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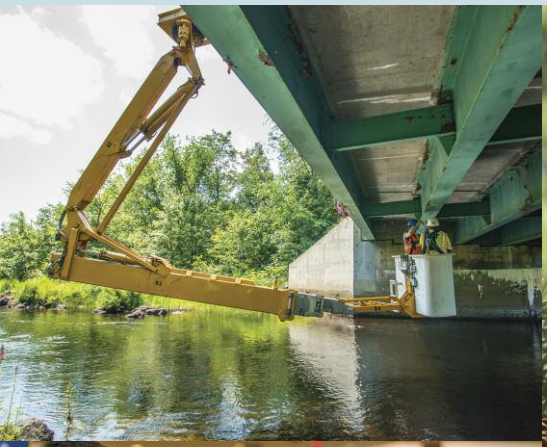
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MAINE ECONOMIC IMPROVEMENT FUND








A successful partnership among Maine's government, private sector and public universities to build Maine's economy and future workforce through research and development.

Maine's Public Universities

UNIVERSITY OF MAINE SYSTEM

Annual Report FY17 • Presented to Maine State Legislature

Maine's Public Universities

UNIVERSITY OF MAINE SYSTEM

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MAINE ECONOMIC IMPROVEMENT FUND
2017 ANNUAL REPORT

Memo from the Chancellor

The Maine Economic Improvement Fund (MEIF) represents Maine's ongoing commitment between the state and our public universities, working together to advance research and economic development for the benefit of all Maine people. In July 2014, the University of Maine System Board of Trustees (UMS BOT) established Strategic Outcomes and metrics to measure the performance of the University of Maine System and its campuses. Included in these Strategic Outcomes are specific goals for research, economic development and workforce development. UMS BOT has applied these overall Strategic Outcomes to research and development, and has established specific goals and metrics for the Maine Economic Improvement Fund to help achieve these Strategic Outcomes. These metrics were approved at the end of FY14, and are applied to all FY17 MEIF activity and included in this annual report. By statute, MEIF-funded activity is restricted to Maine's seven statutorily established R&D sectors.

In FY17, the state's $17.35 million MEIF investment was leveraged at a rate of 3.4:1 by our UMS campuses for an additional $58.6 million in federal and private-sector grants and contracts in the seven sectors.

- MEIF funds and the external grants and contracts it leverages funded the work of 497 researchers and technicians, and 960 graduate and undergraduate students.

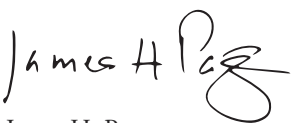
- These grants and contracts provided more than $2 million to purchase major equipment to upgrade and outfit university labs.

- Maine's public universities secured new patents, worked on development projects with large and small businesses and start-ups, and provided R&D support to over 500 hundred companies and individuals.

As required in the statute that created MEIF 20 years ago, included with this FY17 MEIF report are financial and informational details.

If you have any questions about MEIF projects, this report or other University of Maine System research and economic development programs, please contact me.

Sincerely,



James H. Page
Chancellor
University of Maine System

MEIF Background

The Maine Economic Improvement Fund (MEIF) represents the ongoing commitment between the state, the private sector and our public universities, working together to advance research and economic development for the benefit of all Maine people.

Since the Maine Legislature established MEIF in 1997, MEIF has positioned the University of Maine System (UMS) at the center of statewide efforts to leverage economic development through targeted investment in university-based R&D. MEIF continues to be funded through an annual state appropriation to UMS.

These funds provided through state appropriation to the University of Maine System are dollars specifically provided to support university-based research, development and commercialization in the state's legislatively designated seven strategic technology areas:

- Advanced Technologies for Forestry and Agriculture
- Aquaculture and Marine Sciences
- Biotechnology
- Composites and Advanced Materials Technologies
- Environmental Technologies
- Information Technologies
- Precision Manufacturing

The University of Maine and the University of Southern Maine have well-established research, development and commercialization activities accounting for 97 percent of the MEIF activity. In 2009, the University of Maine System established the Small Campus Initiative Fund to promote seven-sector research and development activity at the other five UMS campuses and, as of 2013, Maine Maritime Academy (MMA).



Role of MEIF

The role of MEIF is to provide researchers at Maine's public universities with the investment necessary to:

- Attain external grants and contract to support R&D activities in Maine's seven sectors.
- Attract and retain world-class researchers.
- Provide support for modern laboratories and state-of-the-art equipment.
- Create new products, patents, technologies, companies and exciting job opportunities in Maine.
- Create and sustain economic development and innovation.

MEIF funds often provide the required match to acquire these federal or private sector grants, and this investment in Maine's public university R&D helps faculty and students successfully leverage tens of millions of dollars in grants and contracts annually.

MEIF money also supports equipment purchases or facilities renovations to make the universities more competitive for federal grants.

MEIF increasingly fosters university partnerships with business and industry through economic development collaborations, entrepreneur training programs, business incubators, business research and other programs. These efforts lead to new Maine-based products, technologies, patents and spin-off businesses.

The University of Maine and the University of Southern Maine are the two universities with established research and graduate programs in all of the seven targeted research sectors and have received MEIF funds, with 76.4 percent to the University of Maine, 19.1 percent to the University of Southern Maine, 1.4% to the University of Maine Machias and 3 percent to the other campuses and Maine Maritime Academy.

Indicators of success show that Maine's MEIF investment is paying dividends by:

- Creating businesses and jobs, including the jobs of more than 400 faculty and staff, and over 800 students working on MEIF-funded projects
- Boosting Maine's economy by leveraging MEIF funds to bring federal and private-sector grants and contracts to Maine.
- Building capacity and expertise to help Maine companies solve problems and commercialize innovation.
- Helping commercialize patents, innovations and intellectual property.
- Capitalizing on natural resources and core strengths by focusing R&D efforts on economic sectors where Maine can make real gains. University research personnel use MEIF resources to support the staff, equipment and facilities they need to successfully pursue and develop research projects.

Strategic Outcomes, Goals and Metrics

In July 2014, UMS BOT developed and approved Strategic Outcomes to measure the performance of the University of Maine System and its campuses. In October 2014, UMS BOT approved the use these newly developed Strategic Outcomes to create MEIF specific goals and metrics. Several of the UMS Strategic Outcomes are performance targets for all R&D and economic development activity. The MEIF goals recognize that MEIF activity is restricted to Maine's legislatively selected seven R&D sectors and are, therefore, MEIF goals and metrics, and a subset of the overall UMS goals. The UMS Strategic Outcomes that apply to R&D activity are:

Target 1 – Increase Research Capacity and Activity
Target 2 – Support New Technologies, Licensing and Commercialization
Target 4 – Increase Economic Development Partnerships
Overall Goal – Support R&D Workforce Development

This report addresses those goals. In addition, the University of Maine System reports R&D outcomes annually through the statutorily required survey of Maine R&D activity administered by the Maine Department of Economic and Community Development.

