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# Maine Comprehensive Research and Development Evaluation, 2011

Maine Department of Economic and Community Development

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*A Report to the Maine Department of Economic and Community Development*

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# Executive Summary

For over a decade, Maine has been investing in research and development (R&D) initiatives and innovation-based industry clusters to support the development and growth of globally competitive businesses and jobs. Approximately $20-25 million of state general funds is appropriated each year toward innovation-based efforts with additional general obligation bonds passed on a periodic basis. About one quarter of that investment goes to industry based programs and three-quarters to university and related efforts.

Maine is not alone in this effort. Nearly every state—and every country around the world—invests in R&D and technology-related industries as part of an overall strategy to increase economic competitiveness. Research indicates that investments in innovation results in more competitive in-state companies spurred by new products, assets that attract outside talent and businesses, and well-paying jobs that increase income levels.

Is Maine well prepared to compete and succeed in the global technology economy? Is the state competitive with neighboring states or states with similar economies? The annual evaluation of R&D expenditures is intended to provide insights into these debates, and to outline recommendations for how Maine can become more competitive. The current evaluation process has been underway for five years. This year's analysis and recommendations examine last year's performance, while also reflecting data and observations since 2007.

This analysis also responds to the goals and directions set out in Maine's 2010 Science & Technology Plan. This plan called for a three-fold increase in R&D capacity and significant growth in innovation based industries and jobs. With a global economic slowdown, it is unlikely that the state will reach these aggressive goals. Yet the most recent survey of companies and research institutions indicate positive progress in some key areas. For example:

- Maine's university and nonprofit research institutions have significantly improved their technology transfer outcomes on key measures such as patents, licenses and spin-offs.
- Companies with high growth potential are taking advantage of the state's backing and increasing jobs and revenues at rates above statewide averages, indicating that programs serving emerging innovation-based companies are having a positive economic impact.
- New programs and investments, such as the new $3 million Blackstone Accelerates Growth initiative, are available to help build a more robust and sustainable infrastructure to support Maine's entrepreneurs.

## How Competitive is Maine's Innovation Capacity Compared to Other States?

Like many smaller states, Maine faces a unique set of circumstances as it seeks to support its innovation economy. The low population and rural nature of the state make it difficult to build a critical mass of skilled workers often sought by large technology employers. However, a small state can also be more nimble and entrepreneurial, and may therefore provide a good base of operations in sectors like information technology that operate with a more distributed workforce. In other words, each state has its own distinctive advantages, and Maine should continue to identify and tap these competitive advantages.

Each year, the R&D evaluation assesses a set of national innovation metrics to gauge the State's relative competitiveness. This national data is then combined with a recent survey of Maine companies and research institutions to gain further insights. We assess this performance in three categories:

- ***Innovation Inputs*:** How much is being invested to support R&D and related innovation capacities?
- ***Innovation Outputs*:** Are these investments leading to productivity increases or better company performance?
- ***Innovation Outcomes*:** Are these investments helping to create new jobs, new wealth, and better career options for Maine?

Below are highlights of each category, with additional information contained in the full report and Maine's Annual Innovation Index.

### *Innovation Inputs*

| | Total R&D Expenditures 2008 | Industry R&D 2008 | Academic R&D 2009 | Nonprofit R&D 2007 | Science & Engineering Graduate Enrollments 2009 | 8th Grade Math (2011)/Science Scores (2009) |
|---|---|---|---|---|---|---|
| **Ranking among states** | **40** | **35** | **43** | **4** | **51** | **13 Math / 8 Science** |
| **5-year trend line** | ↑ | ↑ | ↑ | ↔ | ↔ | ↑ |

R&D investment is a core input to the innovation process. These investments help turn new ideas into new products, services, and technologies. In general, Maine ranks in the bottom quartile of states in terms of R&D expenditure. Industry R&D, which represents the largest and often most important part of R&D portfolios across the U.S., has improved but remains considerably below U.S. average. Maine's academic R&D investments are growing and the state ranks high in the share of R&D conducted by non-profits, such as Bar Harbor's Jackson Laboratory.

Our recent survey of research institutions and companies receiving state R&D support tells a similar story. R&D expenditures for companies have been flat or declined slightly, while university R&D expenditures have shown slight increases in recent years. In general, few Maine-based firms make significant, concentrated, and consistent investments in R&D over an extended time period. These metrics suggest Maine's current industry base is not geared toward innovation and that Maine's innovation capacity and infrastructure still need enhancements.

New products and services do not emerge out of thin air. They require a skilled workforce to design, develop, and manufacture them. Much of this talent is home-grown, emerging from the state's school systems. Here, Maine ranks well in 8th grade math & science scores, indicating that our youth has strong potential. Yet this edge erodes over time as students move into higher education. Maine presently ranks 38th in undergraduate degrees in science and engineering and last in the U.S. in graduate level students enrolled in these majors.

### *Innovation Outputs/Productivity Measures*

| | Patents 2010 | Venture Capital Investments 2010 | SBIR/STTR Awards 2010 | Share of Workforce Employed by Foreign-owned Companies 2010 | Scientists & Engineers in the Workforce 2008 |
|---|---|---|---|---|---|
| **Ranking among states** | **35** | **46** | **25** | **14** | **42** |
| **5-year trend line** | ↑ | ↓ | ↓ | **N/A** | ↔ |

On its own, more R&D spending will not necessarily create a better innovation economy if businesses are not prepared to compete in the global marketplace. Therefore, it is important to understand how well a state is turning its innovation assets into concrete results. Are Maine companies attracting private investment and venture capital? Are Maine's researchers receiving patents and federal research awards? Is the state attractive to foreign companies and investors?

Maine's national position on these measures is mixed. The value of Federal small business innovation research (SBIR) awards fell slightly last year, as did the level of institutional or larger scale venture capital. In addition, the percent of Maine's workforce in scientific and engineering occupations still ranks fairly low, making it more difficult to recruit or grow innovation-based companies in the state. On a positive note, Maine appears to be attractive to foreign-owned companies seeking a U.S. presence. Furthermore, patents were up over a five-year period, providing some indication that industry and university R&D investments are bearing fruit.

The survey of companies and research institutions, which contains newer figures than those found in national benchmark data, indicates a more positive trend in the most recent time period. More patents were applied for and issued, and companies are accessing capital to a much greater degree, using angel, debt and other financing tools alongside venture capital.

## *Innovation Outcomes*

| | Fast-Growing Companies 2010 | Workforce Employed Producing Goods and Services for Export 2010 | Entrepreneurial Activity (business formation) 2010 | Per Capita Income 2010 | 5yr Employment Growth in Innovation Sectors 2011 |
|---|---|---|---|---|---|
| **Ranking among states** | **40** | **40** | **30** | **30** | **Maine -7.3% U.S. -5.6%** |
| **5-year trend line** | **N/A** | **N/A** |  |  |  |

Finally, we benchmark a set of measures that indicate whether innovation investment in Maine is resulting in new companies and jobs, higher incomes, and businesses that are globally competitive. On a national basis, Maine fell from 21st for entrepreneurial activity (new business starts) to 30th, and the number of companies experiencing rapid growth is also low. The slow rate of growth may be tied to the fact that the state also ranks fairly low in the workforce employed by companies that export their goods and services. Exporting firms tend to grow faster than comparable firms that only serve smaller local markets. Maine's targeted innovation sectors experienced a decrease in employment of 7.3 percent compared to 5.6 percent decrease in the U.S.

Our survey data also identifies company growth challenges. Start-ups and small firms (those with less than 10 employees) that used state supported business programs saw minimal job growth, especially when compared to slightly larger firms (those with 10-19 employees) who succeeded in adding an average of three jobs per company. Wage data follows a similar pattern. The smallest and the newest firms paid very low wages, with an average annual salary of less than $19,000. However, wages appear to jump rapidly as firms grow. The firms surveyed with five or more employees reported an average wage of $47,550.

The continued growth in Maine's per-capita income is an important bright spot in the data. The survey of supported firms also reflects this trend, as Maine's R&D focused companies generated higher wages last year.

## Where Does Maine Go From Here?

Over the past five years, our annual assessments of Maine's R&D programs have shown that these investments provide a critical lifeline and a leg up for Maine's technology firms. While overall technology investment levels have not met the ambitious goals set out in various state Science and Technology Plans, they have produced important benefits for the state in terms of new research capacity and infrastructure, new and growing companies, and high quality career paths for thousands of Mainers.

Building a successful innovation economy takes time. It is a process of evolution, requiring constant review, re-evaluation, and reinvention. Even the most successful regions like North Carolina's Research Triangle were decades in the making and are in a constant state of building and rebuilding their innovation capacities.

As Maine continues its efforts to nurture a more competitive and resilient innovation economy, it should consider new and updated strategies that:

- **Build a strong base of R&D activity to prime the pump;**
- **Create seamless connections to capital, markets and talent; and**
- **Leverage partnerships among industry, government and education.**

Survey results and benchmark data suggest that smart investments can make a difference. Maine's capacity and performance have improved significantly in areas—such improving academic R&D performance---targeted as priorities in past S&T plans. However, some longstanding challenge areas, such as industry-led R&D, still remain. As noted below, several challenge areas warrant attention in future years.

## Recommendations at a Glance

What can Maine do to spur the further development of a more competitive innovation economy? For years, Maine invested in innovation programs, mostly supporting universities and, to some extent, assisting the private sector. In some instances, these efforts have moved the needle in terms of Maine's relative competitiveness.

This is the fifth and final year in the evaluation cycle. For this year's recommendations, we not only examined current data and information, but also reviewed previous recommendations that may still be relevant to the discussion. The following recommendations contain a mix of new ideas and recommendations from previous annual evaluation reports. They are organized around a set of key issues or observations that highlight what we believe are major obstacles to the growth of Maine's innovation economy.

**Key Issue: Industry, the state's most important engine for R&D, is still underperforming.**

*Desired Outcome: Enhance private sector R&D and build better connections between industry and university R&D efforts.*

Recommendation: Identify high potential, industry-led, commercial opportunities that will stimulate greater private sector research and encourage the development of new products and export opportunities.

- Focus on building capacity and critical mass by allocating a greater portion of the state's R&D investments to industry driven efforts that make strategic plays for national and international markets where their expertise or technology is a key or differentiating asset. Specifically:

- Develop industry-led commercialization roadmaps to identify and prioritize research with strong commercial potential. Such roadmaps are systems-based, rather than project- based and could help to prioritize and integrate the state's seed and development grants as well as cluster projects--building more sustained R&D capacity for key industries.

- Expand means to bring professional resources (intellectual property attorneys, technical evaluators, etc.) to start-up companies and commercialization efforts to more quickly vet and identify ways to scale opportunities. This expertise could be easily integrated into the companies receiving seed and development funds from the state.

- Continue to support specialized investments or programs, such as MTAF, that help build interdisciplinary and cross-institutional partnerships to commercialize state-funded R&D.

**Key Issue: Many companies assisted by state programs tend to be small and remain small in terms of employees and revenues.**

*Desired Outcome: Greater acceleration of job and revenue growth for companies receiving state supported services.*

Recommendations:

- Link capital programs to advanced advisory services. This strategy has been previously recommended, yet is even more critical in current economic environment. While some progress has been made in the state, the connection between capital and advisory services still lags behind similar programs in other states.

- Examine and update screening criteria for innovation services to ensure limited resources are invested in companies with a proven track record or a solid business plan for growth. Many current state grantees have operated for years with limited growth or growth prospects. Limited state resources could be better utilized with more growth-oriented companies.

- Leverage the new Blackstone Foundation effort and other investments to not only expand individual entrepreneurial programs, but to also develop a vibrant and well connected network of entrepreneur programs that support both start-up and early growth companies.

**Key Issue: Maine's incumbent workforce may not be sufficiently competitive in some innovation-based industries, and resources for skills upgrades and other training are limited.**

*Desired Outcomes: Maine's workforce can support the growth of innovation-based sectors; a more talented workforce will be attractive to companies and investors seeking to locate operations in Maine.*

Recommendations:

- Support incumbent worker training to retrain the existing workforce. Ensure job programs with matching state funds can be used for incumbent workers in technical occupations as well as for new hires.

- Adequately support noncredit programs for community colleges, including a state match for federal grants that can build long-term training capacity.

- Encourage workforce investment boards to place a greater emphasis on science, technology, engineering and mathematics (STEM)- related middle skill jobs.

- Better connect workforce-based cluster programs with R&D based cluster programs.

- Utilize the Department of Education's network to help industry-based efforts reach rural areas and achieve scale.

# 1. Introduction

In 2001, the Maine Legislature enacted 5 MRSA §13122-J and 13122-K, which called for an annual evaluation of Maine's public investment in R&D. The Maine Department of Economic and Community Development (DECD) is responsible for developing and overseeing this evaluation process. An advisory body, the Maine Innovation Economy Advisory Board, is charged by the state with providing guidance and input. To conduct the R&D Evaluation, DECD has contracted with Camoin Associates (formerly PolicyOne Research), EntreWorks Consulting, and Scruggs & Associates LLC for data gathering, analysis, and reporting. The evaluation was initially approved by the Legislature for a five-year period, then reauthorized for a second five-year period. This is the last year of the five-year annual evaluation that was reauthorized in 2006.

The evaluation is guided by the Science and Technology Action Plan for Maine, developed in 2010, with the vision to "create an environment where science, technology, innovation and entrepreneurship stimulate Maine's economy." The plan focuses on growing research capacity, businesses, and jobs in seven innovation-based industries where Maine presently holds or is developing a competitive advantage: biotechnology, environmental technology (including energy), advanced technologies for forestry and agriculture, precision manufacturing technology, aquaculture and marine technologies, composites materials technology, and information technology. The plan also recognizes that innovation and entrepreneurship are the drivers of economic growth and that innovation-based sectors tend to require highly skilled workers and provide a large share of high-growth, high-wage occupations.

## 1.1 Strategies and Goals of 2010 Science & Technology (S&T) Action Plan

*Maine's 2010 Science and Technology Action Plan* contains three primary strategies and related goals. They are summarized in **Table 1.1.**

**Table 1.1**

**Strategies and Goals of 2010 Science & Technology (S&T) Action Plan**

| Strategy | Goal |
|---|---|
| **Grow R&D activity to a sustainable level in our private, academic, and nonprofit sectors.** | Maine's total R&D activity will equal $1.4 billion by 2015 (3% of GSP). |
| **Increase employment in the seven targeted technology sectors, creating well-paying jobs for Mainers.** | Maine's innovation sectors will increase their employment by 5,400 jobs, raising total employment in these sectors to 60,000 by 2015. |
| **Increase per capita income through the growth of innovation-based jobs [and the skills of workers].** | Maine's per capita income will increase to $42,000 by 2015, from the 2008 level of $35,381. |

## 1.2 Purpose of the Evaluation

As stewards of public funds, the Legislature has asked for an annual comprehensive evaluation of R&D programs that receive funding from the state. The evaluation considers the performance and impact of R&D programs based on three primary objectives:

1. **A strong foundation for innovation**: To build a *competitive level of R&D* capacity in industry, academia and nonprofits that can turn discoveries and technological advances into new commercial products and services, and support the growth of a *highly skilled workforce* that will be required for economic prosperity.
2. **A robust entrepreneurial environment**: To *assist entrepreneurs* in commercializing new technologies and accessing the capital and networks required to *form and build successful companies*.
3. **Competitive and well-connected innovation industries**: To help existing industries *continually innovate* their products and services, and to create opportunities that *expand their national and global markets*.

Using the State's Science & Technology Plan as a guide, the evaluation has been constructed around the following questions to best relate state investments to innovation plan goals:

- To what degree have state investments led to a stronger foundation for an innovation-based economy, including increases in R&D capacity and development of a more highly skilled workforce?
- To what degree have state investments led to a more robust entrepreneurial environment and a supportive business climate, which fosters the formation of new high-growth businesses?
- To what degree have state investments led to growth in innovation-based sectors and increases in worker wages?

## 1.3 Evaluation Methodology and Use of Data

Information used in this evaluation was collected in multiple ways to both provide an understanding of Maine's performance compared to other benchmark states and to provide in-depth details regarding performance within Maine among state supported companies and research institutions. The comparison data is drawn from a companion report to this evaluation: *Maine Innovation Index: 2012*.[1] This data compares Maine's performance to that of the U.S., New England states, and states that are

[1] Maine Department of Economic and Community Development, *Maine Innovation Index 2012*, January 2012.

part of the Federal EPSCoR program (Experimental Program to Stimulate Competitive Research).[2] All of these benchmarks are based on the latest available data; but, because of delays in some Federal data collection efforts, several of the measures use figures from earlier years. Therefore, readers of this evaluation must not directly correlate the most recent state budget for R&D with the comparison indicators listed in this report. The in-depth state data is collected through annual surveys of companies (see Appendix A for detailed findings) and research institutions (see Appendix C for detailed findings) conducted specifically for this evaluation. Additionally, this data is combined with federal and university technology transfer data sources.

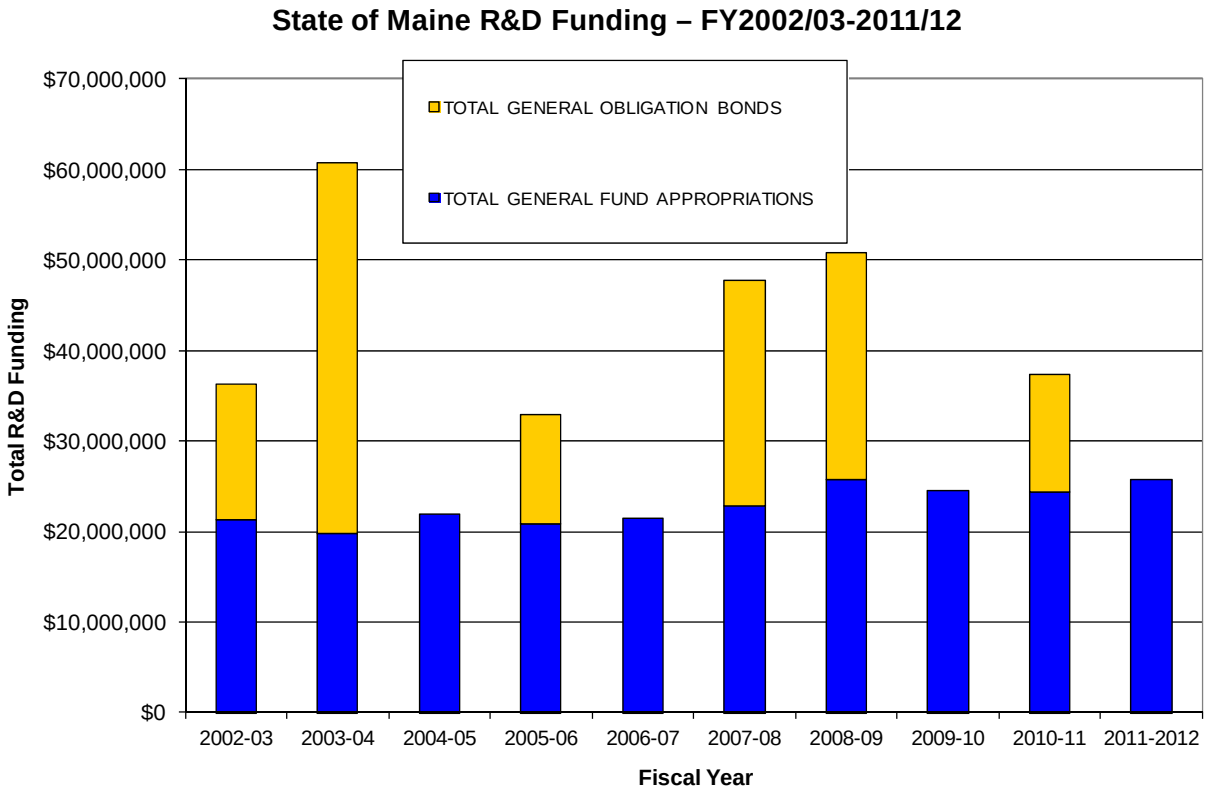
[2] EPSCoR focuses on those states that have historically received lesser amounts of federal R&D funding and have demonstrated a commitment to develop their research bases and to improve the quality of science and engineering research conducted at their universities and colleges. The program currently operates in 23 states: Alabama, Alaska, Arkansas, Delaware, Hawaii, Idaho, Kansas, Kentucky, Louisiana, Maine, Mississippi, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, South Carolina, South Dakota, Tennessee, Vermont, West Virginia, and Wyoming, as well as the Commonwealth of Puerto Rico and the U.S. Virgin Islands. This description is taken from the EPSCoR Web site at: www.ehr.nsf.gov/epscor/start.cfm.

# 2. Overview of Maine R&D Investments

## 2.1 R&D Funding Levels

Since Fiscal Year 1996-97, the State of Maine has appropriated almost $484 million (roughly $30 million per year) to support R&D/innovation programs. During the 1997-2001 period, general funds were allocated for initial capacity building. Since then, investments have been supported by relatively consistent general fund appropriations along with a periodic influx of obligation bonds, which are paid out over a five year period. **Figure 2.1** shows state investments over the past ten years.

**Figure 2.1**



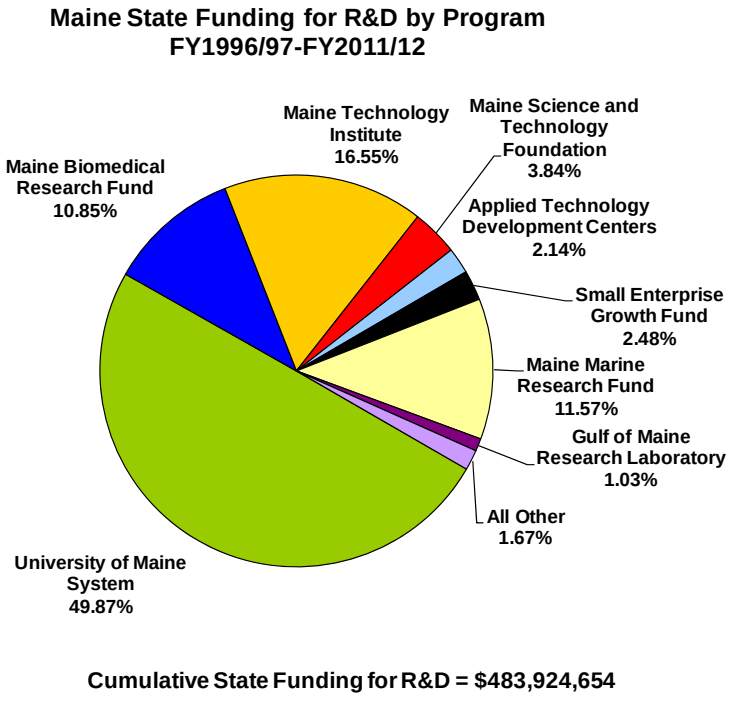

** The chart shows the year general obligation bonds were passed; the distribution of those funds is spread out over the subsequent years.*

## 2.2 Types of R&D Programs Funded

Research and development spending is one of the key raw materials of the innovation economy. Effective state programs support or fund a continuum of research, from basic research in the laboratory to applied research that can be seen on the factory floor. A key challenge across the U.S. is the construction of effective frameworks that help move ideas from the concept phase to the commercialization phase where they become new products and services. Studies of innovation programs suggest that maximum economic impact is achieved when there is a well-connected continuum of programs for university and industry research, entrepreneurial development, and early stage growth and market expansion.[3]

**Figure 2.2** shows the distribution of R&D investments by major program areas since 1996. The University of Maine has consistently received the largest share of funds (49.87 percent), followed by the Maine Technology Institute (16.55 percent) and the Marine Research (11.57 percent) and Biomedical Research Funds (10.85 percent). In all, industry and business development programs received approximately 22 percent of funding while university, nonprofit, and research based programs received 78 percent of funds. *In Maine, investments have been heavily weighted toward research, especially to universities, with less support for business development and growth.*

**Figure 2.2**




[3]For a recent review of such programs, see SSTI, Tech-based Economic Development and the States: Legislative Action in 2011. January 2012. Available at: http://www.ssti.org/Publications/tbedandstates2011.pdf

# 3. Findings

## 3.1 A Strong Foundation for Innovation

**Bottom Line: Maine's R&D capacity, especially in the private sector, is not increasing at levels consistent with the goals in the state's Science & Technology Plan. Furthermore, academic institutions are not producing enough graduates with advanced degrees. On the positive side, the commercialization of research by universities and nonprofits is increasing at a steady pace.**

Innovation capacity directly relates to several goals of the 2010 Science & Technology Plan for Maine. The plan specifically calls for strategies that will:

1. Increase Maine's total research and development by increasing R&D in the academic, non-profit and private sector to $1.4 billion in total R&D by 2015, and

2. Increase per capita income by increasing the skills of Maine workers, through an increase in the number of science, technology, engineering, and mathematics (STEM) graduates and an alignment of K-20 education with skills required by innovation-based sectors.

