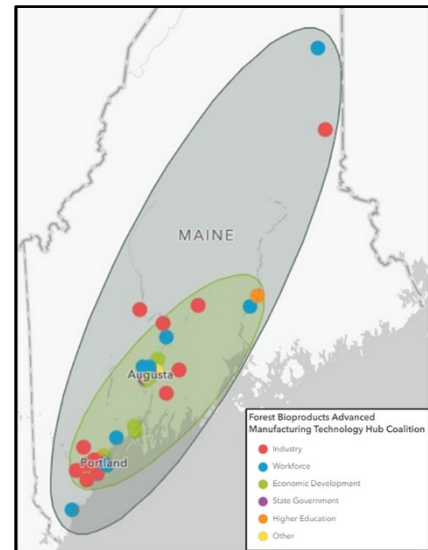


FY 2023 Regional Technology and Innovation Hub Program Phase 1 Case for Designation – Forest Bioproducts Advanced Manufacturing Technology Hub

Tech Hub Geography: Helmed by the Maine Technology Institute (MTI), the Forest Bioproducts Advanced Manufacturing Technology Hub will leverage advanced materials and manufacturing industry, workforce, and research capabilities concentrated along Maine’s I-95/295 corridor between Portland (Portland-S.Portland MSA) and Orono (Bangor MSA). This interconnected core is anchored by a pair of world-class industrial research institutions - Northeastern University’s Roux Institute and the University of Maine (UMaine). MTI is headquartered in between at Brunswick Landing, Maine’s state-of-the-art industrial innovation district. The Maine Community College System offers degree and training programs in each of these communities. The corridor also includes the Lewiston-Auburn MSA and the Augusta-Waterville MSA, where key manufacturing assets are located, and is closely linked in the north and west to mill communities and expansive forests in Somerset and Aroostook Cos.



Core Technology Areas: The consortium’s core technology area is *extracting biological building blocks from forests, manipulating them for use, and manufacturing environmentally sustainable products from those components*, at the intersection of two KTFAs: (4) Robotics, automation, and advanced manufacturing, and (10) advanced materials science. Offering significant opportunities for Made in America products to displace plastics, sequester carbon in buildings, and replace harmful synthetics, much of the technology to separate wood biomass into its component parts was pioneered in Maine’s paper industries and remains the foundation of next generation industries. Through chemical and mechanical means, wood’s component parts can be isolated and extracted into versatile biomaterials—such as nanocellulose, nature’s “super polymer”—suitable for many uses.¹ When incorporated into conventional products, these natural, biodegradable materials offer increased performance (such as improved strength), replacement of toxic additives (such as formaldehyde and PFAS), and carbon sequestration. These materials are also wholly displacing conventional products with environmentally sustainable alternatives, such as wood fiber insulation instead of fiberglass, molded fiber packaging for consumer products instead of single-use plastics, and 3D-printed structural applications replacing traditional construction. The same technology is used in the region to also commercialize products from non-wood sources, such as kelp.

The Seven Key Designation Factors

1. Technology-based potential of the region for global competitiveness:

Economic Opportunity: With increasing plastic and climate restrictions, corporate accounting for scope 3 emissions, and consumer demand for sustainable products, the global economy is shifting away from fossil fuel feedstocks towards biobased products. As a \$3.4 trillion global market growing to \$5 trillion by 2030, biobased products are going to be a crucial market for the U.S. to sustain manufacturing.² The Tech Hub will act as the United States’ spearhead into key subsectors of this biobased economy. By bolstering the already robust assets outlined below, the region will be the center of America’s wood-based bioproduct industry cluster by 2033 -- akin to the Midwest’s leadership in plastics and chemicals. FOR/Maine projected that greater utilization of the state’s sustainably-harvested wood fiber could add an additional \$4 billion in economic value by 2025 at existing productivity levels, as well as 3,000 net new jobs through 2030 from emerging technologies – with an aggressive push into new carbon-reduction markets and technologies as the Tech Hub envisions, the results could be much larger.³