The R&D Strategic Outcomes and related MEIF goals are:

MEIF Target 1

Derived from UMS BOT Research and Economic Development Target 1

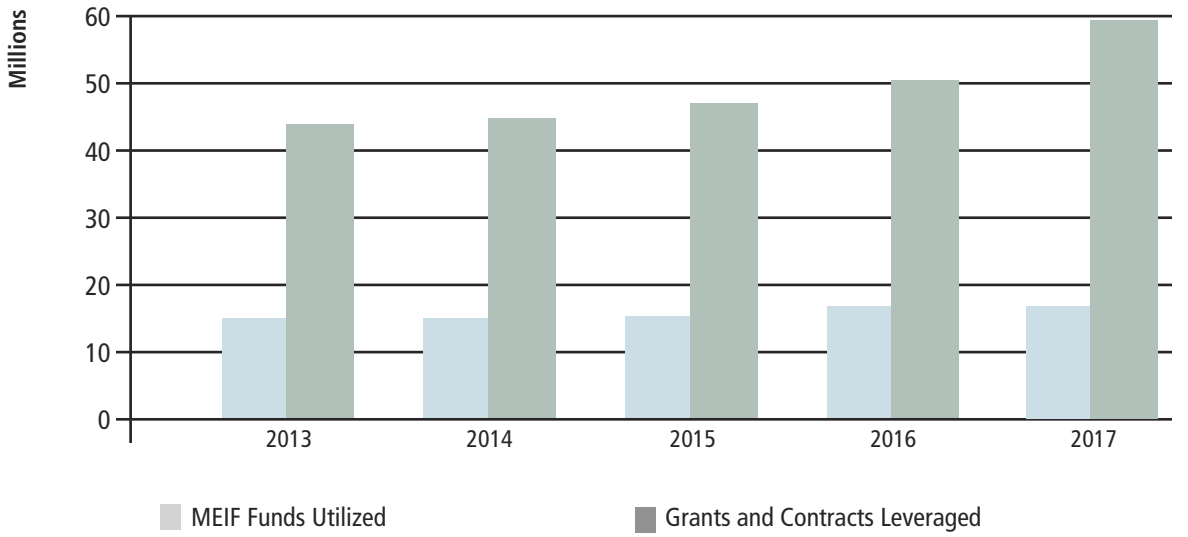
UMS maintains a sponsored programs grant and contracts effort growing greater than 3 percent annually on a three-year rolling average from a 2013 baseline of $45 million and NSF-defined total research expenditures of $45 million in the MEIF sectors. Activity from the seven MEIF sectors will account for 50 percent of the total R&D grants and contracts, with a 3 percent annual growth on a three-year rolling average. The FY13 baseline was a calculated percentage of total activity. Table 1 below shows the actual FY13 baseline at slightly less at $43.5 million.

Table 1

FY17 Total Grants and Contracts	Number of Awards	Total Award Value
Total Proposals Submitted	1,360	$222,596,721
Total Proposals Awarded	1,080	$81,982,987

Grants and Contracts Awarded in MEIF Sectors	FY2013 MEIF Awards	FY2014 MEIF Awards	FY2015 MEIF Awards	FY2016 MEIF Awards	FY2017 MEIF Awards
Aquaculture and Marine	7,045,322	9,153,389	15,187,566	12,631,690	21,229,069
Biotechnology	1,985,295	6,353,450	1,524,204	2,399,487	3,821,390
Composites	9,230,715	5,135,033	5,247,712	6,974,264	13,504,642
Cross Sector	2,990,129	4,681,209	1,018,132	507,842	4,274,394
Environmental Technologies	5,781,658	7,959,264	4,349,651	5,045,536	5,543,121
Forestry and Agriculture	8,642,424	7,654,060	14,194,009	10,317,799	4,660,014
Information Tech	7,422,675	2,520,521	4,473,781	11,497,199	5,292,726
Precision Manufacturing	1,130,746	1,414,700	780,694	1,009,921	1,602,646
Total	**$44,228,964**	**$44,871,626**	**$46,775,749**	**$50,383,738**	**$59,334,874**

Figure 1 MEIF Return on Investment (UMS)
Tens of Millions Leveraged in Grants and Contracts
(Five-Year Snapshot)



In summary, the MEIF Target 1 for increasing external grants and contracts leveraged through MEIF investments saw an increase of 16.4 percent over the previous fiscal year. This favorable trend continues in a positive direction after decreases from FY10 through FY12. This is largely related to changes in the economy and the federal and private sectors partners that are beginning to slowly increase post-recession funding for R&D. Recognizing the lead-time for proposal preparation, sponsor review and selection, and contract activity to begin, there can be a one- to two-year lag in output. Proposal preparation and submissions remain steady. For the purpose of this report, a private-sector contract is counted as a single proposal submission.

MEIF Target 2

Derived from UMS BOT Research and Economic Development Target 2

UMS annual revenue from commercialization including intellectual property licensing increases at least 20 percent annually on a three-year rolling average from a baseline of $150,000 from the MEIF sectors.

Table 2

MEIF Target 2 — Commercialization Activity	FY2013	FY1204	FY2015	FY2016	FY2017
Revenue from Commercialization	$121,250	$96,726	$150,094	$127,949	$186,148
Number of Patents Filed	15	32	22	35	12
Number of Patents Issued	16	12	9	8	6
Number of License Agreements and License Options	6	6	16	8	7

In summary, revenue from the commercialization of intellectual property has decreased over the last several years but continues in an upward trend FY2017. Commercialization in Maine often relies on companies licensing UMS intellectual property to secure private investment to advance technology, products and services into markets. General trends in venture capital and private equity investments are slowly rebounding in Maine and companies are starting to see new equity investments. Patents take four to five years from application to issuance. Newly issued UMS patents reported above and detailed in Appendix 1 were filed four to five years ago. In addition, UMS technologies generally fall into categories, such as transportation infrastructure, pulp and paper, sensors and biotechnology. These sectors have been slower to rebound post-recession and timelines from lab to market can take five to 10 years. UMS is focusing additional effort to accelerate the commercialization with private-sector partners and other investment programs, such as the Maine Technology Institute and Maine Venture Fund.

