

Bigelow | Laboratory for Ocean Sciences







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Executive Summary

Blue biotechnology is the use of algae, seaweed, and other marine organisms to develop products, processes and services. It drives innovation across multiple industries by enabling the discovery of bioactive compounds and high-value materials used in pharmaceuticals, agriculture, manufacturing, and other industry segments (*Figure 1*). This emerging sector **is projected to reach \$10.5B by 2027.** It has an average compound annual growth rate of 15%, with some segments growing at nearly 60% annually.

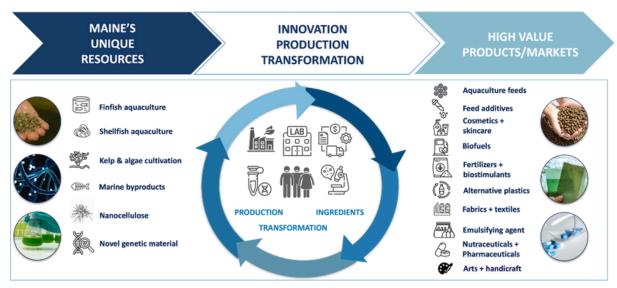


Figure 1. Overview of Maine's Blue Biotechnology Potential. Maine's unique assets support the production of high-value products and markets.

Maine has unparalleled competitive advantages to take a global position in the blue biotechnology sector, a leading element of the state's life sciences and economic development strategy. This can be done by leveraging its deep maritime heritage, abundant marine resources, world-class research institutions, strong coastal communities, growing aquaculture sector, and geographic and cultural ties to the ocean (*Figure 2*). Located in the New England region, Maine is in close proximity to Boston, a global epicenter of biotechnology. This geographic closeness offers a strategic advantage for Maine's emerging blue biotechnology sector, providing access to talent, investment opportunities and established infrastructure that are critical to its future growth and competitiveness.

Our regional blue biotech ecosystem assessment and stakeholder feedback identified over 1,000 organizations in New England connected to enabling blue biotechnology. Maine has the highest concentration of such organizations (384 compared to 353 in Massachusetts, Figure 3). Cumberland county – home to Portland and Scarborough – is the largest regional cluster in New England, with 113 organizations, or nearly 11% of all entities. The strong business presence provides a solid foundation for private sector investment, commercialization, and job creation. Meanwhile, the steady contribution of research and education institutions ensures a continuous pipeline of talent, innovation, and technology transfer.



Figure 2. Maine is well positioned to become the United States' leading hub for blue biotechnology by leveraging its abundant marine resources, world-class research institutions, growing aquaculture sector, and geographic and cultural ties to the ocean.

Maine's leading position in blue biotechnology is rooted in its marine businesses, particularly fishing and aquaculture. This underscores its competitive advantage derived from abundant marine resources and a robust seafood value chain. Maine already has the necessary infrastructure, talent, research, and industry partners to accelerate growth in blue biotechnology, as well as dozens of businesses in life sciences and biotechnology. This showcases the potential to develop new biotech applications from aquaculture and commercial fishing biomass.

To accelerate the development of new blue biotechnology products in the United States, create jobs, and position this field as a pillar of an advanced manufacturing strategy, we have identified **three near-term scalable initiatives** that will help ensure that Maine captures the high-value economic potential of blue biotechnology. These initiatives are:

- **Durch** Upscaling fishing and aquaculture waste into high-value products like fertilizers, bioplastics, and animal feed.
- Harnessing novel marine genetic resources to develop new products and processes in diagnostics, pharmaceuticals, nutraceuticals, and supplements.
- **Expanding seaweed aquaculture** for uses such as food, energy, environmental restoration, and more.

Building on Maine's advantages in blue biotechnology ensures long-term sustainable economic prosperity and environmental health for the state's vital rural and coastal communities, positioning it as a leading innovator and model for the global blue economy. Now is the time to upscale its marine resources into high-value products and services for new markets that provide new economic value. The future of biotech is blue and will grow in Maine.

1. Market Data for Blue Biotechnology in the Blue Economy

1.1. Global blue biotechnology segment market trends & Maine's players

The global blue biotechnology market is projected to reach \$10.5 billion by 2027, with a robust compound annual growth rate of 15 percent¹ and create 50,000 new jobs worldwide by 2030, mainly in regions with strong research infrastructure. North America is projected to have over 40% market share in blue biotechnology².

Figure 1 highlights various blue biotechnology segments; here we focus on trends and those with the largest projected market size in 2030 (summarized in **Table 1**). More details can be found in Appendix 7.1.

Segment	Total Segment Market Size (2022)	CAGR (2022–2030)	Seaweed- or Blue Biotech-Specific Market (2030)
Marine Pharmaceuticals	\$2.6B	8–10%	\$5.0B
Nutraceuticals	\$450.0B	7.5%	\$3.9B
Biostimulants	\$2.6B	~10%	\$1.8B
Livestock Feed Supplements	\$38.9B	~3.9%	\$1.1B
Pet Food	\$115.5B	~5.11%	\$1.1B
Bioplastics & Biopolymers	\$11.5B	~20%	\$0.8B

Table 1. Summary of market size and growth trends for key blue biotechnology segments³

Pharmaceuticals (\$5B by 2030): Maine has one of the world's most diverse marine algae culture collections⁴. This can be tapped into for new pharmaceutical discoveries, while companies like Salmonics are commercializing fish-derived plasma proteins for research and clinical applications. See Appendix 7.2 for more details about some of these companies. These position Maine to discover and develop novel compounds in this high-value market.

¹ Verified Market Reports, <u>Blue Biotechnology Market</u>, 2025

² Camoin Associates report on Marine Biotechnology for Maine's DECD, citing <u>Marine Biotechnology Market Analysis</u> <u>& Forecast: 2025-2032</u>

³ World Bank, Global Seaweed New and Emerging Markets Report 2023

⁴ Bigelow, https://ncma.bigelow.org/

Nutraceuticals (\$3.9B seaweed segment): Maine is home to the nation's largest seaweed farming industry and innovators working with fisheries byproducts. Companies such as Marin Skin Care & Cold Current Kelp are commercializing health products, while others like Ocean's Balance offer animal and human health products. Maine is well-positioned to scale production in this segment to meet growing demand.

Biostimulants (\$1.8B by 2030): Maine companies such as Ocean Organics, Acadian SeaPlants, and North American Kelp are offering synthetic fertilizer alternatives such as seaweed and algae-based biostimulant products and raw materials. New innovations from marine genetic resources are also on the horizon.

Livestock Feed Supplements (\$1.1B by 2030): Among the fastest growing segments in blue biotechnology, this market uses seaweed and algae-based products to boost livestock health and function. Maine's unique algae culture collection and growing seaweed industry provide the raw inspiration and materials to develop new high-value products. The state also has a long-established pipeline of wild-harvest-based feed products used on dairy farms produced by North American Kelp and SOURCE, for example, used on dairy farms. For example, North American Kelp and Source have been selling for decades, with North American Kelp used by 50 - 80% of organic dairy farms, while processing and packing infrastructure is already established.