Assets, resources, and capabilities of the region: The region is strongly positioned to reach global competitiveness over the next decade, with world-class assets propelling each of five steps in the value chain. Future Tech Hub activities will increase the region’s speed and effectiveness for pulling technology-driven innovations through product development and commercial manufacturing to sales:



- *Sustainable feedstock source:* Woody biomass from forest residuals is the most abundant and promising raw material for biobased manufacturing right now.⁴ Using residuals rather than virgin cellulose reduces competition for farmland, eliminates waste, and sequesters carbon while adding value to each harvested log. Maine is home to the largest contiguous privately-owned working forest in the US (16.3 million acres), providing 13 million tons of sustainably harvested timber and biomass to the state’s \$8.1 billion forest economy, employing more than 30,000 people every year. From these vast forests, the region’s harvesters, sawmills, and pulp mills stand ready to supply the world with sustainably managed wood feedstock.

- *Use-inspired research and development:* UMaine is one of industry’s go-to institutions for technical assistance on biomaterials and bioproduct commercialization. The university has the highest number of nanocellulose researchers in the country, boasts internationally recognized forest bioproduct testing and research facilities, and is the world’s largest public supplier of cellulose nanofiber (CNF) – a common form of nanocellulose. Since 2012, 443 companies in 43 countries have sought out samples of cellulose nanomaterials from UMaine and the university has partnered on 15 commercial scale demonstration projects across Europe, Brazil, and the U.S.⁵ Portland’s Roux Institute is a new campus of Northeastern University with cutting-edge R&D facilities that support new materials development, characterization, and prototyping capabilities. Roux’s engineering team of PhD-level scientists and engineers are significant contributors to the fields of advanced material systems development, Industry 4.0 for advanced manufacturing and supply chain systems, and energy/sustainability engineering. Together, Tech Hub affiliated universities had annual research expenditures in excess of \$400 million in 2022.⁶

- *Product and business development:* The region is home to a vibrant network of organizations that support and connect entrepreneurs and has established tools for leveraging private and public funds. Maine ranks in the top 10 states for new entrepreneurship⁷ and registered a record 14,000 new businesses in the last year.⁸ Tech Hub lead MTI, along with consortium members the Maine Venture Fund (MVF), Coastal Enterprises, Inc. (CEI) and the Finance Authority of Maine (FAME) support innovation at both new and established forest biomanufacturing companies. UMaine recently received \$500,000 from MTI to upgrade equipment in their Process Development Center to help forest-products entrepreneurs and companies bring new transformative products to market faster. Through recent work in partnership with Tanbark, the Roux Institute developed a prototyping robot and system for the automated cutting of pressed fiber containers, a feature that increases the value of the product to customers.

- *Advanced manufacturing with a skilled workforce:* “A new era of manufacturing is on the rise in Maine, one in which workers can prosper financially while mastering advanced technical skills working with cutting-edge technologies,” declared MaineBiz in July 2023.⁹ Manufacturing jobs and facilities have been expanding, with the manufacturing sector’s GDP growth rate 2x the national average since 2016.¹⁰ Today, the sector constitutes ~10% of the state’s GDP and employment. Maine MEP helped clients invest more than \$100 million towards modernizing facilities, equipment, and processes in 2022.¹¹ TechPlace, in the middle of the region, includes a shared bio-production lab and a composites layout facility, and is home to dozens of firms in bioproducts and related sectors with common equipment, talent, and supply chain needs. The region has extensive investments enabling more people to join the workforce with the skills needed for

high quality advanced manufacturing careers (further described under designation factor 5).