MEIF Target 3

Derived from UMS Research and Economic Development Target 4

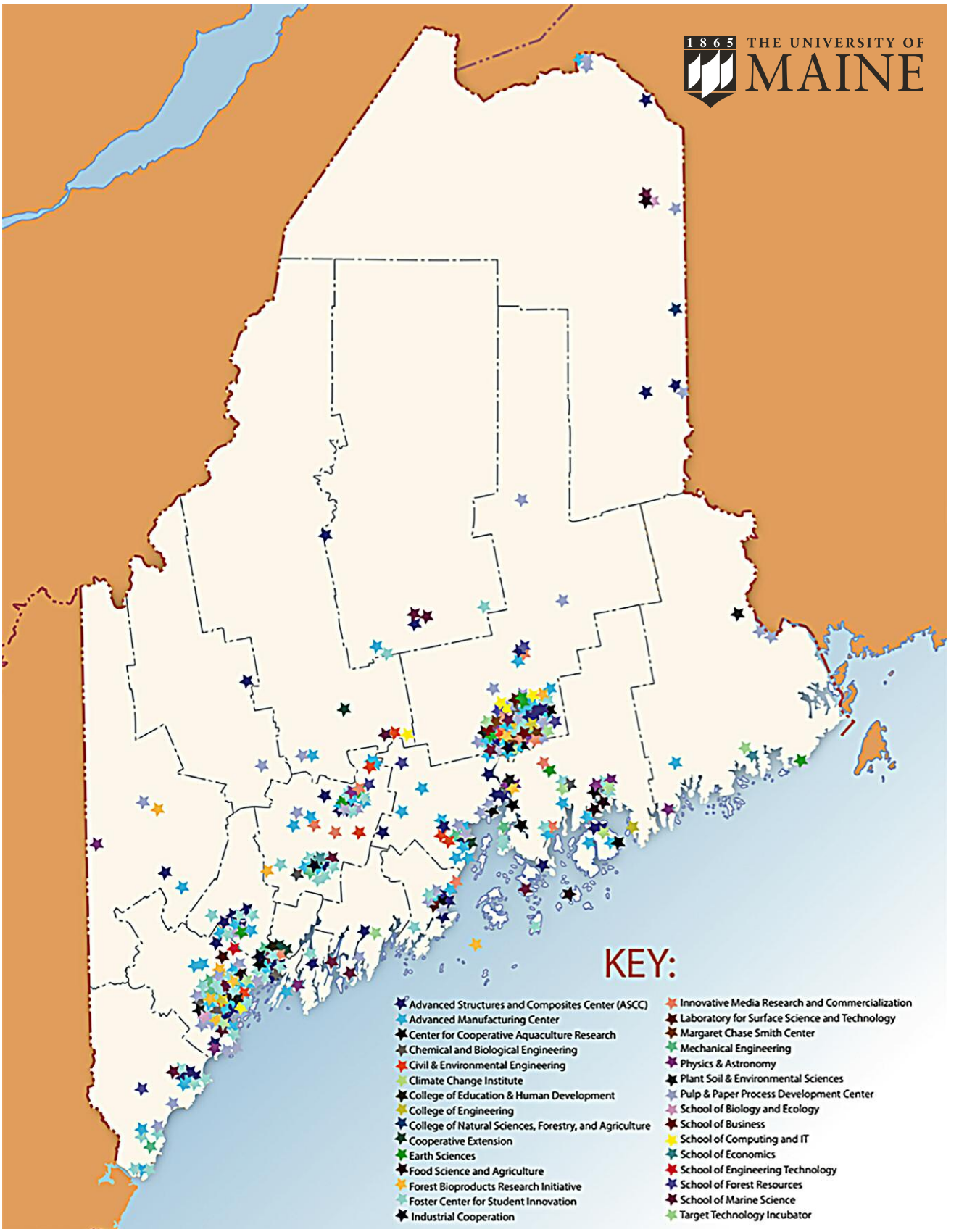
The UMS annual revenue from activities with business and industrial partners in the MEIF sectors increases from an FY13 baseline of $3.15 million to $6.75 million by FY17, and the number of business and industry contracts in the MEIF sectors will increase from a baseline of 400 in FY13 to 450 in FY17.

In summary, many MEIF investments not only leverage external grants and contracts, but through a combination of MEIF funds, and grant and contract funds, have helped UMS campuses build capacity to work directly with industry partners. Some industry partners will be companies licensing and commercializing UMS intellectual property, while many companies are working with UMS campuses to get assistance with solving their problems or perfecting their inventions and innovations. UMS projects with business and industry continue to grow, and activity is meeting the goals and metrics of this Target. Figure 2 demonstrates the statewide nature of these partnerships for those contracts that are currently tracked. Many additional companies, inventors and entrepreneurs receive advice and guidance, but do not result in formal contracts.

Table 3

MEIF TARGET 3 — Business and Industry Contracts	FY2013	FY2014	FY2015	FY2016	FY2017
Revenue from Business and Industrial Contracts	$4,156,184	$4,371,999	$5,759,572	$4,836,138	$5,035,394
Number of Business and Industrial Contracts	407	500	624	519	565

Figure 2 UMS Industry Partnerships FY2010–FY2017



MEIF Target 4

Support R&D Workforce Development

UMS shall maintain a concerted effort to involve faculty, staff and students participating in research, development and commercialization, and shall report annually the number of employees directly supported by MEIF funds and by grants and contracts in the MEIF sectors. As external funding is hard to predict, there is no specific numerical goal for employee count, but UMS shall report the annual number of faculty, staff and students to indicate trends and identify opportunities for growth.

In summary, state economic analysis predicts economic growth in Maine based on an available trained and educated workforce. Growth in the seven MEIF sectors is especially dependent on the available workforce. MEIF seven-sector projects at UMS rely on regular faculty and staff, as well as many "soft money" employees — those hired to work on specific grants and contracts, and paid by those grant and contract funds. UMS employees and students gain valuable on-the-job training and experience, and may then contribute to the employment base within these sectors after completion of the grants or graduation. Grant and contract revenue is a strong contribution to this workforce development. UMS counts employees involved in this activity, and will continue to pursue the growth in employment numbers related to growth in grant and contract activity. Nonstudent employees are tracked as full-time equivalents (FTEs) based on a 40-hour/52-week work year. Student employees, tracked by head count, generally work less than 20 hours per week during the academic year.

Grant and contract revenue also is an important source of funding for students' salary, tuition and other types of support, allowing many research-active students to offset their cost of education while getting valuable skills and on-the-job experience.

