Wolfe Lab, led by Dr. Benjamin Wolfe, is leading research on the microbiome of fermented foods.

Tufts University spans ten unique schools including the Friedman School of Nutrition Science and Policy, the only graduate school for nutrition science and policy in the US; the Cummings School of Veterinary Medicine, which is innovating animal husbandry and understanding of soil science; and Fletcher, which plays a leading role in international policy, including the global food supply chain. All ten schools at Tufts are involved in food system innovation, making Tufts a leader in Boston foodtech.

Boston Foodtech Cluster

138 Companies Across the Value Chain

The Boston Foodtech cluster is large and the metrics below demonstrate its strength. In 2022, the Boston Foodtech cluster represented 138 business, including:

94 “primary market” companies

44 “multi-market” companies

“Primary market” vs. “Multi-market” Companies

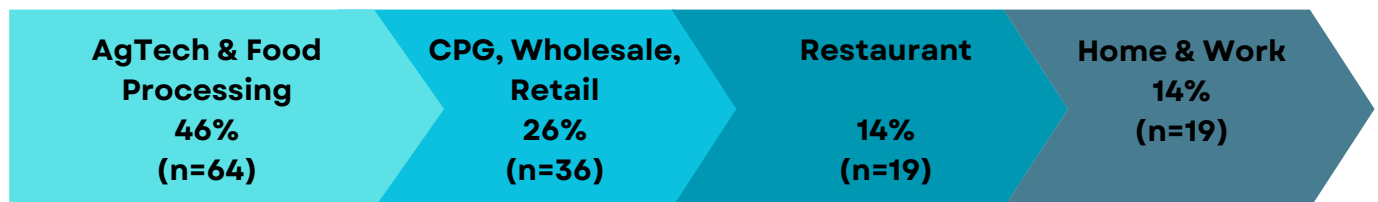
All 138 Boston foodtech companies serve either food & beverage industry customers (like farms and retailers) or home and work applications related to food (like food delivery platforms and kitchen robots). The 138 companies represented do not include the additional 14 organizations listed under “R&D and Entrepreneurship”.

The sub-group of 94 “primary market” companies serve these customers as their primary or only market. Examples include Bevi, ezCater, Indigo Ag, and Toast.

The sub-group of 44 “multi-market” companies serve these customers as one of their top industries. Examples include Ginkgo Bioworks, Perkin Elmer, Salsify, and SharkNinja.

See Figure #2 for distribution of the 138 Boston foodtech companies by sector.

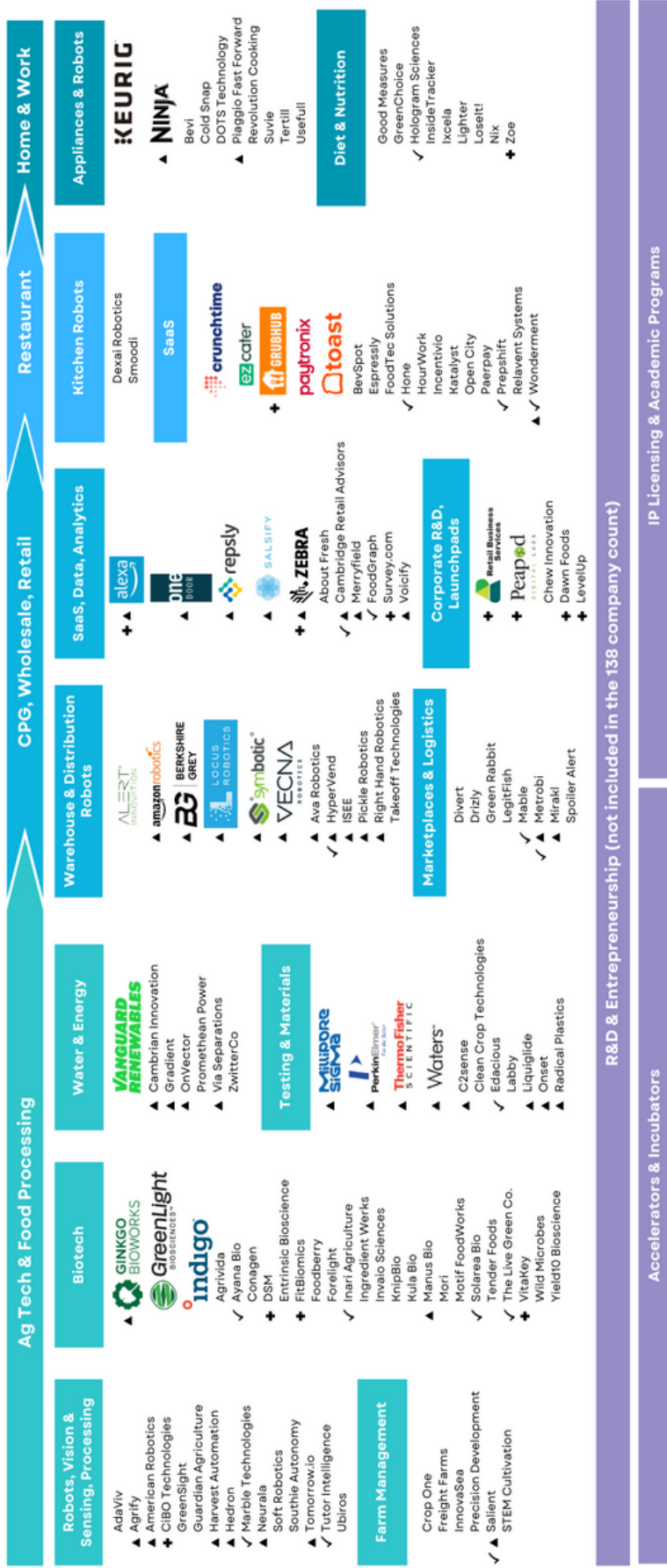
FIGURE #2: COMPANIES & ORGANIZATIONS, COUNTED BY SECTOR



Includes 94 “primary market” & 44 “multi-market” companies.