• *Demand generation and sales:* The Tech Hub features global brands and engineering firms who are buyers of new solutions for packing products and constructing buildings. An expanded Domestic Trade pilot program at DECD is helping companies reach new customers with promotional support, market data, and business counseling services. And Maine’s first-in-the-nation extended producer responsibility (EPR) law incentivizes the region’s brands to lead the US’s transition away from single-use plastics.¹²

2. Role of the Private Sector: The Tech Hub engages private sector partners throughout the forest bioproducts advanced manufacturing value chain: early-stage SMEs bringing new products to market (Tanbark, TimberHP); multinational manufacturers (Sappi, Louisiana Pacific); a leading veterinary health firm seeking alternatives to plastic packaging (IDEXX); a global construction engineering firm (Thornton Tomasetti); a fiber manufacturing equipment company (LaCasse & Weston); financing institutions (FAME, MVF, CEI); and diverse industry associations representing Maine’s loggers (PLC), manufacturers (MAME), and the forest products sector (MFPC through their leadership of FOR/Maine). Collectively, these and other private sector partners have led identification of the region’s key market and commercialization opportunities for Maine to power the US as a bioeconomy superpower:

	Product and business development	Advanced manufacturing with a skilled workforce	Demand generation and sales
OPPORTUNITIES	<ol style="list-style-type: none"> 1. Lower barriers to entry for product, materials, and other “hard tech” startups as sector requires significant technical knowledge and start-up capital 2. Speed turnarounds for product testing to enable firms to win as first-movers 3. Address manufacturing capacity “valley of death” between development and commercial scale production 4. Make business environment attractive for permitting, energy, and siting 	<ol style="list-style-type: none"> 1. Develop more workers with advanced manufacturing skills at all levels 2. Enhance manufacturing productivity with modern technology and data capabilities 3. De-risk innovation-enabling investments and reduce the cost of capital 4. Localize equipment and tooling supply chains 5. Improve production techniques for nanocellulose supply and other inputs 	<ol style="list-style-type: none"> 1. Build region’s reputation as a place where market looks for value-added, environmentally-favorable products 2. Prove out customer demand, carbon benefits, and product performance to educate marketplace

These opportunities shape the Tech Hubs’ goals and activities. Industry partners will continue to inform the Tech Hub’s strategy and implementation. They comprise our Technology Advisory Board and provide input on technology, market opportunities, innovation gaps, workforce needs, and overall Consortium strategy.

3. Regional Coordination & Partnership: Consortium partners share a vision that Maine’s Forest Bioproducts Advanced Manufacturing Technology Hub will be the nationwide leader for firms developing, manufacturing, and selling innovative, climate-forward products derived from forests and other natural sources – with a significant focus on disrupting the global building products and petroleum-based plastics market, two sectors that significantly contribute to climate change and fossil fuel consumption. To accomplish this, the Consortium has set out seven goals:

	Product and business development	Advanced manufacturing with a skilled workforce	Demand generation and sales
GOALS	<ol style="list-style-type: none"> 1. Make region the place where firms can be <u>fastest to market</u> with new products and tech applications 2. Enable Hub-affiliated universities to have the <u>highest rate of bioproduct startups, spinouts, and licensing</u> in the country 	<ol style="list-style-type: none"> 3. <u>Double Maine’s skilled manufacturing talent pool</u> 4. Grow <u>quality and number of good jobs</u> in manufacturing and forests products 5. Improve Maine’s manufacturing productivity <u>to surpass the national mean</u> 	<ol style="list-style-type: none"> 6. Achieve <u>ten high-profile market transactions</u> where bio-based product displaces conventional orders 7. Establish global reputations for Maine and the U.S. as <u>bioeconomy superpowers</u>