Success and Strategic Impact
By leveraging MEIF funds, UMS has attracted more than $283 million since 2012 in federal and private-sector grants and contracts related to the seven strategic research areas. This funding directly results in Maine products and technologies, such as biofuels, pulp and paper products, new potato varieties, aquaculture technologies and software, which lead to improvements in Maine's industries.

Return on Investment
Each year, the state's MEIF appropriation is matched by tens of millions of dollars in federal and private funds for important research & development. The University of Maine as the state's land grant institution utilizes its long-established research capacity and infrastructure to attract the majority of these matching funds. Other UMS schools continue to build and partner within federal and private-sector grants and contracts.

Developing Workforce and Creating Jobs
497 full-time equivalent jobs are funded annually in Maine through the funds leveraged and expended related to MEIF. These positions include faculty, technicians and research staff. 960 graduate and undergraduate students are funded for their involvement in research, development and commercialization. This activity is better than most internships and gives students great real-world experience as well as life-long networks and connections.

Table 4

MEIF Target 4 — Workforce Development	Wages Paid from MEIF	Wages Paid from Grants/Contracts	Totals
Number of Faculty Staff Supported (FTE = Full-Time Equivalent)	186	311	497
Number of Graduate Students Supported (Headcount)	24	317	3414
Number of Undergraduate Students Supported (Headcount)	145	474	619

Student Costs from Grants and Contracts	**FY2014**	**FY2015**	**FY2016**	**FY2017**
Student Salaries and Wages from Grants and Contracts	$4,877,650	$4,603,696	$5,255,861	$5,498,777
Student Tuition Paid by Grants and Contracts	857,781	835,961	956,963	935,494
Student Fellowships Paid by Grants and Contracts	199,400	552,944	197,744	233,111
Student Health Insurance Paid by Grants and Contracts	282,848	62,967	247,960	214,951
Total Soft Money Student Support	**$6,217,679**	**$6,055,568**	**$6,658,528**	**$6,882,333**

MEIF Success Stories

■ Alliance for Maine's Marine Economy

The Alliance is focused on marketing and coordinating existing capacity to support Maine's marine sector including aquaculture, commercial fisheries and value-added processing while building new capacity for workforce development, innovation and business development. Comprised of more than 20 marine research programs and created with a $7 million award from Maine's Marine Economy and Jobs Bond, the Alliance for Maine's Marine Economy brings together key stakeholders from Maine's colleges and universities, aquaculture and community-based organizations, non-profit research institutions, and private sector Maine businesses. This statewide/sector-wide Alliance includes the following partners:

- **Private Companies:** Cape Seafood, Cooke Aquaculture, and Maine Fair Trade Lobster
- Trade Associations: Maine Aquaculture Innovation Center, Maine Aquaculture Association, Maine Lobster Dealers' Association, Maine Lobstermen's Association, and the Downeast Lobstermen's Association
- **Non-profit organizations:** Downeast Institute for Applied Marine Research & Education, the Gulf of Maine Research Institute, Bigelow Laboratory for Ocean Sciences, Coastal Enterprises, Inc., the Island Institute, and the Penobscot East Resource Center
- **Universities:** University of Maine System including UMaine entities: Darling Marine Center, Maine Sea Grant, the School of Marine Sciences, the Aquaculture Research Institute, the Center for Cooperative Aquaculture Research, Cooperative Extension, the School of Food and Agriculture, the Lobster Institute & the Office of Innovation and Economic Development and the University of Maine, Machias

The Alliance is actively engaging with other companies, universities/colleges and non-profits to continue to build strategic alliance to grow Maine's marine economy.

The effort builds on the extensive public and private resources and assets available to support Maine's Marine sector including aquaculture, commercial fisheries and value-added seafood processing. The Alliance is charged with marketing and coordinating the capacity and capabilities while pursuing additional investment to grow this sector. The goal of this new Alliance is, "to ensure that Maine seafood, fishing and aquaculture industries and the natural and innovation ecosystems on which they depend are healthy and benefit Maine people.



■ University of Maine Machias partnership with the Downeast Institute

UMM has been the recipient of numerous grants through the MEIF Small Campus Initiative (MEIF-SCI) since its inception in 2009. All grants have involved applied marine research in the aquaculture sector on soft-shell clams, blue mussels, and Arctic surf clams. The work has taken place at UMM's Marine Science Field Station (MSFS) at the Downeast Institute on Great Wass Island in the town of Beals. Applied marine research has gone hand-in-hand with a quest to create a marine research laboratory that would be used by scientists, their students and staff wishing to conduct work in a pristine, coldwater environment.

During the past two years, MEIF-SCI funds have been used to equip the Field Station for the expansion that is now underway and approximately 40% completed. Monies provided through the MEIF-SCI program have enhanced our ability to leverage funds for the new infrastructure program from both public and private sectors, and given donors confidence that our efforts are scientifically legitimate and beneficial to Maine's coastal communities.

In FY17, UMM and the Downeast Institute leveraged MEIF and competitively awarded State of Maine Marine Bond funds to secure an additional $3.8 million in private foundation funding and have now begun construction on the $5.8 million expansion of the Downeast Institute/UM Machias Marine Field Station.

■ SEA Fellows

Through the SEA (Science for Economic Impact and Application) Fellows program, undergraduate students are selected to conduct research designed to benefit Maine's marine economy and the coastal communities that support it. Co-developed by the University of Maine and the University of Maine at Machias to stimulate university-industry partnerships in the marine economy, this program exposes undergraduate participants to engagement training and the most important marine related research topics. Students work not only with academic researches, but professionals in the marine industry, on a variety of meaningful topics from the best ways to catch fish bound for aquaculture to introducing innovative farming methods for kelp.

■ Maine EPSCoR: SEANET

Through Maine EPSCoR, the statewide, multi-institutional SEANET project was developed to examine the social, economic, and environmental aquaculture systems of Maine's vast coastline. Created by a five-year, $20 million grant from the National Science Foundation, the project seeks to create an aquaculture research network that will assist in feeding a growing population by generating employment opportunities and economic development.

The research done within this project engages a variety of constituents around the state as it strives to train a modern STEM workforce and increase public scientific literacy. To build the workforce, there are more than 4,000 workforce development opportunities and 100 students are being hired across the state's educational institutions.

By comparing three regions – the south, the midcoast, and the downeast – the project is able to examine the diversity of Maine's coast and use this research to offer solutions to aquaculture problems faced around the world.