FIGURE #3: MARKET MAP

2023 Boston FoodTech



R&D & Entrepreneurship (not included in the 138 company count)

Accelerators & Incubators

- branchfood
- ▲ GreentownLabs
- Lab|Central
- ▲ THE ENGINE
- ▲ MASSCHALLENGE
- ▲ MC
- ▲ messirobotics

IP Licensing & Academic Programs

- Massachusetts Institute of Technology
- MIT
- HARVARD UNIVERSITY
- University of Massachusetts Lowell
- WPI
- Northwestern University
- Brandeis University
- Tufts University
- BABSON

Legend

- LOGO 100+ Massachusetts employees
- ▲ Non-Massachusetts HQ with >2 employees in Massachusetts
- ✓ startup founded since 2019
- ▲ multi-market company (food & non-food)

In collaboration with:

- foodgraph
- branchfood

For more information:

Bostonfoodtech.com

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FOOD AND NUTRITION INNOVATION INSTITUTE

Tufts UNIVERSITY

Boston Foodtech Cluster

13,655 Employees and Counting

Many Greater Boston foodtech companies have achieved growth or maturity stages, driving high employment in the cluster.

More than 13,655 employees work for foodtech “primary market” companies that are headquartered in Massachusetts, including:

4,475 employees in Massachusetts

9,180 employees outside Massachusetts (in the US and globally)

These figures do not include the workforce of the “multi-market” companies. These businesses (like Ginkgo Bioworks, Perkin Elmer, Salsify, and Shark Ninja) employ over 100,000 in total, including over 11,000 locally who work entirely or partly on foodtech applications.

These figures also do not include the workforce of the “R&D and entrepreneurship” organizations or those companies with headquarters outside Massachusetts.

See Figures #4 to #7 for additional detail.

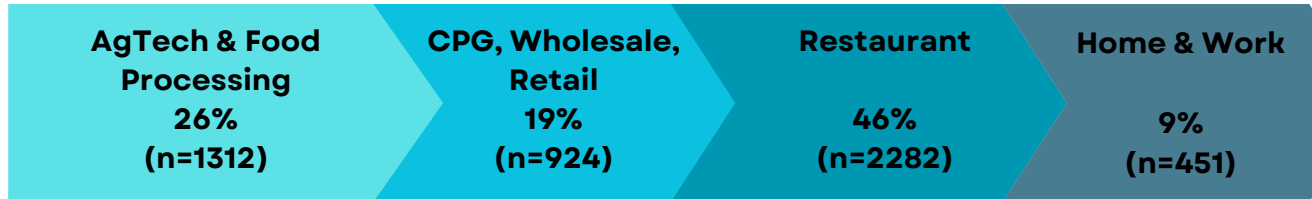
FIGURE #4: COMPANIES & ORGANIZATIONS WITH MASSACHUSETTS HQ, EMPLOYEES BY SECTOR



Primary market employees working both inside and outside Massachusetts.

