2010 Science and Technology Action Plan

A Bold Approach to Stimulate Maine's Economy

FINAL DRAFT

October 28, 2009

Maine Innovation Economy Advisory Board

and

Maine Office of Innovation
Department of Economic and Community Development

Maine Innovation Economy Advisory Board

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Definitions

Angel Investors-- Individuals who back emerging entrepreneurial ventures, sometimes as a bridge to venture capital. Funding levels typically range from $50,000 to $2 million. Usually successful, sophisticated business people but the term can apply to all individual investors in a company regardless of business experience.

Applied research-- Original investigations undertaken in order to acquire new knowledge but are directed primarily towards a specific, practical aim or commercial objective.

Basic research -- Experimental or theoretical work undertaken primarily to acquire new knowledge of the underlying phenomena and observable facts, without any particular application or use in view.

Commercialization -- Sequence of actions necessary to achieve market entry and general market competitiveness of new innovative technologies, processes, and products.

Entrepreneurship -- the art or science of innovation and risk-taking for profit in business; the quality of being an entrepreneur

EPSCoR -- Experimental Program to Stimulate Competitive Research is a federal program to assist those states that have historically received lesser amounts of federal R&D spending and have demonstrated a commitment to develop their research bases and to improve the quality of science and engineering research conducted at their universities and colleges. Maine has been a member of EPSCoR since 1980.

Industry cluster -- Groups of competing, collaborating and interdependent businesses working in a common industry and concentrated in a geographic region. Clusters draw on shared infrastructure and a pool of skilled workers and represent the specialization and comparative advantage of the region.

Innovation --A new way of doing something. It may refer to incremental and emergent or radical and revolutionary changes in thinking, products, processes, or organizations. A distinction is typically made between invention, an idea made manifest, and innovation, ideas applied successfully.

Intrapreneur -- A person within a large corporation who takes direct responsibility for turning an idea into a profitable finished product through assertive risk-taking and innovation

Invention -- The creation of a new technology, item, or process, as opposed to its application in widespread use.

License – A legal agreement where an owner of a technology allows another organization to use or develop that technology in return for consideration.

Open Innovation – A paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as the firms look to advance their technology

Targeted Technologies – (established in statute - 5 MRSA Chapter 407) biotechnology, aquaculture and marine technology, composite materials technology, environmental technology, advanced technologies for forestry and agriculture, information technology and precision manufacturing technology.

Technology Transfer – the transfer of the commercialization rights for a technology from the originator to another organization, typically private. Also involves the legal protection of intellectual property.

Contents

List of Abbreviations

BRAC	Base Realignment and Closure
DECD	Department of Economic and Community Development
EPSCoR	Experimental Program to Stimulate Competitive Research
FAME	Finance Authority of Maine
GSBS	Graduate School of Biomedical Sciences
GSP	Gross State Product
MBRF	Maine Biomedical Research Fund
MCED	Maine Center for Entrepreneurial Development
MDF	Maine Development Foundation
MEIF	Maine Economic Improvement Fund
MIEAB	Maine Innovation Economy Advisory Board
MPP	Maine Patent Program
MTAF	Maine Technology Asset Fund
MIHGH	Maine Institute for Human Genetics and Health
MOU	Memorandum of Understanding
MRRA	Midcoast Regional Redevelopment Authority
MSTAC	Maine Science and Technology Advisory Committee
MTI	Maine Technology Institute
NSF	National Science Foundation
OOI	Office of Innovation, Department of Economic and Community Development
P-K-20	Preschool-Kindergarten-Grade 20
R&D	Research and development
REDI	Joint Select Committee on Research, Economic Development and Innovation
SBIR	Small Business Innovation Research Program
SEGF	Small Enterprise Growth Fund
STEM	Science, Technology, Engineering and Mathematics
STTR	Small Business Technology Transfer Program
UMaine	University of Maine, Orono
UMS	University of Maine System
USM	University of Southern Maine

I
Executive Summary

The Maine Innovation Economy Advisory Board (MIEAB) is required by statute to develop a Science and Technology Action Plan every five years, starting in 2010.

This plan describes a **new phase** of Maine's investment in an innovation economy, **broadening the earlier focus on building research capacity to include investment into innovation and entrepreneurship as well as R&D.**

This is reflected in a new vision:

Create an environment where science, technology, innovation and entrepreneurship stimulate Maine's economy.

Maine is facing global competitive forces that are changing our economy. Instead of focusing on growing and attracting capital investments in factories and other infrastructure, and trying to compete as the lowest-cost alternative, we need find a sustainable advantage. **We need to compete through innovation.**

Innovation is also needed to take advantage of the opportunities that are in front of us, to create new sources of renewable energy, to improve the quality and effectiveness of health care, and to ensure the security of our nation. In all of these cases, innovation can drive job growth and economic development.

The 2005 Science and Technology Action Plan as well as reports by two Joint Select Committees of the Maine Legislature (1998 and 2006) and the Brookings Institution (2006), call for investing in an **innovation-focused economy as a strategy to reach "sustainable prosperity" for Maine.**

Maine has been on this journey since the mid-1990s. The state's sustained investment began with a $20 million bond for research and development approved by Maine's voters in 1998. In 2000, the legislature established the Maine Technology Institute (MTI), the Maine Economic Improvement Fund (MEIF), the Advanced Technology Development Centers, and the Maine Patent Program. Continued general fund investments of between $20 and $25 million per year, as well as additional bond investments in 2003, 2005 and 2008 have continued to fund growth in Maine's research capacity.

We know that these investments have paid off – our total research and development (R&D) performance as measured by the National Science Foundation, including all private and public entities, has reached $524 million and **our ranking among the states on R&D per capita moved from 49th in 1997 to 35th in 2005.** Our universities and nonprofit research laboratories have consistently increased their capacity to perform research and development, and our clusters are strengthening. Maine's private sector R&D remains low, although the companies receiving state investments, primarily through MTI, are showing positive results. Indeed, the return to the State of Maine is consistently 12 times the public investments in R&D.

However, Maine must do more. **The scale of our research is increasing, but its potential impact on Maine's economy is well below other states.** Most research in Maine is not being commercialized or connected to Maine industry in a way that maximizes economic value to the state. Our research institutions, including our colleges and universities, are not the engines of innovation that they have the potential to be, and they do not

contribute to Maine's economy in the same way that their peer institutions do in other parts of the country and the world. On the private sector side, our state does well at starting companies, but poorly at converting start-ups to thriving enterprises with more than a small number of employees.

In short, **we have invested since the late 1990s in building research capacity, but have done little in terms of building our capacity for innovation and entrepreneurship.** This means that we need to do better at converting ideas into products and processes, growing new, sustainable companies, and integrating new concepts into our traditional industries in a way that creates new jobs for Maine citizens.

We are going to document our progress towards the new vision with three benchmarks:

- Research capacity: Maine's total R&D activity will reach $1.4 billion by 2015, 3 percent of gross state product, up from $524 million in 2005 and $148 million in 1997.

- Employment: Maine's innovation-intensive sectors will increase their aggregate employment by 5,400 to 60,000 by 2015. These sectors had employment of 67,073 in 2000 and 54,232 in 2008.

- Per capita income: Maine's per capita income will increase to $42,000 by 2015, up from $33,962 in 2007 and $22,179 in 1997.