■ Boosting the rural economy: expanding production of honey and maple syrup

This three-year project, funded by a USDA award of $498,462, is being led by UMaine's Dr. Jessica Leahy. This award will allow for the examination of the challenges and opportunities faced by the producers of honey and maple syrup in Maine. Once they understand the challenges, researchers will then be able to identify the opportunities for sustainable expansion.

For rural communities, the future of their economy is at the forefront of their minds. Understanding where best to invest efforts and funds will be integral to their long term economic sustainability.
Though this program, a number of undergraduate students from both UMaine and the College of the Atlantic will be given opportunities to do research as part of the Sustainable Food Systems Research Collaborative (SFSRC) and then present their findings at various events across the state. The goal is to create a strong network linking maple syrup and honey producers with economic development professionals, researchers, policy makers, and community members.



■ Darling Marine Center Lowes Cove Pier

The new Lowes Cove pier at UMaine's Darling Marine Center enhances access to the ocean by UMaine faculty and students and enables a variety of new research, education, and workforce development opportunities. Located on the shore of the Damariscotta River in Walpole, the new pier is a critical element of the waterfront infrastructure needed to support research on commercially valuable marine species, including oysters, clams, and lobsters. The new pier also facilitates use of the DMC's experimental aquaculture lease by industry and community partners. DMC training and workforce development programs - including K-12 programs, professional training for current and aspiring shellfish farmers, and courses for citizen scientists, resource managers, and other decision makers – all will benefit from this new connection to Maine's ocean.

■ Bioengineering students develop pediatric breathing simulator

For a senior capstone project, four bioengineering students (Banton Heithoff of Oldwick, New Jersey; William Breeding of East Granby, Connecticut; Amber Boutiette of Skowhegan, Maine; and Madeline Mazjanis of Portland, Maine) have tackled a major problem facing the healthcare community – the ability to easily and affordably train healthcare professionals to provide respiratory care on a realistic pediatric manikin.

This new method does something most manikins don't have the ability to do – realistically simulate lung and abdominal breathing independently.



By creating a manikin that is a real-life simulation, doctors and nurses may be able to diagnose issues based on the breathing pattern being presented. Additionally, this manikin is more affordable than the realistic training manikins on the market. All too often, the cost is a major barrier to health care professionals, and as a result end up with a cheaper option that simply isn't accurate.

Members of this student team have continued to develop this technology beyond their capstone class and are in the process of bringing it to market through their new spinoff company, Zephyrus Simulation LLC. To date, they have received $10,000 in grant funding from the Maine Technology Institute and the Libra Future Fund.



■ SMART Program Nationally Recognized with NSF Grant

The University of Maine's College of Engineering was awarded a $300,000 grant from the National Science Foundation's INCLUDE program to continue its work on the Stormwater Management Research Team (SMART) Program. This NSF-EPSCoR Track III funded program has created a way for high school girls and minority students to engage in learning through experiential projects focused on engineering and science, particularly around community water research. Over the course of a year, selected high school students generate ideas for solutions to the storm water management problem by collaborating with their teachers and the communities in which they live.

By the end of first year, 150 high school students and 15 teachers were trained and part of this state-wide effort. As one of 37 selected programs, UMaine will be in the running to be one of the five final projects to receive an additional $12.5 million in funding at the end of two years.

■ Biofuels may be the future of Maine forestry

Many Maine communities have felt the effects of declining paper industries. In order to revitalize the economies of these towns across the state, it is crucial to find alternative and innovative uses for the mills and resources that are currently underutilized. The Forest Bioproducts Research Institute has been addressing this problem through research into nanocellulose, a forest-based bioproduct, that is showing a variety of useful applications in a range of industries.

A pilot plant was started at the University of Maine's Technology Research Center (TRC) in Old Town, Maine. This new pilot plant is able to process up to 1 ton of woody biomass every day, with the ability to run 100 continuous hours. This woody biomass is processed into chemicals that can be used to manufacture a variety of bioproducts including biofuels, biochemicals and advanced materials. One such example is the conversion of nanocellulose into commercial transportation fuel such as diesel and jet fuel.





Norway Spruce: UMaine Testing leads to introduction of new construction-grade lumber

It was almost 100 years since a new species of lumber had been approved as construction grade. That hiatus was broken thanks to the testing and research done at the University of Maine's Advanced Structures and Composites Center. The decision by the American Lumber Standards Committee (ALSC) to include Norway Spruce as the newest wood species was based heavily on the tests conducted by the University of Maine.

Before the new designation, Norway Spruce was used primarily for pulpwood, but with the closing of the last mill focused on creating spruce pulp, there was no longer a market for this abundant Maine natural resource.

This is an important event for the state as it opens a variety of new markets to loggers while also benefitting landowners, lumber mills, builders and retailers. The University of Maine worked closely with the forest products industry on this project, and engaged a number of students through the process.



■ Food Studies Program Boost Local Agriculture and Combats Food Insecurities

USM's Food Studies Program is designed to use local food production to help with the food insecurity issue the state of Maine currently faces. This program provides a comprehensive learning experience about food systems, combining in-depth classroom learning with real world experiences. It fosters University partnerships with businesses in the food sector, helping to build capacity and expertise. The goal is to increase the revenues of local agriculture while simultaneously increasing the number of people being fed.

An undergraduate minor in Food Studies was launched in January 2017. Faculty/student research has played an important role in the initial stages of the program through involvement in an important collaborative research report produced by Good Shepherd Food Bank and Preble Street. Students worked on additional research with business owners and presented to a community panel of experts.

■ Maine Regulatory Training and Ethics Center

There is a need for Maine businesses to have assistance navigating a complex regulatory environment. The Maine Regulatory Training and Ethics Center (MeRTEC) was founded to serve Maine's seven sectors to develop regulatory compliance professional development training and certification that will allow graduates to provide consultation to businesses about maintaining compliance to regulations in a cost-effective manner, regardless of the field or sector.

One example is of where MeRTEC has help navigate the laws and regulations of a particular industry was in regard to the exportation of Maine beers made with Maine malts, leading to the creation of The Maine Beer Box, a project sponsored by the marine shipping company Eimskip and the Maine Brewer's Guild. In March 2017, the Box was sent on a refrigerated cargo container full of Maine craft beers, with over 50 taps on the outside. It returned to Portland filled with Icelandic beers, completing the first-ever global beer exchange. One of MeRTEC's roles is to contribute to the economic development potential of craft breweries in Maine through developing training and business tools about the export regulations relating to beer, specifically in regard to the North Atlantic and European Union.