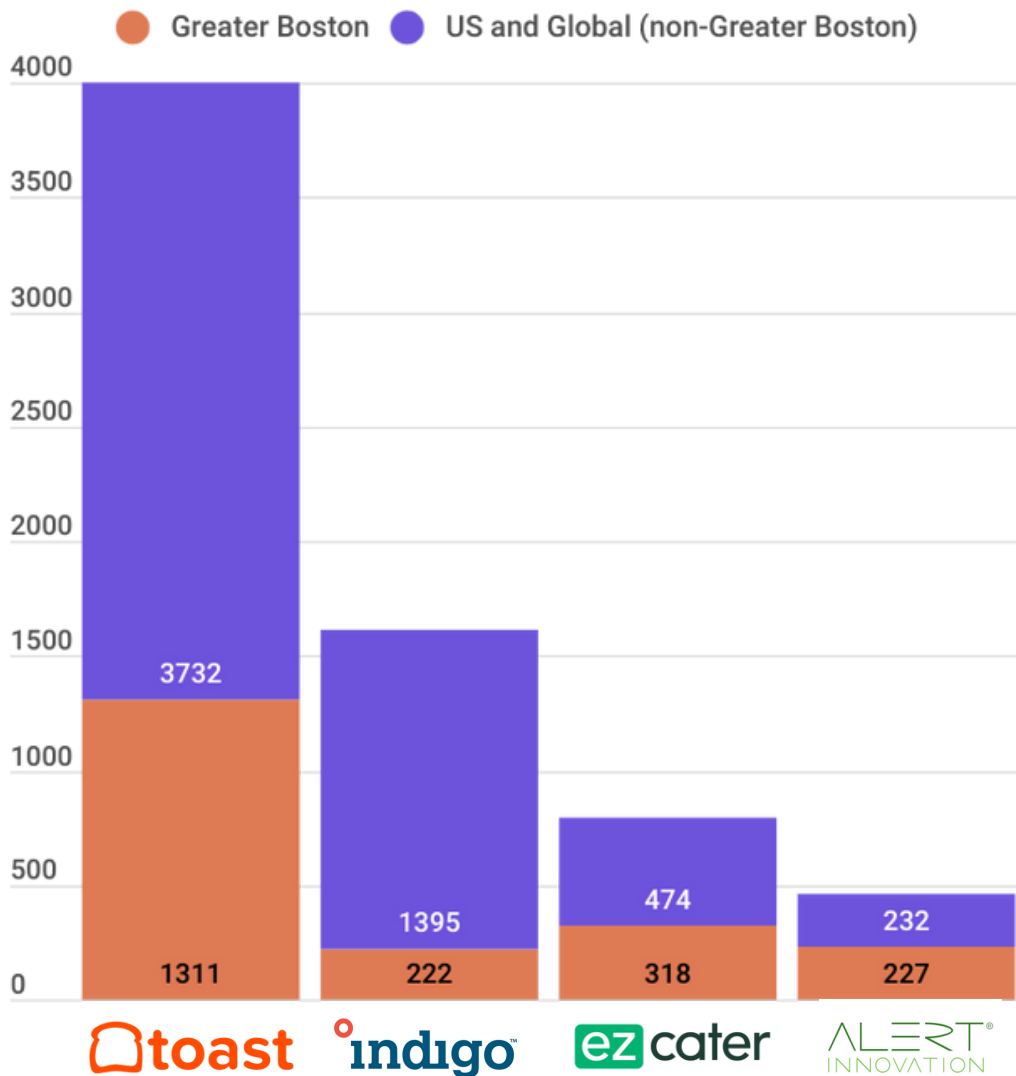
Boston Foodtech Cluster

FIGURE #5: MASSACHUSETTS EMPLOYEES BY SECTOR



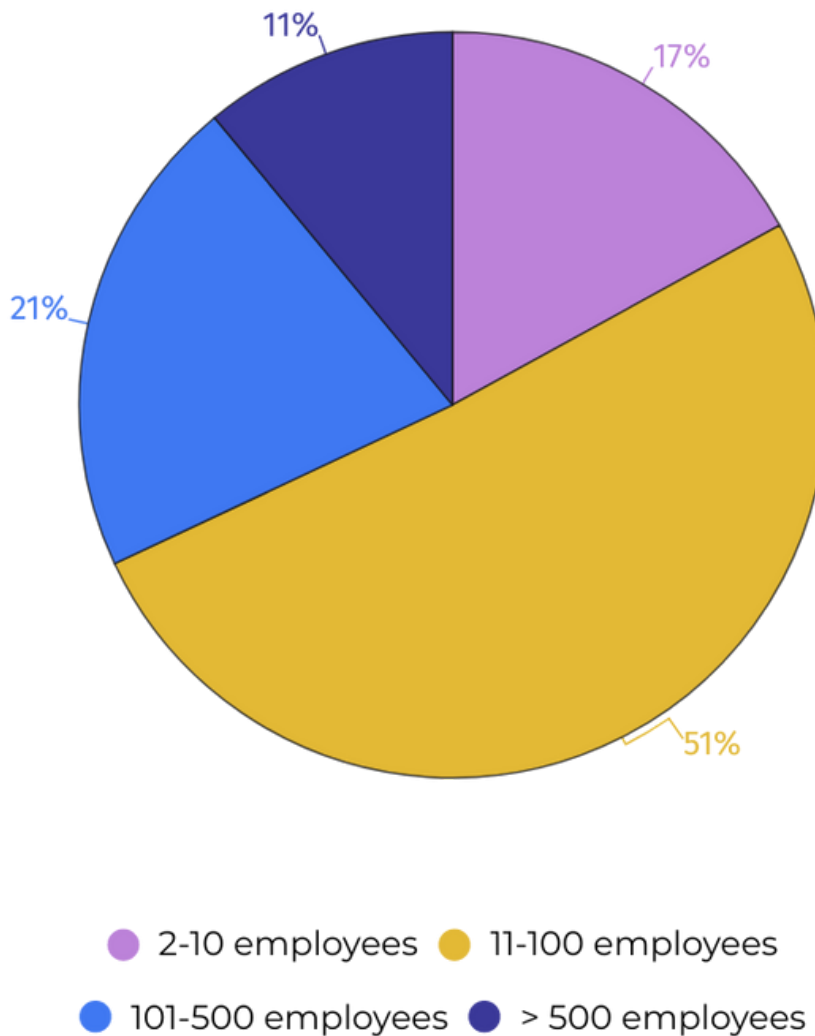
Includes Massachusetts HQ primary market companies.

FIGURE #6: TOP 4 PRIMARY MARKET EMPLOYERS, MASSACHUSETTS HQ



Boston Foodtech Cluster

FIGURE #7: COMPANIES BY SIZE OF WORKFORCE, MASSACHUSETTS HQ, PRIMARY + MULTI SECTOR



\$8.3B Capital Raised in 4 Years

Boston Primary Market foodtech companies were very successful at raising capital from public and private sources over the four years researched for this report, despite the uncertainty of the COVID pandemic.