In this section, R&D capacity and related education performance is assessed to understand how well Maine is performing compared to other regions. The evaluation specifically examines:

- The degree to which entities in Maine generate new ideas and discoveries, measured by R&D spending (expenditures) for industry, academia, and nonprofits.

- The degree to which Maine is educating its youth for jobs of the future as measured by math and science scores of 8$^{th}$ graders and the number of students enrolled in college level science & engineering degree programs.

### Is Maine Growing the Capacity to Generate New Ideas and Discoveries?

Goal: The 2005 and 2010 Science and Technology Plans called for extremely aggressive increases in R&D investment, seeking to nearly triple investments to achieve total funding of over $1.4 billion by 2015. This target, which would put R&D investments at a level of three percent of gross state product, is not achievable at current investment rates. Funding levels will need to grow at nearly three times the current rate of growth to achieve this goal. This will require significantly more R&D investment at all levels, especially in the private sector.

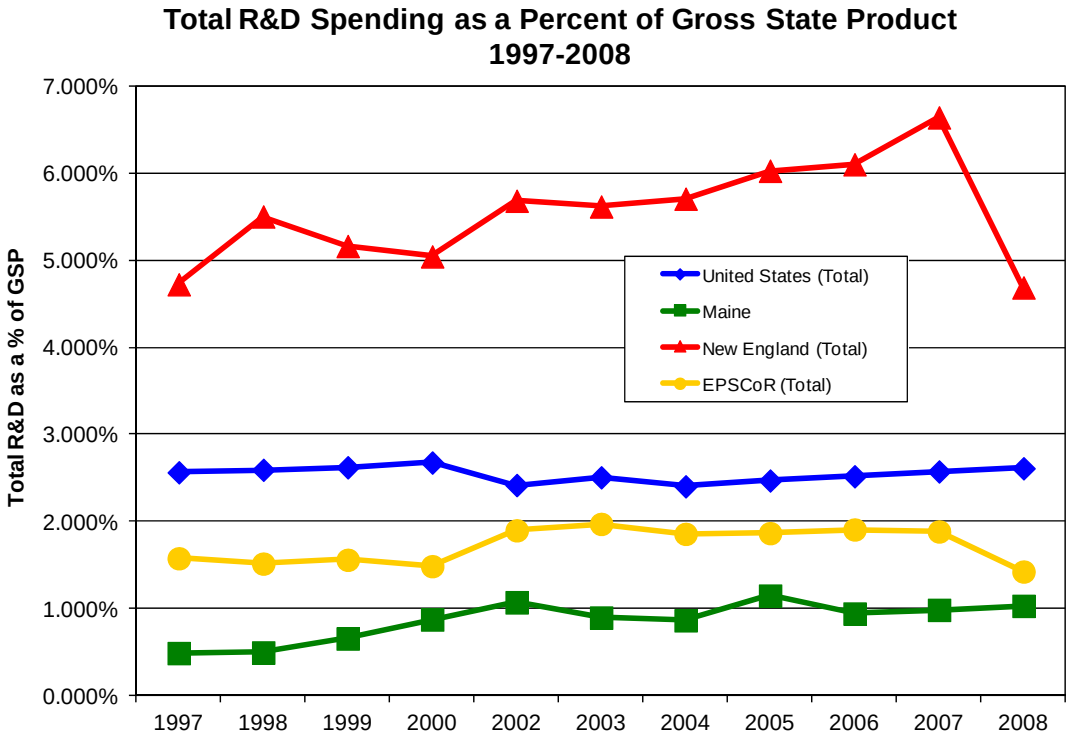
Total R&D Spending[4]: Maine's total R&D capacity (expenditures by industry, academia and nonprofit research institutions) was $516 million in 2008. Maine made progress in R&D spending between 2004

[4] 2008 is the latest data currently available from the National Science Foundation for total R&D.

and 2008 relative to the reference groups. During this period R&D spending increased 34.2 percent in Maine compared to the U.S. average of 31.5 percent.

R&D as a percent of the Gross State Product (GSP): Another way to assess R&D spending is as a percent of the gross state product (GSP). In Maine, R&D spending represents just more than one percent (1 percent) of the GSP, while R&D accounts for 2.58 percent of the U.S. economy and over 6 percent of New England's economic output. In 2008 Maine ranked 40th among states on this indicator. (See **Figure 3.1**).

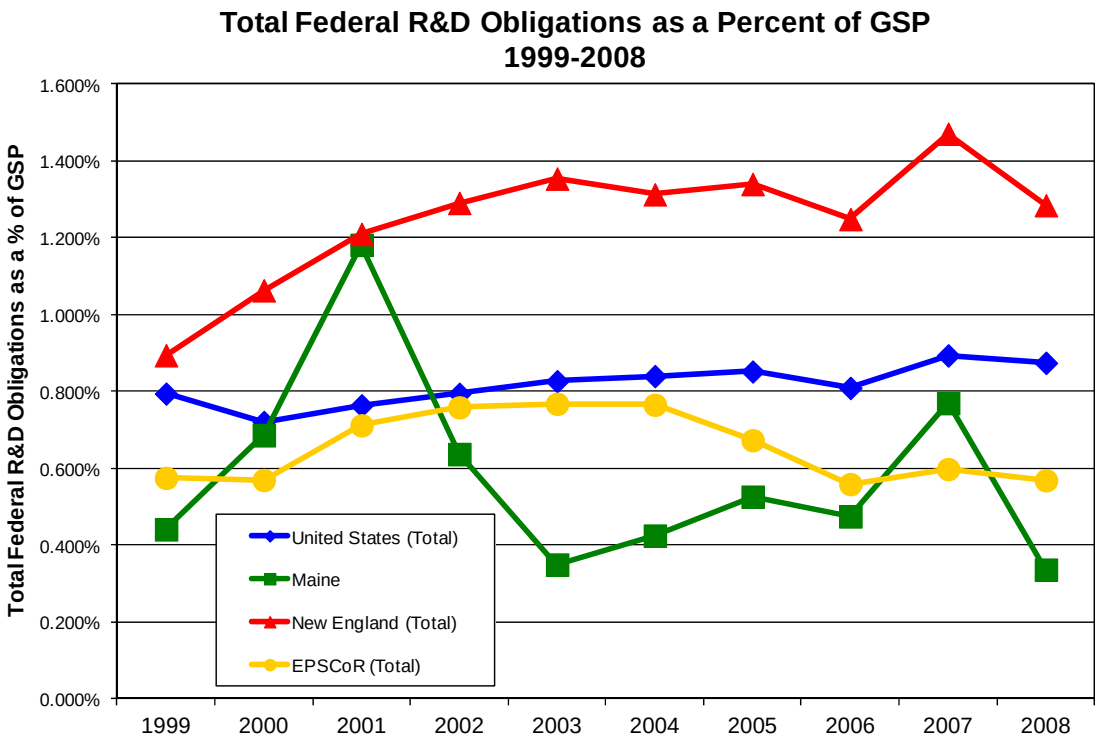
**Figure 3.1**




Note: From 1997-2000 & 2002-2008 chart portrays one-year increments; all other years are in two-year increments.

In 2008, Federal R&D obligations to Maine equaled $168 million. This was a decrease of 56 percent from the 2007 level and was driven largely by a decrease in federal obligations to Maine industries. As indicated in **Figure 3.2**, on a percentage of GSP basis this dropped Maine below that of the other benchmark groups and in 2008 ranked 35th nationally on this indicator.

**Figure 3.2**




## Is Maine's Private Sector Increasing its R&D Capacity?

Industry R&D: To a large extent, Maine's low overall R&D capacity can be attributed to lower levels of industry R&D. In 2008, industry R&D accounted for $308 million, and 59.7 percent of all R&D conducted in the state, while industry R&D for the U.S. in general comprised over 71 percent of total U.S. research spending. (See **Figure 3.3**). Maine's trend line, however, is positive – increasing its share of industry R&D while the U.S. and New England region decreased industry R&D in the most recent year reported.

As a percent of GSP, Maine's total industry R&D activity is one-third that of the U.S. average and one-sixth that of the New England average and Maine ranked 35$^{th}$ among all states on this indicator. (See **Figure 3.4**). If Maine's industry R&D performed at the U.S. average, its 2008 total would be nearly $1 billion, nearly three times larger than the current level of $308 million. In other words, to build competitiveness in total R&D, the state needs to significantly improve and increase the level and volume of R&D conducted by industry.

## Figure 3.3

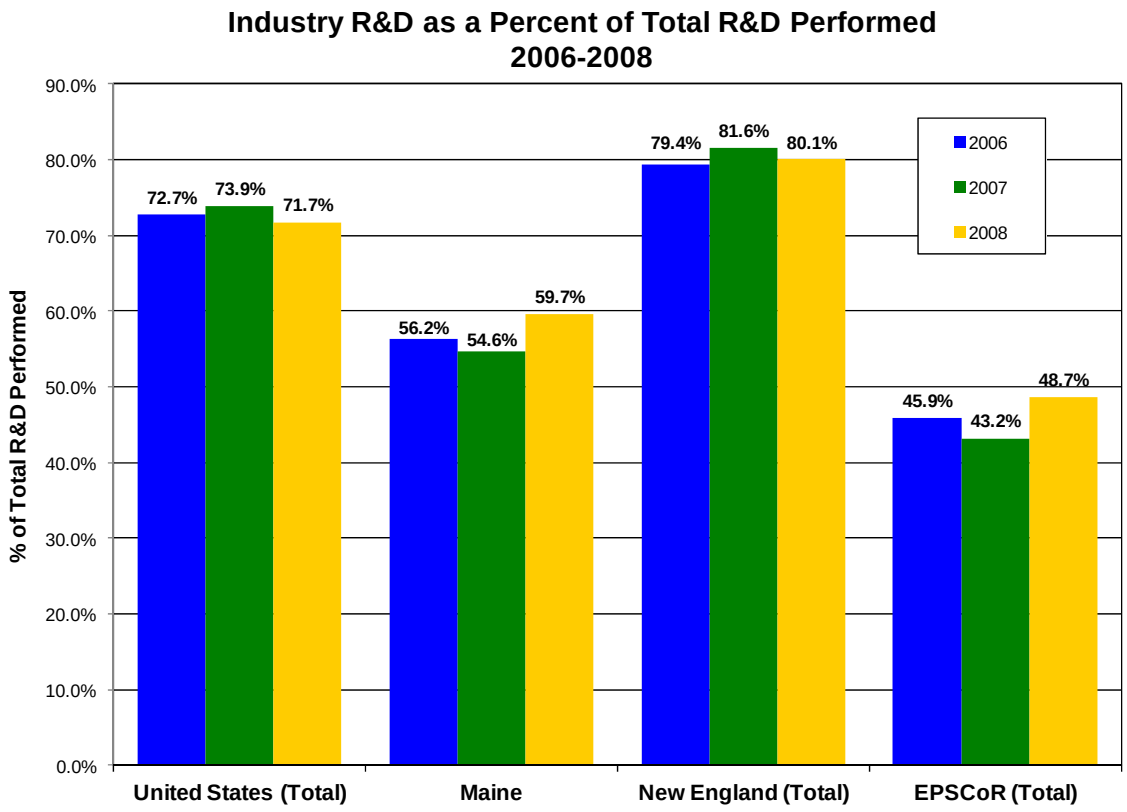
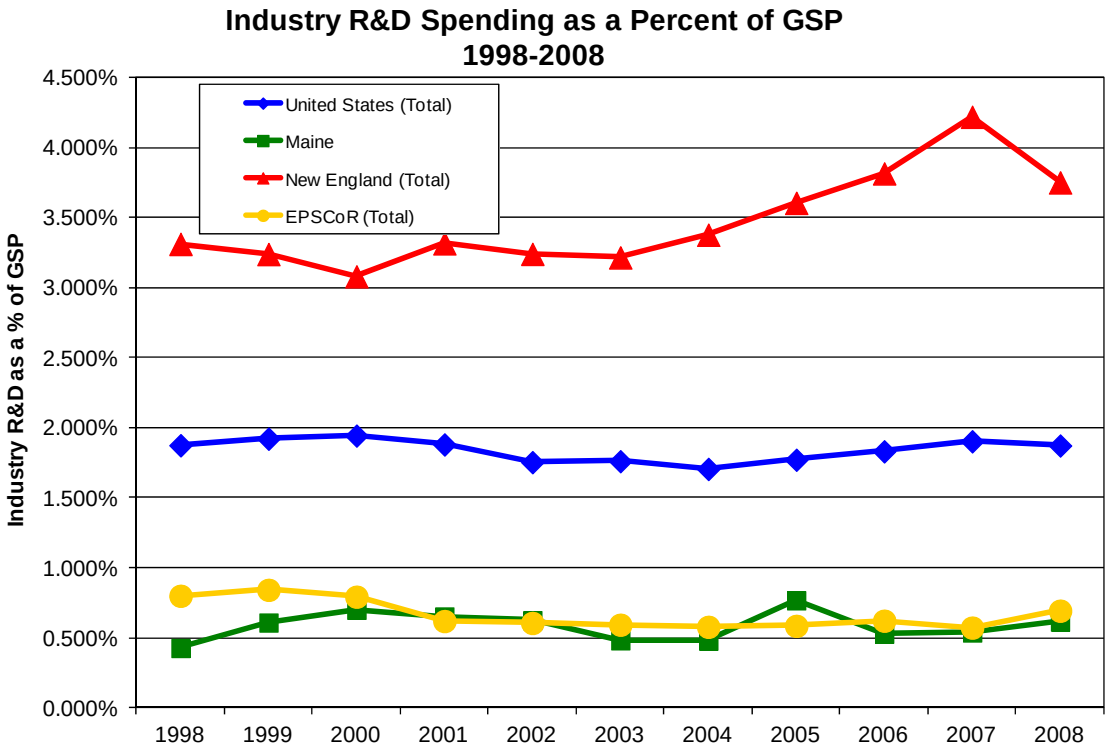

Industry R&D as a Percent of Total R&D Performed
2006-2008
% of Total R&D Performed
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
2006
2007
2008
72.7%
73.9%
71.7%
56.2%
54.6%
59.7%
79.4%
81.6%
80.1%
45.9%
43.2%
48.7%
United States (Total)
Maine
New England (Total)
EPSCoR (Total)

**Figure 3.4**




Federal R&D Obligations to Industry: Federal R&D funds are an important driver of private sector innovation, especially in states that are not home to major technology firms or industries. Therefore, the extent to which Maine businesses can tap into federal funding becomes a critical pipeline for innovation. In 2008, Maine industry received only $44 million from federal funding sources. This represented an 83 percent decrease from the 2007 level of $260 million. During this same period, Federal R&D to industry rose 20 percent nationally.

## Are Maine's Universities and Nonprofits Entities Increasing their R&D Capacity?

When compared to other states, Maine's R&D environment is unusual. Because industry R&D investments are limited and because of the presence of large research centers like the Jackson Laboratory, Maine's overall R&D portfolio contains a larger than average portion of investments from academic and not-for-profit research institutions.

University and Nonprofit Survey Highlights: Each year, university and nonprofits research institutions receiving state funding are surveyed about their R&D expenditures, student enrollment in science and engineering programs, intellectual property (patents, licenses, etc.) and other innovation factors. The 2011 survey results from research institutions highlight trends, many of which do not yet appear in the national benchmarking data used in this year's Innovation Index. In general, the survey results should be a cause for optimism as performance on many key metrics shows significant improvements. Maine's research institutions appear to be making great strides in obtaining new resources—with Federal

research funds up 17 percent — and converting those resources into tangible outputs in the form of licensing income, patents, and improved education performance.

Maine's research institutions (academic and nonprofit combined) reported the following *increases* between 2010 and 2011 in R&D related activity:

- Enrolled science and engineering graduate students (6%)
- Science and engineering graduate degrees awarded (25%)
- Employment (including faculty, research and professional staff and students) (7%)
- Total R&D spending (2%)
- Value of new foundation grants and gifts (76%)
- License income (10%)
- Federal research funding (including funding obligated in past years for current year) (17%)
- Patent applications (35%)
- Patents awarded (150%)
- Copyrights obtained (100%)

While 2011 did see major performance improvements, the news was not uniformly good. Some key areas, such as company spin-offs and industry research funding, did see worsened performance in 2011. Maine's research institutions reported the following *decreases* between 2010 and 2011 in R&D related activity:

- Undergraduate students enrolled in science and engineering majors (-4%)
- Industry research funding (-11%)
- Number of new federal research grants, contracts, subcontracts (-18%)
- Value of new federal research grants, contracts, subcontracts (-13)
- Scientific peer-reviewed journal articles published (-10%)
- Scientific peer-reviewed book chapters published (-35%)
- Scientific peer-reviewed books published (-30%)
- Other papers published (-17%)

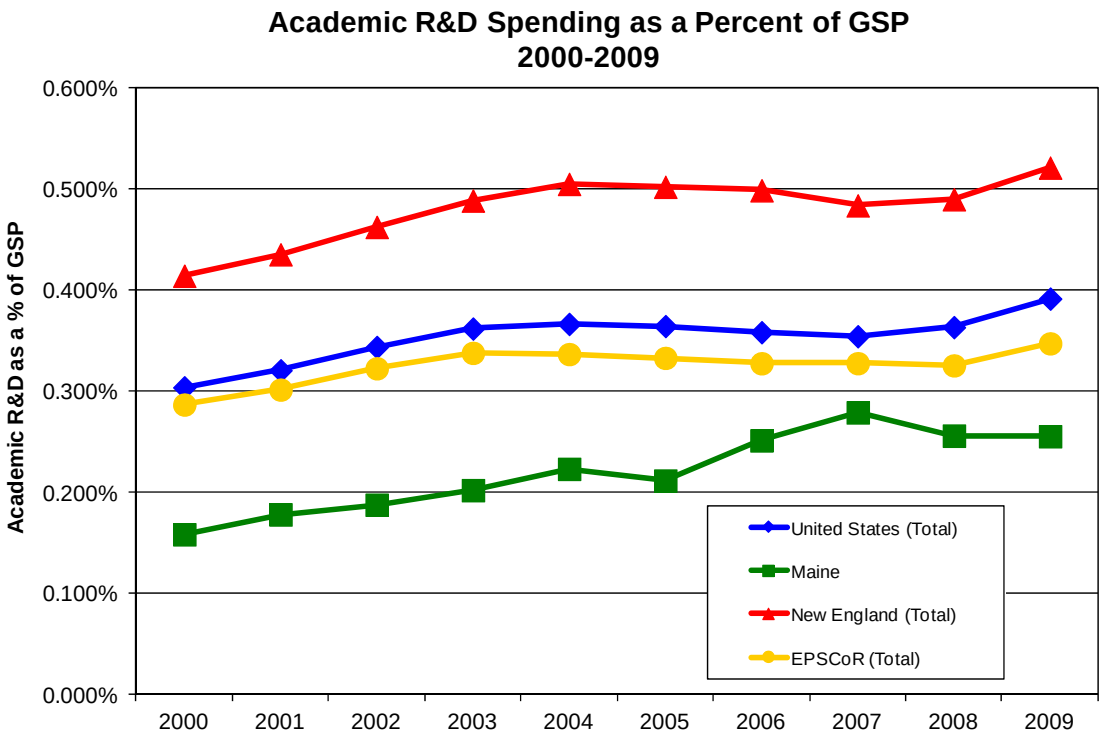
- Number of new companies formed (down from 6 in 2010 to 3 in 2011)
- Number of jobs in these companies at spin-off (down from 15 in 2010 to 7 in 2011)

In addition:

- Universities experienced little change in R&D spending between 2010 and 2011 with over $145 million expended in both years. Maine's nonprofits experienced a 4 percent increase in R&D expenditures between 2010 and 2011, rising from $102 million in 2010 to $107 million in 2011.
- Universities received 479 new federal grants and contracts for research in 2011, down from 569 grants and contracts in 2010. The dollar value of these grants was $109 million in 2011, compared to $131 million in 2010.
- Nonprofits also had decreases in federal awards with a total of 93 grants and contracts in 2011 (compared to 130 in 2010); the dollar value decreased from $88 million in 2010 to $80 million in 2011.
- Universities had 323 new industrial research grants and contracts awarded for a total of $4 million in 2011. This is down from the 341 contracts valued at $6 million in industry research reported the previous year.
- Nonprofits, however, saw an increase in industry-sponsored research, with 43 new industry grants and contracts awarded in 2011 with a value of $4 million compared to 24 in 2010 valued at $2 million.

**Academic and Nonprofit R&D Compared to Other States:** Maine has made progress on academic R&D performance over the past ten years. In 2000, Maine ranked 49$^{th}$ in the U.S. in terms of R&D performed as a percent of gross state product. In 2009, Maine's rank has improved to 43$^{rd}$ among all states. These performance improvements stem directly from the state's commitment to R&D investments. However, in the two most recent years for which comparable data is available, 2008 and 2009, Maine has stalled on its progress in catching up to the reference groups. (See **Figure 3.5**).