To reach these benchmarks, the State of Maine must pursue three strategies:

1. Increase Maine's total research and development by increasing R&D in the academic, non-profit and private sectors.

1.1 Provide incentives to increase private research and development.

1.2. Increase research and development performed at the state's colleges, universities and non-profit research institutions.

2. Increase employment by building innovation capacity.

2.1 Increase the rate at which new ideas become commercial products and processes.

2.2 Support Maine's emerging and established innovation-intensive clusters.

2.3 Build a supportive environment for high-growth, high-potential, innovation-based enterprises.

2.4 Align and integrate Maine's innovation-based strategy with the state's overall economic development strategy, recognizing that innovation has a critical role to play in making all enterprises in Maine more productive, efficient and competitive.

3. Increase per capita income by increasing the skills of Maine workers.

3.1 Increase the supply of knowledgeable entrepreneurs who can successfully take products and processes to the market through training and recruitment.

3.2 Align K-20 education, and workforce training with the skills required by the targeted sectors.

3.3 Increase the number of graduates in STEM disciplines at all levels, especially Masters and PhDs.

3.4 Recruit additional high-skilled workers to Maine.

Implementation of these strategies will require investment at least $32 million annually, the level required by current

statute, as well as a renewed focus on articulating how science, technology, innovation and entrepreneurship affect the future of all Mainers.

Unless the State of Maine embraces the recommendations outlined here, this report is just empty words, doomed to gather dust on a shelf with countless other like documents which demanded change. From our perspective, it is simply not acceptable to look at the investments and commitments we have made to date so that science, technology, innovation and entrepreneurship can help to re-invent the Maine economy and say, "That is fine. Now we can turn our attention to something else." It is simply not acceptable to point to one or two successes and think that no additional investments are required. It is simple not acceptable to turn our backs on the progress we have made and assume Maine's unique quality of place is enough to sustain and grow our economy. It is simply not acceptable to be anything less than bold.

Maine Innovation Economy Advisory Board
October 2009

II
Introduction

Legislative History

During the 123rd Legislature's first session in early 2007, the Maine Innovation Economy Advisory Board (MIEAB) was created to coordinate the State's research and development activities and to foster collaboration among its higher education and nonprofit research institutions and members of the business community. The Board consists of thirty-two members including representatives from the industry and research communities in the seven targeted technology sectors, as well as the Director of the Office of Innovation (OOI) and the President of the Maine Technology Institute (MTI), both from the Maine Department of Economic and Community Development (DECD).

The MIEAB replaced the Maine Science and Technology Advisory Committee (MSTAC) which had been established by Executive Order in 2003. The membership of the MIEAB is substantially the same as its predecessor committee, but is now established in statute.

The Board objectives are to:

- Provide state and federal policy makers assistance in advancing research and development capacity initiatives in the State and in developing corresponding funding strategies;
- Provide input on economic planning and the commercial application of the State's research and development efforts;
- Facilitate research opportunities that create sustained, inter-institutional, collaborative, multidisciplinary, centers-based research projects; advocate for the State's research and development sector and interests;
- Disseminate information about its work throughout the State; and
- Serve as the EPSCoR steering committee for the State and evaluate proposals made to the Maine EPSCoR Program and related programs.

The MIEAB is required to produce an action plan for Science and Technology every five years starting in 2010, and to produce an annual progress report. This document is the first plan produced by MIEAB, however, it is the third science and technology action plan in recent history, following the 2005 plan developed by the OOI with the MSTAC and the 2001 plan written by the Maine Science and Technology Foundation.

Maine's Science and Technology Action Plan, 2005

The previous Science and Technology Plan, drafted in 2004 and adopted in 2005, asserted an ambitious goal: to achieve $1 billion of R&D in Maine by 2010. The Plan included five objectives:

1. Maine's investments in R&D will stimulate and sustain consistent, competitive growth for Maine's economy.
2. Stimulate a robust R&D enterprise by boosting academic R&D capacity, developing an educated, technically skilled workforce, broadening the impact from the nonprofit research institutions and increasing private sector R&D

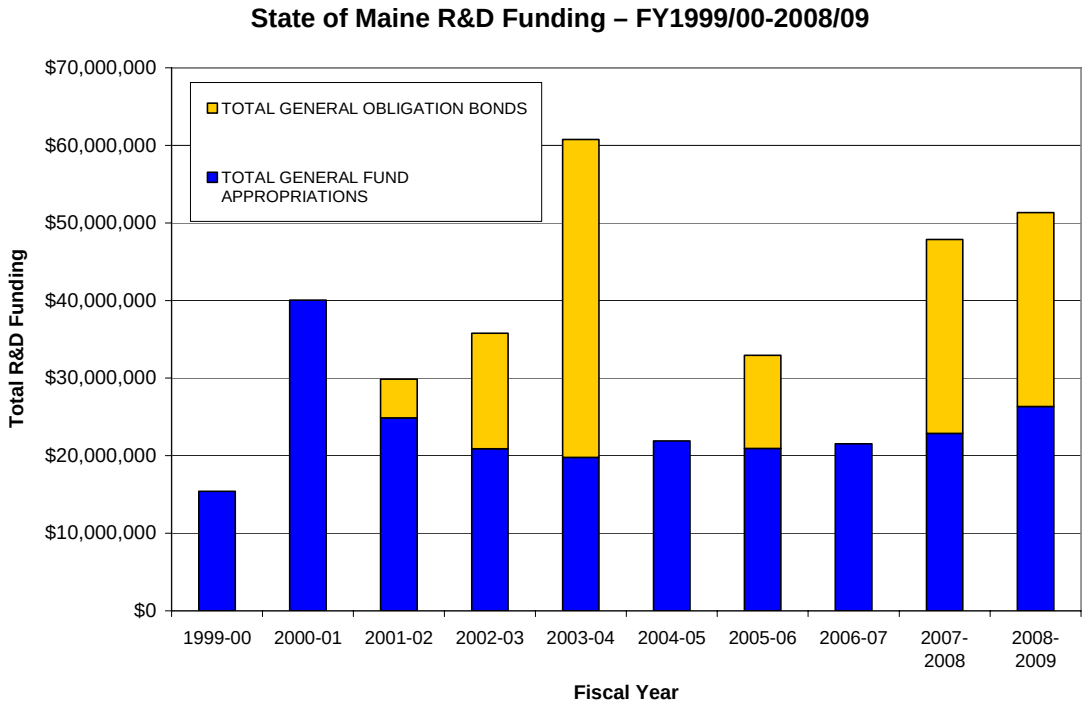
activity in key strategic areas important to Maine.

3. Maine's Legislature and key policy makers recognize, advance and celebrate Maine's R&D investments and strategic priorities.
4. Maine's unique R&D assets and their significance to Maine's economy are used to draw new business and investment to the State of Maine.
5. Foster growth of research intensive companies through a comprehensive network of services and support.

The progress to date can be summarized simply. We have made progress on many of the objectives that were set five years ago, but not as much as envisioned by the authors of the plan. Specific accomplishments are detailed in the annual Progress Reports submitted to the Legislature.

Total state funding for research and development is shown in **Figure 1**. A table of all expenditures by program since 2000 is contained in **Appendix C**.