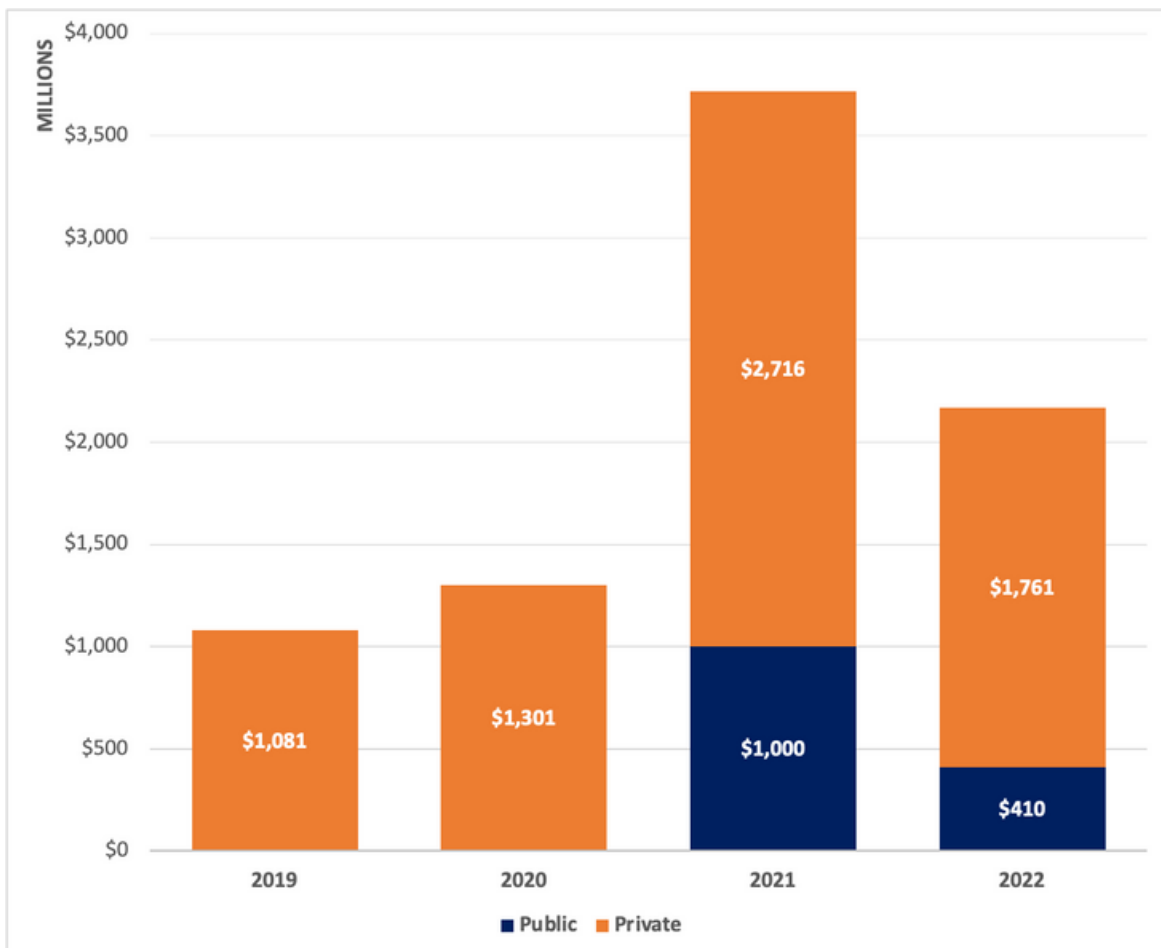
2019-2022

Between 2019 to 2022, 70 Boston “primary market” foodtech companies (companies with Massachusetts headquarters whose customer is primarily food and beverage) raised \$8.3b of capital in 146 fundraising events, as shown in Figure #8, reflecting that some companies had multiple fundraising events during this period, and some had none at all.

Total capital raised was:

- Over \$6.9b from private sources (venture capital, private equity, debt, and grants).
- Over \$1.4b from public markets (IPOs and SPACs, detailed in the next section).

FIGURE #8: CAPITAL RAISED





16 Exits in Four Years

From 2019-2022, 16 Boston foodtech “primary market” companies successfully exited via acquisition or public markets transaction, with total known proceeds of over \$3.7b.

The largest transactions include Toast’s IPO and Drizly’s acquisition by Uber, both detailed below.

Additionally, 4 Boston foodtech “multi-market” companies successfully exited with large proceeds: Berkshire Grey, Symbiotic, Agrify, and Ginkgo Bioworks, each detailed below.

Going Public

Greater Boston foodtech companies are successful at exiting via IPOs and SPACs (Initial Public Offerings and Special Purpose Acquisitions Companies), sometimes with record-breaking proceeds or multi-billion dollar valuations on the first day, as shown in Figure #9.

2019 - 2022

From 2019 to 2022, two Boston foodtech “primary market” companies went public via IPO, with total proceeds of \$1.4b

- **Toast**, a restaurant point-of-sales platform, with \$1b in IPO proceeds in 2021 ... *and Boston’s largest ever IPO valuation at \$20b.*
- **GreenLight Biosciences** offering RNA solutions for plant and animal health, went public in 2022 with \$410m in SPAC proceeds.

Additionally, four Boston foodtech “multi-market” companies went public via SPAC and IPO with total proceeds of over \$3.2b:

- **Berkshire Grey**, a warehouse robotics company, with \$578m in SPAC proceeds in 2021.
- **Ginkgo Bioworks**, a biological engineering platform, with \$1.7b in SPAC proceeds in 2021 ... *and the largest ever biotech go-public transaction in any geography.*
- **Symbiotic**, a warehouse robotics company, went public via SPAC in 2022 with \$875m in proceeds and a \$5.5b valuation.
- **Agrify**, a turnkey indoor farming systems and cannabis equipment and processing company, with \$54m in IPO proceeds in 2021.

FIGURE #9: IPOS & SPACS

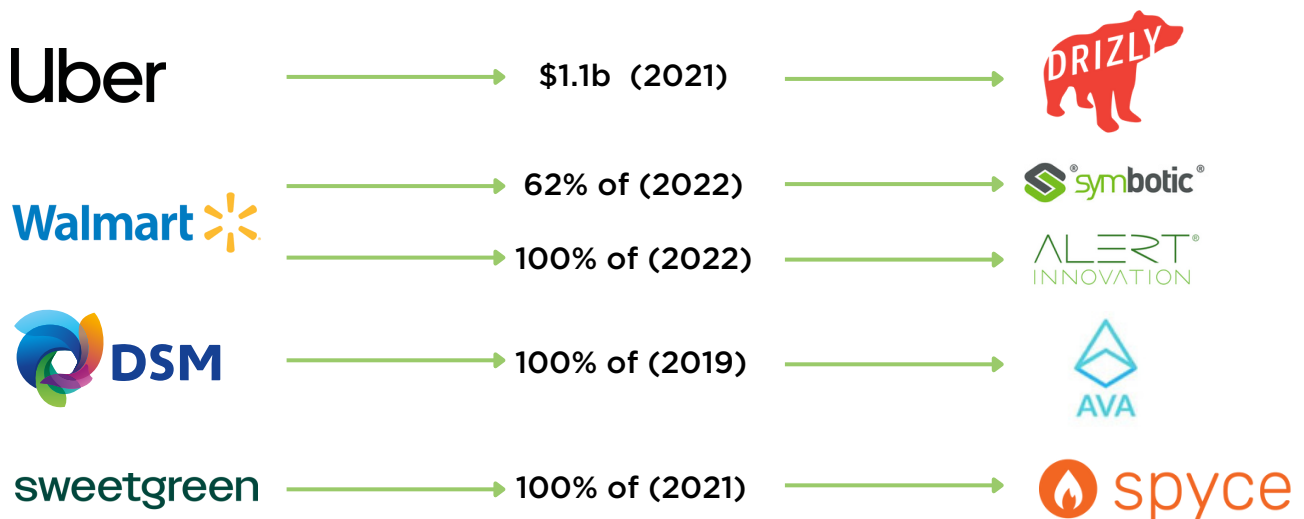
primary market = food and bev		2021 IPO @ \$20b valuation <i>Boston's largest ever IPO valuation</i>
		2022 SPAC @ \$1.5b valuation
multi-market = food & bev and others		2021 SPAC @ \$15b valuation <i>Global biotech's largest ever go-public valuation</i>
		2022 SPAC @ \$5.5b valuation
		2021 SPAC @ \$2.7b valuation
		2021 IPO @ \$155m valuation

Acquisitions

Greater Boston foodtech companies demonstrated success at exiting via acquisition, sometimes for large purchase prices. From 2019 to 2022, 14 Boston foodtech “primary market” companies were acquired for over \$3.7b (some additional acquisition values were undisclosed).

The most notable of these acquisitions was Uber’s purchase of alcohol marketplace Drizly for \$1.1b in 2021.