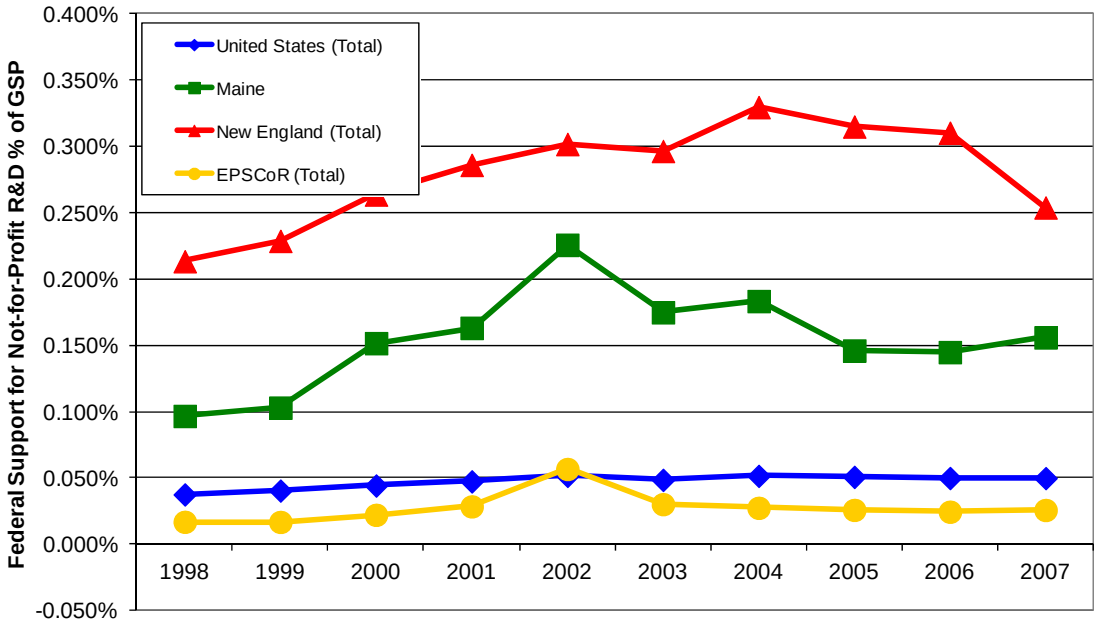
**Figure 3.5**




Nonprofit R&D is the smallest segment of R&D across the nation, yet it is very important in Maine. In 2007, nonprofit institutions spent almost $77 million on R&D, ranking Maine third (3rd) among all states for nonprofit R&D as a percent of GSP. As a percent of GSP, Maine nonprofit R&D accounts for three times as much economic activity as the U.S. average, although the dollar amount is small compared to other R&D segments. (See **Figure 3.6**).

**Figure 3.6**

**Federal Support for Not-for-Profit R&D Spending as a Percent of GSP – 1998-2007**




The performance of Maine's not-for-profits research institutions is largely influenced by one major institution. According to the recent annual R&D survey conducted for this evaluation, the Jackson Labs accounted for 59 percent of R&D expenditures and 75 percent of all research related employment among all Maine not-for-profit institutions.

## Is Maine's Education System Preparing Residents for Future Jobs?

Success in an innovation economy begins with the effective teaching of math and science skills in our K-12 system. Maine's eighth grade students continue to perform well relative to other states in math and science. In 2011, the National Assessment of Education Programs found that Maine eighth graders ranked 13$^{th}$ in math and in 2009 ranked 8$^{th}$ in science.

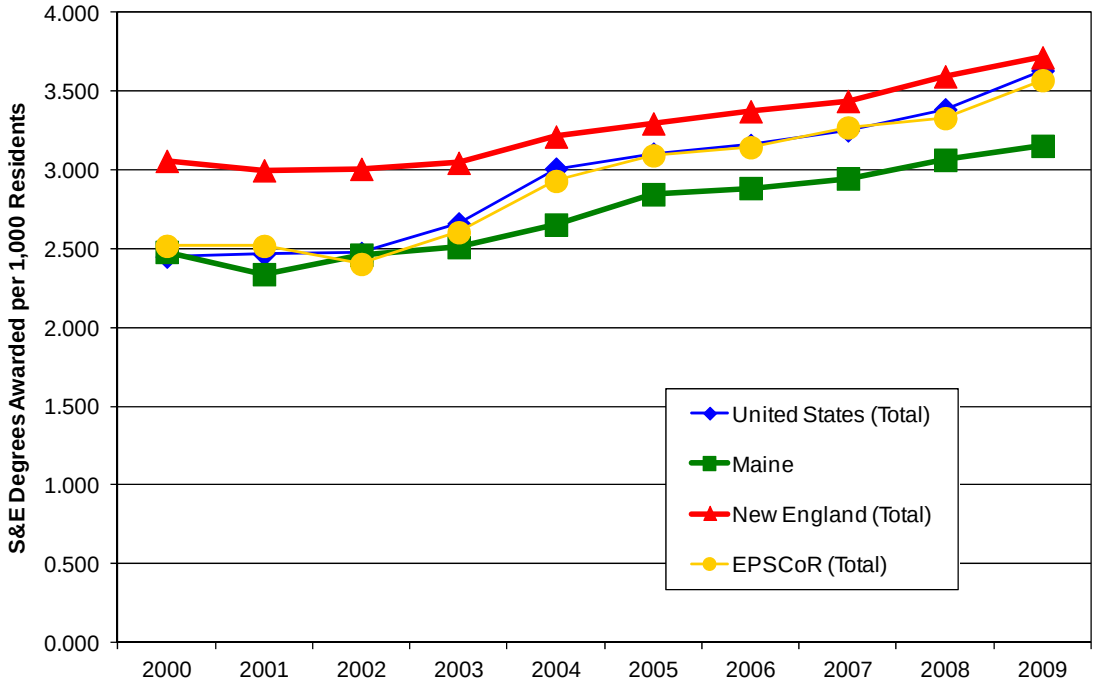
Maine's educational advantages appear to dissipate over time, and do not carry over into higher education performance and outcomes. Despite a relatively strong early foundation for science and engineering skills, students in Maine are not seeking college degrees in these fields at the same rate as their national counterparts. (See **Figure 3.7**).

In 2009, Maine-based institutions awarded 4,151 degrees in science and engineering fields, with master's degree or doctorate representing approximately 15 percent of those degrees. Although Maine performed at the U.S. averages in 2002, the state has slowly lost ground and is now lagging behind both

the U.S. average and EPSCoR states in the number of S&E degrees per 1,000 residents. Maine ranks 38th in S&E degrees among all other states. (See **Figure 3.6**).

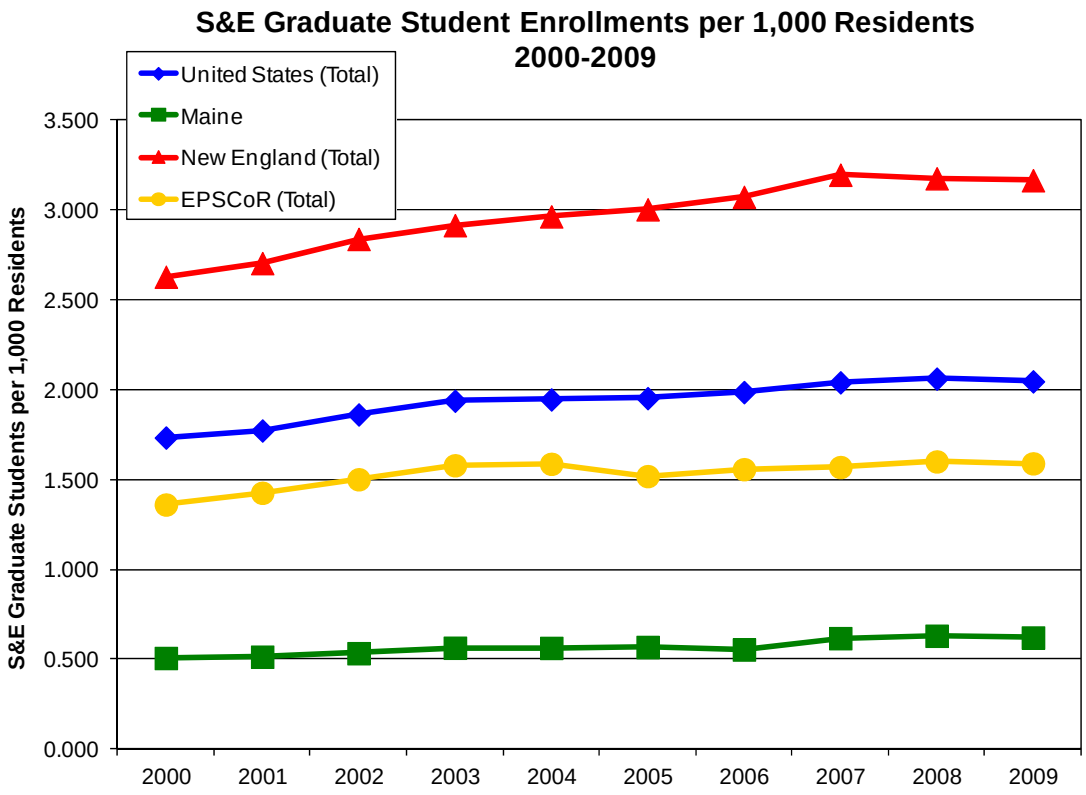
**Figure 3.7**

**S&E Degrees Awarded per 1,000 Residents**
**2000-2009**




Maine's performance lags even further at the graduate level. The number of students enrolled in graduate-level science and engineering fields expressed per 1,000 residents has remained flat over recent years, at levels two to three times lower than EPSCoR or U.S. averages, and almost six times less than that of New England. (See **Figure 3.8**). In 2009, Maine reported 0.62 graduate level students in S&E fields for every 1,000 residents and ranked 51st in the nation. This compares to 2.05 for the U.S. average and 3.17 for New England. More recent survey data for 2011 again suggest that trends may be moving in the right direction. Maine's colleges and universities reported significant annual increases in both enrolled science and engineering graduate students (5 percent), and science and engineering graduate degrees awarded (25 percent).

**Figure 3.8**


S&E Graduate Student Enrollments per 1,000 Residents
2000-2009
United States (Total)
Maine
New England (Total)
EPSCoR (Total)
S&E Graduate Students per 1,000 Residents
3.500
3.000
2.500
2.000
1.500
1.000
0.500
0.000
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009

## 3.2 More Robust Entrepreneurial Climate

**Bottom Line: Entrepreneurial activity in Maine has held steady, but persistent challenges with high-growth firms still remain, especially accessing national and international markets. On the positive side, there are signs that the statewide credit crunch is becoming less severe.**

A second set of desired outcomes from Maine's research and development investments focuses on how the state's science and technology programs help contribute to a more robust and supportive environment for the state's entrepreneurs and their companies. The 2010 Maine Science and Technology Plan identifies four strategies for building these linkages.[5]

- To increase the rate at which new technologies and ideas become new products, processes, and services. Key tools for this goal include expanded angel investments and improved technology commercialization processes at Maine's universities and research centers.
- To support Maine's emerging and established industry clusters.
- To build a more support environment for high-growth entrepreneurs through investments in broadband infrastructure and efforts to build a more entrepreneur-friendly culture and business climate.
- To align Maine's innovation-based economic development efforts with the state's broader overall strategies for future economic prosperity.

If Maine's technology firms are prospering, their success will be reflected in faster company growth rates, increased revenues and sales (especially export sales), increased success in obtaining outside funding and success in developing new technologies. More details on these factors are presented below.

### Are Maine Technology Firms Growing Their Markets?

Overall Growth: Firms assisted by Maine's R&D programs are a diverse group. In terms of firm type, 37 percent are structured as LLC's, 35 percent, and 27 percent are sole proprietors or individuals. They span an array of ages with only 12 percent being formed in 2010 or 2011; and 75 percent formed since 2000. They are also quite small: 83 percent have fewer than ten employees and 58 percent generate less than $100,000 in annual revenue. Because Maine's S&T programs are designed to serve firms with high potential, these low employment and revenue levels, especially for firms in business longer than five years, should be a cause for concern.

Across the U.S. economy, a small cohort of high growth firms accounts for the vast majority of new job creation. A similar process is underway among firms supported by state R&D assistance. Overall, this year's survey respondents experienced a 4.5 percent annual increase in total employment (an increase

[5] 2010 S&T Plan, pp. 14-16.

of 155 jobs). This increase was generated by only 90 of 327 companies or 27.5 percent. Thirty-seven of the 327 companies (11.3 percent) experienced employment decreases and the remaining 200 (61.2 percent) experienced no employment change. Revenue growth—up 11.6 percent overall—was more widely distributed. Sixty two percent of surveyed firms reported increased revenues in 2011.

But, are Maine's R&D assisted firms growing fast enough to build an innovation driven economy? A number of other measures suggest that Maine-based firms may face significant hurdles in achieving rapid growth and becoming what some observers refer to as a gazelle business, i.e. a firm that achieves a consistent double-digit annual growth rate. Recent research suggests that these gazelle businesses are the real generators of new jobs, new wealth, and community prosperity.[6] As noted in previous editions of this evaluation, Maine-based companies appear to face many challenges in achieving rapid growth trajectories. Relatively few Maine firms are recognized in various national rankings of the U.S.'s top companies. For example, no Maine based businesses are ranked in the 2011 Inc. 500 or Deloitte Technology Fast 500 lists. Eleven Maine-based firms appear on the larger Inc. 5000 listing, with Portland's Putney, a pet pharmaceutical firm, serving as Maine's top performer (ranked at #1040 on the Inc. 5000).

Businesses grow and create new jobs by capturing new markets. In a small state like Maine, firms need to compete and win in larger markets here in the U.S. and overseas. In terms of assessing market growth, through our annual R&D evaluation process, we ask recipients of R&D related state government programs to provide information on the location of their customers and key markets. As noted **in Table 3.1**, these results for 2011-12 provide further indications of weak export performance. Eighty-five percent of surveyed firms noted that they generate 10 percent or less of sales from foreign customers and only 4 percent have sales of greater than 50 percent to customers outside of the U.S. The survey further suggests that Maine-based businesses are also failing to capture markets within the U.S. itself. Forty nine percent of respondents note that less than half of sales come from outside of Maine.

## Table 3.1

**U.S. and International Sales from Maine R&D Private Survey Respondents**

| | All Respondents 2011 - 2012 | | | |
|---|---|---|---|---|
| | Sales Outside Maine Companies | | Sales Outside U.S. Companies | |
| Percent of Sales | Number | Percent | Number | Percent |
| 0 - 10 | 73 | 29.7% | 208 | 84.6% |
| 11 - 25 | 14 | 5.7% | 15 | 6.1% |
| 26 - 50 | 33 | 13.4% | 13 | 5.3% |
| 51 - 75 | 28 | 11.4% | 7 | 2.8% |
| 76 - 100 | 98 | 39.8% | 3 | 1.2% |
| Total | 246 | 100% | 246 | 100% |

[6] Dane Stangler, "High Growth Firms and the Future of the American Economy," Kauffman Foundation Research Series: Firm Formation and Economic Growth, March 2010.

As we noted in last year's case study, *From Business Assistance to Market Expansion*[7], Maine's firms and state support agencies, need to be more aggressive in terms of promoting market expansion, especially into lucrative export markets. Too few Maine firms are aggressively seeking to enter national and global markets, and instead tend to rely on markets that are closer to home. While serving Maine businesses and consumers should be encouraged, a sole focus on markets in Maine (or Northern New England) places severe limits on a firm's growth potential. If Maine's entrepreneurs hope to achieve sustained rapid growth over the long term, they must capture markets outside of our region—in other parts of the U.S., and overseas. Where possible, this global outlook should be part of a new firm's culture at the outset. Even the newest start-ups should look beyond Maine for new markets and business opportunities.

## Are Maine Technology Firms Succeeding in Obtaining Private Capital and Government Funding?

Capital is essential to launch and grow innovation based companies. Such capital typically comes from an array of financing tools. Many businesses in Maine grow through bootstrapping, by reinvesting savings and profits back into the business. But not all firms have the luxury of growing in this manner, and this is especially true for firms pursuing or achieving rapid growth. These companies must turn to outside sources, typically banks that provide debt capital in the form of bank loans or lines of credit. Other firms seek equity investments that may come from friends and family, angel investors, or venture capitalists. Last but not least, companies can also tap into grants from government agencies or foundations. These grants are a large part of Maine's innovation economy, accounting for 1/5 of all capital raised by our survey respondents.

Equity Investments: Like most states with smaller populations, Maine has not traditionally served as a major market for new venture capital investments. This is due in part to the smaller size of Maine companies and the trend for venture capital to move toward larger investments. Over the past decade, Maine's overall venture capital investment totals have ranged between $2 and $12 million dollars per year. Because Maine only lands a few VC investments each year, the annual totals can fluctuate on a year to year basis. This pattern was apparent in 2010 where statewide VC investments (at $2.2 million) saw a 58 percent drop from the previous year. This total represented five distinct deals in biotechnology, consumer products and services, and the industrial/energy sector. However, this data does not capture the angel investors who typically provide higher levels of equity investment in smaller states like Maine.

As indicated in **Figure 3.9**, Maine's VC investments as percent of GSP still remain low when compared to key benchmarks. However, it must be noted that the New England-wide data is heavily skewed by the performance of Massachusetts, which continues to serve as a top recipient for VC dollars. Overall, Maine now ranks 46$^{th}$ in the U.S. on this measure.

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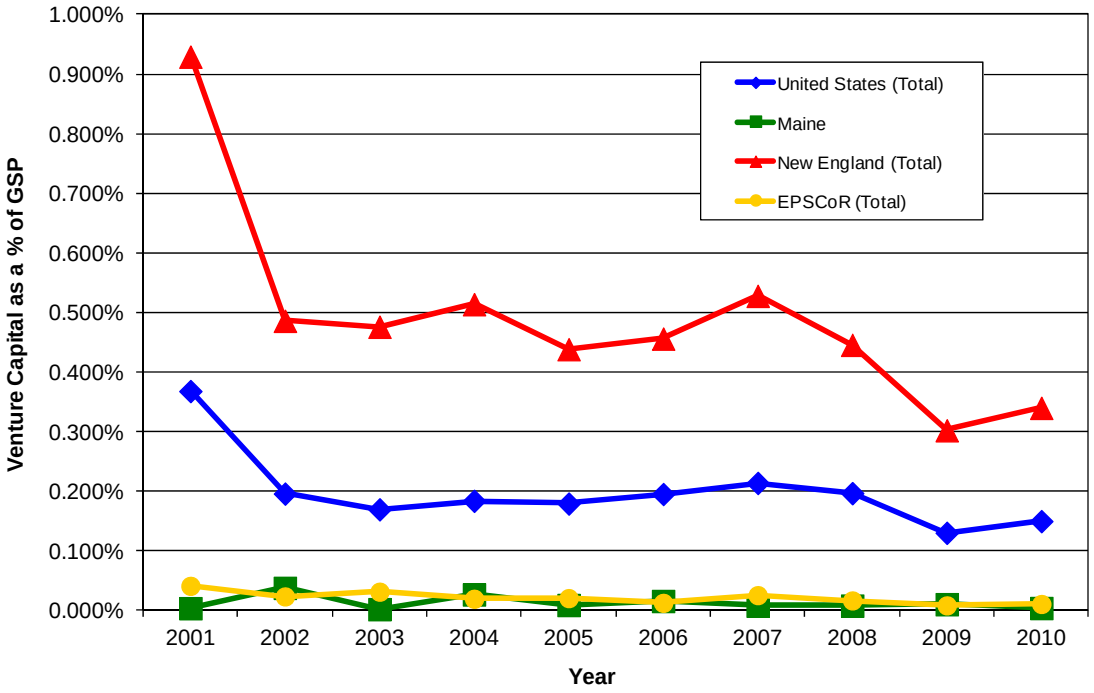
[7] From Business Assistance To Market Expansion: Helping Maine Firms Succeed in National and Global Markets; A Case Study for Maine's 2010-11 Comprehensive Evaluation of State Investments in Research and Development; PolicyOne Research, EntreWorks, and Scruggs & Associates; January 2011

**Figure 3.9**

**Venture Capital Invested as a Percent of Gross State Product – 2001-2010**




Results from our company surveys suggest that, while VC investments are not growing, Maine's firms are accessing other sources of equity capital. Overall, 15.3 percent of surveyed companies received new equity infusions in 2011. (See **Table 3.2**). Few of these firms (six in 2001) have utilized venture capital. Friends and family or angel investors are a much more important source of equity finance. Other sources include owner and/or employee investments.

**Table 3.2**

| Equity Financing Sources | All Respondents 2011-2012 Number of Transactions | Dollars of New Equity | Percent of Total Equity |
|---|---|---|---|
| Venture Capital | 6 | $ 9,504,507 | 34.2% |
| State Seed Capital Funds | 0 | $ - | 0.0% |
| Angel Investors | 12 | $ 7,152,933 | 25.7% |
| Friends and Family | 19 | $ 1,217,980 | 4.4% |
| Other | 20 | $ 9,938,448 | 35.7% |
| Total | 57 | $27,813,868 | 100% |

| Equity Financing Sources | All Respondents 2010-2011 Number of Transactions | Dollars of New Equity | Percent of Total Equity |
|---|---|---|---|
| Venture Capital | 5 | $ 2,865,000 | 20.4% |
| State Seed Capital Funds | 0 | $ - | 0.0% |
| Angel Investors | 8 | $ 3,187,000 | 22.6% |
| Friends and Family | 5 | $ 267,414 | 1.9% |
| Other | 14 | $ 7,754,880 | 55.1% |
| Total | 32 | $14,074,294 | 100% |

Note: The number of transactions is greater than the number of companies/entities because some companies/entities may have had multiple transactions.

**Debt Capital:** Most companies rely on debt capital as a means to finance daily operations and growth. The 2011 survey respondents are not unique in this regard. **Table 3.3** indicates that nearly ¼ of survey respondents accessed new debt financing during their most recently completed fiscal year. These figures, along with the growth in the U.S. of conventional bank loans, suggest that the credit crunch of the past several years may be easing in Maine.

**Table 3.3**

| Debt Financing Sources | All Respondents 2011-2012 Number of Transactions | Dollars of New Debt | Percent of Total Debt |
|---|---|---|---|
| Bank | 32 | $ 35,770,045 | 68.4% |
| SBA Loans | 2 | $ 100,000 | 0.2% |
| Friends and Family | 32 | $ 3,242,085 | 6.2% |
| Other | 35 | $ 13,157,976 | 25.2% |
| Total | 101 | $ 52,270,106 | 100% |

| Debt Financing Sources | All Respondents 2010-2011 Number of Transactions | Dollars of New Debt | Percent of Total Debt |
|---|---|---|---|
| Bank | 27 | $ 6,889,892 | 37.3% |
| SBA Loans | 5 | $ 1,159,500 | 6.3% |
| Friends and Family | 15 | $ 899,855 | 4.9% |
| Other | 29 | $ 9,542,206 | 51.6% |
| Total | 76 | $ 18,491,453 | 100% |

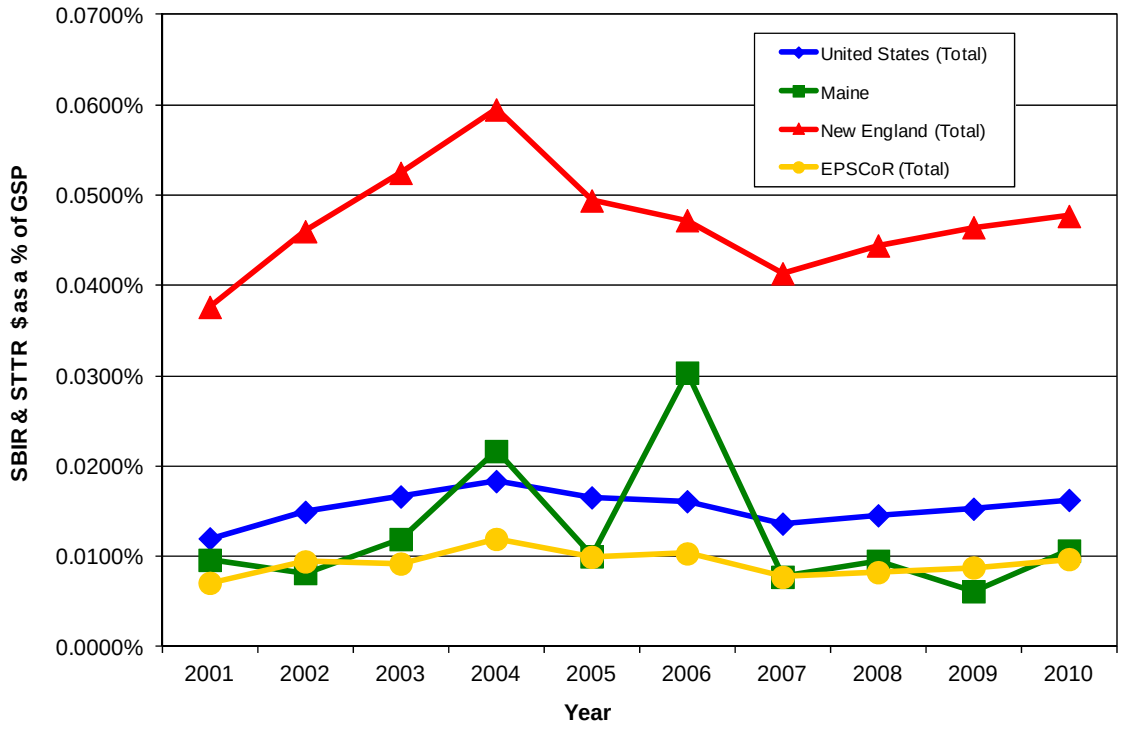
**Note: The number of transactions companies/entities because some companies/entities may have had multiple transactions.**

**Government Funds:** By definition, every firm in our survey has received some level of funding—or other support—from the state of Maine. These companies also pursue other investments, with many of them applying for grants from the Federal Small Business Innovation Research (SBIR) program. SBIR provides research grants to small firms pursuing research relevant to key Federal agency missions. Roughly 2 percent of all Federal R&D funds are earmarked to support small businesses. Because small technology firms can rarely raise start-up funds from traditional finance sources, they often rely on SBIR as seed money as they develop new technologies and processes.