Figure 1. State Funding for Research and Development



Development of this Plan

The MIEAB developed this plan with the OOI with consultation from the research and innovation business community and in conjunction with the key trade associations:

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- Biotechnology Association of Maine
- E2Tech
- Maine Biomedical Research Coalition
- Maine Composites Alliance
- Maine Food Alliance
- Maine Manufacturing Association
- Maine Marine Research Coalition
- TechMaine.

OOI reached out to Maine businesses that are in the seven targeted technology sectors. First, an online survey was used to solicit input on major challenges seen for Maine. Second, a series of 16 focus group meetings were held to review a number of questions raised by the survey and MIEAB. These answers were used to create a first draft of the goals and strategies contained in this plan, and then the final draft was broadly reviewed in a series of public forums. Our objective throughout was to inform and be informed by as many stakeholders and constituents as possible.

The plan also draws heavily on our policy research, including the annual *Comprehensive R&D Evaluation* and the *Maine Innovation Index*, and *Maine's Technology Sectors*, our 2008 report on our clusters.

Format of this Report

This report includes **Section III** which discusses the role of science, technology, innovation and entrepreneurship for economic growth, **Section IV** which outlines the vision, goals, strategies and benchmarks recommended by MIEAB and **Section V** which discusses implementation.

Acknowledgements

MIEAB acknowledges the assistance of the many individuals who took the time to provide input to this plan. Specifically, several individuals were extremely gracious with their time and assistance including Charlie Colgan, Jim Damicis, Maggie Drummond, , Erik Pages, Sue Strommer and Jake Ward. We also acknowledge the University of Maine National Science Foundation EPSCoR office that provided financial assistance for the development of the plan.

III
Innovation and Entrepreneurship in Maine's Economy

In 2006, the Brookings Institution framed a challenge for Maine's citizens and policy makers to identify and implement a strategy to reach an era of "sustainable prosperity." One of the recommendations was to **"Invest in a place-based, innovation-focused economy."** Specifically, the report said:

> "To foster economic growth, Maine should adopt a two-pronged investment strategy focused both on protecting and enhancing the state's quality of place and spurring business innovation by supporting the emergence of new ideas and vibrant industrial clusters."

In fact, Maine has been on a journey towards broader participation in an innovation economy since the mid-1990s when the alarm was sounded after years of disinvestment in higher education. This led to a $20 million bond approved by Maine's voters in 1998. In 2000, a legislative Joint Select Committee on Research and Development report let to the establishment of the Maine Technology Institute, the Maine Economic Improvement Fund, the Advanced Technology Centers, and the Maine Patent Program, the cornerstones of our current strategy. Subsequent bonds were approved by Maine voters in 2003, 2005 and 2007, leading to significant investments in facilities and equipment at the state's colleges, universities and private, nonprofit research institutions.

We know that these investments have paid off – our overall research and development performance has increased from $148 million in 1997 to $524 million in 2005, the latest data available from the National Science Foundation, and **we increased our ranking among the states from 49th to 35th between 1997 and 2005**. Our universities and nonprofit research laboratories have consistently increased their capacity to perform research and development, and our clusters are strengthening.

But, as we have improved, so too have other states and nations. The theory of technology-based economic development has evolved as well, so this Action Plan will look to take into account current thinking, the results of our efforts to date, and the challenges still ahead.

Technology-based Economic Development

Over the past fifteen years, it has been well documented that technology-based growth drives economic success – 65% of the difference in economic success of US regions from 1975 to 1998 is accounted for by the growth and presence of high-tech industries. [1] Furthermore, technology is critical for mature and established industries as well. For instance, six out of ten information technology workers are employed outside of the computer and telecommunications industries.

The innovation economy is dramatically different from the industrial age economy which preceded it. In order to boost the competitiveness of Maine, we must look at a formula for success in innovation. **Instead of focusing on growing and attracting capital investments in factories and other infrastructure, and trying to compete as the lowest-cost alternative, we need to compete through innovation.**

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[1] DeVol, Ross and Perry Wong. 1999. American's High-Tech Economy: Growth, Development and Risks for Metropolitan Areas. Milken Institute. http://www.milkeninstitute.org/.

Developing new products and processes, services and business models makes companies more productive and more competitive and keeps quality jobs in Maine.

The implications for economic development are simple, but profound: **innovation and entrepreneurship are the drivers of economic growth**. And, since Maine is not experiencing population growth, economic growth must come from increased productivity, higher wage jobs and a rising standard of living.

Another important consideration is that **innovation-based sectors tend to require highly skilled workers, and tend to have a disproportionate share of high-growth, high wage occupations.** In Maine, the fastest job growth is expected in occupations requiring post-secondary education and training, paying higher than average earnings. This means technician and other middle skill jobs requiring a two-year degree as well as jobs requiring four-year degrees and/or graduate education.[2]

Recent studies have shown that while successful regions need sources of basic research such as universities or federal laboratories, it is the mechanisms that transform this research into economic activity that have been their distinguishing factors.[3] The newest thinking is that spillovers from research do not automatically occur and need to be supported by policies to encourage entrepreneurship and commercialization.

Another related trend has an important implication for Maine: Open Innovation. This paradigm shift has emerged in the last five years; firms are now looking both externally and internally to develop and advance new ideas and technologies. There is a corresponding rise of a supply chain of innovation – this means that small innovative firms can play an increasingly important role in moving research to application and commercialization. It also means that the end game can be manufacturing and/or integration of technologies at a place that is different from where technology is developed. This is both an opportunity and a challenge – it means our best ideas can be manufactured elsewhere – it also means that ideas from elsewhere could be manufactured here.

A challenge for Maine, however, is that we are not known as a high-technology place. This is in large part because most measures of the existence of clusters in technology-intensive industries are based on economic measures alone, which favor urban regions. We know

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[2] Evans, Dana, Glenn Mills and Merrill Hahtala. June 2008. "An Analysis of High-demand, High-wage Jobs in Maine, Center for Workforce Research and Information, Maine Department of Labor. Davulis, Luke. November 2008. "Science, Technology, Engineering and Mathematics (STEM) Employment in Maine: A Labor Market and Workforce Assessment. Center for Workforce Research and Information, Maine Department of Labor.

[3] See Goldstein, Harvey A., and Michael I. Luger. 1997. "Assisting Economic and Business Development," in M.Q. Peterson, D. Dill and L. Mets, (eds.) Planning and Management for a Changing Environment. San Francisco: Jossey-Bass Publishers. Acs, Zoltan J., David B. Audretsch, Pontus Braunderhjelm, and Bo Carlsson. 2006. "Growth and Entrepreneurship: An Empirical Assessment," Center for Economic Policy Research Working Paper No 5409. (http://www.cepr.org/pubs/dps/DP5409.asp). Lester, Richard K. 2005. "Universities, Innovation and the Competitiveness of Local Economies: A Summary Report from the Local Innovation Systems Project – Phase 1." Massachusetts Institute of Technology, Industrial Performance Center, Local Innovation Systems Project, working paper No. 05-010 (http://web.mit.edu/lis/papers/LIS05-010.pdf).

that in Maine, many of the clusters that we are supporting would not be identified using commonly accepted academic tools because of issues of geography. But there are at least three key elements of the definition of a cluster:

a ***geographically*** limited ***critical*** mass (i.e. sufficient to attract specialized services, resources and suppliers) of companies that are ***interdependent***.