FIGURE #10: NOTABLE ACQUIRERS 2019-2022





Prior to 2019, other major acquisitions of Boston “primary market” and “multi-market” foodtech companies included:

- **Amazon’s purchase of warehouse robotics company Kiva Systems \$775m in 2012.**
- **GrubHub’s series of purchases totaling \$511m for:**
 - Restaurant payments and loyalty platform LevelUp for \$390m in 2018;
 - Restaurant delivery platform DiningIn for \$70m in 2015; and
 - Restaurant delivery platform Fodler for \$51m in 2017.

FIGURE #11: NOTABLE ACQUISITIONS PRIOR TO 2019



2019 - 2022

The full list of 14 acquisitions in this period of Boston “primary market” foodtech companies are summarized below and broken into two categories. First are the companies that retained an identity and location as a Boston Foodtech Company after their acquisition. These companies appear in Figure #3 as a “Boston Foodtech Company”.

The second category are companies that were absorbed into the acquiring company and no longer have the original brand identity and/or are no longer located in Massachusetts or employing Massachusetts residents. This second category of companies are not listed on Figure #3 and are not included in the total Boston Foodtech Company count.

Group #1:

- Food waste recycler Vanguard Renewables (Blackrock)
- Warehouse robotics company Alert Innovation (Walmart)
- Alcohol marketplace Drizly (Uber)
- Retail merchandising company Survey.com (Trax Retail)

Group #2:

- Brewing process company Sandymount (Alfa Laval)
- Personalized nutrition platform AVA (DSM)
- Private-label app company Drync (Proof Network Ventures)
- Restaurant kitchen robotics company Spyce (Sweetgreen)
- Restaurant SaaS company Squadle (Crunchtime)
- Agricultural robotics company Root AI (AppHarvest)
- Biotech company Joyn Bio (Ginkgo Bioworks)
- Marketplace logistic company Noble (GRUBBRR)
- Fresh food kiosk company Leanbox (Garten)
- CPG prescriptive analytics company Profitect (Zebra Technologies)

American Robotics, a multi-market drone technology company, was acquired by Ondas, and remains featured in the Boston Foodtech list. Both enEvolv (acquired by Zymergen) and Erbi Biosystems (acquired by Merck) are multi-market companies and were absorbed by their new parent companies and are not featured as a Boston Foodtech company.

Acquisitions are beneficial to the Greater Boston economy, as they:

- Return risk capital to investors for new investments;
- Often result in increased local hiring by the acquirer; and
- Demonstrate the value of investing in foodtech and Boston startups.

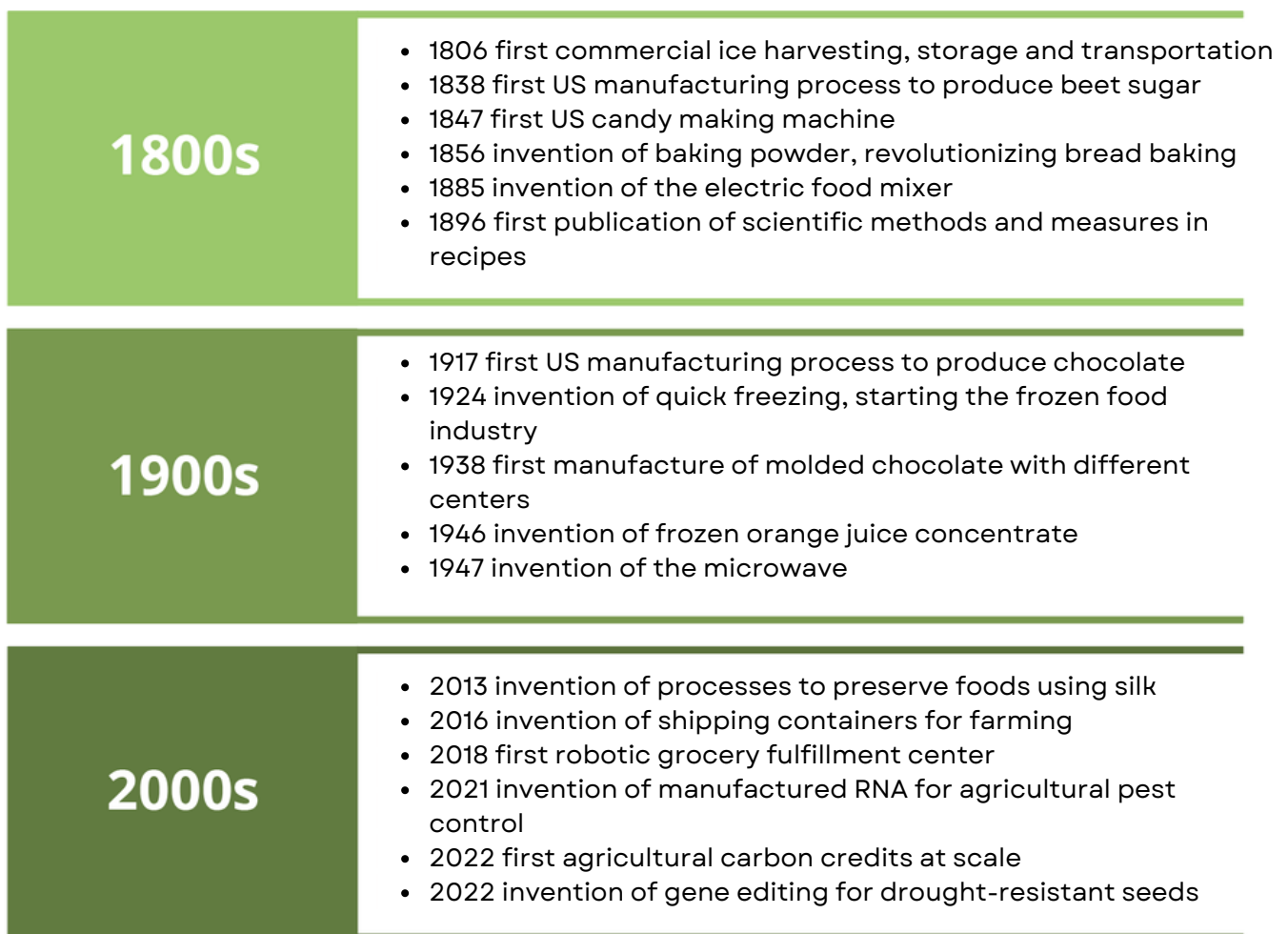


200 Years of Boston Foodtech Innovation

Boston has been a leader in foodtech innovation for over two centuries. Tools, mechanics, processes, ingredients, and other technology-based inventions of their day revolutionized how food was processed, transported, preserved, and prepared.