Maine-based businesses have enjoyed mixed success in terms of accessing grants from the SBIR and STTR (Small Business Technology Transfer) programs. According to the latest 2010 data, Maine ranks 25$^{th}$ in the U.S. in terms of SBIR/STTR funding as a Percent of Gross State Product with a level of 0.011 percent. (See **Figure 3.10**). Maine's 2010 level is below that of the New England States (0.048 percent) and the U.S. (0.016 percent) and equal to that of other EPSCoR states as a whole.

**Figure 3.10**

**Total SBIR & STTR $ as a Percent of Gross State Product**
**2001-2010**




Because of their technology focus, firms that access Maine's R&D programs also tend to seek out SBIR grants and other Federal research funds. These companies have enjoyed some success. In the 2011-2012 survey, 7.9 percent of respondents had received some type of Federal grant for R&D in the most recently completed fiscal year. The total value of these awards exceeded $20 million. SBIR/STTR funds account for $5.9 of these federal awards among respondents. The data suggest that surveyed firms account for nearly all SBIR/STTR grants in the state of Maine. In fact, it appears that nearly every Maine-based SBIR recipient has also accessed state R&D support; due in large part to the fact that the Maine Technology Institute assists applicants to submit competitive proposals.

As **Table 3.4** indicates, sixteen surveyed firms (4.7 percent of respondents) received either an SBIR Phase I or Phase II award or a STTR award during their most recently completed fiscal year. Maine's statewide performance has held steady over the past several years, with few major changes in the total grant volume or in average grant sizes.

**Table 3.4**

| Federal Award | All Respondents 2011-2012 Number of Awards | Total $ of Awards |
|---|---|---|
| SBIR Phase I or Phase II | 14 | $ 4,989,545 |
| STTR | 2 | $ 950,000 |
| Total | 16 | $ 5,939,545 |

| Federal Award | All Respondents 2010-2011 Number of Awards | Total $ of Awards |
|---|---|---|
| SBIR Phase I or Phase II | 15 | $ 3,653,326 |
| STTR | 1 | $ 150,000 |
| Total | 16 | $ 3,803,326 |

As comparisons of equity, debt and federal funding show, government funds are an important source of patient capital for Maine's technology sector. In 2011, these Federal funds represented roughly 1/5 of all outside capital raised by survey respondents.

## 3.3 Competitive and Well-Connected Innovation Industries

**Bottom Line: After several difficult years, surveyed firms appear to be on the move, especially those with 10 or more employees. Job creation and revenue growth are up and firm performance is improving in other areas as well. The low percent of scientific and technical workforce, however, may limit overall growth.**

Maine's innovation strategies serve the same purpose as its other economic development investments: to create jobs, to stimulate business activity, and to build a prosperous economy. The 2010 Maine Science and Technology Plan is based on this logic and recommends that that Maine continues to support investments that help Maine businesses create better-paying jobs and careers, while also supporting initiatives that build and attract a more highly skilled and technology-savvy workforce. [8] Success on this front should be reflected in several ways.

- Maine R&D investments should help companies create more jobs.
- R&D Investments should help these firms create better jobs, i.e. jobs that pay higher wages and provide better career options.
- Investments should help firms develop new technologies that can become new products, services, and processes.
- These efforts should help create a more robust Maine innovation infrastructure that support a more skilled and better trained workforce.

### Are Maine's R&D Investments Creating New Jobs?

This year's private company survey respondents experienced an overall increase in employment, with jobs increasing by 4.5 percent over the previous year. While overall job numbers are small—155 more workers were employed in 2011—the trends are positive, especially when compared to previous years where overall employment levels declined. Job growth among surveyed firms also outpaces the job growth performance of Maine's technology sectors as a whole (all technology firms regardless of whether they received support from the state) and the state as whole, which experienced less than one percent employment growth between 2010 and 2011.

From 2010 to 2011, employment growth varied by company size. (See **Table 3.5**). The largest percentage growth in employment occurred by companies within the 11-25 employment size range. As a group, these companies experienced 17.5 percent employment growth between 2010 and 2011. Companies with 2 or less employees as a group experienced a 5.5 percent decline in employment.

[8] 2010 S&T Plan, pp. 16-17.

**Table 3.5**

| Summary by Company Employment Size (2011) | # of Firms | Employment 2011 | Employment 2010 | Net Change 2010-2011 | % Change |
|---|---|---|---|---|---|
| 2 or Less Employees | 178 | 222 | 235 | -13 | -5.5% |
| 3-10 Employees | 93 | 500 | 489 | 11 | 2.2% |
| 11-25 Employees | 28 | 490 | 417 | 73 | 17.5% |
| 26 or More Employees | 28 | 2,394 | 2,310 | 84 | 3.6% |
| **Total** | **327** | **3,606** | **3,451** | **155** | **4.5%** |

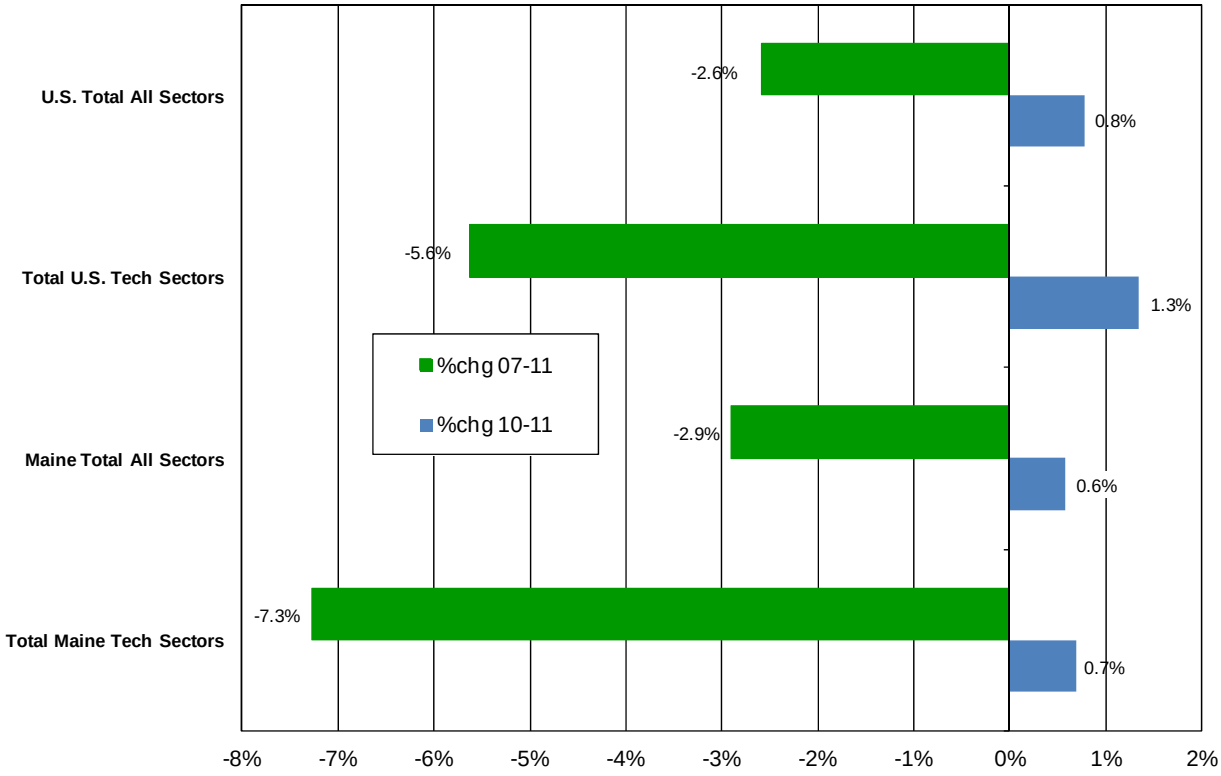
Increases in employment also resulted from the State's investments in the Maine Technology Asset Fund (MTAF). MTAF results are presented in greater detail later in this report but in terms of job growth. The 29 MTAF projects that were included in this analysis created 289.5 new jobs in public, non-profit, and private entities engaged in collaborative R&D.

The economic downturn has created many challenges for Maine technology firms across the board. As a group, their average annual employment dropped 7.3 percent between 2007 and 2011. (See **Figure 3.10**). In 2010-2011, growth returned but overall growth rates have been fairly limited.

Between 2010 and 2011 Maine's targeted technology sectors experienced slight growth (0.7 percent) compared to 0.6 percent for the Maine economy as a whole. While a positive sign, this growth lagged that of the experiences in the U.S. as a whole.

**Figure 3.10**

**Percent Change in Average Annual Employment**

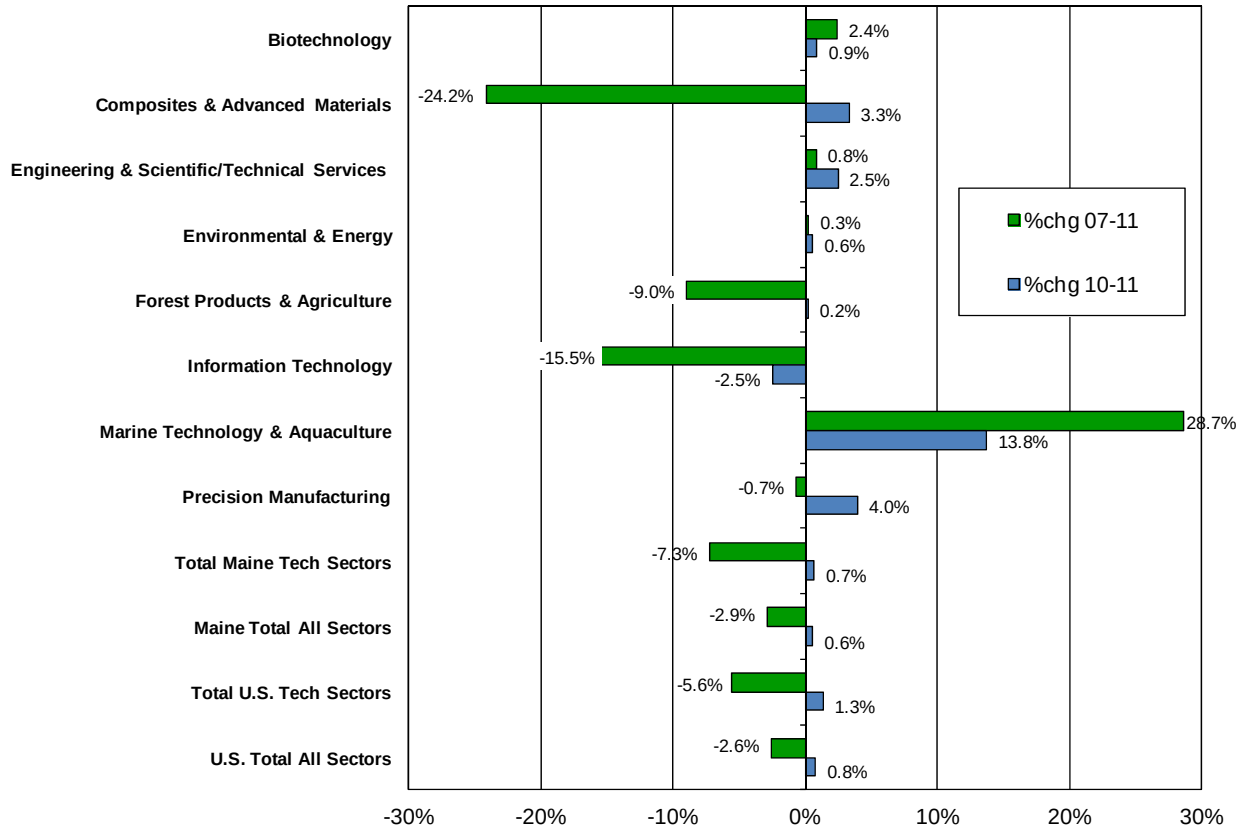



Job Growth by Sector: As **Figure 3.11** shows, employment patterns differ by sector. With the exception of information technology (down 2.5 percent), all other targeted technology sectors experienced some employment growth in the past year. Between 2010 and 2011, employment growth was experienced in biotechnology (0.9 percent), composites and advanced materials (3.3 percent), engineering and scientific/technical services (2.5 percent), environmental and energy (0.6 percent), forest products and agriculture (0.2 percent), marine technology and aquaculture (13.8 percent)[9], and precision manufacturing (4.0 percent).

[9] Marine Technology and Aquaculture employment accounts fo less than 200 jobs, and the 13.8% increase represents only 35 total jobs.

## Figure 3.11

### Percent Change in Average Annual Employment - Maine




Between 2007 and 2011, Maine's targeted technology sectors shed 5,456 jobs. While a few sectors, especially biotechnology, succeeded in creating net new jobs, these totals were outpaced by major job losses in sectors such as composites and advanced materials, forest products and agriculture, information technology, and precision manufacturing. In fact, the forest products and agriculture sector alone accounts for 64.3 percent of the job loss and information technology 27.5 percent. (See **Table 3.6**).

To sum up, Maine's technology sectors, like much of the state's economy, have faced a rough five years since this evaluation process commenced. Overall employment has declined—albeit at a rate lower than the overall state economy. The improved performance in 2011 is hopefully a harbinger of good news, and may signal the beginning of a significant economy recovery in these sectors.

**Table 3.6**

**2007-2011 Employment Trends by Sector[10]**

| Cluster Summary - Employment Change 2007-11 | 2007 | 2008 | 2009 | 2010 | 2011 | # Change 2007-2011 | % of the 2007-2011 Tech Loss | % of the 2007-2011 Tech Gains |
|---|---|---|---|---|---|---|---|---|
| Biotechnology | 5,741 | 5,897 | 6,017 | 5,827 | 5,879 | 138 | | 63.59% |
| Composites & Advanced Materials | 1,602 | 1,592 | 1,162 | 1,176 | 1,215 | -387 | 6.84% | |
| Engineering & Scientific/Technical Services | 4,689 | 4,782 | 4,487 | 4,614 | 4,728 | 39 | | 17.97% |
| Environmental & Energy | 1,897 | 1,944 | 1,710 | 1,891 | 1,902 | 5 | | 2.30% |
| Forest Products & Agriculture | 40,368 | 39,894 | 36,936 | 36,655 | 36,732 | -3,636 | 64.31% | |
| Information Technology | 10,022 | 9,777 | 8,700 | 8,683 | 8,466 | -1,556 | 27.52% | |
| Marine Technology & Aquaculture | 122 | 126 | 134 | 138 | 157 | 35 | | 16.13% |
| Precision Manufacturing | 10,847 | 11,497 | 10,734 | 10,362 | 10,772 | -75 | 1.33% | |
| Total Maine Tech Sectors | 75,049 | 75,292 | 69,585 | 69,116 | 69,593 | -5,456 | | |
| Sum of Tech Sectors Jobs Lost | | | | | | -5,654 | | |
| Sum of Tech Sectors Jobs Gained | | | | | | 217 | | |
| Tech Sectors Jobs Net | | | | | | -5,437 | | |

## Are Maine's R&D Investments Creating Better Jobs?

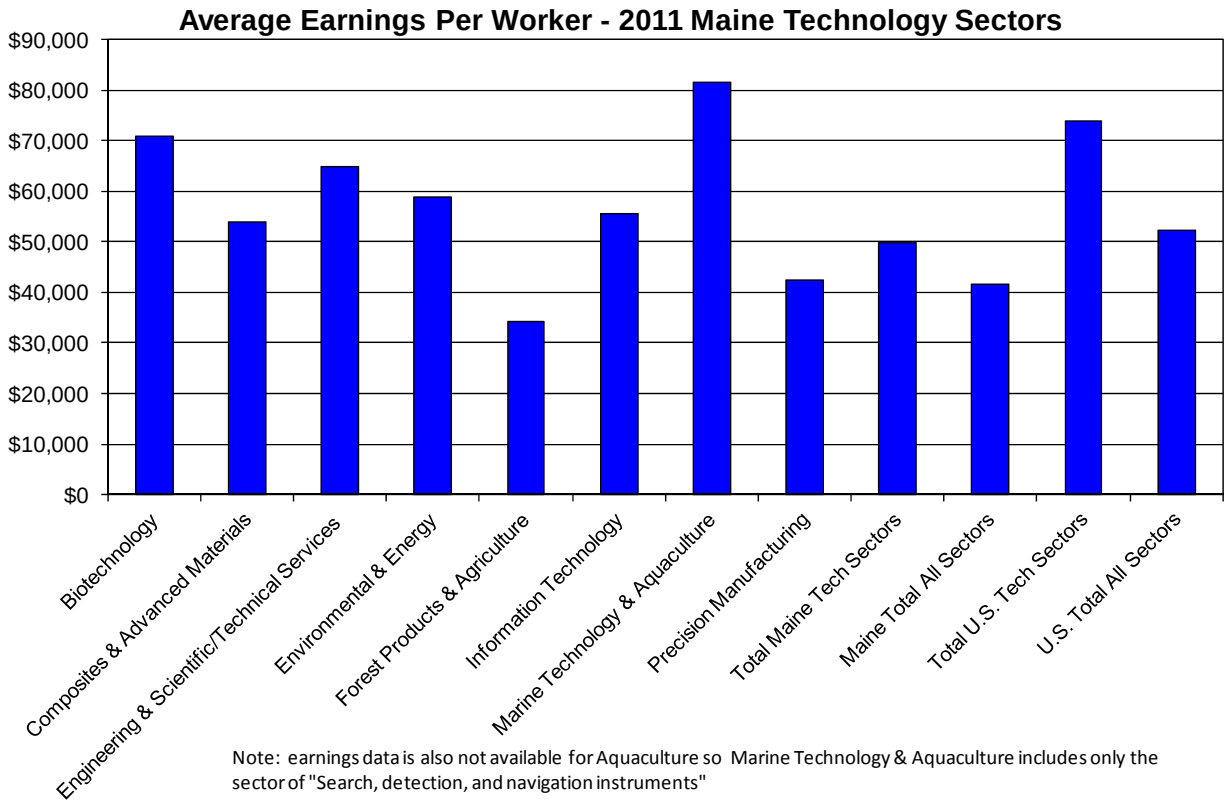
Data from our surveys and related research suggest that Maine's technology sector is helping to create better jobs and career opportunities for Mainers. Overall wage levels vary by sector; but, in most cases, Maine's technology businesses pay significantly higher wages when compared to statewide averages.

**Wages: Figure 3.12** provides details on average earnings per worker in 2011. Marine Technology (excluding aquaculture) was the highest with $81,744 followed by biotechnology ($70,866), and Engineering & Scientific/Technical services ($64,890). The average earnings per worker of all of Maine's targeted technology sectors was $49,900[11], which was higher than Maine as a whole at $41,654. However, this average was lower than the U.S. total average of $52,216 for the same sectors.

[10] Total Maine Tech Sectors does not equal Tech Sectors Jobs Net and its components due to overlap in industries included in the individual industry sectors and not in Total Maine Tech Sectors.

[11] Maine includes Forest Products and Agriculture which is typically not included in other states' definition of innovation sectors, therefore overall wages are lower than other states as Maine typically has higher employment in this sector compared to other states.

**Figure 3.12**




Firms that responded to the 2011 survey reported that their average wages reached $44,717 in 2011. This figure represents a slight increase from last year's average of $43,722. Maine's technology firms are succeeding in creating better paying, higher quality jobs.

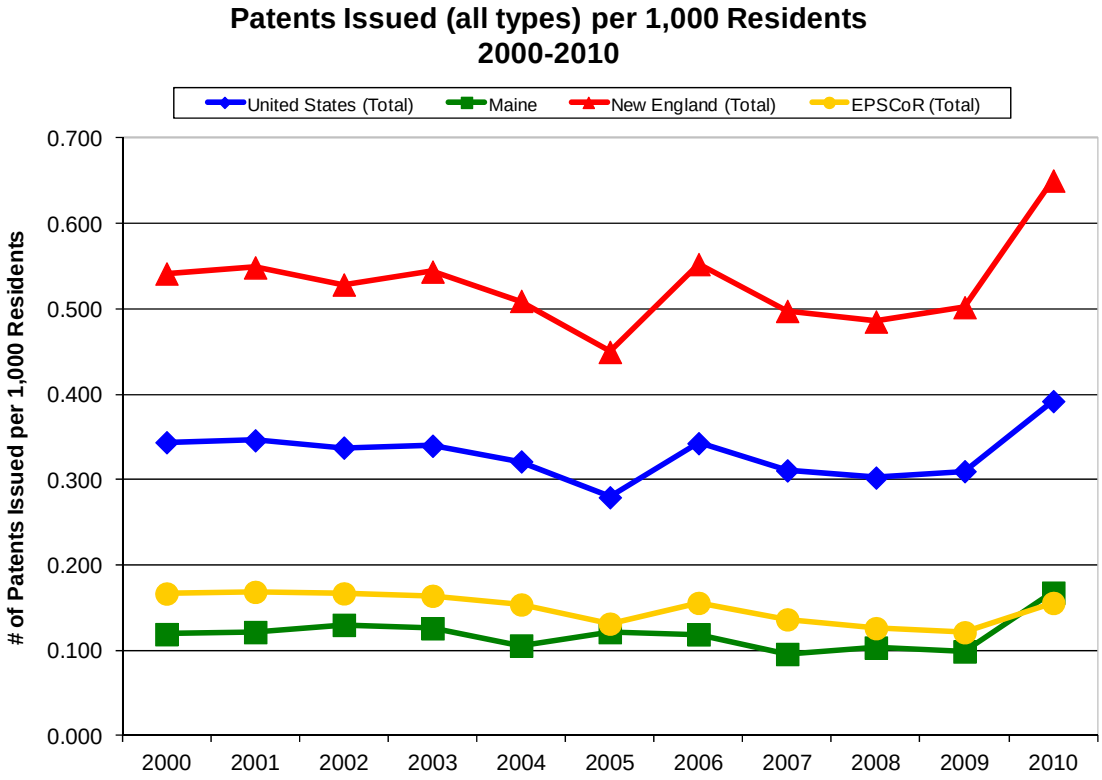
## Are Maine Firms Succeeding in Developing New Technologies?