This suggests that rural clusters are different. First, rural clusters rely heavily on entrepreneurship, and are almost always built upon existing competencies and connections. Almost every rural cluster is built from a local innovation or company that expanded as skilled and entrepreneurial people either grew the initial company, or left to build new, but related companies.[4]

To support each of these parts of the system, however, requires distinctively different strategies; it is important to build research capacity, but also innovation and entrepreneurial capacity.

Research capacity includes the buildings and laboratories in which to conduct research, and the faculty, principal investigators, technicians and students necessary to win federal and private funding and to conduct the research.

Innovation capacity includes access to capital to commercialize technologies, the technology transfer and intellectual property infrastructure to protect technologies, opportunities for prototyping and testing.

Entrepreneurial capacity means the skills and knowledge necessary to grow ventures from ideas to sustainable enterprises.

Benchmarking Our Efforts

Maine evaluates its investments in R&D consistently and has done so since 2000. The most recent report, dated January, 2009, states that:

> "Maine's overall R&D capacity has increased steadily and the direct investment in private sector companies indicates a solid return on public investment, yet the impact of investment has not yet transferred to the broader technology economy."[5]

On the overall measure of R&D as a percent of gross state product, Maine has advanced from 49th among all states in 1997 to 35th in 2005. **However, the state still remains below the US overall, the New England region and other EPSCoR states.** In addition, the universities have increased their total R&D, but the number of science and engineering graduates has declined slightly over the past five years, and commercialization of research is much lower than regional and national averages.

The scale of research at our non-profit institutions remains above the US average, yet most research is not being commercialized or connected to Maine industry in a way that maximizes economic value to the state. The primary role of these institutions is as high quality employers, not as the engines of innovation that they have the potential to be. In this way, these

[4] Rosenfeld, Stuart. 2009. "Generating Local Wealth, Opportunity and Sustainability through Rural Clusters." Regional Technology Strategies. www.rtsinc.org. Supported by the Ford Foundation under a project called Wealth Creation in Rural Communities.

[5] PolicyOne Research, Inc., *Maine Comprehensive Research and Development Evaluation 2008*. Submitted January 29, 2009 to the Maine Office of Innovation, Department of Economic and Community Development. www.maineinnovation.com.

institutions do not contribute to Maine's economy in the same way that Scripps and other nonprofit institutions have led to the development of San Diego's large biotechnology cluster, for instance.

Maine's private sector R&D remains low, although companies receiving state investments in R&D, primarily through MTI, are showing positive results, as documented in our annual evaluations.[6]

The authors of the *Evaluation* made several recommendations:

- **Increase the level of technology transfer and commercialization** at university and nonprofit R&D institutions;
- Enhance opportunities to **align university and nonprofit with industry** and federal research priorities;
- **Enhance the entrepreneurial infrastructure** to foster greater growth and market opportunities for start-ups and small technology businesses; and
- **Increase industry R&D**.

The Maine Innovation Economy Advisory Board concurs with these recommendations and the next section details the strategies to address these challenges.

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[6] http://www.mainetechnology.org/content/4049/MTI_Reports_and_Evaluations/.

IV
Goals, Strategies, and Benchmarks

The Maine Innovation Economy Advisory Board sees the 2010 Action Plan as new phase of the state's investment in an innovation economy, building upon our previous investment in research capacity, and broadening our focus to include building our innovation and entrepreneurial capacity as well as maintaining our R&D investment. In order to help Maine's economy flourish in today's globally competitive climate, we must support innovation and entrepreneurship, as well as science and technology. Therefore, we have articulated the vision below and instituted three aggressive benchmarks as goals.

Vision

Create an environment where science, technology, innovation and entrepreneurship stimulate Maine's economy.

Goals

We translate this vision into three concrete goals with benchmarks that have been and will continue to be documented through our *Innovation Index*.

The **first goal, R&D activity**, continues the benchmark used in the 2005 plan, and recognizes that without a sustainable level of research and development activity in our private, academic and nonprofit laboratories, we will be unable to achieve our vision.

- Maine's total R&D activity will equal $1.4 billion by 2015, three percent (3%) of Gross State Product.

  This measure was $148 million in 1997 and $524 million in 2005, the last year for which NSF has published state figures.[7]

The **second goal, employment in the seven targeted technology sectors**, is a new benchmark which explicitly ties R&D activity to job growth. This goal is designed to focus attention on the need to translate new ideas and knowledge generated from R&D investment into products, processes and services which create sustainable Maine companies and therefore, well-paying jobs for Mainers.

- Maine's innovation-intensive sectors will increase their aggregate employment by 5,400 to 60,000 by 2015, an increase of 10 percent over the five year period.

  Maine's employment in the seven sectors (NAICS codes listed in Appendix B) was 67,073 in 2000 and 54,232 in 2008[8].

The third goal, increased per capita income, recognizes that many jobs in the seven sectors pay higher wages than the average in the Maine economy, and increases in employment at these wages should move per capita income higher. The goal proposed here assumes that

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[7] All benchmarks reference regularly collected indicator data with the most recent data available. Since different sources have different data collection timeframes, not all dates are consistent. Except as noted, all data are available in *Maine's Innovation Index* and available at www.maineinnovation.com.

[8] Data provided by the Maine Department of Labor, Labor Market Information Service, and analyzed by the Office of Innovation.

jobs in the seven sectors pay approximately 25% higher wages than the average in Maine and that the employment goal is reached.

- Maine's per capita income will increase to $42,000 by 2015.

  Maine's per capita income in 2007 was $33,962, an increase from $22,179 in 1997. [9]

Strategy 1. Increase Maine's total research and development by increasing R&D in the academic, non-profit and private sectors.

Although Maine increased its state investment in research and development over the last fifteen years, Maine's total research and development performed by industry, academia and the nonprofit, private laboratories did not meet the 2005 benchmark of $1 billion. The latest National Science Foundation data shows that we only have reached only $524 million.[10] While this represents a great improvement in rankings among the states – we moved from 49th in 1997 among all states in total R&D as a percent of gross state product to 35th in 2005 – we still have challenges ahead.

Most importantly, industry research and development in Maine, at $253 million in 2006, is significantly lower than the US as a whole as a percent of gross state product, and we have dropped to 38th among the states on this indicator.[11] This is a measure of private sector innovation. Industry R&D drives state economic growth by increasing productivity and generating new products, processes and services. Industry R&D can strengthen our traditional, natural-resource-based industries and create opportunities for new industrial sectors.

Strategy 1.1. Provide incentives to increase private research and development.

The strategies below focus on increasing private research and development through five activities. First, **increased funding to the Maine Technology Institute (MTI) will directly create additional industrial R&D** as has been amply demonstrated by past investments. MTI provides funding for early-stage research that cannot be funded by traditional sources of debt or equity financing.

Second, **Maine should broaden its R&D tax credit** which is currently very narrow and affects a small number of Maine companies. This credit would help Maine companies invest more and incent out-of-state companies with locations in Maine to move their R&D operations to the state.

Third, the state should **assist Maine companies to be more aggressive in pursuing federal R&D grants and foundation funding**. Federal funding for R&D is a big part of funding that is available and our companies could leverage these grants to develop new products, services and processes.

Fourth, Maine companies should specifically **focus on Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) grants** available from the federal government and current efforts by Maine Technology Institute to assist companies should be expanded.