The partnership with the University of Maine School of Law resulted in co-designing and delivering a professional certificate program to help non-lawyer professionals across Maine in businesses, nonprofits and government agencies navigate the regulatory minefield in such areas as finance, health care, environment and energy. There is also an undergraduate certificate and minor in Regulatory Ethics housed at Lewiston Auburn College.

■ Environmental Decision Support Tool for Penobscot Bay

The purpose of this project is to build a framework that will help to develop a holistic view of Penobscot Bay and Estuary, from physics to fish, that is needed to better predict outcomes of restoration, fisheries, aquaculture, and other changes to the system. With a focus on river herring, a local and valued bait fish for the lobster fishery, and their restoration in the Penobscot River and other rivers in Maine, students conducted research to determine if increased numbers of juvenile river herring have led to a trophic cascade within the estuary and to begin the process of developing an environmental decision support tool for the Estuary and Bay. The ultimate goal is to help fisheries and aquaculture rehabilitate and diversify nearshore marine fisheries. Environmental Science Program students worked on the project throughout 2017, including student experience at a busy research lab on the coast of Maine. Two students worked side by side with UMaine faculty and

graduate students, contributing to a long-term monitoring effort by the Darling Marine Center. Because of this experience, one student was hired to work with SEANET, the current Maine EPSCOR Track I grant, on related work in the Penobscot and other estuaries in Maine.

■ Data Innovation Project

The Data Innovation Project (DIP) helps nonprofits and small businesses make better data informed businesses decisions. Those involved with the DIP strive to provide access to affordable information and instruction, skilled technical assistance, and open access to a growing data and resource repository. The DIP offers Program Evaluation, Data Clinics, and Workshops that help community organizations and University partners build data literacy and capacity throughout their programs. Over the past year, the DIP has leveraged over $1.6 million dollars in new funds; held Summit events in Portland and Orono reaching over 250 people representing over 100 for-profit and non-profit organizations; conducted 26 free Data Clinics with non-profits; delivered 14 Workshops focused on theory of change, logic models, and data collection methods; and hired 5 USM Graduate Assistants to work with the DIP and community-based organizations to provide evaluation support.





■ Working in Rural Maine to Strengthen the Economy

The USDA awarded $458,275 to fund a three-year study that examines the characteristics and perceptions of rural communities that have traditionally been dependent on the forestry industry. With a particular focus on youth perceptions, UMaine researchers hope they will gain an understanding of where these young folks see themselves and their communities in the future, as well as how these future choices may affect these communities. Through this project, the goal is to create and foster strong, resilient rural communities by encouraging the youth to seek jobs and pursue entrepreneurship activities within them.

Table A1-1

University of Maine System New Patent Applications Filed FY2017

Title	Application Type	Filing Date
MICROFLUIDIC DEVICE AND RELATED METHODS	US	5/31/2017
CONTROLLED POROSITY STRUCTURAL MATERIAL WITH NANOCELLULOSE FIBERS	PCT	3/21/2017
SYSTEMS AND METHODS FOR INTERFERENCE MITIGATION IN PASSIVE WIRELESS SENSORS	US - CONTINUATION	2/14/2017
METHOD OF PRETREATMENT OF PULP TO INCREASE YIELD	US - PROVISIONAL	12/27/2016
SYSTEM AND APPARATUS FOR ILLUMINATING A SPECIMEN	US	12/14/2016
STYLIZED ADAPTIVE MOBILITY DEVICE	US - PROVISIONAL	11/22/2016
HYBRID COMPOSITE MATERIAL SYSTEMS FOR OFFSHORE FLOATING PLATFORMS	US - CONTINUATION	11/8/2016
HIGH EFFICIENCY PRODUCTION OF NANOFIBRILLATED CELLULOSE	US	11/4/2016
DEVICES, SYSTEMS AND METHODS FOR ENDOVASCULAR SURGERY	US - PROVISIONAL	10/20/2016
ALCOHOLIC BEVERAGES AND METHOD OF MAKING THE SAME	PCT	10/17/2016
COMPOSITE LAMINATES	PCT	9/9/2016
COMPOSITE LAMINATES	US - PROVISIONAL	9/8/2016
ADVANCED SEGMENTAL PRECASE CONCRETE HULLS FOR WAVE ENERGY CONVERTERS	US - PROVISIONAL	9/2/2016
COMPOUNDS AND METHODS FOR IMPROVING PLANT PERFORMANCE	MOROCCO	8/8/2016
BIODEGRADABLE MATERIALS AND METHODS OF MAKING THE SAME	US - CONTINUATION	8/3/2016
COMPOUNDS AND METHODS FOR IMPROVING PLANT PERFORMANCE	US - CONTINUATION	8/1/2016

Table A1-2

University of Maine System — Patents Issued FY2017

Title	Patent No.	Issue Date
METHOD AND SYSTEM FOR COMPLETE INTERFERENCE MITIGATION IN PASSIVE WIRELESS SENSORS AND RFID TAGS - US	9607187 B2	3/28/2017
EXPLOITING PCM WRITE ASYMMETRIES TO ACCELERATE WRITE - US	9601191	3/21/2017
POTATO AF3001-6 (EASTON) - US PLANT VARIETY PROTECTION	5439	3/14/2017
SYSTEM AND APPARATUS FOR ILLUMINATING A SPECIMEN - US	9557551	1/31/2017
COMPOUNDS AND METHODS FOR IMPROVING PLANT PERFORMANCE	9446992	9/20/2016
CONTAINER HAVING COMPOSITE WELDABLE PANEL WITH EMBEDDED DEVICES - US	9,406,209	8/2/2016
FLOATING HYBRID COMPOSITE WIND TURBINE PLATFORM AND TOWER SYSTEM - US	9,394,035 B2	7/19/2016
COMPOSITE WELDABLE PANEL WITH EMBEDDED DEVICES - US	9,396,635	7/19/2016

Table A2-1

A History of Legislative Actions on Appropriating State Research Funds

The following is a summary of the actions of the 118th–127th (first regular session) Maine Legislature with regard to appropriating research and development funds to the University of Maine System

118th LEGISLATURE

March 26, 1997: Governor signed into law the Economic Improvement Strategy (Chapter 24) that appropriated $500,000 to UMS for research.

April 1, 1998: Governor signed into law the Economic Improvement Strategy (Chapter 643, Part LL, Sec. S-3) that appropriated $4 million to UMS for research. These funds were allocated from the FY98 year-end state surplus for use in FY99.

119th LEGISLATURE

March 15, 1999: Governor signed into law the Part I Current Services budget (Chapter 16) that appropriated $4 million in 1999–2000 and 2000–01 to UMS on a "base budget" basis for research. This extends the one-time FY99 $4 million research appropriation that was funded from the FY98 year-end state surplus.