Obtaining patents and other forms of intellectual property can be an expensive and time-consuming process. When firms or inventors file for or receive patents, they are an important indicator that an idea or technology has commercial potential. These measures are thus a useful proxy measure of whether a company—or a state economy—is developing research that can generate commercial benefits.

Patents: Maine has traditionally lagged other benchmark states in various measures of patenting activity. However, in 2011, we witnessed significant improvements as overall patenting rates exceed EPSCoR benchmark averages and national rankings also improved. On the keys measure of patents issues per 1,000 residents (2010 data), there were 0.168 patents issued per 1,000 Maine residents in comparison to 0.392 for the U.S. as a whole, 0.651 in New England, and 0.156 among the EPSCoR states. (See **Figure 3.13**). In 2010, Maine's national ranking improved to 35$^{th}$, from its 2006 level of 40$^{th}$ and its 2001 level of 43$^{rd}$. Between 2009 and 2010, patents issued in Maine rose 69.2 percent, from 130 in 2009

to 220 in 2010. This exceeds the percent increase in the U.S. (27.5 percent), New England (30.0 percent), and among the EPSCoR states (29.3 percent).

**Figure 3.13**




Licenses, Copyrights and other Intellectual Property: Recipients of Maine's R&D programs have aggressively pursued intellectual property protections for their technologies and products. Sixty percent of all respondents report that they have used or intend to use a form of intellectual property protection (Patents, Trade Secrets, Licensing, Copyrights, Trademarks, or other) for one of their discoveries. This cohort likely represents a significant portion of the state's overall intellectual property activity, perhaps accounting for roughly half of all patents awarded in Maine. Data presented in this year's Innovation Index shows that Maine has averaged 155 patents annually in the past ten years.[12] In 2011, 82 were granted to survey respondents and an additional 243 patent requests were either filed for a patent or in the process of being filed. While not all of these applications will be approved, it is clear that Maine R&D program users constitute a large part of Maine's overall patent portfolio. Additionally, 35 percent have or plan to enter into a licensing agreement and 24 percent of those will be agreements with companies in Maine.

University Technology Transfer: University-industry partnerships and research activities produced a mix of results in 2011. Additionally, Maine's research institutions reported the following:

[12] *Maine Innovation Index 2012*

- **Licensing Agreements:** While total licenses signed with firms dropped slightly (from 42 to 40 between 2010 and 2011) with only 6 agreements from universities; research institutions signed six licensing agreements with Maine firms, up from five in 2010.

- **License Income**: Total income from licensing activity reached $1.7 million in the last year, up from the 2010 level of $1.5 million.

- New Firm Spin-Offs: Three new firms were spun-off from research centers in 2011, down from six in 2010. Jobs from new spin-offs dropped from fifteen to seven.

Maine's research institutions perform fairly well when compared to nationwide technology commercialization benchmarks. **Table 3.7** projects the commercialization outcomes that would occur in Maine if universities and nonprofits were performing at the same level as the average for the 175 universities that report technology transfer activity to the Association of University Technology Managers (AUTM).[13] In previous years, Maine institutions performed below average in almost all categories. In 2011, Maine meets or outperforms most benchmarks.

[13] Association of University Technology Manager; Statistics Access for Tech Transfer (STATT)

**Table 3.7**

**Predicted and Actual Technology Transfer Metrics for Maine Universities**

| | Average U.S. for universities, hospitals, and nonprofit inst. | Predictions based on the total R&D reported in evaluation survey to universities & nonprofits | Actual for both universities and nonprofits in Maine (survey totals) | Predictions for universities only | Actual for universities only |
|---|---|---|---|---|---|
| **Invention disclosures** | **$2.86 m in R&D expenditure per disclosure** | **88 disclosures** | **39** | **50** | **27** |
| **Patents Issued** | **$13.2 m in R&D expenditure per filed patent** | **19 patents** | **15** | **11** | **10** |
| **New Licenses** | **$13.8 m in R&D expenditure per license** | **18 licenses based on survey reporting** | **42** | **11** | **6** |
| **Start-ups** | **$90m in R&D expenditure per start-up** | **3 start-ups per year** | **3** | **2** | **2** |

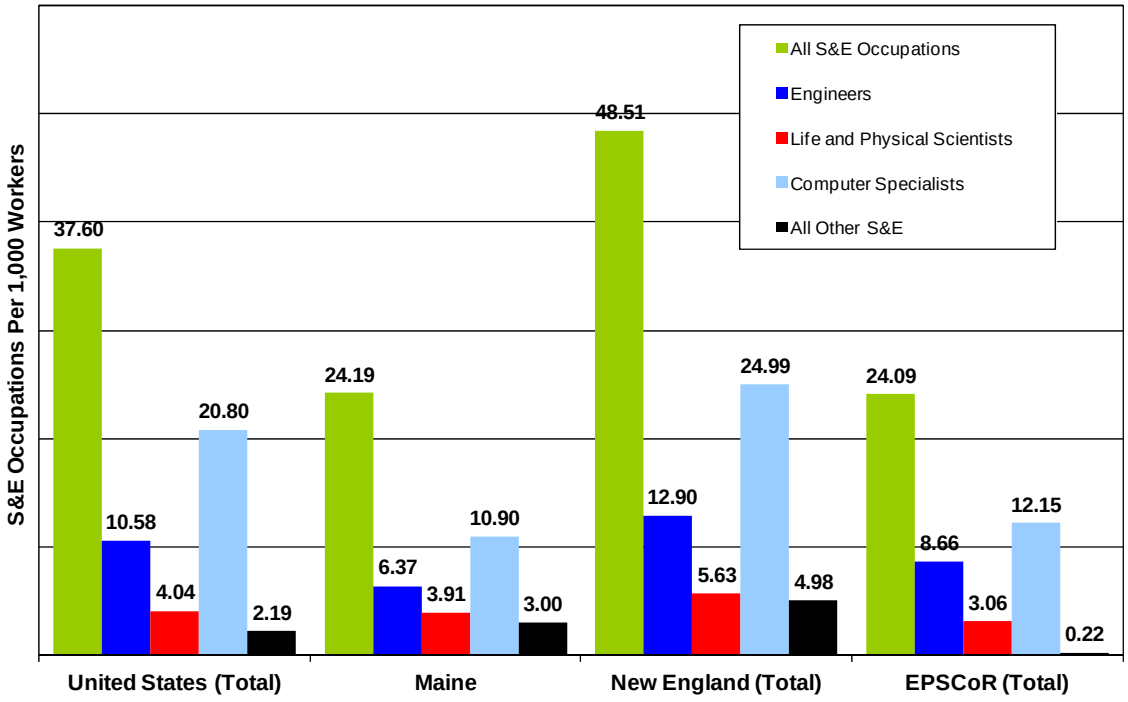
## Are New Innovation Capacities and Infrastructure Being Developed?

Science and Technology Workforce: Human capital is the most important ingredient in a successful innovation economy. States with a talent pool of workers, who can fill jobs at all skill levels, are more attractive to technology firms who require skilled technicians, researchers, analysts, and managers. This talent also serves as the foundation for the state's homegrown entrepreneurs, who start new technology new businesses or who employ these workers.

Data from this year's Innovation Index suggest that, Maine must do a better job of creating, supporting, and attracting a technology-savvy workforce. When compared to national or New England benchmarks, Maine has a lower proportion of workers in key science and engineering occupations. In 2008, there were an estimated 17,000 science and engineering (S&E) occupations in Maine's workforce. This proportion lagged behind the U.S., and New England, but was on par with the EPSCoR states. Maine improved two spots in national ranking from 44th in 2006 to 42nd in 2008. (See **Figure 3.14**).

## Figure 3.14

### S&E Occupations in the Workforce Per 1,000 Workers – 2008




In terms of building a future science and engineering workforce, data from this year's Innovation Index do indicate some positive trends. Over the past decade, Maine has seen important improvements on key measures such as science and engineering graduate enrollments, degrees awarded, and overall educational attainment.[14] However, in most cases, these growth rates have simply kept pace with U.S. and regional benchmarks.

Science and engineering occupations span an array of education levels. While innovation studies typically focus on jobs with four-year and advanced degrees, a large percent of the innovation workforce has post-secondary education levels that are less than a four-year degree. These middle skill jobs are critical to Maine industries like manufacturing, forestry, energy and IT, and are projected to grow in the years ahead. This year's case study highlights these jobs and their importance in the innovation economy.[15]

[14] Maine Innovation Index 2011, pp v.

[15] The Role Of Middle Skill Jobs In Maine's Innovation Economy, Maine Department of Economic and Community Development for Maine's 2011-12 Comprehensive Evaluation of State Investments in Research and Development; Camoin Associates, EntreWorks, and Scruggs & Associates; January 2012

## *Highlights of the Maine Technology Asset Fund (MTAF)*

In 2007, the Maine State Legislature authorized and Maine voters approved $50 million in bond funds for "research, development and commercialization projects that boost economic development and create jobs across the State." In 2010, voters approved an additional $3 million for this fund. The Legislature directed the Maine Technology Institute (MTI) to administer this fund and MTI established the Maine Technology Asset Fund (MTAF) in response to this directive.

MTAF is a competitive award program to fund research, development and commercialization projects that lead to "significant" economic benefits for Maine.[16] They promote collaboration among university and private sector partners as well as among institutions. As of June 30, 2011, 34 projects have been funded with a total of $26.8 million paid out by MTI.

The following data includes the subset of 29 MTAF projects for which activity has been reported. These projects account for $47.3 million of the state MTAF funds. The entities receiving MTAF awards matched that amount with $69.7 million or $1.47 for every state dollar.

These 29 MTAF projects have spent $25 million in state funds to date with the following results:

- 289.5 new jobs created directly by 21 of the projects
- 303.0 jobs preserved/retained by 18 projects
- 19 projects led to the creation of new products or services (many of which included multiple new products or services) within project team or lead institution
- 15 projects led to invention disclosures, license and/or intellectual property protections, copyrights within project team or lead institution
- $17.1 million in sales or licensing revenue within 9 projects
- $100.7 million in new grants and/or contracts from non-state government sources within 19 project teams or institution
- $29.4 million in debt or equity investments from private capital within 4 project teams or institutions

Detailed results are contained in Appendix D.

[16] The expenses may include facilities construction and renovation, machinery and equipment (including computers, software and licenses required for their use, as well as related technician training for operation of equipment and machinery purchased) and land purchase. This may also include expenses directly associated with the acquisition and installation of such assets. The awards may not be used to fund ordinary annual operating expenses.

## What Impact Do Companies Being Supported By Maine R&D Funding Have On The Maine Economy?

The following findings are based on the 329 companies that have received support from R&D programs funded by the State of Maine and provided data on employment and revenues as part of the annual survey of private companies conducted for the evaluation. This represents the subset of companies that reported data on revenues and employment. Since business growth depends on a number of factors, it is difficult to attribute a specific economic impact to the state investment by itself. Therefore, the data below represents the overall impact these companies had on the Maine economy and not the isolated impact that state investments had on these private companies.

R&D Performed

- In 2011, the companies received a total of $3,666,293 in state funding for R&D related activities.
- In 2011, the companies expended a total of $29,556,116 on R&D from all sources of revenues.
- State investments comprise 12 percent of the overall firm R&D portfolio.

Employment

- In 2011, these companies directly employed 3,606 persons.
- This impacts an estimated additional 5,269 indirect jobs.
- The estimated total job impact of these companies is 8,875 jobs.

Revenues

- In 2011, these companies generated a total of $860,363,701 in company revenues from all sources.
- This impacts an estimated additional $617,259,012 in indirect revenues.
- The estimated total revenue impact of these companies is $1,477,622,713.

# 4. Recommendations

What can Maine do to spur the further development of a more competitive innovation economy? For years, Maine invested in innovation programs, mostly supporting universities and to some extent assisting the private sector. In a few instances, these efforts have moved the needle in terms of Maine's relative competitiveness, yet the state is unlikely to reach the goals set forth in the 2010 Science & Technology Plan. Is it because other states also continue to fund innovation efforts? Is it due to a lack of integration among R&D programs? Is it a lack of industry-led initiatives? These answers are less clear, although other state and regional programs offer productive insights.

This is the fifth and final year in the evaluation cycle. For this year's recommendations, we not only examined current data and information, but also reviewed previous recommendations that may still be relevant to the discussion. The following recommendations contain a mix of new ideas and recommendations from previous annual evaluation reports. They are organized around a set of key issues or observations that highlight what we believe are major obstacles to economic growth in Maine.

- Industry, the state's most important engine for R&D, is still underperforming.
- Many companies assisted by state programs tend to start small and remain small in terms of employees and revenues.
- Maine's incumbent workforce may not be sufficiently competitive in some innovation-based industries, and resources for skills upgrades and other training are limited.

Each key issue is tied to the state's desired outcome and recommendations are based on being able to accelerate the current path toward the desired outcome.

**Key Issue #1: Industry, the state's largest engine for R&D, is still underperforming**

*Desired Outcome: Enhance private sector R&D and build better connections between industry and university R&D efforts.*

Recommendation: Enhance engagement of and support to the private sector. The vast majority of R&D comes from the private sector, yet only a small percent of Maine's R&D investments are targeted toward the private sector. The state should consider increasing or reallocating a greater portion of its R&D investments to industry driven efforts.

- Develop industry-led commercialization roadmaps to identify and prioritize research with strong commercial potential. Such roadmaps are systems-based, rather than project- based, and could help to prioritize and integrate the state's seed and development grants as well as cluster projects--building more R&D capacity for key industries. Ohio's NorTech is an award-winning program to develop commercialization strategies for key local clusters such as energy and flexible electronics. Programs in Austin, Texas, the Research Triangle region of North Carolina, the Tech Corridor of Florida, and others provide services to actively

commercialize technologies by providing facilities, intensive entrepreneurial support services, and gap funding—all with heavy industry interaction.

- Establish means to enhance the level of professional resources (IP attorneys, technical evaluators, etc.) to start-up companies and commercialization efforts that can more quickly vet and identify ways to scale opportunities. This expertise could be easily integrated into the companies receiving state seed and development funds from the state. San Diego's CONNECT program is a good example of this type of effort.

- Identify high potential, industry-led, commercial opportunities that lead to a robust "pull" system for R&D efforts. Now that universities and nonprofit research institutions have more vigorous technology transfer operations, the level of industry engagement can be increased to result in more products being brought to market. Maryland and the Rochester area in New York has built a strong industry-university pathway for its R&D.

- Continue to support specialized investments or programs, such as MTAF, that help build interdisciplinary and cross-institutional partnerships to commercialize state-funded R&D.

**Key Issue #2: Many companies assisted by state programs tend to start small and remain small in terms of employees and revenues.**

*Desired Outcome: Greater acceleration of job and revenue growth for companies receiving state supported services.*

Recommendations: Many states across the U.S. are enjoying great success by providing targeted innovation services to start-up and early growth companies in high impact industries. Maine's efforts can and should build upon the experiences of these industry leaders. Successful programs share several key characteristics:

- Capital programs are strongly tied to advanced advisory services. This has been previously recommended, and is even more critical in the current economic environment. Maine's early stage investment programs—Seed Grants and Development Awards—invest approximately $5 million per year. These early stage investments tend to produce better results when they are connected with hands-on advisory services. These supports help ensure that the business model and management team is being effectively developed alongside the technology. In Maine, the majority of early-stage funding programs have little direct advisory capacity attached to the funding. This may be one reason why the job and revenue growth of companies receiving state support has been minimal. In recent years, MTI has strengthened its referral network and conditions of awards to include more advisory services that are key components for high performing models[17] in other states. To make this connection even more robust and beneficial to companies, we encourage these

[17] Models include i2E In Oklahoma, Jumpstart and NorTech in Ohio, and Innovation Works in Pennsylvania.

programs to make advisory services a condition of receiving state-supported early stage capital.

- Update screening criteria for innovation services to ensure limited resources are invested in companies with a proven track record or a solid business plan for growth. Data suggests that early job and revenue performance is a strong indicator of success. Many current state grantees have operated for years with limited growth or growth prospects. Limited state resources could be better utilized with more growth-oriented companies. Leverage newly received funds to establish a vibrant network for entrepreneurs. Recently, Maine received a sizable grant from the Blackstone Charitable Foundation for entrepreneurial development. This grant along with other recent state efforts can not only expand individual programs like Top Gun, but can create a much needed network that acts as a resource broker to entrepreneurs. As mentioned in earlier reports, well-known examples include Tech Columbus (Ohio), North Carolina's Council for Entrepreneurial Development, and the Oregon Entrepreneur's Network.

**Key Issue #3: Maine's incumbent workforce may not be sufficiently competitive in some innovation-based industries, and resources for skills upgrades and other training are limited.**

*Desired Outcomes: Maine's workforce can support the growth of innovation-based sectors; a more talented workforce will be attractive to companies and investors seeking to locate operations in Maine.*

Recommendations:

- Increase support for incumbent worker training to retrain the existing workforce. Ensure job programs with matching state funds can be used for incumbent workers in technical occupations as well as for new hires. Minnesota's Special Incumbent Worker Training Program is an example of an initiative dedicated to helping resident companies be competitive in the current economy.

- Adequately support noncredit programs for community colleges, especially those training efforts that partner closely with innovation-based industries and projects, which require state matching funds to receive significant federal grants that can build long-term training capacity.

- Encourage workforce investment boards to place a greater emphasis on STEM related middle skill jobs, with enhanced coordination of investments such as individual training accounts (ITAs) with STEM programs at community colleges. States like Washington have made significant progress in this area.

- Support key industries by better coordinating selected workforce and R&D efforts focused on cluster development. Currently, there are cluster efforts within workforce organizations and another set of cluster efforts managed by innovation organizations, with little

coordination at the strategic or tactical level. These programs could meet on a yearly basis to develop a shared focus as well as address issues unique to each of their needs. For industries like manufacturing or IT, this would mean better leveraging of state dollars for competitiveness issues that include both workforce and R&D. Oregon's innovation strategy includes strong engagement from community colleges and workforce boards, which sit on the Oregon Innovation Council as well as on various innovation task forces.

- Utilize the Department of Education's network to help industry-based efforts reach rural areas and achieve scale.

### *Getting the Most Out Of State Resources*

As these efforts move forward, the issue of integration and coordination remains critical. Over the years, industry and education partners regularly report that various innovation programs are relatively effective in addressing their slice of the pie, yet are not well coordinated with other initiatives. While the state has an innovation plan, it is not clear to partners that there is an effective level of central coordination to ensure that various state programs are cohesive in their missions and are achieving the maximum economic impacts.

In last year's recommendations, we noted the following:

"To improve its competitive position, Maine must become very strategic about managing its R&D investments. It is not enough to simply have an assortment of institutions and companies performing research. Research has shown that the economic impact of R&D reaches its peak when research becomes a differentiating asset—"the place to go" for specific knowledge and technologies. In these cases, leveraged assets of industry, academic and nonprofits create a sum that is greater than the parts. While Maine has identified a number of industry sectors with R&D needs and growth potential, it has not necessarily established a global reputation around specific sets of differentiating assets."

This statement remains true today. Small states like Maine have limited resources and must invest wisely. Program managers must resist the temptation to create multiple initiatives that satisfy a wide array of stakeholders, but cannot achieve a scale that yields significant economic impact. Successful state technology-based economic development (TBED) efforts tend to focus on allocating public funds toward a limited set of R&D and cluster efforts that are industry-driven and make strategic plays for national and international markets where their expertise or technology is a key or differentiating asset.

# 5. Conclusion

The goals and objectives set forth in the State's Science & Technology Plan were optimistic in the best of economic times. While it is unlikely these aggressive goals will be reached, it is still reasonable to expect positive movement on many critical economic measures.

We have seen, through the rise of national rankings, that real progress can be made when Maine's political and business leadership focuses attention and resources. Perhaps the best example is the increase in technology transfer within our university and nonprofit research institutions. Less than five years ago, the state's research institutions produced patents, licenses and invention disclosures at a rate less than half of the U.S. average. Today, Maine's researchers perform at the U.S. average and the trend line continues to improve each year. These measures are important to the economy because they suggest that the research produced by Maine institutions have commercial potential and economic value that can lead to new products and new companies.

Moving ahead, Maine leaders should ask themselves where to focused limited resources to best leverage economic outcomes. We suggest that the state continues its support of research institutions, while it increases its attention on industry R&D and brings more integrated resources to bear on the issue of making the current workforce competitive and vital to our innovation-based companies.

# Appendices

- **Appendix A:** Data from Private Sector Survey
- **Appendix B:** Economic Impact of Supported Private Sector Companies
- **Appendix C:** R&D Institutions Survey Data 2010-2011
- **Appendix D:** Findings Related to Funding for the Maine Technology Asset Fund
- **Appendix E:** Target Technology Sector Description

# Appendix A: Findings from Annual Private Sector Survey, 2011[18]

**1. Survey Response**

The total number of companies/entities surveyed in 2011–2012 is 875 (in comparison with 829 in the 2010-2011 survey). 443 companies/entities started the survey and 412 companies/entities have completed the survey for a response rate of 47.1 percent. This compares to 281 companies and a response rate of 34.0 percent for 2010-2011. The response rate for individual questions varies and is noted throughout the narrative.

**2. Maine R&D Program Affiliation**

875 total entities surveyed in 2011-2012 represented 1,035 awards or instances of assistance from State R&D programs, and the 432 total respondents to the survey represented 545 awards or instances of assistance. Entities can receive assistance from multiple programs. On a program basis response, 2011-2012 survey rates range from a low of 25.0 percent for the Maine Aquaculture Innovation Center (MAIC) to a high of 100 percent for the Experimental Program for the Stimulation of Competitive Research (EPSCoR). The response rate for Maine Technology Institute (MTI) clients is 88.4 percent.

| | All Respondents 2011-2012 | | All Surveyed 2011-2012 | | 2011-2012 Program |
|---|---|---|---|---|---|
| State R&D Programs | Number | Percent | Number | Percent | Response Rate |
| ATDC | 53 | 9.7% | 103 | 10.0% | 51.5% |
| MAIC | 1 | 0.2% | 4 | 0.4% | 25.0% |
| EPSCOR | 1 | 0.2% | 1 | 0.1% | 100.0% |
| MPP | 161 | 29.5% | 507 | 49.0% | 31.8% |
| MSCTC | 27 | 5.0% | 71 | 6.9% | 38.0% |
| SEGF | 5 | 0.9% | 13 | 1.3% | 38.5% |
| MTI | 297 | 54.5% | 336 | 32.5% | 88.4% |
| Total | 545 | 100.0% | 1035 | 100.0% | 52.7% |

| | All Respondents 2010-2011 | | All Surveyed 2010-2011 | | 2010-2011 Program |
|---|---|---|---|---|---|
| State R&D Programs | Number | Percent | Number | Percent | Response Rate |
| ATDC | 32 | 7.8% | 76 | 7.6% | 42.1% |
| MAIC | 1 | 0.2% | 5 | 0.5% | 20.0% |
| EPSCOR | 1 | 0.2% | 1 | 0.1% | 100.0% |
| MPP | 100 | 24.5% | 499 | 50.2% | 20.0% |
| MSCTC | 20 | 4.9% | 59 | 5.9% | 33.9% |
| SEGF | 1 | 0.2% | 10 | 1.0% | 10.0% |
| MTI | 253 | 62.0% | 345 | 34.7% | 73.3% |
| Total | 408 | 100.0% | 995 | 100.0% | 41.0% |

[18] All data is from Annual Survey of Private Sector Recipients of State R&D Support.