Pet Food (\$1.1B by 2030): Companies like Ocean's Balance and Acadian Seaplants in Maine have long supplied seaweed to North American and global markets. Rising demand for vegan, clean-label, and sustainable products, along with growth in functional pet foods, is opening new high-value opportunities. Given the premium pricing of pet food-driven by pets' integration into the family and demand for healthy alternatives, this segment offers compelling opportunities for marine biotech players.

Bioplastics & Biopolymers (\$0.8B algae-based by 2030): Maine companies like Viable Gear, and Dirigo Sea Farm are demonstrating early commercialization capabilities in this emerging market.

1.2. Maine and New England's blue economy market trends

Blue biotechnology is part of the broader "Blue Economy", which includes traditional sectors like fisheries and shipbuilding and emerging sectors like aquaculture and offshore wind. New England's blue economy includes roughly 16,000 businesses, 250,000 employees, and accounts for \$23.7B in regional GDP. From 2011 to 2021, the blue economy workforce grew by 13% and GDP by 28%. In comparison, New England's highest-exporting industry, manufacturing, grew by only 10% in GDP during that time. In 2022, over \$2B in venture capital was invested in the blue economy in New England – 4x more than a decade ago⁵.

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⁵ NOAA and State of Maine DECD

Maine has a prominent position in the blue economy sectors of seafood and aquaculture, both of which provide resources to fuel blue biotechnology potential. Maine's seafood sector has a total economic output of \$3.2 billion, representing over 33,000 jobs. Meanwhile, from 2016-2021, aquaculture and fishing jobs in the state more than doubled, with shellfish farming driving growth⁶. These jobs are 20 times more concentrated in Maine than in the rest of the nation. In 2021, Maine seafood sales totaled \$904.1 million - \$305 million from lobster alone⁷.

Maine's aquaculture sector is growing rapidly, with the number of permitted farms and farmers steadily increasing. There are now roughly 700 limited purpose aquaculture (LPA) licenses, 150 licensed marine farms, and about a dozen land-based facilities⁸. Many of the permitted licences are for facilities that cultivate multiple species, offering farmers a year-round income. Coastal communities also benefit from a steadier income compared to seasonal fishing when working waterfronts and related infrastructure are constantly used. This growth is supported by organized state-wide efforts to diversify and increase value from Maine's seafood sector across markets to support the development of value-added products beyond traditional food consumption. The seaweed farming sector in Maine is experiencing remarkable expansion, positioning it as the fastest-growing aquaculture sector in the state. Maine-based Atlantic Sea Farms, which partners with local fishing families, harvested a record-breaking 1.3 million pounds of farmed seaweed in 2024. This represents a steady and significant leap from the early years: harvests were just 14,500 pounds in 2015, grew to 45,000 pounds in 2017, and crossed the 1 million-pound mark in 2022. This growth is driven by increasing consumer demand for domestically farmed, regenerative products and provides a vital source of income for fishing communities facing volatility in traditional fisheries.

As of last year, Maine already had nearly 1,000 jobs in the blue biotechnology sector⁹, ranging from high-skill jobs like biochemists and industrial engineers to mid-skill roles such as packing, chemical operations, and technicians. Mid-skill jobs are growing most significantly, highlighting the need to train and upskill workers in this sector, as recommended by the BETF.

⁶ DECD/Camoin – Maine's Food Sector Report, May 2023

⁷ SEA Maine Economic Input Analysis Report 2023

⁸ Maine Aquaculture ROADMAP 2022–2032

⁹ Report by Camoin Associates for Maine's Department of Economic & Community Development.

2. Assessment of Maine's Blue Biotechnology Ecosystem

2.1. Stakeholder input on competitive advantage

Stakeholders highlighted that Maine's blue biotechnology opportunity lies in leveraging its abundant marine resources – especially algae and other marine biomass (both harvested and farmed) – alongside its statewide working waterfronts, and existing technologies and infrastructure for biotechnology, big data processing and advanced life sciences. The state's innovation ecosystem, research institutions, and entrepreneurial talent are seen as key drivers for building scalable, export-driven business models— particularly benefiting rural communities with natural resources.

Key competitive advantages identified by stakeholders include:

- Abundant marine and bio-resources: Over 3,500 miles of coastline (4th in the US, 2nd on the East Coast after Florida, and largest in New England), rich marine biodiversity, wild and cultivated marine biomass (algae, seaweed, fisheries and aquaculture) and access to agriculture and forestry bioresources.
- Marine heritage: Strong cultural heritage in harvesting, production and cultivation from fishing, aquaculture, and seafood processing.
- **Blue workforce:** Established, capable maritime and marine workforce with strong heritage connection to the ocean, generational knowledge around farming, harvesting and processing, multi--generational expertise in marine resources, colleges and universities supporting workforce development programs and initiatives.
- Strong research & innovation ecosystem: Leading life science, animal health, and ocean science research institutions (Bigelow Laboratory, UMaine, UNE, JAX, MDIBL, Downeast Institute, Colby, Roux Institute, GMRI and others) with expertise in marine and life sciences, Al, biotechnology, genomics, and nanomaterials.
- **Strong collaborative and supportive ecosystem:** Strong networks of partner organizations, ecosystem support organizations, and access to dilutive and non-dilutive funding sources.
- **Track record of entrepreneurs:** An established system to support and scale entrepreneurs, and access to mentorship networks, both of which showcase a diverse, thriving environment for blue economy entrepreneurship.
- Premium "clean ocean" brand: Maine's cold, pristine North Atlantic waters give its marinederived biotechnology products instant market credibility. Consumers and B2B customers associate Maine with environmental responsibility, traceability, and product purity—critical differentiators in biotechnology markets where provenance and ethical sourcing increasingly drive purchasing decisions and command premium pricing.
- **Strategic location:** Proximity to major East Coast markets, Boston's strong biotechnology hub, EU markets, and North Atlantic global partners.

2.2. Insights from mapping of the blue biotechnology ecosystem

We conducted a comprehensive ecosystem mapping exercise to highlight companies and institutions that could form the foundation of Maine's blue biotechnology sector, and provide a clear view of available assets and opportunities to build a robust, interconnected blue biotechnology ecosystem in the state. The analysis categorized organizations by relative position in the ecosystem, specific economic sector, value chain role and stakeholder type (See Section 6 for more details). We identified 1,038 organizations relevant to the development of an emerging blue biotechnology ecosystem in Maine. While the assessment excluded Maritime Canada – a close regional partner with significant growth and leadership in diverse blue economy sectors – due to time constraints, it is worth widening this lens in a future assessment.