These successful creations changed the food & beverage industry, health, and the pleasure of food worldwide. Today's technologies are new, but Boston's role in their invention continues and is accelerating. See Figure #12 for a timeline and Appendix C for more details.

FIGURE #12: SELECTED BOSTON FOODTECH INNOVATIONS





Industry Perspectives on Boston Foodtech

For perspectives on the future of foodtech locally and globally, we invited some of Boston's leading industry participants to contribute their views on the future and importance of this growing cluster.

Warehouse Robotics / Max Pedró

Co-Founder & CEO, Takeoff Technologies, takeoff.com

My co-founder, José Vicente Aguerrevere, and I met as classmates and study group partners in Harvard Business school. Throughout our time at HBS, we met once a week to discuss our future plans. I knew that the right zip code for a start-up was right here where we began our journey together. Our focus was finding the right people to work with and that was going to be crucial in the DNA of Takeoff.

‘Boston is an endless talent hub of scientists, engineers, and entrepreneurs who share the same hunger we do.’

To create the best team possible to make our vision become a reality, we knew that Boston was the place to launch Takeoff. Fourteen years later, in 2016, we co-founded Takeoff Technologies. José and I launched Takeoff because we recognized a need in the food tech industry for a new approach to fulfilling online groceries. There were several business models at the time, but none of them had exactly cracked the code on efficient and affordable online fulfillment. We knew we could help grocery stores get the results they needed.

Some of the players in the market were fulfilling orders quickly by assigning people to roam the shelves of a grocery store and pick items manually.



Industry Perspectives on Boston Foodtech

Grocery stores have the benefit of being located very close to where shoppers work and live; however, manual picking is very expensive – in fact, it can eat up to 20% of your profits. Some players had tried to fulfill online grocery orders using automation. This was cost effective and efficient, but their automation was far away in centralized warehouses, 50 miles+ away from the end shopper. They could not fulfill orders quickly and the delivery cost was astronomical, often undoing the benefits the automation provided.

At Takeoff, we decided to combine the best of both methods: we introduced a hyperlocal, automated, micro-fulfillment solution. When we initially launched Takeoff in 2016, we set out to build a product. We were the first to use the term “micro fulfillment,” meaning we shrunk down the automated warehouse and placed it in the back of your local grocery store. Back then, no one had heard of this concept. Now micro fulfillment is an entire industry, with many global players around the world. Looking to the future, we understand that grocers want to meet shoppers wherever they are. No online shopper shops exclusively online – it is a mix. Shoppers want omni-channel offerings that are convenient and consistent whether they choose to shop in-store, online, or even using a third-party app. Takeoff’s solution offers affordable and fast online fulfillment that integrates into grocery business as a whole and complements all methods of fulfillment.





Industry Perspectives on Boston Foodtech

The Digital Shelf / Justin King

VP B2B & Chief Evangelist, Salsify, salsify.com

For any food tech startup or brand, the path to purchase must be front and center.

“In the Food and Grocery industry, the Digital Shelf has replaced the Physical Shelf for product discovery, purchase, and replenishment.”

The Digital Shelf self-describes as any digital medium where consumers or buyers are making discovery and/or buying decisions. Examples of the Digital Shelf include search engines (i.e. Google), brand websites, retailers (i.e. Walmart, Kroger), marketplaces (i.e. Amazon) and influencer platforms (social, websites, and mobile apps).

For brands, the Digital Shelf is a complex ecosystem and is difficult to manage at scale let alone optimize and win. However, the future of the Digital Shelf points to continued expansion. From retailer and marketplace branding opportunities to new digital platforms, the digital shelf will be the primary destination for all product discovery.

Salsify is a Boston SaaS startup purpose built to help brand manufacturers win on the Digital Shelf. This includes managing and publishing product experiences on all the digital shelf destinations such Amazon, Walmart, Target, Kroger, and social media platforms such as Instagram. Food brands recognize that by managing and controlling their brand on the Digital Shelf there is a direct correlation to revenue and profit.



Industry Perspectives on Boston Foodtech

The Guest Experience / Ayr Muir

Founder & CEO, Clover Food Lab, cloverfoodlab.com

As a company that includes “Lab” right in our name, Foodtech is at the heart of Clover’s mission and it’s thrilling to see the pace of change in the industry. While advancements are being made throughout all parts of the food production and consumption process, the thing that excites me most is the way tech is providing greater transparency to consumers. That means that people can make more informed decisions about what, how, and where they eat.

And from the company’s side, we can better understand what sort of flavors and values our customers are craving, and then design our sourcing, recipes, food prep, and service systems accordingly.

Real-time data, consumer-friendly UX design, and closer integration between mobile ordering and point-of-sale systems mean that consumers can dig deep into where ingredients come from; at Clover, in many cases that means getting down to the very name of the Massachusetts farm where our vegetables were picked.

**“Nutritional information empowers customers
to eat healthier.”**

Quick service restaurants like Clover can update customers in real-time on how quick (or not!) our service is at any moment, and we can adapt our menus instantly, based on freshness, supply, time-of-day, and a million other factors that ultimately translate to a more delightful, more human experience for the customer.



Industry Perspectives on Boston Foodtech

Accelerating Entrepreneurs / Cait Brumme

CEO, MassChallenge, masschallenge.org

“Boston has an unparalleled reputation as a global epicenter of transformative science-led invention and innovation.”

As we look at the promise and potential of innovation to create a healthier, more sustainable, and more affordable food supply chain – it is awesome to see how Boston’s existing strengths – whether in biotech, advanced manufacturing or robotics (to name just a few) – contribute to a Foodtech scene in Boston that is wholly differentiated by its science and engineering roots. Take for example the work of MassChallenge Alumni Boston Meats, now Tender Food, whose alternative protein offers the same texture as real meat due to the discovery of a novel technology using natural proteins to create real texture in a scalable process. Now that is Boston Foodtech in action!