Note: State R&D programs include:

ATDC: Advanced Technology Development Centers
MAIC: Maine Aquaculture Innovation Center
EPSCOR: Experimental Program for the Stimulation of Competitive Research
MPP: Maine Patent Program
MSGC: Maine Space Grant Consortium
MSCTC: Maine Seed Capital Tax Credit Program
SEGF: Small Enterprise Growth Fund
MTI: Maine Technology Institute. The program includes Development Awards, Performance Grants, Small Business Innovation Research Phase 0 Grants, and the Seed Grant Program.

In comparison between the 2010-2011 and 2011-2012 surveys, program response rates ranged from 4.1 percent (for the MSCTC) to 28.5 percent (for SEGF) higher in the 2011– 2012 survey, with the exception of the EPSCOR program, which had 100 percent response rate in both.

**3. Entity Type**

| | All Respondents 2011-2012 | | All Respondents 2010-2011 | |
|---|---|---|---|---|
| **Entity Type** | **Number** | **Percent** | **Number** | **Percent** |
| Corporation | 157 | 35.4% | 155 | 39.7% |
| LLC | 164 | 37.0% | 135 | 34.6% |
| Not a business, but an individual | 71 | 16.0% | 50 | 12.8% |
| Partnership | 3 | 0.7% | 3 | 0.8% |
| Sole Proprietorship | 48 | 10.8% | 47 | 12.1% |
| Total | 443 | 100.0% | 390 | 100.0% |

**4. Company Headquarters**

Of the 358 companies/entities who responded to this question in the current survey, 343, or 95.8 percent, are headquartered in Maine.

Fifteen are headquartered in the U.S., but outside of Maine. The other states represented are Colorado, Connecticut, Georgia, Idaho, Illinois, Massachusetts, North Carolina, New Hampshire, New York, Ohio, and Vermont. One company reported having their headquarters outside of the United States, located in the United Kingdom.

In the previous survey, 283 companies responded to this question, and 273, or 96.4 percent, were headquartered in Maine.

**5. Geographic Breakdown**

| County Breakdown | All Respondents 2011-2012 Number | Percent | All Respondents 2010-2011 Number | Percent |
|---|---|---|---|---|
| Androscoggin | 11 | 3.1% | 6 | 2.1% |
| Aroostook | 4 | 1.1% | 7 | 2.5% |
| Cumberland | 128 | 35.8% | 94 | 33.2% |
| Franklin | 3 | 0.8% | 3 | 1.1% |
| Hancock | 18 | 5.0% | 17 | 6.0% |
| Kennebec | 20 | 5.6% | 16 | 5.7% |
| Knox | 8 | 2.2% | 9 | 3.2% |
| Lincoln | 13 | 3.6% | 12 | 4.2% |
| Oxford | 7 | 2.0% | 8 | 2.8% |
| Penobscot | 44 | 12.3% | 36 | 12.7% |
| Piscataquis | 0 | 0.0% | 0 | 0.0% |
| Sagadahoc | 12 | 3.4% | 8 | 2.8% |
| Somerset | 3 | 0.8% | 3 | 1.1% |
| Waldo | 8 | 2.2% | 5 | 1.8% |
| Washington | 6 | 1.7% | 8 | 2.8% |
| York | 58 | 16.2% | 40 | 14.1% |
| Other State | 15 | 4.2% | 11 | 3.9% |
| Total | 358 | 100% | 283 | 100% |

| Regional Breakdown | All Respondents 2011-2012 Number | Percent | All Respondents 2010-2011 Number | Percent |
|---|---|---|---|---|
| Central | 72 | 20.1% | 56 | 19.8% |
| Eastern | 24 | 6.7% | 25 | 8.8% |
| North | 4 | 1.1% | 7 | 2.5% |
| South | 186 | 52.0% | 134 | 47.3% |
| Western | 57 | 15.9% | 50 | 17.7% |
| Other State | 15 | 4.2% | 11 | 3.9% |
| Total | 358 | 100% | 283 | 100% |

Central region: Androscoggin, Kennebec, Knox, Lincoln, Sagadahoc, and Waldo
Eastern region: Hancock and Washington
North region: Aroostook
South region: Cumberland and York
Western region: Franklin, Oxford, Penobscot, Piscataquis, and Somerset

While there was a substantial increase between the 2010-2011 and 2011-2012 surveys in the amount of companies that responded, there is no significant difference as far as where company headquarters are located. Cumberland, Penobscot and York counties remain the counties with the highest representation.

**6. Year Organized**

| Year Organized | All Respondents 2011-2012 Number | Percent | All Respondents 2010-2011 Number | Percent |
|---|---|---|---|---|
| Pre-1980 | 20 | 5.6% | 21 | 7.4% |
| 1980-1984 | 6 | 1.7% | 13 | 4.6% |
| 1985-1989 | 8 | 2.2% | 13 | 4.6% |
| 1990-1994 | 19 | 5.3% | 21 | 7.4% |
| 1995-1999 | 37 | 10.3% | 33 | 11.6% |
| 2000-2004 | 79 | 22.0% | 77 | 27.1% |
| 2005-2009 | 147 | 40.9% | 106 | 37.3% |
| 2010+ | 43 | 12.0% | * | * |
| Total | 359 | 100% | 284 | 100% |

**This category was not included in the prior evaluation*

In 2011-2012, of the 359 respondents, 52.9 percent were organized since 2005. A total of 74.9 percent were organized since 2000.

**7. Number of Employees (including employer)[19]**

| Number of Employees | All Respondents 2011-2012 Number | Percent | All Respondents 2010-2011 Number | Percent |
|---|---|---|---|---|
| 1 - 10 | 267 | 82.7% | 210 | 81.1% |
| 11 - 20 | 19 | 5.9% | 14 | 5.4% |
| 21 - 30 | 11 | 3.4% | 6 | 2.3% |
| 31 - 40 | 6 | 1.9% | 5 | 1.9% |
| 41 - 50 | 4 | 1.2% | 6 | 2.3% |
| 51 - 100 | 12 | 3.7% | 10 | 3.9% |
| 101 - 499 | 3 | 0.9% | 7 | 2.7% |
| 500+ | 1 | 0.3% | 1 | 0.4% |
| Total | 323 | 100% | 259 | 100% |

[19] The data is based on the 2011-2012 respondents reporting their employment numbers for the prior month and 12 months prior.

Total Number of employees this year: 3,606 (11.1 employees per firm average)
Total Number of employees last year: 3,451 (10.7 employees per firm average)
Change in employment: 4.5 percent increase / 155 more employees
In the 2010-2011 survey, respondents reported a 2.8 percent decrease in employment from the prior year.

Employment growth varied by company size. The largest percentage growth in employment occurred by companies within the 11-25 employment size range. As a group, these companies experienced 17.5 percent employment growth between 2010 and 2011. Companies with 2 or less employees, as a group experienced a -5.5 percent decline in employment.

| Summary by Company Employment Size (2011) | # of Firms | Employment 2011 | Employment 2010 | Net Change 2010-2011 | % Change |
|---|---|---|---|---|---|
| 2 or Less Employees | 178 | 222 | 235 | -13 | -5.5% |
| 3-10 Employees | 93 | 500 | 489 | 11 | 2.2% |
| 11-25 Employees | 28 | 490 | 417 | 73 | 17.5% |
| 26 or More Employees | 28 | 2,394 | 2,310 | 84 | 3.6% |
| **Total** | **327** | **3,606** | **3,451** | **155** | **4.5%** |

**8. <u>Wages</u>**

Total wages and salaries paid this year: $ 161,250,483
Average wage and salary per employee this year: $44,717
Average wage and salary per employee last year: $43,722 (data based on 2010-2011 survey)

Change in average wage and salary per employee: 2.3 percent / $995

Two hundred and nine respondents reporting paying wages, and for those reporting both having employees and paying wages, the average wage per employee was $47,135. The mean median wage was $25,000. The mean wages for these respondents was $771,553.

**9. Revenues**[20]

| Company Revenues | All Respondents 2011-2012 Number | Percent | All Respondents 2010-2011 Number | Percent |
|---|---|---|---|---|
| $0 | 66 | 19.4% | 71 | 25.3% |
| $1 - 49,999 | 102 | 29.9% | 65 | 23.1% |
| $50,000 - 99,999 | 31 | 9.1% | 21 | 7.5% |
| $100,000 - 499,999 | 61 | 17.9% | 57 | 20.3% |
| $500,000 - 999,999 | 22 | 6.5% | 16 | 5.7% |
| $1,000,000 - 4,999,999 | 37 | 10.9% | 25 | 8.9% |
| $5,000,000+ | 22 | 6.5% | 26 | 9.3% |
| Total | 341 | 100% | 281 | 100% |

Company revenues earned this year: $ 860,363,701 ($2,523,061 per firm average)
Company revenues earned last year: $770,939,061 ($2,260,818 per firm average)

Change in company revenue: 11.6% / $89,424,640 (11.6% / $262,243 per firm average)

There were 275 respondents who reported having revenues greater than zero in the last fiscal year, with a mean revenue of $3,128,595 and a median revenue of $50,000. There were 235 respondents who reported revenues greater than zero in the prior year, with a mean revenue of $2,260,818 and a median revenue of $30,000.

Revenue per employee this year: $238,592
Revenue per employee last year: $223,396
Change in revenue per employee: 6.8% / $15,196

Of those who reported having revenues greater than zero, the revenue per employee was slightly higher with an average of $246,876 for the last fiscal year and $236,993 for the year prior.
In the 2010-2011 survey, respondents reported an increase of 0.7 percent in revenue from the prior year.

[20] The data is based on the 2011-2012 respondents reporting their employment numbers for the prior month and 12 months prior.

**10. Sources of Revenue**

| Revenues | All Respondents 2011-2012 Dollars | Percent of Total | All Respondents 2010-2011 Dollars | Percent of Total |
|---|---|---|---|---|
| Sales of Products and Services | $ 831,145,142 | 93.8% | $ 888,428,575 | 95.0% |
| Grants and Contracts | $ 20,466,425 | 2.3% | $ 30,104,885 | 3.2% |
| All Other Sources | $ 34,691,210 | 3.9% | $ 16,711,735 | 1.8% |
| Total | $ 886,302,776 | 100% | $ 935,245,195 | 100% |

Note: The totals in the previous revenue section do not match the totals here because respondents utilized different sources of data for the two sets of questions.

**11. R&D Expenditures**

The respondents spent $29,738,116 in R&D in the reporting period ($124,950 per firm average).
The respondents spent $34,123,504 in R&D in the previous year ($180,548 per firm average) (data taken from 2010-2011 survey).

Change in R&D Expenditures: -12.9% / -$4,385,388 (-30.8% / -$55,598 per firm average)

There were 238 respondents that reported some expenditure for R&D. The mean expenditure reported was $87,209 and the median expenditure was $10,000.

**12. Corporate Income Tax Paid**

The respondents spent $1,114,483 in Maine corporate income tax in the reporting period ($3,268 per firm average).

The respondents spent $475,608 in Maine corporate income tax in the previous year ($1,815 per firm average) (data taken from 2010-2011 survey).

Change in Corporate Income Tax Paid: 134.3% / $690,710 (80.0% / $1,453 per firm average)

**13. Tax Credits Claimed**

| Maine R&D Tax Credits Claimed | All Respondents 2011-2012 Number | Percent of Total | All Respondents 2010-2011 Number | Percent of Total |
|---|---|---|---|---|
| No | 322 | 94.4% | 266 | 94.7% |
| Yes | 19 | 5.6% | 15 | 5.3% |
| Total | 341 | 100% | 281 | 100% |

There are no noteworthy changes in tax credits claimed between the 2010-2011 and 2011-2012 surveys.

**14. <u>Where are Your Customers?</u>**

| | All Respondents 2011 - 2012 | | | | | |
|---|---|---|---|---|---|---|
| | Sales in Maine | | Sales Outside Maine | | Sales Outside U.S. | |
| Percent of Sales | Number | Percent | Number | Percent | Number | Percent |
| 0 - 10 | 113 | 45.9% | 73 | 29.7% | 208 | 84.6% |
| 11 - 25 | 16 | 6.5% | 14 | 5.7% | 15 | 6.1% |
| 26 - 50 | 21 | 8.5% | 33 | 13.4% | 13 | 5.3% |
| 51 - 75 | 18 | 7.3% | 28 | 11.4% | 7 | 2.8% |
| 76 - 100 | 78 | 31.7% | 98 | 39.8% | 3 | 1.2% |
| Total | 246 | 100% | 246 | 100% | 246 | 100% |

This table shows that more respondents report the majority of their sales occurring outside of Maine rather than inside the state. Of those who do report sales in Maine, the largest percent range for these says was in the 76 to 100 percent range. Most respondents report little to no sales outside of the U.S.

The methodology for the data changed in the most recent survey year. As a result, this data is not directly comparable to last year's report.

**15. Debt Financing**

84 companies or 24.6 percent (84 out of the 341 respondents who answered that question) accessed new debt financing during their most recently completed fiscal year.

In the previous survey year, 51 companies or 18.1 percent (51 out of 281 respondents who answered that question) accessed new debt financing.

| | All Respondents 2011-2012 | | |
|---|---|---|---|
| Debt Financing Sources | Number of Transactions | Dollars of New Debt | Percent of Total Debt |
| Bank | 32 | $ 35,770,045 | 68.4% |
| SBA Loans | 2 | $ 100,000 | 0.2% |
| Friends and Family | 32 | $ 3,242,085 | 6.2% |
| Other | 35 | $ 13,157,976 | 25.2% |
| Total | 101 | $ 52,270,106 | 100% |

| | All Respondents 2010-2011 | | |
|---|---|---|---|
| Debt Financing Sources | Number of Transactions | Dollars of New Debt | Percent of Total Debt |
| Bank | 27 | $ 6,889,892 | 37.3% |
| SBA Loans | 5 | $ 1,159,500 | 6.3% |
| Friends and Family | 15 | $ 899,855 | 4.9% |
| Other | 29 | $ 9,542,206 | 51.6% |
| Total | 76 | $ 18,491,453 | 100% |

Note: The number of transactions is greater than 84 because some companies/entities may have had multiple transactions.

Of those companies that reported receiving new debt financing the mean amount was $1,117,814 for bank financing; $50,000 for SBA Loans; $101,409 from Friends and Family; and $375,942 in other financing.

In a comparison between the 2010-2011 and 2011-2012 surveys, bank financing has increased from 37.3 percent to 68.4 percent, an increase of 31.1 percent between the previous and current surveys. Financing from other sources has decreased from 51.6 percent to 25.2 percent, a decrease of 26.4 percent.

**16. Equity Financing**

53 companies or 15.5 percent (53 out of the 341 respondents who answered that question) accessed new equity financing during their most recently completed fiscal year.
In the previous survey year, 30 companies or 10.7 percent (30 out of 281 respondents who answered that question) accessed new equity financing.

| | All Respondents 2011-2012 | | |
|---|---|---|---|
| Equity Financing Sources | Number of Transactions | Dollars of New Equity | Percent of Total Equity |
| Venture Capital | 6 | $ 9,504,507 | 34.2% |
| State Seed Capital Funds | 0 | $ - | 0.0% |
| Angel Investors | 12 | $ 7,152,933 | 25.7% |
| Friends and Family | 19 | $ 1,217,980 | 4.4% |
| Other | 20 | $ 9,938,448 | 35.7% |
| Total | 57 | $27,813,868 | 100% |

| | All Respondents 2010-2011 | | |
|---|---|---|---|
| Equity Financing Sources | Number of Transactions | Dollars of New Equity | Percent of Total Equity |
| Venture Capital | 5 | $ 2,865,000 | 20.4% |
| State Seed Capital Funds | 0 | $ - | 0.0% |
| Angel Investors | 8 | $ 3,187,000 | 22.6% |
| Friends and Family | 5 | $ 267,414 | 1.9% |
| Other | 14 | $ 7,754,880 | 55.1% |
| Total | 32 | $14,074,294 | 100% |

Note: The number of transactions is greater than 22 because some companies/entities may have had multiple transactions.

Of those companies that reported receiving new equity financing the mean amount was $1,584,084 for Venture Capital; $596,078 from angel investors; $64,104 from Friends and Family; and $496,922 in other financing.

In a comparison between the 2010-2011 and 2011-2012 surveys, venture capital has increased from 20.4 percent to 34.2 percent, a difference (increase) of 13.8 percent between the previous and current surveys. Financing from other sources has decreased from 55.1 percent to 35.7 percent, a decrease of 19.4 percent.

**17. Federal Awards**

In the 2011-2012 survey year, 27 or 7.9 percent (27 out of 341 respondents who answered that question) of respondents received some type of Federal grant for R&D in the most recently completed fiscal year. The total of the awards was $20,645,922 ($60,545 per company average). 23 or 8.2 percent (23 out of 281 respondents who answered that question) of respondents in 2010-2011 received some type of Federal grant. The total of awards for 2010-2011 was $16,482,655 ($50,716 per company average).

16 or 4.7 percent (16 out of 341 respondents who answered that question) of respondents received either an SBIR Phase I or Phase II award or a Small Business Technology Transfer (STTR) award during their most recently completed fiscal year. This compares to 16 or 5.7 percent (16 out of 281 respondents who answered that question) of respondents who received an SBIR or STTR award in 2010-2011.

| | All Respondents 2011-2012 | |
|---|---|---|
| Federal Award | Number of Awards | Total $ of Awards |
| SBIR Phase I or Phase II | 14 | $ 4,989,545 |
| STTR | 2 | $ 950,000 |
| Total | 16 | $ 5,939,545 |

| | All Respondents 2010-2011 | |
|---|---|---|
| Federal Award | Number of Awards | Total $ of Awards |
| SBIR Phase I or Phase II | 15 | $ 3,653,326 |
| STTR | 1 | $ 150,000 |
| Total | 16 | $ 3,803,326 |

Respondents in 2011-2012 reported $5,939,545 in SBIR and STTR awards ($15,074 per firm average) which was an increase of $2,435,219 or 69.5 percent from the 2010-2011 amount of $3,803,326 ($12,607 per firm average).

## 18. Intellectual Property

Did you or do you intend to use any form of intellectual property protection (Patents, Trade Secrets, Licensing, Copyrights, Trademarks, or other) for any of your discoveries?

| Intellectual Property Protection | All Respondents 2011-2012 | | All Respondents 2010-2011 | |
|---|---|---|---|---|
| | Number | Percent | Number | Percent |
| Yes | 237 | 60.2% | 172 | 61.2% |
| No | 157 | 39.8% | 109 | 38.8% |
| Total | 394 | 100% | 281 | 100% |

**Copyrights:**
Did you or do you plan to use copyright protection?

| Copyright Registration | All Respondents 2011-2012 | | All Respondents 2010-2011 | |
|---|---|---|---|---|
| | Number of Companies | Percent (of 237) | Number of Companies | Percent (of 172) |
| Have Registered | 11 | 4.6% | 12 | 7.0% |
| Intend to Register | 43 | 18.1% | 28 | 16.3% |
| Filed | 15 | 6.3% | 9 | 5.2% |
| Not Sure | 76 | 32.1% | 54 | 31.4% |
| Total | 145 | 61% | 103 | 60% |

The above table shows that 29 percent are in some aspect of actively pursuing copyright protection, compared to 28.5 percent of respondents in the 2010-2011 survey.

Comparing the previous and current survey years, the data show an increase in the number of companies who have intended to register or who have filed for copyright protection.

**Licenses:**
Did you or do you plan to enter into a licensing agreement?

| Licensing Agreements | All Respondents 2011-2012 Number of Companies | Percent | All Respondents 2010-2011 Number of Companies | Percent |
|---|---|---|---|---|
| Yes | 84 | 35.4% | 74 | 43.3% |
| No | 56 | 23.6% | 33 | 19.3% |
| Not Sure | 97 | 40.9% | 64 | 37.4% |
| Total | 237 | 100% | 171 | 100% |

| License Locations | All Respondents 2011-2012 Number of Companies | Percent | All Respondents 2010-2011 Number of Companies | Percent |
|---|---|---|---|---|
| Maine | 56 | 23.6% | 45 | 26.3% |
| Not in Maine | 70 | 29.5% | 52 | 30.4% |
| Not Sure | 111 | 46.8% | 74 | 43.3% |
| Total | 237 | 100% | 171 | 100% |

In the two tables above, a comparison of the survey years shows a decrease from 43.3 to 35.4 percent, or 7.9 percent, from 2010-2011 to 2011-2012 in the percentage of companies who either did or plan to enter into a licensing agreement. The data also show a decrease of 2.7 percent (from 26.3% to 23.6%) in the percentage of companies for whom Maine is or will be the licensing agreement location. There is also a decrease of 0.9 percent and an increase of 3.5 percent in the companies who did or plan to enter into a licensing agreement in locations other than Maine, or are not sure, respectively.

**Patents:**
Did you or do you plan to file for patent protection for any of your discoveries?

U.S patent protection:

| U.S. Patent Protection | All Respondents 2011-2012 Number of Companies | Percent (of 393) | All Respondents 2010-2011 Number of Companies | Percent (of 325) |
|---|---|---|---|---|
| Have Filed | 73 | 18.6% | 59 | 21.1% |
| Intend to File | 81 | 20.6% | 53 | 19.0% |
| Granted | 49 | 12.5% | 52 | 18.6% |
| Rejected | 6 | 1.5% | 6 | 2.2% |
| Total | 209 | 53% | 170 | 61% |

A comparison of survey years in the table above shows a slight decrease of 2.5 percent from 2010-2011 to 2011-2012 in the percentage of companies that have filed, a decrease of 6.1 percent in those that have been granted U.S. patent protect, an increase of 1.6 percent in intending to file and a decrease of 0.7 percent rejected.

| U.S. Patent Protection | Patents 2011-2012 | Patents 2010-2011 |
|---|---|---|
| Have Filed | 109 | 119 |
| Intend to File | 134 | 78 |
| Granted | 82 | 88 |
| Rejected | 6 | 7 |
| Total | 331 | 292 |

Foreign patent protection:

| Foreign Patent Protection | All Respondents 2011-2012 | | All Respondents 2010-2011 | |
|---|---|---|---|---|
| | Number of Companies | Percent (of 393) | Number of Companies | Percent (of 325) |
| Have Filed | 38 | 9.7% | 27 | 9.7% |
| Intend to File | 40 | 10.2% | 32 | 11.5% |
| Granted | 18 | 4.6% | 16 | 5.7% |
| Rejected | 3 | 0.8% | 2 | 0.7% |
| Total | 99 | 25% | 77 | 28% |

The percentage of companies who have been granted foreign patent protection has decreased from 5.7 percent to 4.6 percent from the previous to the current survey. The percent of companies that have intended to file has decreased as well.

| Foreign Patent Protection | Patents 2011-2012 | Patents 2010-2011 |
|---|---|---|
| Have Filed | 62 | 93 |
| Intend to File | 65 | 160 |
| Granted | 46 | 37 |
| Rejected | 3 | 2 |
| Total | 176 | 292 |

For total U.S. and foreign patents granted this represents 0.33 per all respondent companies in 2011-2012 and 0.38 per respondent company in 2010-2011.