Our findings indicate that Maine has the highest concentration of blue biotechnology-related organizations in New England, with 384, compared to 353 in Massachusetts and 140 in Rhode Island (*Figure 3*). This leading position is closely tied to Maine's marine production businesses (fishing and aquaculture), highlighting its competitive advantage in abundant marine resources and robust seafood value chain. Across most of the New England states, including Maine, the majority of blue biotechnology organizations are concentrated in Production & Manufacturing, reinforcing blue biotechnology's potential to create jobs within existing local supply chains in Maine.

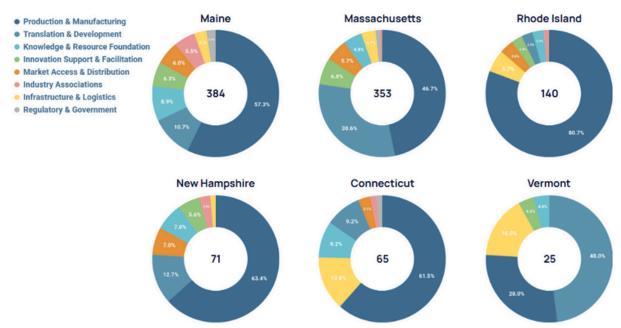


Figure 3. Number of blue biotechnology organizations in New England states. The total number of organizations is shown in the center of each state's donut, and percentages in slices show the fraction of the organizations in each part of the value chain.

Another finding - not unexpectedly - is the strong coastal concentration of blue biotechnology organizations across New England, with nearly 87% along the coastline (*Figure 4*).

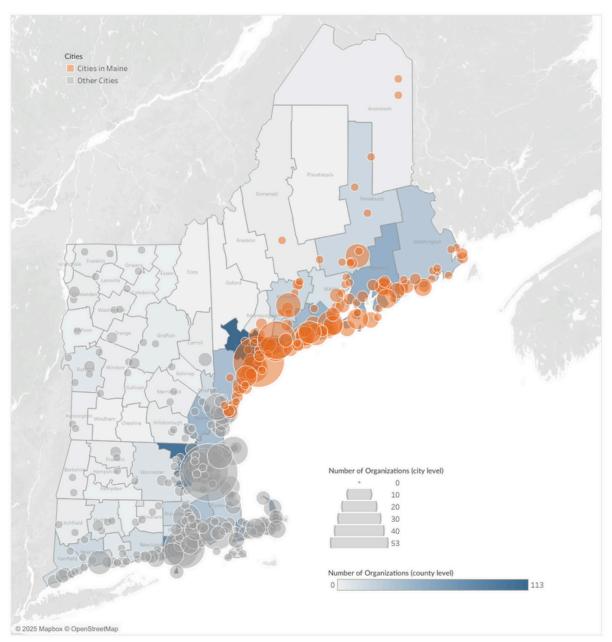


Figure 4. Blue biotechnology organizations in New England are concentrated in coastal areas.

A key finding from this mapping (*Figure 4*) is that Cumberland county – home to Portland and Scarborough – is the largest regional cluster in New England, home to 113 organizations, or nearly 11% of all blue biotechnology entities. This places Cumberland ahead of Middlesex County, MA (101) and Washington County, RI (82). Boston currently leads with 53 organizations, followed closely by Portland with 41. Given the large clusters in Brunswick and Scarborough near Portland, this positions southern Maine as a rising blue biotechnology hub. There are also significant clusters around the University of Maine in Penobscot county, and in multiple more rural coastline communities in Lincoln, Knox and Hancock counties.

For Maine, these concentrations are highly significant: they demonstrate that the state already has the necessary infrastructure, talent, research, and industry partners to accelerate growth in blue biotechnology. By building on its coastal assets and fostering connections between these clusters and the wider regional ecosystem, Maine can transform its natural advantages into sustainable economic growth and global leadership in blue biotechnology.

Production & Manufacturing is the most dominant value chain role in Maine (57% or mapped organizations) (*Figure 3*). This reflects the state's strengths in seafood production, aquaculture, and marine processing, an existing industrial base that can be leveraged for blue biotechnology applications. Translation & Development (41 organizations) and Knowledge & Resource Foundation (34 organizations) provide the critical innovation, research, and technical expertise to turn Maine's marine resources into high-value bioproducts.

This distribution is highly relevant for emerging ecosystem development: it indicates that **Maine** already has the necessary industrial infrastructure, skilled workforce, and research capabilities to scale blue biotechnology. By linking production strengths with innovation and knowledge resources, Maine can accelerate commercialization, attract investment, create high-quality jobs, and position itself as a regional and global hub for blue biotechnology innovation.

Across all New England states, businesses account for at least 75% of the total stakeholder group (*Figure 5*), making them the backbone of the emerging blue biotechnology sector and a strong opportunity validation. Many are small aquaculture farms with limited innovation capacity. This highlights the need for deeper collaboration with the ecosystem's second-largest stakeholder group - research and education institutions — that provide expertise, technology transfer, and R&D capabilities. These are essential to convert Maine's marine resources into high-value bioproducts.

The strong business presence provides a solid foundation for private sector investment, commercialization, and job creation. Meanwhile, the steady contribution of research and education institutions ensures a continuous pipeline of talent, innovation, and technology transfer. Together, these dynamics create a self-reinforcing ecosystem: research drives innovation, businesses scale and commercialize products, and both generate high-quality jobs that attract further investment. Maine's strong marine and research base, combined with a strong business network across New England, provides opportunities for regional supply chain development, workforce mobility, and cross-state collaboration. By connecting its natural resource—driven blue economy with the innovation capacity of neighboring states, Maine can position itself as a hub where research translates into commercial growth, export opportunities, and long-term competitiveness in the global blue biotechnology market.

Maine's Blue Biotechnology Ecosystem by Stakeholder Type

Note: one organization can fall in multiple stakeholder types (i.e., the total number shown exceeds the actual number of organizations).

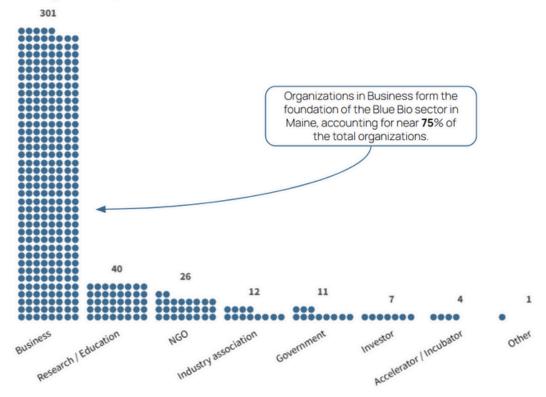


Figure 5. Overview of Maine's blue biotechnology organizations by stakeholder. Note that one organization may group into multiple stakeholder types, so the total number of stakeholders exceeds the number of organizations shown in Figure 3.