June 4, 1999: Governor signed into law the Part II Supplemental Appropriation budget (Chapter 401) that appropriated an additional $5.55 million in 1999–2000 and an additional $50,000 in 2000–01 to UMS on a "base budget" basis for research.

April 25, 2000: Governor signed into law the Part II Supplemental Appropriation budget (Chapter 731) that appropriated $300,000 in 2000–01 to UMS on a "base budget" basis for the Maine Patent Program.

120th LEGISLATURE

June 21, 2001: Governor signed into law the Part II Supplemental Appropriation budget (Chapter 439) that appropriated an additional $2 million in 2002–03 to UMS on a "base budget" basis for research.

March 25, 2002: Governor signed into law a deappropriation (Chapter 559) that reduced the FY03 $2 million Supplemental Appropriation by $1 million.

July 1, 2002: Governor signed a Financial Order that curtailed the FY03 $2 million Supplemental Appropriation by an additional $1 million. This eliminated the FY03 increase of $2 million for research, bringing the FY03 research and development appropriation back to the FY02 level of $10.1 million.

November 18, 2002: Governor signed into law a Supplemental Appropriation budget (Chapter 714) that deappropriated the $1 million curtailment that was signed July 1, 2002.

121st LEGISLATURE

March 27, 2003: Governor signed into law the Part I Current Services budget (Chapter 20, Part RR) that appropriated $100,000 in 2003–04 and 2004–05 on a "base budget" basis for research.

January 30, 2004: Governor signed into law a Supplemental Appropriation budget (Chapter 513, Part P, Sec. P-2) that includes a provision to transfer to MEIF up to $2 million of any unbudgeted State revenue remaining at the close of FY04. The full amount was subsequently transferred to UMS. This same Chapter 513, Part P, Sec. P-3 made the $2 million part of the MEIF FY05 base appropriation.

122nd LEGISLATURE

March 29, 2006: Governor signed into law a Supplemental Appropriations budget (Chapter 519, Part A, Sec. A-1) that includes providing one-time funding of $600,000 in FY07 for the commercialization of research and development activity, and for the Gulf of Maine Ocean Observing System.

123rd LEGISLATURE

June 7, 2007: Governor signed into law a budget (Chapter 240, Part A, Sec. A-68) that provides an increase of $1.5 million in FY08 and an additional $1 million in FY09 on a "base budget" basis for research.

124th LEGISLATURE

May 28, 2009: Governor signed into law a budget (Chapter 213, Part A, Sec. A-67) that maintains the annual funding at the FY09 level of $14.7 million.

125th LEGISLATURE

June 15, 2011: Governor signed into law a budget (Chapter 380) that maintains the annual funding at $14.7 million. May 29, 2012: PUBLIC Law (Chapter 698) creates the formula funding for the Small Campus Initiative, reserving a percentage of MEIF exclusively for the five smaller campuses of the University of Maine System.

126th LEGISLATURE

June 10, 2013: Governor signed into law (Chapter 225) an amendment to the MEIF statute to include Maine Maritime Academy as a MEIF-eligible small campus.

June 26, 2013: Legislature approved into law a budget (Chapter 368) that maintains the annual funding at $14.7 million.

127th LEGISLATURE

June 30, 2015: Legislature approved into law a budget (Chapter 267) that increases the annual funding by $2.65 million in each year of the biennium.

128th LEGISLATURE

July 4, 2017: Governor signs into law the state budget that maintains the annual funding at $17.35 million (FY17/FY18).

Table A2-2

Legislative History of MEIF New Appropriations

118th LEGISLATURE

	FY1998	FY1999	Total 2-Year
UMaine	$400,000	$3,200,000	$3,600,000
USM	100,000	800,000	900,000
Total	$500,000	$4,000,000	$4,500,000

119th LEGISLATURE

	FY2000	FY2001	Total 2-Year
UMaine	$4,440,000	$40,000	$4,480,000
USM	1,110,000	10,000	1,120,000
Total	$5,550,000	$50,000	$5,600,000

120th LEGISLATURE

	FY2002	FY2003	Total 2-Year
UMaine	$0	$0	$0
USM	0	0	0
Total	$0	$0	$0

121st LEGISLATURE

	FY2004	FY2005	Total 2-Year
UMaine	$80,000	$1,600,000	$1,680,000
USM	20,000	400,000	420,000
Total	$100,000	$2,000,000	$2,100,000

122nd LEGISLATURE

	FY2006	FY2007	Total 2-Year
UMaine	$0	$540,000	$540,000
USM	0	60,000	60,000
Total	$0	$600,000	$600,000

123rd LEGISLATURE

	FY2008	FY2009	Total 2-Year
UMaine	$1,200,000	$720,000	$1,920,000
USM	300,000	180,000	480,000
S.C. Initiatives	0	100,000	100,000
Total	$1,500,000	$1,000,000	$2,500,000

124th LEGISLATURE20

	FY2010	FY2011	Total 2-Year
UMaine	$0	$0	$0
USM	0	0	0
S.C. Initiatives	0	0	0
Total	$0	$0	$0

125th LEGISLATURE

	FY2012	FY2013	Total 2-Year
UMaine	$0	$0	$0
USM	0	0	0
S.C. Initiatives	0	0	0
Total	$0	$0	$0

126th LEGISLATURE

	FY2014	FY2015	Total 2-Year
UMaine	$0	$0	$0
USM	0	0	0
S.C. Initiatives	0	0	0
Total	$0	$0	$0

127th LEGISLATURE

	FY2016	FY2017	Total 2-Year
UMaine	$2,056,400	$0	$2,056,400
USM	514,100	0	514,100
S.C. Initiatives	79,500	0	79,500
Total	$2,650,000	$0	$2,650,000

128th LEGISLATURE

	FY2017	FY2018	Total 2-Year
UMaine	$0	$0	$0
USM	0	0	0
S.C. Initiatives	0	0	0
Total	$0	$0	$0

Total Yearly Research Appropriations for FY2017

	FY2017 Appropriation
UMaine	$13,263,600
USM	3,315,900
UMM	250,000
UMFK	0
UMF	0
UMA	0
UMPI	0
MMA	520,500
Total	$17,350,000

S.C. Initiatives ..... Small Campus Initiatives
University of Maine ..... UMaine
University of Southern Maine ..... USM
University of Maine at Augusta ..... UMA
University of Maine at Farmington ..... UMF
University of Maine at Fort Kent ..... UMFK
University of Maine at Machias ..... UMM
University of Maine at Presque Isle ..... UMPI
Maine Maritime Academy ..... MMA