**Trademarks:**
Did you or do you plan to use trademark protection?

| Trademark Registration | All Respondents 2011-2012 Number of Companies | Percent (of 237) | All Respondents 2010-2011 Number of Companies | Percent (of 172) |
|---|---|---|---|---|
| Have Registered | 48 | 20.3% | 40 | 23.3% |
| Intend to Register | 58 | 24.5% | 39 | 22.7% |
| Filed | 50 | 21.1% | 39 | 22.7% |
| Not Sure | 65 | 27.4% | 42 | 24.4% |
| Total | 221 | 93% | 160 | 93% |

The above table shows that 65.9 percent of respondents are in some aspect of actively pursuing trademark protection (compared to 68.7 percent in the 2010-2011 survey). Additionally, comparing the previous and current survey years, the data in the table above show a 3.0 percent decrease (from 23.3 percent to 20.3 percent) in the percentage of companies who registered for trademark protection, though the actual number of companies increased by 8.

**Trade Secrets:**
Did you or do you plan to use trade secrets?

| Trade Secret Usage | All Respondents 2011-2012 Number of Companies | Percent | All Respondents 2010-2011 Number of Companies | Percent |
|---|---|---|---|---|
| Yes | 98 | 41.4% | 72 | 42.1% |
| No | 52 | 21.9% | 51 | 29.8% |
| Not Sure | 87 | 36.7% | 48 | 28.1% |
| Total | 237 | 100% | 171 | 100% |

There is a decrease of 0.7 percent (from 42.1 percent to 41.4 percent) in the percentage of companies who did or who plan to use trade secrets between the 2010-2011 and 2011-2012 survey years as well as an increase of 8.6 percent (from 28.1 percent to 36.7 percent) who were not sure if they would use trade secrets.

**Other Intellectual Property:**
Did you or do you plan to use other intellectual property protection?

| Utilization of Other Intellectual Property | All Respondents 2011-2012 Number of Companies | Percent (of 237) | All Respondents 2010-2011 Number of Companies | Percent (of 172) |
|---|---|---|---|---|
| Have Registered | 2 | 0.8% | 2 | 1.2% |
| Intend to File | 35 | 14.8% | 26 | 15.1% |
| Filed | 14 | 5.9% | 8 | 4.7% |
| Not Sure | 80 | 33.8% | 56 | 32.6% |
| Total | 131 | 55% | 92 | 53% |

The table shows that 28.7 percent of respondents in the current survey are in some aspect of actively pursuing other intellectual property protection. This compares to 24.4 percent in the 2010-2011 survey.

**19. <u>Support Organizations</u>**

The tables below show the support organizations that were used and a ranking of how important the services were to the participating companies (1 = 'completely unimportant', to 5 = 'critically important'). MTI received the highest mean score of 4.16 followed by the University of Maine at 3.73, the Maine Patent program at 3.59, and firms outside of Maine at 3.55.

| | All Respondents 2011-2012 | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Degree of Importance | | | | | |
| Support Organizations | Didn't Use | 1 | 2 | 3 | 4 | 5 | Mean Score |
| ATDC | 259 | 16 | 16 | 16 | 9 | 17 | 2.93 |
| Education/Research Outside Maine | 174 | 11 | 27 | 49 | 32 | 40 | 3.40 |
| Maine Patent Program | 185 | 12 | 24 | 27 | 34 | 51 | 3.59 |
| Maine Procurement Technical Assistance Center | 255 | 19 | 15 | 25 | 7 | 12 | 2.72 |
| Maine Trade Associations | 175 | 18 | 32 | 52 | 40 | 16 | 3.03 |
| MEP | 241 | 18 | 26 | 19 | 13 | 16 | 2.82 |
| MSBDC | 204 | 19 | 20 | 39 | 30 | 21 | 3.11 |
| MTI | 64 | 4 | 15 | 54 | 57 | 139 | 4.16 |
| Non-Profit Research Institutes in Maine | 220 | 14 | 26 | 33 | 21 | 19 | 3.04 |
| Other Educational Instutitions in Maine | 216 | 16 | 21 | 31 | 29 | 20 | 3.14 |
| Other Firms Outside Maine | 136 | 10 | 26 | 57 | 53 | 51 | 3.55 |
| Other Maine Firms | 137 | 15 | 28 | 58 | 61 | 34 | 3.36 |
| Trade Associations Outside Maine | 191 | 11 | 38 | 43 | 27 | 23 | 3.09 |
| Umaine System | 133 | 15 | 25 | 38 | 43 | 79 | 3.73 |

| Support Organizations | Importance of Services<br>Mean Scores 2009-2010 to 2011-2012<br>2011-2012 | 2010-2011 | 2009-2010 |
|---|---|---|---|
| MTI | 4.16 | 4.18 | 4.19 |
| Umaine System | 3.73 | 3.80 | 3.67 |
| Maine Patent Program | 3.59 | 3.60 | 3.39 |
| Other Firms Outside Maine | 3.55 | 3.43 | 3.44 |
| Other Educational Instutitions in Maine | 3.14 | 3.32 | 2.92 |
| Other Maine Firms | 3.36 | 3.42 | 3.40 |
| Education/Research Outside Maine | 3.40 | 3.34 | 3.33 |
| Non-Profit Research Institutes in Maine | 3.04 | 3.09 | 2.85 |
| MSBDC | 3.11 | 3.05 | 3.06 |
| Trade Associations Outside Maine | 3.09 | 2.98 | 3.08 |
| MEP | 2.82 | 2.89 | 2.85 |
| Maine Trade Associations | 3.03 | 2.81 | 3.02 |
| ATDC | 2.93 | 2.83 | 2.80 |
| Maine Procurement Technical Assistance Center | 2.72 | 2.67 | 2.75 |

Note for above tables:

MTI: Maine Technology Institute
ATDC: Advanced Technology Development Centers
MSBDC: Maine Small Business Development Centers
MEP: Manufacturing Extension Partnership

A comparison of the means in the table above shows a general steadiness in the importance of support, with some change from year-to-year. There are no consistent increases or decreases in the importance of support as a whole.

**20. <u>Importance of Assistance</u>**

| How Important? | All Respondents 2011-2012<br>Number of Companies | Percent | All Respondents 2010-2011<br>Number of Companies | Percent |
|---|---|---|---|---|
| Critically Important (5) | 56 | 38.6% | 50 | 42.4% |
| Very Important (4) | 47 | 32.4% | 39 | 33.1% |
| Frequently Important (3) | 20 | 13.8% | 10 | 8.5% |
| Occasionally Important (2) | 17 | 11.7% | 14 | 11.9% |
| Not Important (1) | 5 | 3.4% | 5 | 4.2% |
| Total | 145 | 100% | 118 | 100% |

Seventy one percent of respondents in the current survey (2011-2012) indicated that the assistance they received was either very important or critically important. In the previous survey (2010-2011), the comparable percentage was 75.5 percent.

**21. Satisfaction with Assistance**

| How Satisfied? | All Respondents 2011-2012 Number of Companies | Percent | All Respondents 2010-2011 Number of Companies | Percent |
|---|---|---|---|---|
| Very Satisfied (5) | 91 | 60.3% | 61 | 52.1% |
| Satisfied (4) | 45 | 29.8% | 40 | 34.2% |
| Somewhat Satisfied (3) | 9 | 6.0% | 10 | 8.5% |
| Unsatisfied (2) | 3 | 2.0% | 1 | 0.9% |
| Very Unsatisfied (1) | 3 | 2.0% | 5 | 4.3% |
| Total | 151 | 100% | 117 | 100% |

Ninety one percent of respondents in the current survey indicated that they were either very satisfied or satisfied in the assistance they received. In the previous survey (2010-2011), the comparable percentage was 86.3 percent.

# Appendix B: Economic Impact of Supported Private Sector Companies

The following economic impact assessment was completed as part of the 2011 Maine Comprehensive Evaluation of R&D Investments.

## Methodology

To measure the economic impact resulting from companies supported by Maine's R&D programs, the input-output model developed by the Economic Modeling Specialist, Inc (EMSI) was used. The EMSI's Economic Impact Regional I/O model produces regional multipliers for each industry at the six-digit level of NAICS codes. The multiplier values allow for the estimation of the outcomes of direct and indirect jobs and revenues generated from additional inputs into the regional economy[21].

The analysis is based on the results from the annual private survey conducted for this evaluation by Camoin Associates. Each survey respondent was asked to identify a six-digit North American Industrial Classification code (NAICS) that best described their business operations. For those companies that didn't indicate the NAICS code on the survey, we used the business database of *InfoUSA and web research* to assign an appropriate NAICS code to each respondent. In instances where NAICS could not be determined, we used the average multiplier for the response group to estimate impacts.

To estimate the economic impact of state investment on Maine's R&D companies, it is assumed that all economic outputs from the companies are exclusively the results of state grants. No other variables or additional funding (i.e., federal money) were included in the estimates. In actuality, these other factors do contribute to the outputs and impacts. Therefore, it is important to stress that results of this impact analysis are not meant to be interpreted as direct causation from or even correlation to State support.

The total number of companies surveyed was 875. 329 companies responded and provided employment, revenue, and R&D expenditure data needed for the impact analysis for a response rate of 38 percent.

## Findings

The following findings are based on the 329 companies that have received support from R&D programs funded by the State of Maine and provided data on employment and revenues as part of the annual survey of private companies conducted for the evaluation. This is a subset of 443 companies that responded to the survey, as not all of those companies provided data on employment and revenues.

[21] See explanations on the EMSI's Economic Impact Input-Output Model at www.economicmodeling.com/

R&D Performed

- In 2011, the companies received a total of $3,666,293 in state funding for R&D related activities.
- In 2011, the companies expended a total of $29,556,116 on R&D from all sources of revenues.
- State investments comprise 12 percent of the overall firm R&D portfolio.

Employment

- In 2011, these companies directly employed 3,606 persons.
- This impacts an estimated additional 5,269 indirect jobs.
- The estimated total job impact of these companies is 8,875 jobs.

Revenues

- In 2011, these companies generated a total of $860,363,701 in company revenues from all sources.
- This impacts an estimated additional $617,259,012 in indirect revenues.
- The estimated total revenue impact of these companies is $1,477,622,713.

## Appendix C: Findings from Annual Institution Survey, 2011

| Research Institutions Reporting Results - Nonprofit and Academic Institutions Combined | | | | |
|---|---|---|---|---|
| | **2011** | **2010** | **# Change** | **% Change** |
| **Institutional Capacity** | | | | |
| Number (FTE) of enrolled science and engineering graduate students | 895 | 847 | 48 | 6% |
| Number of science and engineering graduate degrees awarded | 247 | 198 | 49 | 25% |
| Number (FTE) undergraduate students enrolled in science and engineering majors | 6,527 | 6,825 | -298 | -4% |
| Number (FTE) of undergraduate students participating in science and engineering programs | 1,259 | 1,207 | 52 | 4% |
| R&D space | 1,136,560 | 1,389,203 | -252,643 | -18% |
| Current, depreciated, value of facilities and fixed equipment | 706,818,039 | 658,703,168 | 48,114,870 | 7% |
| Major (purchase price >$50,000) research equipment purchased this year. | 8,912,891 | 6,887,687 | 2,025,204 | 29% |
| Number of positions FTE | 5,802 | 5,408 | 395 | 7% |
| Faculty | 1,282 | 1,255 | 28 | 2% |
| Research staff (non-faculty) | 181 | 212 | -31 | -15% |
| Professional staff | 2,020 | 1,884 | 136 | 7% |
| Students | 456 | 229 | 226 | 99% |
| Classified personnel | 1,864 | 1,829 | 35 | 2% |
| **Research and Development Outcomes** | | | | |
| ***Publications*** | | | | |
| Number of scientific peer-reviewed journal articles published | 1,283 | 1,431 | -148 | -10% |
| Number of scientific peer-reviewed book chapters published | 113 | 174 | -61 | -35% |
| Number of scientific peer-reviewed books published | 35 | 50 | -15 | -30% |
| Number of other papers published | 1,047 | 1,269 | -222 | -17% |
| Number of other papers not published (e.g. research reports for industry) | 3,835 | 2,919 | 916 | 31% |
| ***Research Proposals*** | | | | |
| Number of peer-reviewed and/or competitive research proposal submitted | 1,293 | 1,327 | -34 | -3% |
| Dollar Value | 623,954,920 | 666,019,531 | -42,064,611 | -6% |
| Number of these proposals submitted jointly with other main institutions | 120 | 133 | -13 | -10% |
| Dollar Value | 41,711,877 | 62,754,950 | -21,043,073 | -34% |
| Number of these proposals submitted jointly with non-Maine institutions only | 293 | 188 | 105 | 56% |
| Dollar Value | 114,702,038 | 67,238,328 | 47,463,710 | 71% |
| Number of these proposal submitted jointly with both Maine and non-Maine institutions | 16 | 21 | -5 | -24% |
| Dollar Value | 5,743,709 | 16,498,343 | -10,754,634 | -65% |
| ***Research Awards*** | | | | |

| Research Institutions Reporting Results - Nonprofit and Academic Institutions Combined | | | | |
|---|---|---|---|---|
| | **2011** | **2010** | **# Change** | **% Change** |
| Number of new Federal research grants, contracts, subcontracts | 572 | 699 | -127 | -18% |
| Dollar Value | 189,598,406 | 218,736,811 | -29,138,405 | -13% |
| Number of these awarded under EPSCOR | 6 | 18 | -12 | -67% |
| Dollar Value | 6,497,039 | 9,468,631 | -2,971,592 | -31% |
| Number of these that were earmarked | 17 | 11 | 6 | 55% |
| Dollar Value | 13,558,879 | 8,425,537 | 5,133,342 | 61% |
| Total Expenditures for R&D in the Fiscal Year | 252,127,046 | 248,083,729 | 4,043,317 | 2% |
| Federal sources of funds for R&D expenditures | 197,481,549 | 168,496,060 | 28,985,489 | 17% |
| State sources of funds for R&D expenditures | 30,375,527 | 6,566,883 | 23,808,644 | 363% |
| Industry sources of funds for R&D expenditures | 5,567,348 | 6,282,479 | -715,131 | -11% |
| Individual and Foundations sources of funds for R&D expenditures | 16,053,832 | 17,822,064 | -1,768,233 | -10% |
| Number of industrial research grants, contracts and subcontracts awarded | 366 | 365 | 1 | 0% |
| Dollar Value | 7,995,293 | 7,854,284 | 141,009 | 2% |
| Number of these industrial research contracts awarded by Maine companies | 92 | 188 | -96 | -51% |
| Dollar Value | 2,008,131 | 3,662,362 | -1,654,231 | -45% |
| Number of new foundation grants and gifts | 137 | 94 | 43 | 46% |
| Dollar Value | 15,058,260 | 8,575,113 | 6,483,147 | 76% |
| ***Intellectual Property*** | | | 0 | |
| Number of disclosures made | 39 | 43 | -4 | -9% |
| Number of patents applied for | 70 | 52 | 18 | 35% |
| Number of patents awarded | 15 | 6 | 9 | 150% |
| Number of copyrights obtained | 2 | 1 | 1 | 100% |
| Number of plant breeder's rights obtained | 0 | 0 | 0 | |
| Number of licensing agreements signed | 40 | 42 | -2 | -5% |
| Number of licensing agreements signed with Maine companies | 6 | 5 | 1 | 20% |
| License income received this year | 1,669,098 | 1,521,465 | 147,633 | 10% |
| ***Spin-off Companies*** | | | 0 | |
| Number of new companies formed | 3 | 6 | -3 | -50% |
| Number of jobs in these companies at spin-off | 7 | 15 | -8 | -53% |

Source: Compiled by Camoin Associates from 2011 Survey for Research Institution Recipients of Maine State R&D Funding, Fall 2011

| Research Institutions Reporting Results - Non-Profit Research Institutions | | | | |
|---|---|---|---|---|
| | **2011** | **2010** | **# Change** | **% Change** |
| **Institutional Capacity** | | | | |
| Number (FTE) of enrolled science and engineering graduate students | 17 | 13 | 4 | 31% |
| Number of science and engineering graduate degrees awarded | 1 | 1 | 0 | 0% |
| Number (FTE) undergraduate students enrolled in science and engineering majors | 6 | 2 | 4 | |
| Number (FTE) of undergraduate students participating in science and engineering programs | 0 | 0 | 0 | |
| R&D space | 398,265 | 405,424 | -7,159 | -2% |
| Current, depreciated, value of facilities and fixed equipment | $256,476,332 | $229,195,758 | 27,280,574 | 12% |
| Major (purchase price >$50,000) research equipment purchased this year. | $4,500,575 | $3,180,458 | 1,320,117 | 42% |
| Number of positions FTE | 1,686 | 1,703 | -17 | -1% |
| Faculty | 79 | 77 | 2 | 3% |
| Research staff (non-faculty) | 161 | 193 | -32 | -16% |
| Professional staff | 691 | 664 | 27 | 4% |
| Students | 51 | 77 | -27 | -35% |
| Classified personnel | 705 | 692 | 12 | 2% |
| **Research and Development Outcomes** | | | 0 | |
| ***Publications*** | | | | |
| Number of scientific peer-reviewed journal articles published | 358 | 355 | 3 | 1% |
| Number of scientific peer-reviewed book chapters published | 33 | 18 | 15 | 83% |
| Number of scientific peer-reviewed books published | 1 | 2 | -1 | -50% |
| Number of other papers published | 56 | 66 | -10 | -15% |
| Number of other papers not published (e.g. research reports for industry) | 6 | 15 | -9 | -60% |
| ***Research Proposals*** | | | | |
| Number of peer-reviewed and/or competitive research proposal submitted | 366 | 372 | -6 | -2% |
| Dollar Value | $288,593,830 | $328,216,705 | -39,622,875 | -12% |
| Number of these proposals submitted jointly with other main institutions | 28 | 38 | -10 | -26% |
| Dollar Value | $14,037,291 | $36,887,833 | -22,850,542 | -62% |
| Number of these proposals submitted jointly with non-Maine institutions only | 109 | 67 | 42 | 63% |
| Dollar Value | $77,312,659 | $39,334,281 | 37,978,378 | 97% |
| Number of these proposal submitted jointly with both Maine and non-Maine institutions | 13 | 19 | -6 | -32% |
| Dollar Value | $5,144,794 | $15,572,175 | -10,427,381 | -67% |
| ***Research Awards*** | | | | |

| Research Institutions Reporting Results - Non-Profit Research Institutions | | | | |
|---|---|---|---|---|
| | **2011** | **2010** | **# Change** | **% Change** |
| Number of new Federal research grants, contracts, subcontracts | 93 | 130 | -37 | -28% |
| Dollar Value | $80,364,631 | $88,078,627 | -7,713,996 | -9% |
| Number of these awarded under EPSCOR | 2 | 2 | 0 | 0% |
| Dollar Value | $803,799 | $1,562,000 | -758,201 | |
| Number of these that were earmarked | 2 | 2 | 0 | 0% |
| Dollar Value | $1,500,000 | $2,790,007 | -1,290,007 | -46% |
| Total Expenditures for R&D in the Fiscal Year | $106,845,800 | $102,306,440 | 4,539,360 | 4% |
| Federal sources of funds for R&D expenditures | $86,230,028 | $85,997,293 | 232,735 | 0% |
| State sources of funds for R&D expenditures | $4,550,161 | $1,250,233 | 3,299,928 | 264% |
| Industry sources of funds for R&D expenditures | $1,614,115 | $2,281,156 | -667,041 | -29% |
| Individual and Foundations sources of funds for R&D expenditures | $14,033,926 | $12,448,873 | 1,585,053 | 13% |
| Number of industrial research grants, contracts and subcontracts awarded | 43 | 24 | 19 | 79% |
| Dollar Value | $3,792,925 | $1,896,420 | 1,896,505 | 100% |
| Number of these industrial research contracts awarded by Maine companies | 3 | 4 | -1 | -25% |
| Dollar Value | $76,211 | $259,840 | -183,629 | -71% |
| Number of new foundation grants and gifts | 97 | 50 | 47 | 94% |
| Dollar Value | $9,484,275 | $3,347,731 | 6,136,544 | 183% |
| ***Intellectual Property*** | | | | |
| Number of disclosures made | 12 | 16 | -4 | -25% |
| Number of patents applied for | 13 | 15 | -2 | -13% |
| Number of patents awarded | 5 | 2 | 3 | 150% |
| Number of copyrights obtained | 2 | 0 | 2 | |
| Number of plant breeder's rights obtained | 0 | 0 | 0 | 0% |
| Number of licensing agreements signed | 34 | 36 | -2 | -6% |
| Number of licensing agreements signed with Maine companies | 2 | 1 | 1 | 100% |
| License income received this year | $1,391,038 | $1,271,465 | 119,573 | 9% |
| ***Spin-off Companies*** | | | | |
| Number of new companies formed | 1 | 1 | 0 | |
| Number of jobs in these companies at spin-off | 2 | 3 | -1 | |

Source: Compiled by Camoin Associates from 2011 Survey for Research Institution Recipients of Maine State R&D Funding, Fall 2011

| Research Institutions Reporting Results - University Research-based Institutions | | | | |
|---|---|---|---|---|
| | **2011** | **2010** | **# Change** | **% Change** |
| **Institutional Capacity** | | | | |
| Number (FTE) of enrolled science and engineering graduate students | 878 | 834 | 44 | 5% |
| Number of science and engineering graduate degrees awarded | 246 | 197 | 49 | 25% |
| Number (FTE) undergraduate students enrolled in science and engineering majors | 6,521 | 6,823 | -302 | -4% |
| Number (FTE) of undergraduate students participating in science and engineering programs | 1,259 | 1,207 | 52 | 4% |
| R&D space | 738,295 | 983,779 | -245,484 | -25% |
| Current, depreciated, value of facilities and fixed equipment | 450,341,707 | 429,507,410 | 20,834,296 | 5% |
| Major (purchase price >$50,000) research equipment purchased this year. | $4,412,316 | $3,707,229 | 705,087 | 19% |
| Number of positions FTE | 4,116 | 3,705 | 412 | |
| Faculty | 1,203 | 1,178 | 26 | 2% |
| Research staff (non-faculty) | 20 | 19 | 1 | 5% |
| Professional staff | 1,329 | 1,220 | 109 | 9% |
| Students | 405 | 152 | 253 | 166% |
| Classified personnel | 1,159 | 1,136 | 23 | 2% |
| **Research and Development Outcomes** | | | 0 | |
| ***Publications*** | | | | |
| Number of scientific peer-reviewed journal articles published | 925 | 1,076 | -151 | -14% |
| Number of scientific peer-reviewed book chapters published | 80 | 156 | -76 | -49% |
| Number of scientific peer-reviewed books published | 34 | 48 | -14 | -29% |
| Number of other papers published | 991 | 1,203 | -212 | -18% |
| Number of other papers not published (e.g. research reports for industry) | 3,829 | 2,904 | 925 | 32% |
| ***Research Proposals*** | | | | |
| Number of peer-reviewed and/or competitive research proposal submitted | 927 | 955 | -28 | -3% |
| Dollar Value | $335,361,090 | $337,802,826 | -2,441,736 | -1% |
| Number of these proposals submitted jointly with other main institutions | 92 | 95 | -3 | -3% |
| Dollar Value | $27,674,586 | $25,867,117 | 1,807,469 | 7% |
| Number of these proposals submitted jointly with non-Maine institutions only | 184 | 121 | 63 | 52% |
| Dollar Value | $37,389,379 | $27,904,047 | 9,485,332 | 34% |
| Number of these proposal submitted jointly with both Maine and non-Maine institutions | 3 | 2 | 1 | 50% |
| Dollar Value | $598,915 | $926,168 | -327,253 | -35% |
| ***Research Awards*** | | | | |

| Research Institutions Reporting Results - University Research-based Institutions | | | | |
|---|---|---|---|---|
| | **2011** | **2010** | **# Change** | **% Change** |
| Number of new Federal research grants, contracts, subcontracts | 479 | 569 | -90 | -16% |
| Dollar Value | $109,233,775 | $130,658,184 | -21,424,409 | -16% |
| Number of these awarded under EPSCOR | 4 | 16 | -12 | -75% |
| Dollar Value | $5,693,240 | $7,906,631 | -2,213,391 | -28% |
| Number of these that were earmarked | 15 | 9 | 6 | 67% |
| Dollar Value | $12,058,879 | $5,635,530 | 6,423,349 | 114% |
| Total Expenditures for R&D in the Fiscal Year | $145,281,246 | $145,777,289 | -496,043 | 0% |
| Federal sources of funds for R&D expenditures | $111,251,521 | $82,498,767 | 28,752,754 | 35% |
| State sources of funds for R&D expenditures | $25,825,366 | $5,316,650 | 20,508,716 | 386% |
| Industry sources of funds for R&D expenditures | $3,953,233 | $4,001,323 | -48,090 | -1% |
| Individual and Foundations sources of funds for R&D expenditures | $2,019,906 | $5,373,191 | -3,353,286 | -62% |
| Number of industrial research grants, contracts and subcontracts awarded | 323 | 341 | -18 | -5% |
| Dollar Value | $4,202,368 | $5,957,864 | -1,755,496 | -29% |
| Number of these industrial research contracts awarded by Maine companies | 89 | 184 | -95 | -52% |
| Dollar Value | $1,931,920 | $3,402,522 | -1,470,602 | -43% |
| Number of new foundation grants and gifts | 40 | 44 | -4 | -9% |
| Dollar Value | $5,573,985 | $5,227,382 | 346,603 | 7% |
| ***Intellectual Property*** | | | | |
| Number of disclosures made | 27 | 27 | 0 | 0% |
| Number of patents applied for | 57 | 37 | 20 | 54% |
| Number of patents awarded | 10 | 4 | 6 | 150% |
| Number of copyrights obtained | 0 | 1 | -1 | 0% |
| Number of plant breeder's rights obtained | 0 | 0 | 0 | 0% |
| Number of licensing agreements signed | 6 | 6 | 0 | 0% |
| Number of licensing agreements signed with Maine companies | 4 | 4 | 0 | 0% |
| License income received this year | $278,060 | $250,000 | 28,060 | 11% |
| ***Spin-off Companies*** | | | | |
| Number of new companies formed | 2 | 5 | -3 | -60% |
| Number of jobs in these companies at spin-off | 5 | 12 | -7 | -58% |

Source: Compiled by Camoin Associates from 2011 Survey for Research Institution Recipients of Maine State R&D Funding, Fall 2011

# Appendix D: Findings Related to Funding for the Maine Technology Asset Fund

## Background

In 2007, the Maine State Legislature authorized and Maine voters approved $50 million in bond funds for" research, development and commercialization projects that boost economic development and create jobs across the State." In 2010, voters approved an additional $3 million in for this fund. The Legislature directed the Maine Technology Institute (MTI) to administer this fund and MTI established the Maine Technology Asset Fund (MTAF) in response to this directive.