A closer examination of Maine's blue biotechnology ecosystem shows that the marine sector forms its core. (*Figure 6*). Together, aquaculture and commercial fishing represent 66% of all organizations, underscoring the state's strong natural and industry-based assets as the backbone of its emerging blue biotechnology sector. The dominance of aquaculture and fishing organizations highlights an existing blue industry base with established production capacity, skilled labor, and supply chains, all of which can be leveraged to expand blue biotechnology applications.

More details about the ecosystem assessment are available upon request. Overall, the assessment shows that Maine can leverage its strengths in marine resources and research to drive high-value innovation, job creation, and investment, especially in areas such as sustainable seafood production, aquaculture-based bioproducts, and waste valorization. Maine's aquaculture focus also complements neighboring states' biotechnology and commercial fishing, creating opportunities for regional collaboration and scaling a knowledge- and innovation-driven blue biotechnology economy in New England.

Maine's Blue Biotechnology Ecosystem by Sector

Note: one organization can be involved in multiple sectors (i.e., the total number shown exceeds the actual number of organizations).

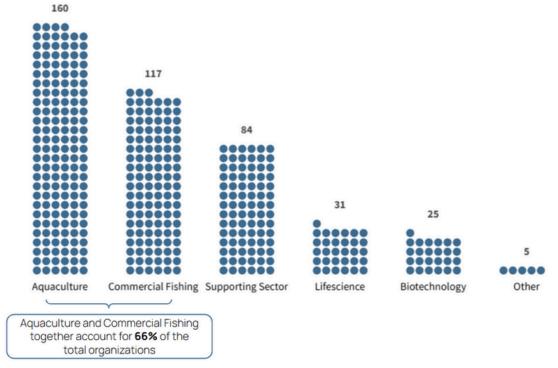


Figure 6. Overview of organizations by sector in Maine's blue biotechnology ecosystem. Note that an organization can belong to multiple sectors, so the total exceeds the total number of organizations shown in Figure 3.

3. Vision, Value Proposition & Competitive Edge

Maine is well positioned to become the United States' leading hub for blue biotechnology by leveraging its abundant marine resources, world-class research institutions, growing aquaculture sector, and geographic and cultural ties to the ocean.

Positioning Pillars

Unmatched marine resources: Maine has the nation's largest and fastest-growing seaweed aquaculture industry, a genetically diverse algae and seaweed culture collection, and abundant wild and farmed marine biomass. Its 3,500-mile coastline, clean waters, and strong fisheries heritage offer innovators unparalleled raw material access to scale blue biotechnology.

A research ecosystem with translational power: Institutions such as Bigelow Laboratory for Ocean Sciences, the Island Institute, the Downeast Institute, The Jackson Laboratory, MaineHealth, MDI Biological Laboratory, The Roux Institute at Northeastern University, University of Maine, Gulf of Maine Research Institute, Maine Maritime Academy, University of New England, University of Southern Maine, Colby, Bates and Bowdoin Colleges and Maine's community colleges form one of the strongest marine and life sciences research networks in the U.S. This is directly connected to commercialization programs, accelerators, and international entrepreneurship networks, turning discovery into scalable ventures.

Early commercial momentum and entrepreneurial pipeline: Maine is already home to pioneering blue biotechnology companies, demonstrating the state's ability to attract capital and talent, and provide models for scaling startups from concept to market.

Coastal communities as a driver of value creation: Blue biotechnology can create jobs in Maine's coastal communities through seaweed farming, aquaculture, biologics production, and advanced processing facilities. Unlike urban biotechnology clusters, Maine's model enables rural coastal communities to benefit from a high-value, resource based innovation economy. There are also likely to be new income opportunities for fishermen and lobstermen, generating tax revenue that can support schools, parks, and other community services.

Strategic location & political capital: Maine is the first U.S. port for vessels from Europe and sits at the nexus of the U.S. East Coast life sciences cluster and North Atlantic markets. Its strong, clean, natural, trusted brand aligns with consumer demand for sustainable and traceable biomaterials, foods, and pharmaceuticals. There is also strong political support.

Narrative Statement for Maine

Based on our research and stakeholder insights, we propose the following narrative statement for Maine:

"Maine aims to lead in blue biotechnology by combining its rich marine resources, world-leading research facilities, and supportive entrepreneurial ecosystem to build companies with high growth potential to address market demand for natural solutions in health and medicine, food and feed, and biomaterials. Anchored in its coastal heritage and marine workforce, Maine offers a solid foundation for the next generation of biotechnology ventures that drive coastal, social and economic development."

Proposed Vision Statement: "Maine will be the nation's launchpad for next-generation blue biotechnology companies, fueling innovation and growth in the coastal economy." Here, ocean science, marine resources, and entrepreneurship converge to deliver sustainable innovations in food, health, energy, and the environment. By turning marine resources into high-value products, Maine will be the nation's launchpad for a new generation of biotechnology companies advancing a resilient coastal economy."

Maine's Blue Biotechnology Value Proposition: Blue biotechnology companies need high-quality marine resources, specialized research infrastructure, and market credibility to scale ocean-derived innovations. Maine offers one of the largest regional networks of marine biotech organizations, access to pristine coastal resources through the nation's fastest-growing seaweed sector, and world-class research facilities. Companies choosing Maine gain instant market credibility through its trusted "clean ocean" brand and are positioned to lead in three high-growth segments: transforming marine waste into valuable products, discovering novel compounds from genetic resources, and advancing offshore cultivation. With dedicated blue biotech zones and streamlined processes, Maine offers an unmatched competitive advantage - authentic sustainability credentials and infrastructure support.

Strategic messaging to key audiences

For Investors: "Maine's blue biotechnology sector is poised for exponential growth, tapping into a global market in nutraceuticals, bioplastics, animal feed and marine pharmaceuticals. Valued at USD 6.8 Billion in 2024, this market is projected to reach USD 12.3 Billion by 2033¹⁰. With abundant marine biomass, world-class science, and proven startups, Maine offers an unrivaled risk–reward profile for investors seeking the next high-growth frontier in biotech."

Maine's Blue Biotechnology Potential - Oct 2025 - Bigelow Laboratory for Ocean Sciences

¹⁰ Verified Market Report, Blue Technology Market, October 2025

For Entrepreneurs: "Maine is the nation's testbed for marine biotech startups: abundant marine resources, translational science, pilot facilities, and a collaborative innovation ecosystem are available in a place that values ocean stewardship, collaboration, and community."

For Policymakers: "Blue biotechnology is the future economic engine for Maine. It will create high-paying jobs in rural and coastal communities, diversify the aquaculture and seafood sectors, and strengthen New England's leadership in helping biotechnology ventures scale up in an emerging biotech solutions market."