The Consortium is led by MTI, Maine’s publicly-funded economic development organization that helps innovators accelerate progress to the market, leverage additional private and public investment, and ultimately, expand their economic impact in Maine. The Regional Innovation Officer is the Policy Director for Economy and Workforce in the Governor’s Office of Policy Innovation and the Future, who also serves on the MTI board along with several other consortium members. The cross-sector Steering Committee will

lead the consortium strategy and oversee projects delivered by consortium members. The consortium partners have a long track record of productive collaboration. Many members are part of the **Forest Economy Roadmap/Maine (FOR/Maine)**, an EDA funded cross-sector collaboration and BBBRC finalist. **MTI** has partnerships with **CEI, EforAll, UMaine, Roux, and GPIWC** to grow inclusive entrepreneurship. **Maine DOL, DECD, GOPIF, Maine AFL-CIO, MSBCTC, and MCCC** have previously collaborated on workforce development roadmaps and implementation strategies for Maine’s health sector, clean energy industry, and infrastructure jobs. Many more examples are included in the attached letters of commitment.

4. Equity & Diversity: An important part of implementation work will be to grow access to resources for under-represented individuals to bring innovations to market that support a more diverse, resilient, American supply chain. The Tech Hub will generate input from business owners in low income, rural, and otherwise disadvantaged, communities on strategies to further cultivate and propel hard-tech entrepreneurship. Consortium members have substantial records delivering inclusive innovation programs. For example, at UMaine, nearly half of participants in the MIRTA accelerator come from groups historically underrepresented in commercialization; at the Roux Institute, 80% of companies are led by founders who identify as BIPOC, Female, or LGBTQ+; at MTI, 43% of recovery grants for innovation-economy businesses were deployed into Justice40 designated disadvantaged communities; and at CEI, 54% of 2021 SME loans were placed to women, 37% to borrowers with low incomes, and 16% to immigrants and entrepreneurs of color. Critical to the Tech Hub’s success will be ensuring Maine has a robust, inclusive workforce with high quality career opportunities in bioproduct-related fields. An Advanced Manufacturing Talent Roadmap developed with SDG funding will include a focus on equity in opportunity to high-quality jobs and training opportunities. The Tech Hub consortium includes members who will incorporate input of diverse populations, including labor, veterans, immigrants, under/unemployed individuals, and others. As providers of evidence-based skill development programs – such as apprenticeships and industry-driven job training – many of these entities also will also implement workforce strategies identified by the Roadmap.

5. Composition and Capacity of the Regional Workforce: From land management to logging to sawmilling to paper and packaging manufacturing to equipment design, Maine’s large, specialized workforce has made constant advancements into new stages of production technology. The next stage that the Tech Hub will foster—advanced manufacturing of biobased building and consumer products—offers opportunities to add high-quality jobs and pathways for career advancement to workers, while attracting talent. Manufacturing jobs are growing in Maine, reversing a multi-decade downward trend, providing 54,000 jobs with an average income of over \$65,000¹³ -- well over Maine’s average wage -- 20,000 of which are in industries related to the Tech Hub’s focus, such as wood products and machinery manufacturing. Another 4,000 work in engineering and 2,700 in scientific R&D.¹⁴

The region is heavily invested in enabling more people join the workforce with the skills needed for these types of industries. In 2020, Maine’s public higher education institutions granted nearly 2,500 degrees in STEM fields.¹⁵ Maine’s community colleges offer free tuition and are providing no-cost job training in critical trades to thousands of Mainers. Maine DOL, with unions and others, are doubling registered apprenticeships. Maine has just signed into law one of the nation’s strongest workforce training incentives, has one of the most generous student loan repayment benefits of any state, and is one of just 13 states to guarantee paid family and medical leave. The state deployed federal recovery funds into workforce programs estimated to offer career exploration, education, and training to 22,000 people. The Consortium will establish a public-private Advanced Manufacturing Careers Partnership that ensures a robust, inclusive workforce with high quality career opportunities and will use SDG funds for a Roadmap prioritizing workforce gaps, career pathways, and training priorities.