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[9] http://www.maine.gov/spo/economics/economic/percapitaincome.htm.
[10] PolicyOne Research, 2009. *Maine Innovation Index*. Prepared for the Office of Innovation. www.maineinnovation.org.
[11] Ibid.

Finally, State of Maine should **attract out-of-state research institutions and companies** to expand here.

1.1.1 Increase state funding for early stage R&D activities through MTI and other organizations.

FY2010 funding for MTI is $7,011,961.[12]

1.1.2 Broaden state R&D tax credits and other incentives for companies to do R&D in Maine.

FY2010 R&D tax credits are estimated at $6.38 million.[13]

1.1.3 Increase technical assistance so that Maine companies can win more federal R&D grants and contracts.

In 2007, $19 million (7.2%) of the industrial R&D in Maine was federally funded.[14]

1.1.4 Increase the level of matching grants and technical assistance so that Maine companies can win more SBIR and other federal R&D grant s.

SBIR and STTR programs contributed $14 million to Maine companies in 2006.

1.1.5 Attract R&D facilities from outside the state.

Only one new nonprofit R&D facility has been established in Maine in the past 10 years.

Strategy 1.2. Increase research and development performed at the state's colleges, universities and non-profit research institutions.

Academic R&D totaled $120 million in 2006 while the nonprofit laboratories had federal funding of $67 million in 2005. These benchmarks have seen great improvement in the past fifteen years, but we are far from where we could be. Maine must continue to invest in research and development facilities and infrastructure, attract and keep high-quality researchers and graduate students who can win competitive research grants, provide matching funds necessary to win federal grants, especially EPSCoR funding, and create incentives for companies to work collaboratively with our research institutions.

1.2.1 Continue to build and maintain appropriate facilities and infrastructure for the conduct of competitive research.

Maine Technology Institute awarded $50 million from the Maine Technology Asset Fund in FY2008 and FY2009 for facilities and equipment for R&D and commercialization.

1.2.2 Attract and keep high quality researchers and students who can win competitive federal research grants.

Maine has nearly 300 full-time equivalent faculty and staff performing research[15] *and 728 graduate students enrolled in science and engineering (2006).*

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12 http://www.maine.gov/legis/ofpr/total_state_budget/approps_alloc/1011_Approps_Alloc.pdf.

13 http://www.maine.gov/revenue/research/tax_expenditure_report_09.pdf.

14 National Science Foundation, NSF-09-316, July 2009.

15 PolicyOne Research, 2009. *Comprehensive Economic Development Evaluation.* Prepared for Office of Innovation. www.maineinnovation.org. Attachment B.

1.2.3 Provide matching funds to increase the amount of federal and foundation funds for research and development won (competitively) by Maine's research institutions, colleges, universities and private companies.

Federal funding for R&D in Maine totaled $240 million in 2005.

1.2.4 Maximize Maine's opportunity to win EPSCoR grants through technical assistance to principal investigators, relationships with federal program managers and matching funds.

Maine won over $20 million in EPSCoR grants in FY2009.

1.2.5 Deepen R&D relationships between Maine's research institutions and Maine companies by encouraging collaborative research and development using funding criteria and implementing company-friendly technology transfer policies.

Maine's research community reported 154 industrial research grants, contracts and subcontracts with Maine companies in 2008 for $1,274,621.

Strategy 2. Increase employment by building innovation capacity.

Recent studies have shown that while successful regions need sources of basic research such as universities or federal laboratories, it is the mechanisms that transform this research into economic activity that have been their distinguishing factors.[16] The newest thinking is that spillovers from research do not automatically occur and need to be supported by policies to encourage entrepreneurship and commercialization.

While Maine has done some work in this area, our spending on innovation capacity and entrepreneurship is only one-third of our total investment from general funds. Therefore, MIEAB recommends four strategies in this area.

First, Maine must increase the rate at which new ideas become commercial products, processes and services, or we will not experience the employment growth that we desire. Key areas for investment are equity capital which will fund new ideas, and technology transfer which will enable new ideas to flow out of the laboratories. The *Comprehensive R&D Evaluation* has consistently shown these as bottlenecks in our commercialization pipeline.

Second, Maine should continue to invest in our innovation clusters. Our unique cluster initiative at the Maine Technology Institute is helping build the cross-industry linkages that will overcome our geographic challenges and accelerate the growth of our innovation sectors.

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[16] See Goldstein, Harvey A., and Michael I. Luger. 1997. "Assisting Economic and Business Development," in M.Q. Peterson, D. Dill and L. Mets, (eds.) Planning and Management for a Changing Environment. San Francisco: Jossey-Bass Publishers. Acs, Zoltan J., David B. Audretsch, Pontus Braunderhjelm, and Bo Carlsson. 2006. "Growth and Entrepreneurship: An Empirical Assessment," Center for Economic Policy Research Working Paper No 5409. (http://www.cepr.org/pubs/dps/DP5409.asp). Lester, Richard K. 2005. "Universities, Innovation and the Competitiveness of Local Economies: A Summary Report from the Local Innovation Systems Project – Phase 1." Massachusetts Institute of Technology, Industrial Performance Center, Local Innovation Systems Project, working paper No. 05-010 (http://web.mit.edu/lis/papers/LIS05-010.pdf).

Third, Maine should invest in the 21st century infrastructure and business climate that supports and rewards creative and innovative activity. This includes critical broadband and wireless technology.

Fourth, Maine should recognize that innovation has the potential to make all sectors of our economy more competitive and prosperous, and should therefore align economic development strategies and organizations to effectively and efficiently deliver services and support to all.

Strategy 2.1. Increase the rate at which new ideas become commercial products and processes.

2.1.1 Increase incentives for angel investors and venture capital firms to invest in Maine companies to increase the amount of equity capital available to fund the translation of ideas into commercial products and processes.

Maine received $6.6 million in venture capital investments in 2007.

2.1.2 Improve the capacity for ideas that reside at colleges, universities and other non-profit research institutions to be transferred to entities with the ability to commercialize them, especially within Maine.

Maine academic and nonprofit research institutions were awarded 6 patents in 2008 and signed 19 license agreements, four with Maine companies.

Strategy 2.2. Support Maine's emerging and established innovation-intensive clusters.

2.2.1 Maine Technology Institute should continue to invest in Maine's emerging and sustainable clusters by providing funding and support for cluster initiatives that are technology-driven and industry-led.

MTI invested $2.48 million in cluster initiatives in FY2009.

Strategy 2.3. Build a supportive environment for high-growth, high-potential, innovation-based enterprises.

2.3.1 Provide the telecommunications infrastructure necessary for Maine businesses to compete globally by:

- Providing high-speed, high bandwidth broadband to businesses throughout the state.
- Improving wireless coverage.

Maine has 305,883 broadband Internet subscribers in 2006, roughly 25% of all residents.

2.3.2 Enhance Maine's entrepreneurial culture by:

- Celebrating entrepreneurial successes through award programs.
- Teaching entrepreneurship in Maine's schools, colleges and universities.

The 2009 Kauffman Index of Entrepreneurial Activity ranked Maine 12th among the states.[17]

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[17] http://www.kauffman.org/uploadedFiles/kiea_042709.pdf.

2.3.3 Improve business climate by

- Reducing infrastructure and operational costs such as energy, healthcare
- Reducing permitting and regulatory costs.