For Researchers & Collaborators: "Maine's strong research community, leading-edge lab facilities, and cross-disciplinary research partnerships accelerate the path from discovery to practical applications. Blue biotechnology research does not stay in the lab; it turns into real-world solutions."

For Communities: "Communities and their leaders are key to the growth of Maine's blue biotechnology sector. Listening to community needs and fostering open, ongoing dialogue ensures that innovation aligns with local values and priorities. Blue biotechnology is a way to strengthen Maine's heritage fishing sector through new revenue streams and jobs. It supports coastal economies while honoring the traditions and livelihoods that have defined Maine for generations."

4. Key Findings & Recommendations

4.1. Scalable initiatives to grow Maine's blue biotechnology economy

Three strategic scalable initiatives can drive the growth of blue biotechnology in Maine as part of the Blue Economy. These **near-term scalable initiatives** leverage Maine's competitive advantages and ecosystem features and position it for future expansion into higher-value biotech applications.

- **Durcycling fishing and aquaculture waste** into highervalue products like fertilizers,
 bioplastics, and animal feed.
- Harnessing novel marine genetic resources to develop new high value products and processes in diagnostics, pharmaceuticals, nutraceuticals, and supplements.
- aquaculture to create new opportunities for food, energy, environmental restoration, and more.

Marine biotechnology can create new jobs in Maine's coastal communities. Expanding aquaculture fosters new marine product industries and creates jobs from entry-level technical roles to advanced scientific and entrepreneurial positions in research, biomanufacturing, and environmental management. Growth in marine biotechnology also supports aquaculture diversification, including farming new species (seaweed, shellfish, finfish), developing sustainable feeds, and improving disease resistance, driving demand for farmers, hatchery technicians, processors, and logistics coordinators. As value-added seafood products and export markets grow, Maine's aquaculture industry is expected to add thousands of jobs in the coming decade. The commercialization of seaweed and algae for biofuels, foods, bioplastics, cosmetics, and nutraceuticals will also generate roles in cultivation, processing, manufacturing, product development, and marketing. Programs like Aquaculture in Shared Waters also train new entrepreneurs and workers to launch and scale seaweed and shellfish farming businesses, building workforce resilience.

Growth in marine pharmaceuticals, enzymes, and biomaterials requires laboratory scientists, quality assurance professionals, and manufacturing technicians. The adoption of new biotechnologies for environmental monitoring, blue carbon projects, water quality management, and restoration also creates roles in environmental science, consulting, and data analysis focused on local coastal ecosystems.

4.2. Key gaps to further scale Maine's blue biotechnology ecosystem

Developing a strong blue biotechnology ecosystem in Maine involves structural, regulatory, talent, and funding challenges. However, these obstacles are opportunities for strategic interventions that could enable greater scale and market impact in blue biotechnology. It is clear that growing Maine's blue biotechnology sector must go hand-in-hand with the growth of other blue economy sectors such as aquaculture, and waste valorization from fisheries. This means that the obstacles facing those sectors also apply to blue biotechnology. Many of the challenges listed here align with findings in other blue economy reports¹¹.

<u>Infrastructure Challenges</u>

- Limitations on living resource biomass available to upscale: Although Maine lands significant marine biomass, most is shipped out of state for processing and consumption. As a result, little remains available to support local waste valorization for higher-value products. This is partially driven by limited processing facilities. Maine has the nation's oldest fishing fleet, limited on-board processing and outdated shore infrastructure. Fuel and ice are concentrated in Portland, leaving mid-coast and Downeast fisheries and aquaculture underserved. This creates inefficiencies, such as long transit times to offload catch. Most fish processing still relies on manual labor. Byproducts processed in the state are also underutilized, with most used as lobster bait, limiting opportunities for biomaterials, pharmaceuticals, or feed innovation.
- Missing laboratory and biomanufacturing capacity for scale up: A shortage of wet labs, shared laboratory space, pilot facilities, and bioreactors often forces early-stage companies to leave Maine after the research phase. Recent investment by the Maine Technology Institute to create more laboratory space for life science innovation and incubator spaces for research organizations aims to ease this challenge soon.

<u>Regulatory Challenges</u>

- Complicated state permitting and zoning: Local approval processes are often slow and skeptical of new or external industries, creating uncertainty and discouraging new investment.
- Federal regulatory challenges for innovative products: Use of some marine-derived feeds and feed/food additives has not yet received federal approval, limiting their ability to go to market.

¹¹ Aquaculture Roadmap, SEA Maine Workforce Assessment, MAA Seaweed Benchmarking, MAIC Climate Report

Talent Challenges

- Limited technical and business expertise: There is a shortage of individuals with the necessary industry-specific skills to advance in blue biotechnology ventures.
- Small (but mighty!) pool of experienced entrepreneurs: Maine lacks enough experienced early-stage CEOs and founders to scale emerging ventures.
- **No critical mass:** The region has not yet reached a critical mass of early-stage companies to build peer networks, attract support services, and sustain an innovation cluster.
- **High quality-of-life barriers to recruiting and retaining:** Rural areas face housing shortages and limited local infrastructure, making it difficult to bring in specialized expertise.
- Weak linkages to larger ecosystems: There are weak connections between local innovators and larger, well-resourced institutions out of state that could provide partnerships, mentorship, and scaling opportunities.

Funding Challenges

- Throttles for biomass producers to find alternative markets: The current marine biomass
 auction system restricts fishers' ability to negotiate prices with alternative buyers. This results
 in a limited alignment between primary producers and downstream industries, hindering
 innovation in value chains beyond the dock.
- Early-stage financing gaps: There is limited access to first-of-a-kind (FOAK) project financing and capital for innovative ventures.
- Small and fragmented investor network: Maine has low deal flow with external investors, which reduces familiarity and trust in the blue biotechnology pipeline. The investment ecosystem remains fragmented, with limited capital to commercialize new technologies.

4.3. Recommendations to overcome obstacles

To build a competitive, scalable blue biotechnology ecosystem, Maine must address these gaps in infrastructure, regulatory, talent, and funding. The following points outline stakeholder recommendations to overcome the barriers.

Infrastructure and Business Clustering

- Support community engagement and listening sessions
- Establish dedicated blue biotechlogy zones and coastal hubs supported by tax or location incentives.
- Invest in shared wet lab and pilot-scale biomanufacturing facilities to anchor startups in the state.
- Expand in-state processing to retain more catch and byproducts for innovation.
- Modernize shore infrastructure (processing, ice, fuel) and upgrade fleets with on-vessel processing.

Talent Recruitment, Retention and Development

- Recruit high-performing entrepreneurs with Maine connections.
- Incentivize business relocation through debt financing and tax benefits.
- Offer long-term tax incentives (e.g., 10-year income tax holiday) for startup management teams in Maine.
- Increase funding for blue biotechnology academic, technical, and vocational training programs.
- Address housing shortages to attract talent to rural and coastal regions.