6. Innovative “Lab to Market” Approaches: Establishing a Tech Hub with MTI at the core will help

connect Maine innovators with customers and markets across the world, while simultaneously creating a high-profile platform for attracting more ideas, talent, and capital to the region. Since 1999, MTI has deployed over \$365 million in nearly 3,800 innovation, commercialization, and ecosystem projects, generating over \$2.2 billion in private sector matching investment. This proven model of translating innovation into local economic competitiveness results in new jobs, new technologies, regional economic activity, and accelerated business growth. For example, MTI recently invested \$500,000 to \$1 million into Sappi North America, Tanbark, and TimberHP to advance technology development, expand customer channels, and grow products/markets. Industry collaboration through the Tech Hub will also play an important role in linking technology to customers. Our Technology Advisory Board includes supplier firms, customer-facing firms/advisors, and firms that do both. These firms will share technology progress, identify product opportunities, and collaborate to educate consumers and shape market sentiment.

The Consortium envisions using Tech Hub implementation funds to establish a “Hard Tech” Startup Accelerator to catalyze early-stage advanced manufacturing and advanced materials ventures. Initial work, funded with SDG funds, includes conducting a strategic assessment of the Region’s start-up ecosystem for the development of new products and manufacturing techniques. The Consortium also intends to use implementation funds to strengthen technology commercialization initiatives at Tech Hub university partners. Initial work, funded through the SDG, will pilot offering established firms individualized assistance to design a project that addresses a key commercialization gap and swiftly connect to the right resources to implement and fund that project. The consortium will also develop partnerships with regional and national industry associations positioned to promote the technology and introduce consumer brands to forest bioproducts market opportunities. Finally, the Consortium intends to use Tech Hub implementation funds to establish an Industry 4.0 Center of Excellence to provide advanced materials and manufacturing firms with access to individualized technical assistance, financing support, and permitting and energy navigations tools. SDG funds will be used to pilot Industry 4.0 readiness assessments with an initial cohort of firms.

7. Impact on Economic and National Security of the Entire United States: The Biden administration’s “Bold Goals for U.S. Biotechnology and Biomanufacturing” and “Strategy for Plastics Innovation,”¹⁶ recognize that domestically produced bioproducts will be critical to achieve the President’s target for the US economy to achieve net-zero emissions by 2050 and mitigate the well-documented security risks associated with a warming planet.¹⁷ Transitioning to more biomass-based products provides an opportunity to grow a product economy rooted within U.S. borders, providing more resilient supply chains, and capturing more value by replacing plastic products that are often imported. However, while there is positive movement in these industries in the U.S., there is a risk that firms in Europe and Asia are better poised to capture these future markets. Europe now has a head start in many of these markets, representing nearly three times the biobased chemical production capacity and 1.5 times the bioplastic production capacity of North America. Surpassing both regions, however, is Asia, with China leading in production capacity.¹⁸ Through investments from a five-year bioeconomy plan and regulations including a phased-in ban on single-use plastics, one analysis estimated that by 2025 Chinese producers of biodegradable polymers could account for two thirds of global output, although that success is far from guaranteed.¹⁹ It is possible to envision a 2033 where the U.S. is the global leader in biobased product manufacturing, but it will require concerted coordination and investment over the coming decade.

Geographic Constraints: The Consortium substantially benefits and is rooted in small and rural communities as defined by 15 U.S.C. § 3722a(a)(8)—the Bangor MSA has a population less than 250,000, multiple consortium members are based in small MSAs, micropolitan areas, or noncore areas; the Consortium is headquartered in Maine, which is eligible to receive EPSCoR funding; and Maine is a “low population state” as defined by 15 U.S.C. § 3722a(a)(7).