Maine ranked 34th among the states for business climate in 2009.[18]

Strategy 2.4. Align and integrate Maine's innovation-based economic development strategy with the state's overall economic development strategy, recognizing that innovation has a critical role to play in making all enterprises in Maine more productive, efficient and competitive.

2.4.1 Prioritize business attraction, especially of businesses in the targeted sectors.

Only one company in the targeted sectors announced plans to move to Maine in 2009.[19]

2.4.2 Work closely with Maine's seven regional economic development organizations and the Northern Border Commission to identify assets, develop appropriate strategies and implementation to ensure that all counties in Maine participate in the innovation economy.

Strategy 3. Increase per capita income by increasing the skills of Maine workers.

The availability of a skilled and educated workforce is consistently ranked as a key factor in determining whether a business can expand and prosper. Further, per capita income is closely linked with the skills of the workforce in a state, with educational attainment, especially in science, technology, engineering and math (STEM) disciplines. Another element required is greater entrepreneurial skills among those who are starting and growing businesses in the state.

Our recommendations are that the state should increase entrepreneurial education for adults as well as students, more closely align the educational opportunities at our colleges and universities with the skills required by our fastest growing industries, increase the number of STEM students, especially graduate students, and recruit high-skilled individuals to Maine.

Strategy 3.1. Increase the supply of knowledgeable entrepreneurs who can successfully take products and processes to the market through training and recruitment.

3.1.1 Increase funding to the Technology Centers to implement a statewide, high quality entrepreneurial skills curriculum.

3.1.2 Teach entrepreneurship in schools, especially middle and high schools, and as part of college and university programs.

3.1.3 Develop statewide mentorship programs to link successful business owners with new entrepreneurs.

3.1.4 Recruit entrepreneurs from out-of-state to start their businesses in Maine.

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[18] http://www.taxfoundation.org/files/bp59.pdf.

[19] www maineco.org.

Strategy 3.2. Align K-20 education, and workforce training with the skills required by the targeted sectors.

3.2.1. Engage educators and workforce development leadership with the science and technology community.

3.2.2. Develop and implement curriculum aligned with the specific needs of the seven targeted technology.

Strategy 3.3. Increase the number of graduates in STEM disciplines at all levels, especially Masters and PhDs.

3.3.1 Increase financial aid for post-secondary students in the STEM disciplines.

3.3.2. Attract high-quality faculty and graduate students in the STEM disciplines.

In 2006, Maine had 728 graduate students enrolled in science and engineering programs. In 2006, Maine colleges and universities awarded 3,731 degrees in science and engineering disciplines, 15.6 percent masters or higher.

Strategy 3.4. Recruit additional high-skilled workers to Maine.

3.4.1. Increase the visibility of available jobs in the seven targeted technology sectors.

3.4.2. Use national advertising, social media, etc., to highlight Maine's technology sectors to workers in other regions.

3.4.3. Target Mainers who live outside the state and alumni of the state's colleges and universities to return to Maine.

In 2008, 26.4 percent of Maine's population twenty-five years and older held four-year college degrees or more. In 2006, there were approximately 15,950 science and engineering occupations in Maine's workforce.

V
Implementation

Implementation Principles

In order to achieve the benchmarks set in this plan, the state should follow five principles:

1. **Ensure Competitive Processes**. Make state investments in the highest quality projects through competitive processes that weigh scientific and technical excellence as well as the potential to contribute to Maine's innovation economy. Projects that link closely to previous investments and build upon our strategically important clusters should be emphasized.

2. **Insist on Evaluation**. Consistently evaluate all investments to promote continuous improvement, monitor client satisfaction and document impact.

3. **Focus on Targeted Sectors**. Technology clusters are drivers of regional economic development. Make state investments in innovation capacity that build on core competencies and market opportunities as described by existing and emerging high-potential clusters within the seven targeted technology sectors, while recognizing that many promising opportunities continue to emerge at the intersections of these sectors.

   Operationalize the legislative list of sectors as:
   a. ***Biotechnology*** (includes biomedical)
   b. ***Environmental*** to include renewable energy and other clean technologies
   c. ***Forestry and agriculture*** emphasizing products that are value-added
   d. ***Precision manufacturing*** now manufacturing technology and includes semiconductor manufacturing, other electronics, aerospace and any other high-value add manufacturing activities
   e. Marine technologies and aquaculture
   f. Advanced materials and composites
   g. ***Information technology*** (and communications).

   This list should be used as the basis for investments in technology, clusters, workforce training, focusing on what we do well and what we can exploit.

4. **Facilitate Interactions with the Private Sector**. Organize Maine's state innovation-based economic development infrastructure so that it is responsive to the needs of the research community and innovation-based businesses, and sustainably funded at a level sufficient to accomplish the goals of this plan. The private sector should also reorganize itself to provide support to its members and provide a consistent and strong voice in Augusta.

5. **Identify Sources of Sustainable Funding**. Maine's ability to maintain its momentum in adapting to the innovation economy is sorely hampered by year-to-year

variation in funding for the programs that make up our science and technology initiatives. In addition, bond funding, while appropriate for new facilities and equipment, will not serve well as a funding source for many of the investments that are needed at this stage. MIEAB must identify a new source of dedicated funding that is appropriately linked with success in the seven sectors.

State Funding Required

The goals articulated in the previous section assume an increase in funding from state sources, leveraged at least 12 times per our past experience. This is consistent with state statute (5 MRSA §1664, sub-§3-A) which calls for a funding level for research and development to be not less than 1% of total actual General Fund revenues of the previous fiscal year starting in FY09-10, and increasing by at least 2/10 of 1 percent until this reaches 3%. **Under this formula, funding for FY10 should have been $32.8 million, versus actual FY10 budget of $22 million.**

The $32.7 million general fund target assumes funding for research capacity at a minimum of $20 million per year for MEIF, and MTI programs at $10 million per year, along with increased funding for innovation and entrepreneurship detailed below. The goals articulated in this plan also assume an additional $25 million per year for new infrastructure (MTAF bonds).

To reach the employment goal will require an increase in the R&D and Seed Capital Tax Credits, new sources of equity capital, a restoration of Technology Center and Patent Program funding to appropriate levels ($500,000 each), and new investment in technology transfer and star scientists of approximately $2 million annually.

To reach the per capita income increases requires a significant investment in workforce training and recruitment of several million dollars per year.

Outreach

Outreach both to the public and to policy makers is required to ensure that the components of this plan are implemented to create an environment where innovation and entrepreneurship can flourish in the Maine economy.

2010 will provide unique opportunities to build a broad base of public support for innovation in Maine's economy, including Legislative and Gubernatorial races as well as a June 2010 Economic Development Bond ballot question for Maine voters.

The technology associations and their industry and nonprofit partners must explore new ways to work together. Speaking with one voice, but with a broad sector base, to support the implementation of the innovation and entrepreneurship plan will be critical to keep both decision makers and members of the public focused on this strategy.

Outside of the halls of the State House or certain industry sectors, Maine's economic strategy as it pertains to innovation and entrepreneurship is not common knowledge. Creating a greater awareness of our past successes and of the strategy proposed in this plan to strengthen Maine's economy will help to ensure greater public support.