Funding and Investment Strategy

- Attract more private and growth capital to scale companies. Develop local angel and earlystage investor networks, potentially with philanthropic support.
- Create state-backed or matching state funds to attract venture investment and de-risk first-ofa-kind projects.
- Provide public funding to support prototyping and proof-of-concept ventures.
- Attract and support accelerators and incubators linking research organizations with industry.

Cross-Sector and Ecosystem Alignment

- Secure legislative support to expand aquaculture as a source of biomass inputs.
- Foster community-building initiatives to strengthen collaboration across startups, research, and industry leveraging other state initiatives like the new Life Sciences Center.
- Expand commercialization support for academic and research institutions to turn innovation into market opportunities.
- Maintain and elevate Maine's academic leadership in marine and life sciences to attract external partnerships.
- Implement Blue Economy Task Force recommendations, including establishing a statewide Center for Blue Economy to enhance coordination, visibility, and access to funding.

Regulatory Improvements

- Streamline permitting and zoning to reduce barriers and improve predictability for new ventures
- Introduce flexible regulations to accelerate innovative technology adoption.
- Supporting federal biotechnology regulation streamlining to help unlock the full potential of blue biotechnology.

5. Next Steps on the Horizon

The next steps for growing Maine's blue biotechnology sector require moving from planning to implementation. As a major first step, the Maine Technology Institute recently selected the Bigelow Laboratory for Ocean Sciences to launch a Blue Biotech Innovation Ecosystem with Hatch Blue, Ocean House Consulting, and other industry experts. This nearly \$1M project cofunded by MTI and Bigelow Laboratory will start with entrepreneur and innovator recruitment in fall 2025, culminating in an intensive, place-based 10-day innovation studio and investor summit in spring 2026. Participants will receive high-quality mentoring, strategic consulting, market research, and direct access to R&D facilities to amplify the technical readiness of their ideas. A major goal is for participating teams to receive follow-on funding. The ecosystem will signal to global investors Maine's readiness to support blue biotechnology ventures. Hatch Blue brings deep experience and proven expertise in this area, with past programs unlocking over \$300 million in follow-on capital. With follow-on sponsor funding, there will be a hub to continue growing Maine's talent pipeline and funding opportunities. To accelerate this growth, our goal is to seek engagement with leading corporate partners and investors interested in scaling solutions in the blue biotechnology space.

Another important step is helping researchers interested to translate their blue biotech innovations to market to get coaching and support on business development, to help speed new innovations into the studio pipeline. Bigelow Laboratory is partnering with the Roux Institute of Northeastern University and the University of Maine, as part of the NSF I-Corps Hub: New England Region¹², to offer customer discovery training. Through a new **blue biotech iCorps cohort**, anticipated to launch in early 2026, innovators from Maine and around the region will receive coaching on finding product-market fit via engagement with potential users of the use-inspired outcomes of their research. These trainings will help accelerate deal flow into the innovation studio, ultimately leading to more and faster licensing and/or startup creation.

The ecosystem mapping and stakeholder engagement that went into this report was just a first step, to inspire collaboration and aspiration to grow blue biotechnology in Maine. Further conversations are absolutely necessary, especially with communities, established industry, investors and elected representatives to further build this innovation ecosystem. Bigelow Laboratory intends to use our new forum to bring together conversations, to leverage our teaching resources to support workforce development programming, and to offer our expertise to state and federal agencies eager to capitalize on place-based innovation to support regional and national priorities.

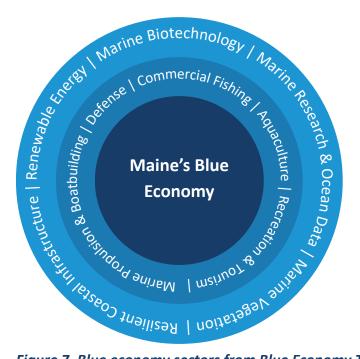
Finally, we hope that this report's key recommendations are considered by the Maine Blue Economy Task Force and the newly formed Maine Life Science Center as they continue important work to identify the biggest challenges and opportunities to grow Maine's blue economy and life science economy.

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¹² NSF I-CORPS Hub New England Region, https://neicorps.org/

6. Background, Motivation & Methods

In early 2025, Maine's Blue Economy Task Force (BETF) identified marine biotechnology as an emerging economic engine for Maine (*Figure 7*), driven by the state's abundant marine resources and scientific innovation¹³. However, it noted that "fully realizing this vast potential demands a more cohesive and deliberate approach". It underscored a need for enhanced coordination among stakeholders, more targeted investment, and a clearer strategic focus to overcome fragmentation and gaps that have previously hindered Maine's competitive edge. The BETF report highlighted that Maine lacks a clear vision for growing this emerging sector, including its starting point, obstacles, and priorities.



<u>Inner circle</u> = Traditional/evolving blue economy industries for Maine <u>Outer circle</u> = Emerging/developing blue economy industries for Maine

Figure 7. Blue economy sectors from Blue Economy Task Force Jan 2025 report

To address the gaps highlighted in the BETF report, Bigelow Laboratory for Ocean Sciences in East Boothbay, ME, commissioned an innovation ecosystem assessment from Hatch Blue and Ocean House Consulting, supported by the Maine International Trade Center and in collaboration with Maine's Department of Economic and Community Development. Conducted from July 1 - September 30, 2025, the assessment gathered stakeholder input and ecosystem data to identify opportunities and gaps for targeted development.

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¹³ Maine's Blue Economy Task Force, <u>January 2025 Report</u>.

This report summarizes those findings and proposes a value proposition for Maine as a leading blue biotechnology hub. Bigelow Laboratory's motivation behind the championing of this economic sector springs from the diverse use-inspired solutions developed by its scientists and partners across the state. It also recognizes that bringing those solutions to market requires a broader ecosystem of support.

Over 90 days, Bigelow Laboratory for Ocean Sciences convened experts from Hatch Blue and Ocean House Consulting to conduct the background research and ecosystem assessment that informs this report, which is co-funded by Bigelow Laboratory for Ocean Sciences and the Maine International Trade Center. The Maine Department of Economic and Community Development also contracted Camoin Associates to conduct an economic analysis of the emerging blue biotechnology sector in Maine, which provided further data inputs to the stakeholder analysis and ecosystem mapping activities. The goal was to co-develop a qualitative, regionally grounded baseline to support the future development of an economically thriving blue biotechnology sector in Maine.

For the ecosystem assessment, experts compiled and screened a database of organizations with potential relevance to the blue biotechnology sector in Maine (and more broadly across New England). Three main categories of participants were considered:

- **1.Blue economy supply chain companies:** seafood production (wild harvest or aquaculture), seafood processing, product transformation, or management of associated waste streams.
- 2. Life sciences companies: organizations with processes, technologies, or products that could be applied to blue biotechnology.
- 3. Blue biotechnology companies: firms at the intersection of the blue economy and life sciences.