Industry Perspectives on Boston Foodtech

Foodtech Robotics / Fady Saad

General Partner, Cybernetix Ventures, cybernetix.vc

The COVID-19 pandemic has exacerbated agricultural labor shortages, particularly in the U.S. The food service industry has struggled with rising labor costs, availability of labor especially in 24x7 food services, and decreasing margins for years. With the help of robots and AI, machines have the potential to impact the supply chain from farm to fork. Robots & AI are helping drive productivity on the farm, improve the supply chain, and have the potential to efficiently, safely, and reliably assemble, cook, and serve food to consumers.

The world's population is growing, while the industry that feeds it is under constant pressure. Agriculture is already highly automated in the United States, but farms still need people to pick many fruits and vegetables.

“Boston companies are changing the way we find and choose restaurants, pick up groceries, and even cook our meals.”

Starting from farming, you can look at companies like Root AI, a Somerville-based startup developing the Virgo harvesting robot for indoor farms that can identify and harvest multiple crops, including tomatoes, peppers, cucumbers, and more. AppHarvest acquired Root AI for \$60 million. The fast-food and fast-casual industries are also interested in automation, and companies are partnering to expand robotics deployments. Spyce, a Boston-based startup that developed a robotic kitchen that serves salads and other healthier food options, was acquired in August 2021 by Sweetgreen.

More and more of these startups are being acquired by established companies and it's a sign of what the next phase will look like. The global market for agriculture is ready for automation and robots. Boston is at the forefront of this new era. Robots and AI are now in all areas of agriculture from farm to fork, and Boston companies are spearheading this charge.

Methodology



Our findings are based on research from public sources, as described below, as of December 31, 2022.

Companies

We applied strict qualifying criteria to count a company as part of Boston Foodtech.

We began by gathering a list companies and organizations to consider as candidates for inclusion. We collected more than 300 candidate entities from:

- Outreach via LinkedIn postings and email outreach to Boston industry leaders.
- Company updates in Pitchbook and Crunchbase.
- Research in industry reports as shown in Appendix C.
- Media research in Boston Business Journal, Boston Globe, Progressive Grocer, TechCrunch, and other sources.

Using this candidate list, we applied qualifying criteria to include or exclude each entity.

The 1st set of criteria was applied to every entity. The company or organization must offer goods or services based on technology, which is clearly identified as part of its main value proposition to either:

- food & beverage companies as a primary market.
- consumers related to food behaviors (e.g. selection, purchase, preparation).
- businesses related to food behaviors (e.g. selection, purchase, preparation).

Methodology



The 2nd set of criteria was applied based on the type of company:

Massachusetts HQ companies

- Has its global or US headquarters in Massachusetts
- Has 2 or more current employees Massachusetts in 2021
- Qualifying examples: Bevi, ezCater, Toast

Massachusetts R&D location companies

- Has a clearly-identified R&D location in Massachusetts, but not its headquarters
- Has 25 or more current employees in Massachusetts 2021
- Qualifying examples: DSM, GrubHub

Massachusetts incubators and accelerators

- Has an explicit or demonstrated focus on food & beverage as a vertical industry served
- Has 3 or more current or alumni foodtech companies during 2019-2022
- Qualifying examples: MassChallenge, MassRobotics

Massachusetts academic institutions

- Has an explicit academic program or 3+ IP licenses in foodtech, food science, or nutrition.
- Qualifying examples: Harvard, Tufts, UMass (multiple campuses)

We used data from the following sources to address the criteria above.

Company website pages

- “locations” or “contact” pages for locations
- “industries”, “solutions”, or similar for markets served
- “alumni” or similar for accelerators and incubators
- “tech transfer” or similar for universities

LinkedIn for employee counts in “Massachusetts”

We *included* 138 entities from our candidate list using the criteria above.

We *excluded* 165 entities from the candidate list because they did not meet the criteria or were other types of companies.

Methodology



While the examples below are an important part of the food & beverage industry, they did not meet the inclusion criteria as foodtech entities.

Food product companies, whether CPG, DTC, or wholesale

- Examples: Boston Beer (Sam Adams), Butcher Box, HP Hood

Retailers and wholesalers

- Examples: BJ’s Wholesale Clubs, DeMoulas Super Markets (Market Basket)

Restaurants, catering, & food service

- Examples: Clover Food Labs, Dunkin, Legal Sea Foods, Stockpot Malden

Farms & CSAs

- Examples: Little Leaf Farms, Siena

Media companies

- Examples: America’s Test Kitchen, BevNet.com, Christopher Kimball’s Milk Street.

Non-tech incubators & accelerators

- Examples: Commonwealth Kitchen, Foundation Kitchen

Food product (CPG) investors and investment bankers

- Examples: Branch Venture Group, Centerman Capital, Whipstitch Capital

Primary Market vs Multi-Market

To further qualify companies and organizations by whether their primary market is based on foodtech, we reviewed each entity’s own website description of market(s) served, and screened for food & beverage applications or sub-sectors (e.g. agriculture, CPG, retail).

We then categorized each entity as “primary market” or “multi-market” as follows.

category	definition	included in these metrics
“Primary Market”	food & beverage applications are identified as the leading or only market served	all
“Multi-Market”	food & beverage applications are identified as one of multiple markets served	only company counts

Methodology



Employees

To gather data about employees, we used LinkedIn as our source by filtering for employee counts based on “Massachusetts”.

We recognize that LinkedIn as a source is imperfect, with the following effects:

Undercounting

- Employees who do not have LinkedIn profiles.

Undercounting or overcounting

- Employees whose LinkedIn profiles are not up-to-date with their employers.
- Geographic differences between the company location vs the employee listed location in LinkedIn (e.g. a Cambridge-based company with commuting employees whose LinkedIn location is New Hampshire, may not be recognized as “Massachusetts”).

Overcounting

- Part-time employees or consultants who list their employer in their profiles.

However, we found that these variances tend to cancel each other out, based on comparing company reporting, when available, to LinkedIn research. We believe that our research about employee counts is reasonably accurate and sufficient for the purposes of this research.

Capital, IPOs, SPACs, & Acquisitions

To gather data about capital raised, IPOs, SPACs, and acquisitions during 2019-2022, we collected data from public sources including company announcements, CB Insights, Crunchbase, Pitchbook, and media reports (such as Boston Business Journal, Reuters, TechCrunch).