Table A2-3 Maine Economic Development Fund

Utilization of FY2017 Operating Research Appropriation by Targeted Research Areas

UMAINE	Source of R&D Funds					Utilization of R&D Funds					Balance
Targeted Research Area	FY2017 R&D Initial Base Budget	Unused R&D Funds from Prior Years As Reported	Adjustment To Prior Years Unused R&D Funds	Adjusted Unused R&D Funds From Prior Years	FY2017 R&D Funding Transfers	FY2017 Total R&D Funds Available	FY2017 R&D Actual Expenditures	Transferred To Match Grants & Contracts	Transferred Between R&D Accounts	Total R&D Funds Utilized	Unused Funds Carried Forward To FY2018[1]
Adv. Technology Forestry & Agriculture	$1914960	$(202,091)	$(44)	$(202,135)		$1,712,825	$2,953,107	$174,985	$(898,123)	$2,229,969	$(517,144)
Aquaculture & Marine Science	3,274,811	(2,053,111)	(159)	(2,053,270)		1,221,541	3,188,937,	1,208,592	(1,175,655)	3,221,874	(2,000,333)
Biotechnology	869,732	78,369		78,370		948,102	1,990,256	100,546	(418,225)	1,672,577	(724,475)
Composites	1,565,235	1,024,669		1,024,669		2,589,904	2,131,687	11,663	(887,717)	1,255,633	1,334,271
Environmental	1,255,372	164,914		164,914		1,420,286	2,252,767	50,915	(673,467)	1630,215	(209,929)
Information Technology	2,183,482	(164,598))		(164,598)		2,018,884	3,005,830	33,419	(872,624)	2,166,625	(147,741)
Precision Manufacturing	1,602,646	82,583		82,583		1,685,229	2,087,855	41,500	(654,450)	1474,905	210,324
Cross Sector	597,362	(364,445)		(364,445)		232,917	951,871	150,240	(165,559)	936,552	(703,635)
Total State Funding	$13,263,600	$(1,433,710)	(202)	$(1,433,912)		$11,829,688	$18,562,310	$1,771,860	$(5,745,820)	$14,588,350	$(2,758,662)
UMaine Cost Sharing Funding[2]	5745,820					5,745,820			5,745,820	5,745,820	
Total Funding	$19,009,420	$(1,433,710)	$(202)	$(1,433,912)		$17,575,508	$18,562,310	$1771,860		$20,334,170	$2,758,662)

[1] Includes year-end equipment carry-over funds (equipment ordered, not received and not paid).
[2]Salary and benefits from university.

USM	Source of R&D Funds					Utilization of R&D Funds					Balance
Targeted Research Area	FY2017 R&D Initial Base Budget	Unused R&D Funds from Prior Years As Reported	Adjustment To Prior Years Unused R&D Funds	Adjusted Unused R&D Funds From Prior Years	FY2017 R&D Funding Transfers[3]	FY2017 Total R&D Funds Available	FY2017 R&D Actual Expenditures	Transferred To Match Grants & Contracts	Transferred Between R&D Accounts	Total R&D Funds Utilized	Unused Funds Carried Forward To FY2017[1,2]
Forestry & Agriculture		$209,757		$209,757	$889,980	$1,099,737	$686,426	$10,504		$696,930	$402,807
Aquaculture & Marine		384,632		384,6321	788,962	1,173,594	829,654			829,654	343,940
Biotechnology		34,737		34,737	92,180	126,917	113,180			113,180	13,737
Environmental		162,644		162,644	200,275	362,919	316,329		10,081	326,410	36,509
Information Technology		618,261		618,261	1521,095	2,139,356	1,459,544	(3,694)		1,455,850	683,506
Precision Manufacturing		710		710	22,855	23,565	23,565			23,565	
Cross Sector		(364)		(364)	837,318	836,954	836,907			836,907	47
Unassigned - Reallocated By System	3,315,900	2,805,335		2,805,335	(4,352,665)	1,768,570		149,334	(10,081)	139,253	1,629,317
Total State Funding	$3,315,900	$4,215,712		$4,215,712		$7,531,612	$4,265,605	$156,144		$4,421,749	$3,109,863

[1] Includes year-end equipment carry-over funds (equipment ordered, not received and not paid).
[2] At USM, projects are funded on a year-to-year basis with renewals contingent on performance. A majority of the unused funds carried forward into FY17 are committed but not yet allocated to multiyear projects.
[3] Transfers for current year funding of USM R&D programs and awards from "Unassigned" UM base budgets the MEIF appropriation by sector and thus does not use funding transfers.

Table A2-4 Maine Economic Development Fund

FY2017 Summary Utilization of Operating Research Appropriation by University

	Source of R&D Funds				Utilization of R&D Funds						Balance
	FY2017 R&D Initial Base Budget	Unused R&D Funds from Prior Years As Reported	Adjustment To Prior Years Unused R&D Funds[4]	Adjusted Unused R&D Funds From Prior Years	FY2017 R&D Funding Transfers[3]	FY2017 Total R&D Funds Available	FY2017 R&D Actual Expenditures	Transferred To Match Grants & Contracts	Transferred Between R&D Accounts	Total R&D Funds Utilized	Unused Funds Carried Forward To FY2018[1]
UMaine	$13,263,600	$(1,433,710)	(202)	$(1,433,912)		$11,829,688	$18,562,310	$1,771,860	$(5,745,820)	$14,588,350	$(2,758,662
USM	3,315,900	4,215,712		4,215,712		7,531,612	4,265,605	156,144		4,421,749	3,109,863
UMM	250,000	189,678		189,678	200,000	639,678	417,022			417,022	222,656
UMFK		107,085		107,085		107,085	82,691			82,691	24,394
UMPI		9		9	145,000	145,009	25,020			25,020	119,989
UMA		38,413		38,413		38,413	18,546			18,546	19,867
UMF		39,565		39,565	77,000	116,565	58,997			58,997	57,568
UMS	520,500	157,101	9	157,110	(519,257)	158,353					158,353
MMA		61,812	(9)	61,803	97,257	159,060	37,620			37,620	121,440
Total State Funding	$17,350,000	$3,375,665	(202)	$3,375,463		$20,725,463	$23,467,811	$1,928,004	$(5,745,820)	$19,649,995	$1,075,468

[1] Includes year-end equipment carry-over funds (equipment ordered, not received and not paid).
[2] UM cost sharing.
[3] Interunit R&D funding transfers related to FY2017MMA and Small Campus Initiative (SCI) awards.



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