Each organization was classified by stakeholder type, sector, and value chain position, as shown below:

Stakeholder Types	Sectors	Position in Value Chain
Accelerator / Incubator	Aquaculture	Knowledge & Resource Foundation
Business	Biotechnology	Translation & Development
Entrepreneur	Commercial Fishing	Innovation Support & Facilitation
Family Office / Foundation	Life Science	Production & Manufacturing
Government	Supporting Sector	Market Access & Distribution
Industry Association	Other	Regulatory & Government
Investor		Industry Associations
NGO		Infrastructure & Logistics
Research / Education		
Research Project		
Other		

The database compiles information from diverse sources, including:

- Accelerators & Innovation Hubs: GMRI Ventures, Maine Center for Entrepreneurs, Dirigo Labs, Greentown Labs, GMGI (Gloucester Marine Genomics Institute), BlueSwell.
- Economic Research: Reports from Camoin Associates.
- Ecosystem & Industry Databases: Maine Life Sciences Network, BioME, FocusMaine, Maine Blue Index, MassBio, Maine International Trade Center (MITC).
- Industry Reports: Maine Blue Economy Task Force, SEA Maine.
- Public Databases: Publicly available information from sources like MTI, NOAA, EDA and Crunchbase.

This resulted in a comprehensive ecosystem mapping of 1,038 organizations across New England. The database is available upon request.

To gather stakeholder input, Bigelow Laboratory for Ocean Sciences held a workshop on July 1, 2025, and collected feedback through interviews and an online form. A brief summary of the workshop input¹⁴ helped to frame follow-up engagement from interested parties and sector experts who could not attend.

The recommendations outlined in this report directly align with and will accelerate the outcomes sought by Maine's Economic Development 10-Year Plan and the Maine Innovation Economy Action Plan. Both strategies emphasize fostering innovation-driven sectors, expanding high-quality job opportunities, and building resilient regional economies. Blue biotechnology, leveraging Maine's unique marine resources, research expertise, and coastal infrastructure sits squarely within these priorities, offering a pathway to diversify the state's economy while addressing global sustainability challenges. By advancing targeted investments, strengthening industry-academic partnerships, and enhancing workforce skills, the initiatives in this report will help realize the state's vision of positioning Maine as a leader in emerging ocean-based industries, driving both economic growth and environmental stewardship.

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¹⁴ Bigelow,: <u>Blue Biotechnology Ecosystem Assessment Executive Summary (July 1 2025 Workshop)</u>

7. Appendices

7.1. Market trends

Pharmaceuticals¹⁵: The global marine-derived drugs market – a subset of the over \$1.4 trillion medical market – was valued at \$2.57 billion in 2022. The global blue biotechnology pharmaceuticals market is projected to reach approximately \$5 billion by 2030, with a compounded annual growth rate (CAGR) of 8-10%. This growth is driven by the demand for new pharmaceuticals and advanced therapies, offering high-value opportunities due to their potential for novel drug leads with lower toxicity and fewer side effects than conventional treatments. By 2021, over 30,000 natural marine products had been reported, resulting in 15 FDA-approved drugs – 60% targeting cancer – and over 300 related patents approved globally. Many substances are also in clinical trials. Advances in the genomics of uncultivated marine species and Al-driven synthetic biology are enabling the discovery of new bioactive molecules.

Nutraceuticals¹⁶: The \$450 billion nutraceutical market is growing at a 7.5% CAGR(2022-2030). Seaweed-based nutraceuticals are projected to reach a market potential of \$3.9 billion by 2030. The U.S. is the largest market, with high demand for marine-derived supplements including omega-3s from fish oil and algae-based products. Marine sources provide key compounds that support bone health, joint pain relief, and gut health.

<u>Biostimulants</u>¹⁷: The agricultural sector's shift toward synthetic fertilizer alternatives is fueling growth in the global biostimulants market, which is projected to grow at a CAGR of roughly 10% per year. The global seaweed-based biostimulants industry is currently valued at \$0.8 billion with a CAGR of 7.3%, and is projected to reach \$1.8 billion by 2030 with a 30% market share in the biostimulants market. Rising global fertilizer prices are also increasing demand for sustainable alternatives like seaweed-based products.

¹⁵ González Peña et al., 2021; 360 research reports, 2022; Banerjee et al., 2022

¹⁶ Fortune Business Insights, 2022a; Santini et al., 2023

¹⁷ Baffes et al., 2022

Bioplastics, Biopolymers, and Biomanufacturing: Increasing awareness of plastic pollution and demand for sustainable alternatives are driving the global bioplastics and biopolymers market, which is predicted to grow from \$11.5 billion in 2022 to \$49 billion by 2030 at a CAGR of about 20%. The market model predicts an algae-based bioplastics/biopolymers market share of \$0.73 billion in 2030. This growth is fueled by regulatory guidelines and consumer demand for sustainable packaging, with many corporations setting targets to use 100% recyclable, compostable, or reusable packaging. PLA, a common bioplastic, can be derived from seaweed, while PHAs, bio-based and biodegradable polymers can be synthesized by microorganisms using seaweeds and carbon sources. The sector also includes industrial enzyme products like detergents.

Livestock Feed Supplements¹⁸: Efforts to reduce methane emissions to address global warming has led to the recent development of anti-methanogenic seaweed-based feed supplements. The global seaweed-based livestock feed additive market was valued at \$0.05 billion in 2022 and is expected to grow at a rate of 57% CAGR between 2022-2030 to a value of \$0.31 billion by 2030. Based on the supplements' efficacy, some estimates indicate that 20% market penetration of these supplements could remove up to 15% of global enteric livestock methane emissions, one the largest sources of atmospheric methane. Livestock farmers could get carbon market credits for these reductions, while nutritional benefits from the supplements could also bring them economic value.

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¹⁸ Kinley et al., 2020

7.2. Case studies



Viable Gear LLC, a Portland, Maine-based company, is a mission-driven startup focused on replacing traditional petroleum-based plastics with seaweed-based alternatives for the fishing, aquaculture, and agriculture industries. The company was founded in 2021 by Katie Weiler, who was inspired by the global plastics crisis and its impact on human health and food systems.

Viable Gear's innovative material is a marine-compostable bioplastic designed to perform similarly to existing plastic products. The company's pilot product, SeaTwine, is slated to launch in 2025 as a plastic-free alternative to the nylon twine currently used in seaweed aquaculture and for baling and greenhouses in the farming industry. The company is also developing lobster bait bags from its seaweed polymer, with the goal of providing a sustainable alternative to a common piece of gear that can easily become "ghost gear" in the ocean.