Our research also included reported angel investments, venture capital, private equity, IPO and post-IPO proceeds, SPAC proceeds, debt, and grants. We excluded announced or planned, but unrealized, fundraising events or transactions.



Appendix A: Market Studies

To discover Boston foodtech companies, gather definitions of “foodtech”, and study cluster taxonomy, we reviewed the following 46 market studies

published by	website	report
AgFunder	agfunder.com	AgriFoodTech Investment 2022 AgriFoodTech Investment 2021 AgroHub Farm Management Systems 2021 Farm Tech Investment Report 2021
Better Food Ventures	betterfoodventures.com	Farmtech Landscape 2020 Foodtech & Media Landscape 2019
CB Insights	cbinsights.com	Food & beverage Value Chain Market Map 2023 Food & beverage research and trends to watch, 2023 State Of Food Tech 2021 Q2 State Of Retail Tech 2021
DigitalFoodLab	digitalfoodlab.com	Foodtech unicorns 2023 Foodtech Unicorns 2022 Foodtech Trends 2021
Finistere Ventures	finistere.com	AgriFood Tech Investment Review 2020
Forward Fooding	forwardfooding.com	The FoodTech 500 2022 The FoodTech 500 2021 The State of Global Foodtech 2020
MIT / The Engine	engine.xyz	Tough Tech: The Food & Ag Issue (Publication No. 3, May 2019)
The Mixing Bowl	mixingbowlhub.com	Crop Robotics 2022



Appendix A: Market Studies

Pitchbook	pitchbook.com	Agtech 2023 Q1 Agtech 2022 Q2 Agtech 2022 Q1 Agtech 2021 Annual Agtech 2021 Q3 Agtech 2021 Q2 Agtech 2021 Q1 Q1 2023 – Foodtech VC Ecosystem Foodtech 2023 Q1 Foodtech 2022 Q2 Foodtech 2022 Q1 Foodtech 2021 Annual Foodtech 2021 Q3 Foodtech 2021 Q2 Foodtech 2021 Q1 Retail Healthtech Report 2020 Q2
Qina	qina.tech	Personalized Nutrition Company Map 2021
S2G Ventures	s2gventures.com	Trends Shaping the Future of Food in 2023 Trends Shaping the Future of Food in 2022 Market Review and the Implications for Food and Ag Investing 2021 The Ingredients for a Food System Revolution 2021 The Future of Food: Through the Lens of Retail 2020
The Spoon	thespoon.tech	2023 Restaurant Tech EcoSystem: Nourishing the Bottom Line Alternative Dairy Landscape 2022 Booze Tech 2019 Food Robotics Market Map 2019 Food Waste Innovation 2019



Appendix B: Boston's Foodtech Innovations

The following list of selected innovations and sources support figure #12.

1806 first commercial ice harvesting tools, storage and transportation

- “Nathaniel Jarvis Wyeth” (obituary), Boston Evening Transcript, September 2, 1856, accessed at www.newspapers.com.
- Smith, Philip Chadwick Foster, “Crystal Blocks of Yankee Coldness”, accessed at www.iceharvestingusa.com.
- MacDonald, Katie, Commercial Use of Ice, HistoryCambridge.org, 2012.
- Michelle Prior, The History of Ice Harvesting in New England, Wright-Locke Farm, September 2018.
- Wikipedia, Frederic Tudor and Nathaniel Jarvis Wyeth
- Johnson, Steven, “Creating Cold”, www.bbc.co.uk, February 18, 2015.
- Howe, M.A. De Wolfe, Boston: The Place and The People, The Macmillan Company, 1903, page 175, archive.org.

1838 first US manufacturing process to produce beet sugar

- History of Sugar, The Sugar Association, www.sugar.org

1847 first US candy making machine

- MacDonald, Katie, Automated Candy Production, HistoryCambridge.org, 2012.

1856 first manufacturing process to produce baking powder, revolutionizing bread baking

1885 invention of the electric food mixer

- Wikipedia, Mixer (appliance)

1896 first publication of scientific methods and measures in recipes

- Moskin, Julia, Overlooked No More: Fannie Farmer, Modern Cookery’s Pioneer, The New York Times, June 13, 2018.

1917 first US manufacturing process to produce chocolate

- White, Anna, Dorchester History Lesson: Baker Chocolate Factory, CaughtInDot.com, November 15, 2021.
- Bologna, Jamie and Chakrabati, Meghna, Fluff At 100: The Sweet History Of New England’s Sticky Spread, WBUR.org, March 8, 2017.

1924 invention of quick freezing, starting the frozen food industry.

- Wikipedia, Clarence Birdseye

1938 first manufacturing process to mold chocolate bars with different centers

- MacDonald, Katie, Baking Powder, HistoryCambridge.org, 2012.



Appendix B: Boston's Foodtech Innovations

1946 invention of manufacturing processes to produce frozen orange juice concentrate

- Wikipedia, Minute Maid
- Rude, Emelyn, The Surprising Link Between World War II and Frozen Orange Juice, Time, August 31, 2017.
- MacDonald, Katie, Frozen Orange Juice, HistoryCambridge.org, 2012.

1947 invention of the microwave

- MacDonald, Katie, Microwaves, HistoryCambridge.org, 2012.

2013 invention of process to preserve foods using silk proteins

- Patents, mori.com

2016 invention of shipping containers for farming

- US Patent 9288948B2, Insulated shipping containers modified for high-yield plant production capable in any environment

2018 first robotic grocery fulfillment center

- Castelluccio, Michael, America's First Robotics Supermarket, Strategic Finance, December 20, 2018.
- Redman, Russell, Sedano's teams with tech firm to launch 'robotic supermarket', Supermarket News, October 3, 2018.

2021 invention of RNA manufacturing processes for agricultural pest control

- Vogt, Willie, Startup GreenLight turns RNA into crop protection tool, American Agriculturist, November 10, 2021.

2022 first agricultural carbon credits at scale

- Carbon, indigoag.com

2022 invention of gene editing to produce drought-resistant seeds

- Elkin, Elizabeth, Agtech Startup Nabs Two Patents For Gene Edited Corn, Soybean Seeds, February 9, 2022, Bloomberg



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