Appendix I References

-
- ¹ “Nanocellulose,” Sappi, accessed August 11, 2023, <https://www.sappi.com/nanocellulose>; “Nanocellulose Valley,” The University of Maine, accessed August 11, 2023, <https://umaine.edu/nanocellulosevalley/>.
- ² Market size excludes food. Based on Boston Consulting Group analysis in: World Business Council for Sustainable Development, *Circular bioeconomy: The business opportunity contributing to a sustainable world*, (Geneva: World Business Council for Sustainable Development, 2020), 67.
- ³ Vision and Roadmap for Maine’s Forest Products Sector, (Forest Opportunity Roadmap/Maine, 2018); Ryan Wallace, Deborah Strumsky, Laura Yeitz, Shane O’Neill, and Megan Bailey, The Forest Opportunity Roadmap for Maine Workforce Development Strategy, (Portland: University of Southern Maine, 2021), 12
- ⁴ Biobased Maine and Environmental Health Strategy Center, *Plants to Products: Renewable Materials Manufacturing—A Maine Pathway to Prosperity*, (Portland, Maine: Biobased Maine, 2020), 9.
- ⁵ Data from Process Development Center at the University of Maine as of July 25, 2023.
- ⁶ <https://umaine.edu/research/wp-content/uploads/sites/281/2023/01/2022-Research-Report-FINAL-012723-web.pdf>
- ⁷ Robert Fairliel and Sameeksha Desail, *State Report on Early-Stage Entrepreneurship in the United States: 2020*, (Kansas City: Kauffman Indicators of Entrepreneurship, Ewing Marion Kauffman Foundation, 2021), 5.
- ⁸ Governor Janet Mills, “State of the Budget Address,” (speech, Augusta, Maine, February 14, 2023).
- ⁹ J. Craig Anderson, “Maine manufacturing careers offer the opportunity to master advanced technical skills,” MaineBiz, July 19, 2023, accessed August 11, 2023, <https://www.mainebiz.biz/article/maine-manufacturing-careers-offer-the-opportunity-to-master-advanced-technical-skills>.
- ¹⁰ <https://mepdashboard.creconline.org/?state=23>, “Manufacturing GDP growth”
- ¹¹ <https://www.nist.gov/mep/centers/maine-manufacturing-extension-partnership>
- ¹² Allyn Stern, Leigh Barton, Nikki Waxman, and Clirae Bourke, “Maine Becomes First State to Sign Extended Producer Responsibility Law for Packaging, Other States with Plastics and Packaging Bills May Follow Shortly,” Beveridge and Diamond, August 11, 2021, accessed August 11, 2023, <https://www.bdlaw.com/publications/maine-becomes-first-state-to-sign-extended-producer-responsibility-law-for-packaging-other-states-with-plastics-and-packaging-bills-may-follow-shortly/>.
- ¹³ Sector data reflects privately owned employers only. 2022 averages accessed in: “Quarterly and Annual Industry Employment and Wages,” Maine Department of Labor, Center for Workforce Research and Information, accessed August 8, 2023, <https://www.maine.gov/labor/cwri/qcew1.html>.
- ¹⁴ Maine Department of Labor analysis of Bureau of Labor Statistics Quarterly Wage and Employment data.
- ¹⁵ Maine Department of Labor analysis of Maine Post-Secondary Outcomes Report data.
- ¹⁶ <https://www.whitehouse.gov/wp-content/uploads/2023/03/Bold-Goals-for-U.S.-Biotechnology-and-Biomanufacturing-Harnessing-Research-and-Development-To-Further-Societal-Goals-FINAL.pdf>; <https://www.energy.gov/strategy-for-plastics-innovation>.
- ¹⁷ <https://www.nytimes.com/2021/10/21/climate/climate-change-national-security.html>
- ¹⁸ European Commission, Joint Research Centre, Spekrijse, J., Vikla, K., Vis, M., et al., *Bio-based value chains for chemicals, plastics and pharmaceuticals: a comparison of bio-based and fossil-based value chains*, (Luxembourg: Publications Office, 2021), 5-6.
- ¹⁹ Gao Baiyu, “China cools on biodegradable plastic,” *China Dialogue*, March 3, 2022, accessed August 7, 2023, <https://chinadialogue.net/en/pollution/china-cools-on-biodegradable-plastic/>