Viable Gear has been funded through non-dilutive grants, allowing it to focus on R&D and product development. The company has received multiple grants, including a \$50,000 grant from the Maine Technology Institute in 2024 for a project in the aquaculture and marine program area. This support highlights how state funding can help a small business innovate in the blue biotechnology sector and bring a unique, sustainable product to market.



Salmonics is a biotechnology startup based in Brunswick that exemplifies the potential of circular economy business models within the blue economy. The company, founded in 2020, manufactures fish-derived plasma proteins and reagents intended for use in research, diagnostics, and clinical applications. It is building on more than 20 years of research from a predecessor company, Sea Run Holdings Inc., which it acquired.

The company provides products such as salmon plasma, serum, fibrinogen, and thrombin, which are derived from blood harvested from farmed salmon that would otherwise be discarded as waste. The global market for these products is estimated to be between \$35 billion and \$40 billion. This process not only creates a valuable product but also supports environmental responsibility and sustainability by providing a value-added return for partner aquaculture companies. The company's products offer a sustainable alternative to traditional products derived from mammalian sources, such as bovine serum, which can be subject to supply chain issues and carry the risk of mammalian viruses. Salmonics' manufacturing facility is located at TechPlace, Brunswick Landing's Technology Accelerator. Under the leadership of CEO Cem Giray, a marine scientist with a Ph.D. in Oceanography, the company continues to innovate new products and build its team. The company recently became an inaugural member of the Roux Institute's BioPILOT Lab, which provides access to shared lab space, equipment, and expertise to help accelerate innovation.



Marin Skincare is a Portland-based company that exemplifies the power of upcycling marine resources to create high-value products. Founded by University of Maine biomedical engineering alumni Amber Boutiette and Patrick Breeding, the company's origin story is deeply personal. Boutiette, who had struggled with severe eczema for years, discovered a solution while working with a lobster scientist researching glycoproteins. Glycoproteins are proteins found in lobster circulatory fluid, a natural byproduct of lobster processing that typically goes to waste. The scientists found that in the same way these proteins help a lobster regenerate limbs and heal wounds, they could also help repair the skin barrier in humans.

After creating a prototype cream and seeing a dramatic improvement in Boutiette's eczema, the cofounders were inspired to launch Marin Skincare in 2020 to share their discovery with others. The company's hero product, the Soothing Hydration Cream, is designed to provide relief for those with eczema, psoriasis, and dry skin. Marin Skincare has partnered with another Maine business, Luke's Lobster, to sustainably collect the glycoproteins, creating a new, value-added supply chain from a previously wasted resource. The company has received funding from the Maine Technology Institute (MTI) and has secured a partnership with L.L. Bean to sell its products in select stores. This case demonstrates the potential for blue biotechnology to create innovative, sustainable consumer products while supporting Maine's legacy industries.



Cold Current Kelp is a women-owned kelp farm and skincare company in Southern Maine, co-founded by marine biologist Dr. Inga Potter and Krista Rosen. The company was founded in 2021 with the goal of creating clean skincare products using kelp as a primary ingredient. Cold Current Kelp exemplifies a "seato-skin" business model, managing every step of the process from growing kelp in local Maine waters to harvesting, drying, and developing the final product.

The company's flagship product is the KelpGlow Facial Oil, which combines regeneratively grown sugar kelp extract with nourishing organic oils. The bioactive compounds in kelp, such as polysaccharides (fucoidan and laminarin), vitamins C & E, and phlorotannins, provide antioxidant, anti-aging, hydrating, and soothing benefits for the skin. The company's focus on regenerative kelp farming highlights its commitment to sustainability, as kelp requires no freshwater, fertilizer, or pesticides to grow, and it actively improves ocean health. Cold Current Kelp has received several grants, including a \$15,000 grant from the Maine Technology Institute in 2024 and a \$175,000 research and development grant through the USDA's Small Business Innovation Research (SBIR) program to improve its extraction process. This support demonstrates how state and federal funding can help a small, women-owned business innovate in the blue biotechnology sector and bring a unique product to market.



Ocean's Balance is a Biddeford, Maine-based seaweed company that embodies the principles of sustainability and value-added product innovation in the blue biotechnology sector. Founded by Mitchell Lench, Lisa Scali, and David Labbe, the company's mission is to make seaweed from the Gulf of Maine a delicious and essential part of the American diet. The company has expanded from a small operation to a leading seaweed ingredient producer by focusing on sustainable harvesting practices and cutting-edge processing technology.

The business model of Ocean's Balance is vertically integrated, spanning from regenerative ocean farming to the development of consumer and industrial products. The company cultivates seaweed, a zero-input crop that requires no fresh water, arable land, or fertilizers and absorbs carbon at seven times the rate of plants and trees. This regenerative farming approach provides new jobs and a revenue stream for Maine's lobstering community, which is facing challenges from climate change.

Ocean's Balance produces a variety of seaweed-based products, including organic kombu flakes, kelp purees, and flavored seaweed sprinkles (furikake). The company has been successful in tapping into the growing global market for furikake due to its bold flavors, versatility, and appeal to health-conscious consumers. The company also sells its products in bulk for industrial use. In 2024, Ocean's Balance received a \$76,000 grant from the Maine Technology Institute for its aquaculture and marine initiatives. It also won a \$100,000 grand prize in the "Greenlight Maine" entrepreneurial contest, which it plans to reinvest to further expand its personnel, production capabilities, and farming operations.



Dirigo Sea Farm is a Maine-based startup dedicated to combating plastic pollution by creating biodegradable bioplastic from kelp. The company was founded in 2024 by Alexa McGovern, a former software developer with a background in consumer packaged goods. Inspired by her personal health journey and an increasing awareness of plastic toxins in the environment, McGovern started the company with a vision to create a scalable, value-added product that could utilize the abundant supply of Maine kelp. The company's name, Dirigo, is Maine's state motto and translates to "I lead". Dirigo Sea Farm LLC was awarded a \$25,000 grant in August 2024 for a project in the aquaculture and marine program area.

Dirigo Sea Farm's core innovation is a dissolvable bioplastic film made from compounds extracted from kelp. This material serves as a truly biodegradable alternative to the single-use plastics found in products like laundry and dishwasher pods. These pods, while marketed as eco-friendly, are often made of polyvinyl alcohol (PVA), a plastic that is not truly biodegradable in wastewater treatment plants, contributing to microplastic pollution. Dirigo Sea Farm's product offers a safer, non-plastic alternative that gives consumers convenience without sacrificing performance or ethics.

The company has successfully raised \$150,000 from grants to fund its initial operations. It has also received support from the Shaw Institute, a non-profit science research center, which is assisting with lab space and general knowledge resources to help develop the kelp bioplastics. Dirigo Sea Farm's business model is to be an "off-taker" for other Maine kelp farms, buying bulk supply and converting it into high-value products. This approach supports and grows Maine's heritage sea economy while creating innovative end markets for its kelp.

Growing Blue Biotechnology in Maine

October 2025

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