Ongoing Information Needed

The annual evaluation, Innovation Index and periodic cluster studies

should be continued to provide timely, accurate and independent assessments of progress on this plan. As required by statute, MIEAB and the Office of Innovation should provide annual Progress Reports to the Joint Standing Committee on Business, Research and Economic and Development and the Governor.

To inform the implementation of this plan, more information is needed about a number of topics:

1. What are current best practices with regard to R&D tax credits? What relationship is there between tax credits and levels of private sector R&D? What level of credits should Maine have?
2. What are the organizational constructs that various states have used to provide the services envisioned in this plan? What are the pros and cons of the various approaches? What should Maine do?
3. What sources of funding have other states used to support sustained investment in technology-based economic development? What options does Maine have?

The Office of Innovation will pursue grant opportunities to support these studies.

Legislative Agenda

Each summer, the Office of Innovation, in consultation with the Maine Innovation Economy Advisory Board, should propose to the Governor through the Department of Economic and Community Development, legislation and budget levels required to meet the goals set out in this plan. This agenda should reflect the progress identified in the annual assessments and evaluations.

Implementation Summary

Reference	***Action***	***Lead organization(s)***
Strategy 1.1.1	Increase funding of early-stage R&D	Maine Technology Institute
Strategy 1.1.2	R&D Tax Credits Increased	Department of Economic and Community Development (DECD)
Strategy 1.1.3	Integrate Procurement Technical Assistance Center (PTAC) with targeted technology sectors and innovation programs	DECD
Strategy 1.1.4	Increase SBIR and STTR wins	Maine Technology Institute (MTI)
Strategy 1.1.5	Attract R&D facilities	DECD
Strategy 1.2.1	Build and maintain facilities	DECD, Colleges and Universities, Research institutions, MTI
Strategy 1.2.2	Attract and maintain faculty and students	DECD, Colleges and Universities, Research Institutions
Strategy 1.2.3	Increase federal funds	DECD, Colleges and Universities, Research Institutions
Strategy 1.2.4	Increase EPSCoR grants	DECD, Colleges and Universities, Research Institutions
Strategy 1.2.5	Increase industrial research grants	Colleges and Universities, Research institutions
Strategy 2.1.1	Increase equity availability	Maine Venture Capital Association, Maine Angels, Maine Technology Institute, Small Enterprise Growth Fund
Strategy 2.1.2	Technology transfer	DECD, Colleges and Universities, Research Institutions, Maine Patent Program
Strategy 2.2.1	Cluster investment	MTI
Strategy 2.3.1	Telecommunications infrastructure	ConnectME
Strategy 2.3.2	Entrepreneurial culture	All
Strategy 2.4.1	Business climate	Maine trade associations
Strategy 2.4.2	Business attraction	DECD, Maine and Company
Strategy 2.4.3	Work with regional economic development organizations	DECD
Strategy 3.1.1	Tech Centers and Entrepreneurial training	DECD, Technology Centers
Strategy 3.1.2	Entrepreneurship in schools	Dept of Education, Colleges and Universities
Strategy 3.1.3	Mentorship programs	DECD, Technology Centers
Strategy 3.1.4	Recruit entrepreneurs	DECD
Strategy 3.2.1	Education and Workforce training	Maine Community College System (MCCS), Colleges, Universities, workforce investment boards, DECD, Department of Labor (DOL), industry
Strategy 3.2.2	Curriculum development	MCCS, colleges, universities, workforce investment boards, DECD, DOL, industry
Strategy 3.3.1	Financial aid for STEM graduates	Colleges, Universities and MCCS
Strategy 3.3.2	Faculty and graduate students	Colleges, Universities and Research institutions
Strategy 3.4.1	Websites for technology jobs	Trade associations
Strategy 3.4.2	National advertising	DECD
Strategy 3.4.3	Target Mainers	Colleges, universities

Appendix A
Science and Technology Community in Maine

The science and technology community in Maine is comprised of academic institutions, non-profit research laboratories and companies in seven broadly defined technology sectors. The academic institutions include:

- University of Maine System
- University of Maine, Orono
- University of Southern Maine
- University of Maine, Augusta
- University of Maine, Presque Isle
- University of Maine, Machias
- University of Maine, Farmington
- University of Maine, Fort Kent
- University of New England
- Bates College
- Bowdoin College
- Colby College
- Maine Maritime Academy

The non-profit research institutions include:

- The Bigelow Laboratory for Ocean Sciences
- Downeast Institute for Applied Marine Research
- Foundation for Blood Research
- The Gulf of Maine Research Institute
- The Jackson Laboratory
- Maine Institute for Human Genetics and Health
- Maine Medical Center Research Institute
- Mount Desert Island Biological Laboratory

Approximately 58,000 employees work for companies loosely categorized in the seven technology sectors listed below:

- Biotechnology
- Aquaculture and marine technology
- Composite materials technology
- Environmental technologies
- Advanced technologies for forestry and agriculture
- Information technology
- Precision manufacturing technology.

What We Do Now

1. The State's current list of R&D programs and services includes:
    a. Maine Economic Improvement Fund
    b. Maine Technology Institute
        i. Seed grants

ii. Development Awards
iii. Accelerated Commercialization Fund
iv. Cluster Awards
v. Maine Technology Asset Fund (R&D bond)
vi. SBIR matching

c. Technology Centers
d. Maine Patent Program
e. Tax Credits for R&D, Seed Capital investments
f. Small Enterprise Growth Fund

Past Bond investments like Marine and Biomedical funds, Maine Technology Asset Fund.

Appendix B
NAICS Codes for Targeted Technology Sectors

NAICS Description	NAICS Code	Cluster Description
Pharmaceutical and medicine manufacturing	3254	Biotechnology
Electro-medical apparatus manufacturing	334510	Biotechnology
Analytical laboratory instrument mfg.	334516	Biotechnology
Irradiation apparatus manufacturing	334517	Biotechnology
Medical equipment and supplies manufacturing	3391	Biotechnology
Physical, engineering and biological research	541710	Biotechnology
Research and Development in the Physical, Eng	541712	Biotechnology
Resin, rubber, and artificial fibers mfg.	3252	Composites & Advanced Materials
Boat building	336612	Composites & Advanced Materials
Engineering services	541330	Engineering & Other Scientific/Technical Services
Other technical consulting services	541690	Engineering & Other Scientific/Technical Services
Other electric power generation	221119	Environmental Services & Alternative Energy Generation
Water, sewage and other systems	2213	Environmental Services & Alternative Energy Generation
Testing laboratories	541380	Environmental Services & Alternative Energy Generation
Environmental consulting services	541620	Environmental Services & Alternative Energy Generation
Waste treatment and disposal	5622	Environmental Services & Alternative Energy Generation
Crop production	111	Forest Products & Agriculture Crop, Food, & Beverages
Animal production	112	Forest Products & Agriculture Crop, Food, & Beverages
Support activities for crop production	1151	Forest Products & Agriculture Crop, Food, & Beverages
Support activities for animal production	115210	Forest Products & Agriculture Crop, Food, & Beverages
Sugar and confectionery product manufacturing	3113	Forest Products & Agriculture Crop, Food, & Beverages
Fruit and vegetable preserving and specialty	3114	Forest Products & Agriculture Crop, Food, & Beverages
Dairy product manufacturing	3115	Forest Products & Agriculture Crop, Food, & Beverages
Bakeries and tortilla manufacturing	3118	Forest Products & Agriculture Crop, Food, & Beverages

Other food manufacturing	3119	Forest Products & Agriculture Crop, Food, & Beverages
Beverage manufacturing	3121	Forest Products & Agriculture Crop, Food, & Beverages
Forestry and logging	113	Forest Products & Agriculture Lumber, Paper, & Wood Products
Wood product manufacturing	321	Forest Products & Agriculture Lumber, Paper, & Wood Products
Paper manufacturing	322	Forest Products & Agriculture Lumber, Paper, & Wood Products
Furniture and related product manufacturing	337	Forest Products & Agriculture Lumber, Paper, & Wood Products
Support activities for forestry	115310	Forest Products & Agriculture: Lumber, Paper, & Wood Products
Software publishers	511210	Information Technology
Internet publishing and broadcasting	516110	Information Technology
Wired telecommunications carriers	517110	Information Technology
Internet service providers	518111	Information Technology
Web search portals	518112	Information Technology
Data processing and related services	518210	Information Technology
Internet Publishing and Broadcasting and Web	519130	Information Technology
Computer systems design and related services	5415	Information Technology
Computer and electronic product manufacturing	334	Manufacturing: Computer & Electronics
Fabricated metal product manufacturing	332	Manufacturing: Fabricated Metals & Machinery
Machinery manufacturing	333	Manufacturing: Fabricated Metals & Machinery
Animal aquaculture	1125	Marine Technology & Aquaculture
Search, detection, and navigation instruments	334511	Marine Technology & Aquaculture

Source: Colgan, Charles, et al, March 2008. "Maine's Technology Sectors and Clusters: Status and Strategy." Maine Center for Business and Economic Research. Prepared for Maine Technology Institute and Office of Innovation, Department of Economic and Community Development.

Appendix C
R&D Expenditures by Program, FY 2000 to 2009

Research and Development Category[1]	Fiscal Year									
	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-2008	2008-2009	Total
University of Maine System[1]	**$ 12,469,100**	**$ 12,713,953**	**$ 21,775,000**	**$ 27,875,000**	**$ 14,875,000**	**$ 14,875,000**	**$ 15,475,000**	**$ 16,375,000**	**$ 17,375,000**	**$ 153,808,053**
General Fund Appropriations	$ 12,469,100	$ 12,713,953	$ 12,775,000	$ 12,875,000	$ 14,875,000	$ 14,875,000	$ 15,475,000	$ 16,375,000	$ 17,375,000	**$ 129,808,053**
General Obligation Bonds	$ -	$ -	$ 9,000,000	$ 15,000,000	$ -	$ -	$ -	$ -	$ -	**$ 24,000,000**
Maine Technology Institute[2]	**$ 6,400,000**	**$ 5,403,912**	**$ 4,786,836**	**$ 5,586,486**	**$ 5,758,274**	**$ 5,509,051**	**$ 5,487,528**	**$ 6,012,885**	**$ 8,467,977**	**$ 53,412,949**
General Fund Appropriations	$ 6,400,000	$ 5,403,912	$ 4,786,836	$ 5,586,486	$ 5,758,274	$ 5,509,051	$ 5,487,528	$ 6,012,885	$ 8,467,977	**$ 53,412,949**
General Obligation Bonds	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**
Maine Biomedical Research Fund	**$ 10,000,000**	**$ 8,067,000**	**$ 6,449,000**	**$ 20,000,000**	**$ -**	**$ 8,000,000**	**$ -**	**$ -**	**$ -**	**$ 52,516,000**
General Fund Appropriations	$ 10,000,000	$ 4,067,000	$ 949,000	$ -	$ -	$ -	$ -	$ -	$ -	**$ 15,016,000**
General Obligation Bonds	$ -	$ 4,000,000	$ 5,500,000	$ 20,000,000	$ -	$ 8,000,000	$ -	$ -	$ -	**$ 37,500,000**
Maine Marine Research Fund	**$ -**	**$ 1,000,000**	**$ -**	**$ 1,000,000**	**$ -**	**$ 4,000,000**	**$ -**	**$ -**	**$ -**	**$ 6,000,000**
General Fund Appropriations	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**
General Obligation Bonds	$ -	$ 1,000,000	$ -	$ 1,000,000	$ -	$ 4,000,000	$ -	$ -	$ -	**$ 6,000,000**
Maine Technology Asset Fund	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 50,000,000**		**$ 50,000,000**
General Fund Appropriations	$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ -	**$ -**
General Obligation Bonds	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 50,000,000	$ -	**$ 50,000,000**
Applied Technology Development Center System	**$ 5,500,000**	**$ 99,252**	**$ 385,696**	**$ 2,535,181**	**$ 408,101**	**$ 242,250**	**$ 242,250**	**$ 262,250**	**$ 262,250**	**$ 9,937,230**
General Fund Appropriations	$ 5,500,000	$ 99,252	$ 385,696	$ 535,181	$ 408,101	$ 242,250	$ 242,250	$ 187,250	$ 187,250	**$ 7,787,230**
General Obligation Bonds	$ -	$ -	$ -	$ 2,000,000	$ -	$ -	$ -			**$ 2,000,000**
Maine Patent Program[3]	**$ 375,000**	**$ 300,000**	**$ 375,000**	**$ 281,000**	**$ 237,120**	**$ 75,000**	**$ 75,000**	**$ 75,000**	**$ 75,000**	**$ 1,868,120**
General Fund Appropriations	$ 375,000	$ 300,000	$ 375,000	$ 281,000	$ 237,120	$ 75,000	$ 75,000	$ 75,000	$ 75,000	**$ 1,868,120**
General Obligation Bonds	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**
Small Enterprise Growth Fund	**$ 3,000,000**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 3,000,000**
General Fund Appropriations	$ 3,000,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ 3,000,000**
General Obligation Bonds	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$ -**
Other[4]	**$ 2,298,059**	**$ 1,985,192**	**$ 2,004,867**	**$ 495,523**	**$ 316,201**	**$ 216,390**	**$ 231,390**	**$ 224,083**	**$ 212,146**	**$ 7,983,851**
General Fund Appropriations	$ 2,298,059	$ 1,985,192	$ 1,604,867	$ 495,523	$ 316,201	$ 216,390	$ 231,390	$ 224,083	$ 212,146	**$ 7,583,851**
General Obligation Bonds		$ -	$ 400,000	0	0	$ -	$ -	$ -	$ -	**$ 400,000**

1 - UMS funding includes Maine Economic Improvement Fund, State Res. Lib. for Business, Science & Technology, Strategic Technology Initiative Program Funding, Debt Service for previous R&D Bonds, and Bonds for the Advanced Engineered Wood Composites Center, USM Bioscience Wing, and Maine Agricultural Research Farms; Includes all campuses within UMaine System

2 - MTI excludes Maine Marine Research Fund and Maine Technology Asset Fund which is presented as a separate category

3 - Includes Maine Patent Program & Center for Advanced Law and Management at USM

4 - Includes: Maine Science and Technology Foundation, Centers for Innovation, ME Research for Science and Technology, Scienceworks, Governor's Marine Science Fellowships, EPSCoR; Education Partnership with NASA; Gulf of Maine Research Laboratory; Downeast Institute for Applied Marine Research; Schoodic Education and Research Center.