MTAF is a competitive award program to fund capital and related expenditures supporting research, development and commercialization projects that will lead to "significant" economic benefits for Maine. The expenses may include facilities construction and renovation, machinery and equipment (including computers, software and licenses required for their use, as well as related technician training for operation of equipment and machinery purchased) and land purchase. This may also include expenses directly associated with the acquisition and installation of such assets. The awards may not be used to fund ordinary annual operating expenses.

**This year's annual R&D evaluation includes 29 MTAF projects for which data was available and findings are reported assessed. Results are based on data reported for these projects as of September 30, 2011.**

## Findings on MTAF

- 29 awards made. Each award has a lead institution and they were broken down by sector as follows:
    - 15 to Maine's academic institutions
    - 8 to Maine's not-for-profit research labs
    - 6 to Private companies in Maine's
- Projects also have collaborating institutions, organizations, and companies. The 29 projects/awards involved 127 entities.

*A list of specific awards and collaborators are contained at the end of this section*

- $47.3 million awarded in public funds by the State of Maine
- $69.7 million in amount of funding matched by the awardees or $1.47 in match for every $1.00 in award
- For a total of $117.0 million in state funds and awardee match combined

- $25.0 million of the State Awarded Amount in funds have been spent to date or 52.8 percent of contracted amount and $22.3 million in funds are remaining to be spent by awardees or 47.2 percent

- Among the 29 projects and 25.0 million in state funds expended to data have resulted in the following impacts:

    - 289.5 new jobs created directly by 21 of the projects

    - 303.0 jobs preserved/retained by 18 projects

    - 19 projects led to the creation of new products or services (many of which included multiple new products or services) within project team or lead institution

    - 15 projects led to invention disclosures, license and/or intellectual property protections, copyrights within project team or lead institution

    - $17.1 million in sales or licensing revenue within 9 projects

    - $100.7 million in new grants and/or contracts from non-state government sources within 19 project teams or institution

    - $29.4 million in debt or equity investments from private capital within 4 project teams or institutions

## Maine Technology Asset Fund Awards

| MTAF Project # | Lead Institution | Project Title | Final Award $ | Match $ | Total Project $ |
|---|---|---|---|---|---|
| MTAF1016 | University of New England | University of New England College of Pharmacy Drug Research & Development | $4,000,000 | $6,998,521 | $10,998,521 |
| MTAF1020 | AEWC, University of Maine | Advanced Nanocomposites for the Renewable Energy Industry | $4,999,460 | $7,725,750 | $12,725,210 |
| MTAF1021 | FHC, Inc. | Development of Micro-fabrication Facility for Neurosurgical Devices | $438,077 | $766,231 | $1,204,308 |
| MTAF1027 | The Jackson Laboratory | Expanding The Jackson Laboratory Product Development Pipeline | $4,775,000 | $11,910,820 | $16,685,820 |
| MTAF1038 | Downeast Institute for Applied Marine Research & Education | Investing in Downeast Maine's Marine Resource-Based Economy | $1,059,900 | $1,372,852 | $2,432,752 |
| MTAF1071 | University of Maine, Center for Aquacultural Research | Building capacity & excellence in Maine's marine aquaculture R&D infrastructure | $2,619,807 | $2,879,932 | $5,499,739 |
| MTAF1074 | Maine Aquaculture Innovation Center | Improvements to Maine's Aquaculture Business Incubation Infrastructure | $360,548 | $1,085,238 | $1,445,786 |
| MTAF1079 | Laboratory for Surface Science & Technology (LASST), University of Maine | Maine Nanofabrication R&D Infrastructure Enhancement | $480,000 | $480,019 | $960,019 |
| MTAF1100 | University of Maine, Forest Bioproducts Research Technology Center | Forest & Ag Bioproducts Research, Development, & Commercialization Facility | $4,875,000 | $4,875,000 | $9,750,000 |
| MTAF1106 | Dept. Physics & Astronomy, University of Maine | Ultra-High Resolution Imaging Facility | $158,706 | $360,256 | $518,962 |

| MTAF Project # | Lead Institution | Project Title | Final Award $ | Match $ | Total Project $ |
|---|---|---|---|---|---|
| MTAF2008 | University of Maine at Presque Isle | Implementing an Advanced Geospatial Information Mapping and Analysis Facility | $96,800 | $121,200 | $218,000 |
| MTAF2009 | Process Development Center, University of Maine | University of Maine Process Development Center Infrastructure Improvement Project | $1,083,197 | $2,364,812 | $3,448,009 |
| MTAF2012 | Maine Institute for Human Genetics and Health | Maine Regional Flow Cytometry Collaborative | $1,247,875 | $2,330,374 | $3,578,249 |
| MTAF2022 | New Media Department, University of Maine | University of Maine Innovative Industries Initiative | $3,690,000 | $3,934,830 | $7,624,830 |
| MTAF2030 | ORPC | OCGen Turbine Generator Unit Commercialization | $806,138 | $897,702 | $1,703,840 |
| MTAF2047 | Dielectric Communications Division of SPX Corp. | New Design for Universal Rural Wireless Connectivity to Fixed and Mobile Users | $2,200,000 | $2,200,000 | $4,400,000 |
| MTAF2052 | University of New England | Animal Facilities to Enhance Translational Neuroscience and Pharmacology Research | $1,533,929 | $2,209,669 | $3,743,598 |
| MTAF2053 | Maine Aquaculture Innovation Center | Improvements to Maine's Aquaculture Business Incubation Infrastructure | $213,900 | $236,348 | $450,248 |
| MTAF2054 | Bigelow Laboratory for Ocean Sciences | Bigelow Center for Blue Biotechnology | $4,528,971 | $4,528,971 | $9,057,942 |
| MTAF2059 | The Jackson Laboratory | Solidifying The Jackson Laboratory's Position in the Emerging Biomedical Market | $2,137,429 | $2,137,429 | $4,274,858 |
| MTAF2061 | University of Maine | Strengthening Biotechnology and Supporting the STEM Education Initiative in Maine | $883,160 | $993,430 | $1,876,590 |

| MTAF Project # | Lead Institution | Project Title | Final Award $ | Match $ | Total Project $ |
|---|---|---|---|---|---|
| MTAF3001 | University of Maine | Advanced Biomechanics Laboratory for Injury Reduction & Rehabilitation | $533,300 | $570,392 | $1,103,692 |
| MTAF3004 | Biovation LLC | Laboratory Facilities for Wound Care Products | $125,000 | $257,995 | $382,995 |
| MTAF3011 | University of Maine | FishLab: Fishery Innovation, Sustainability & Health Lab | $600,000 | $1,135,271 | $1,735,271 |
| MTAF3013 | University of Maine | Commercialization of New Technologies for Animal Disease Surveillance | $497,392 | $497,394 | $994,786 |
| MTAF3017 | University of Maine | CIDER: Cyberinfrastructure Investment for Development, Economic Growth, and Research | $250,000 | $254,000 | $504,000 |
| MTAF3020 | ORPC | TidGen Power System Commercialization Project | $1,260,000 | $4,573,064 | $5,833,064 |
| MTAF3022 | E-Pack, LLC | E-Pack Drum | $950,000 | $1,000,000 | $1,950,000 |
| MTAF3027 | The Jackson Laboratory | Complex Workflow Management: An Engineered Solution | $900,000 | $1,000,000 | $1,900,000 |
| **Totals** | | | **$47,303,589** | **$69,697,500** | **$117,001,089** |

Source: Data provided by the Maine Technology Institute

## Maine Technology Asset Fund Awards - Collaborators

| MTAF Project # | Lead Institution | Collaborators |
|---|---|---|
| MTAF1016 | University of New England | No Collaborators Listed |
| MTAF1020 | AEWC, University of Maine | U Maine: Dr. Douglas Gardner, Dr. Habib Dagher |
| MTAF1079 | Laboratory for Surface Science & Technology (LASST), University of Maine | U Maine: Scott Collins, PhD, David E. Kotecki, PhD, Robert Lad, PhD,<br>Nuri Emanetoglu, PhD |
| MTAF1106 | Dept. Physics & Astronomy, University of Maine | UMaine: Professor Michael D. Mason, PhD, Professor Carol H. Kim; Brandeis University: Dr. David Santucci, Professor John Lisman; Dr. Joe Verdi, Maine Medical Center Research Institute; Joerg Bewersdorf, PhD, The Jackson Laboratory; Dr. Joshua Zimmerberg, NIH; Eastern Maine Medical Center, Bangor: Lawrence Alquist, PhD., Radiological Physicist. |

| MTAF Project # | Lead Institution | Collaborators |
|---|---|---|
| MTAF2008 | University of Maine at Presque Isle | City of Presque Isle; City of Caribou; Town of Fort Fairfield; Town of Houlton; Town of Easton; Town of Mapleton; Town of Wade; Natural Resources Department of Houlton Band of the Maliseet; South Aroostook Soil and Conservation District; St. John River Valley Soil and Conservation District; Aroostook County Action Program (Healthy Aroostook); Power of Prevention; Northern Maine Development Commission; Micmac Environmental Laboratory; Aroostook State Park; MSAD #1 School Farm; Maine Public Service; Presque Isle Fairmount Cemetery Association; Maine Winter sports Center Healthy Hometown Program; Maine Forest Service; County Environmental, LLC. |
| MTAF2009 | Process Development Center, University of Maine | Mr. Jason Lyons, Account Manager NE Region Honeywell Process Solutions, Westbrook, ME |
| MTAF2022 | New Media Department, University of Maine | UMaine: Department of New Media, ASAP Media Labs, Department of Communication and Journalism, Intermedia Graduate Program, Innovation Engineering, Foster Student Innovation Center. |
| MTAF2052 | University of New England | No Collaborators listed |

| MTAF Project # | Lead Institution | Collaborators |
|---|---|---|
| MTAF2061 | University of Maine | The Jackson Laboratory, Bar Harbor: Joerg Bewersdorf, PhD, Research Scientist; Eastern Maine Medical Center, Bangor: Lawrence Alquist, PhD., Radiological Physicist. |
| MTAF3001 | University of Maine | U Maine Mechanical Engineering Department: Mohsen Shahinpoor, Professor and Chair; Elizabeth DePoy, Center for Community Inclusion and Disabilities Studies; Richard Eason, Assoc. Professor of Electrical and Computer Engineering, John Belding, Advanced Manufacturing Center, Victoria Blanchette, College of Engineering, Jason Harkins, Knowledge Transfer Alliance; Jim Ferguson, President, Alba-Technic LLC; Dr. John Lloyd, Department of Veterans Affairs Patient Safety Research Center; Dr. Steven Castle, Professor of Geriatric Medicine, UCLA; Dr. Stephen Gilson, President, Astos Innovations; Thomas Judge, Executive Director LifeFlight of Maine. |
| MTAF3013 | University of Maine | James Weber PhD, DVM, Animal and Veterinary Sciences, UMaine , Anne Lichtenwalner DVM, PhD, Cooperative Extension, UMaine |
| MTAF3017 | University of Maine | UNET: Jeff Letourneau, John Grover. UMaine: Yifeng Zhu, Dave Kotecki, Phil Dickens, Peter Koons, Mick Peterson, Fei Chai, Huijie Xue, Jim Fastook, Andre Khalil, UMaine and Jackson Laboratory. Clare Congdon, University of Southern Maine, Karyn Kunzelman, Central Maine Heart and Vascular Institute |

| MTAF Project # | Lead Institution | Collaborators |
|---|---|---|
| MTAF1027 | The Jackson Laboratory | The Jackson Laboratory: Dr. Richard P. Woychik, Dr. Robert Taft, Dr. Michael Wiles, Joan Malcolm; Richard Allred, Clear H2O; Thomas Christensen, Advanced Manufacturing Center; Timothy Cowan, Lane Conveyors & Drives, Inc., Craig Cunningham, Maine Manufacturing LLC; Richard Masters, Masters Machine Company; Dr. Philip S. Perlman, Howard Hughes Medical Institute; Dr. William F. Rall, National Institutes |
| MTAF1038 | Downeast Institute for Applied Marine Research & Education | U Maine: Dr. Robert L. Vadas, Sr., Dr. Robert Bayer; Dr. Douglas McNaught, UMaine at Machias; The Maine Seafood Alliance; The Maine Clammer's Association; The Maine Aquaculture Innovation Center; The Downeast Resource Conservation and Development |
| MTAF2059 | The Jackson Laboratory | College of Engineering, University of Maine, Orono: John Belding, Assistant Director of Operations, Advanced Manufacturing Center; The Jackson Laboratory, Bar Harbor: Eric Antoniou, PhD, Manager, Gene Expression Services, Madeleine Braun, PhD, Manager, Product Development, Charles Hewett, PhD, Chief Operating Officer, Operations, Douglas Hinerfeld, PhD, Sr. Manager, Phenotyping Services, Joan Malcolm, BS, Biomedical Engineer, Technology Evaluation and Development, Valerie Scott, BS, Senior Director, Scientific Services, Kathy Vandegrift, MBA, Associate General Manager, Finance. |
| MTAF3027 | The Jackson Laboratory | Lanco Assembly Systems, Westbrook ME; Maine Manufacturing, Sanford ME; Fikst Product Development and HighRes Biosolutions, Woburn, MA. |

| MTAF Project # | Lead Institution | Collaborators |
|---|---|---|
| MTAF1021 | FHC, Inc. | Laboratory for Surface Science and Technology, UMaine |
| MTAF2047 | Dielectric Communications Division of SPX Corp. | University of Maine, Orono, Electrical and Computer Engineering Department: Professor M. Musavi, A. Abedi, M.P. da Cunha, N.W. Emanetoglu; Radio Innovation Sweden AB, Vinsta, Sweden: Torjborn Johnson, President. |
| MTAF3004 | Biovation LLC | No Collaborators Listed |
| MTAF3020 | ORPC | University of Maine; Maine Marine Technology Center-City of Eastport; Eastport Port Authority; Many other private, public, and non-profit organizations |

| MTAF Project # | Lead Institution | Collaborators |
|---|---|---|
| MTAF2030 | ORPC | Eastport Port Authority, Eastport: Christopher Gardner, Executive Director; Devine Tarbell & Associates, Portland: Mary McCann, Manager of Environmental Services, Regulatory, and Aquatic Resources; Harbor Technologies, Brunswick: Martin Grimnes, President; The Boat School, Husson University, Bangor: Greg Miller, Vice President and Dean of New Programs; Maine Marine Technology Center and the City of Eastport, Eastport: George Finch, City Manager; Maine Maritime Academy, Castine: Dr. Richard Kimball, Professor; The University of Maine, Orono: Dr. Michael Peterson, Professor; U.S. Windblade, LLC Bath: Keith Burgess, Chief Technical Officer. |
| MTAF3022 | E-Pack, LLC | No Collaborators listed |
| MTAF 1074 | Maine Aquaculture Innovation Center | U Maine: Nick Brown, Jake Ward, Dr. Susan Brawley; Soren Hansen, Sea and Reef Aquaculture, LLC; Jim Wadsworth, Friendship International |
| MTAF 2054 | Bigelow Laboratory for Ocean Sciences | Kennebec River Biosciences, Richmond, ME |

| MTAF Project # | Lead Institution | Collaborators |
|---|---|---|
| MTAF 2053 | Maine Aquaculture Innovation Center | School of Marine Sciences, University of Maine, Orono: Dr. Paul Rawson, Associate Professor of Marine Science; Darling Marine Center, Walpole: Timothy Miller, Laboratory Manager, Scott Feindel, Hatchery Manager |
| MTAF 3011 | University of Maine | Cook Aquaculture (D. Miller), Great Bay Aquaculture of Maine (G. Nardi), Micro-Technologies, Inc. (B. Keleher), Dept. of Inland Fisheries & Wildlife, Dept. of Marine Resources, USDA APHIS, several other UMaine affiliates, and private businesses (veterinary clinics, biotech firms, fishermen). UMaine's team includes: School of Marine Science (L. Kling, P. Rawson, S. Brawley, I. Bricknell); Lobster Institute (R. Bayer); UMAHL (A. Lichtenwalner, D. Bouchard); Biomedical Sciences (C. Kim); and Industrial Cooperation (J. Ward). UMaine is partnering with the USDA ARS (B. Wolters). |
| MTAF1071 | University of Maine, Center for Aquacultural Research | U Maine: Jake Ward, Dr. Susan Brawley, Ian Bricknell; Steve Page, Ocean Farm Technologies; Shep Erhart, Maine Coast Sea Vegetables; Tollef Olson, Ocean Approved LLC; Dr. William Wolters, USDA/ARS; George Nardi, Great Bay Aquaculture |
| MTAF 1100 | University of Maine, Forest Bioproducts Research Technology Center | Dick Arnold, Site Manager, Old Town Fuel and Fiber; Paul Nace, President, Maine Bioproducts, LLC; Ford Reiche, President, Safe Handling, Inc.; Stacie Beyer, Maine Sustainable Bioplastics Council |

| MTAF Project # | Lead Institution | Collaborators |
|---|---|---|
| MTAF2012 | Maine Institute for Human Genetics and Health | University of Maine: Robert Wheeler, PhD, Assistant Professor; Dahl-Chase Pathology Associates, Bangor, ME: George Eyerer, MD, President, Andrea Illingworth, Operational Director, Trillium Diagnostics, LLC, Brewer: Bruce Davis, President; Eastern Maine Medical Center, Bangor: Deborah Carey Johnson, RN, CEO, Michelle Hood, President/CEO |

Source: Data provided by the Maine Technology Institute

# Appendix E: Targeted Technology Sector Description

Definition of Targeted Technology Sectors is from Maine Office of Innovation and is based on targeted sectors identified by the State Legislature in the late 1990's and further defined by the Statewide Cluster Analyses in 2002 and 2008, most recently reported in: Maine's Technology Sectors and Clusters: Status and Strategy; Maine Center for Business and Economic Research, University of Southern Maine; Battelle Technology Partnership Practice, Battelle Institute; Planning Decisions Inc; and PolicyOne Research, March 2008. To this definition engineering and other scientific/technical was added as it relates to most of the tech sectors. They include the following:

| NAICS Description | NAICS Code | Maine Cluster |
|---|---|---|
| Pharmaceutical and medicine manufacturing | 3254 | Biotechnology |
| Medical equipment and supplies manufacturing | 3391 | Biotechnology |
| Electromedical apparatus manufacturing | 334510 | Biotechnology |
| Analytical laboratory instrument mfg. | 334516 | Biotechnology |
| Irradiation apparatus manufacturing | 334517 | Biotechnology |
| Research and Development in Biotechnology | 541711 | Biotechnology |
| Research and Development in the Physical, Engineering, and Life Sciences (except Biotechnology) | 541712 | Biotechnology |
| Medical Laboratories | 621511 | Biotechnology |
| Diagnostic Imaging Centers | 621512 | Biotechnology |
| Resin, rubber, and artificial fibers mfg. | 3252 | Composites & Advanced Materials |
| Boat building | 336612 | Composites & Advanced Materials |
| Engineering services | 541330 | Engineering & Scientific/Technical Services |
| Other technical consulting services | 541690 | Engineering & Scientific/Technical Services |
| Water, sewage and other systems | 2213 | Environmental & Energy |
| Waste treatment and disposal | 5622 | Environmental & Energy |
| Other electric power generation | 221119 | Environmental & Energy |
| Testing laboratories | 541380 | Environmental & Energy |
| Environmental consulting services | 541620 | Environmental & Energy |
| Crop and animal production | 111A | Forest Products & Agriculture |
| Forestry and logging | 113 | Forest Products & Agriculture |
| Wood product manufacturing | 321 | Forest Products & Agriculture |
| Paper manufacturing | 322 | Forest Products & Agriculture |
| Furniture and related product manufacturing | 337 | Forest Products & Agriculture |
| Support activities for crop production | 1151 | Forest Products & Agriculture |
| Support activities for animal production | 1152 | Forest Products & Agriculture |
| Support activities for forestry | 1153 | Forest Products & Agriculture |
| Sugar and confectionery product manufacturing | 3113 | Forest Products & Agriculture |
| Fruit and vegetable preserving and specialty | 3114 | Forest Products & Agriculture |
| Dairy product manufacturing | 3115 | Forest Products & Agriculture |
| Bakeries and tortilla manufacturing | 3118 | Forest Products & Agriculture |
| Other food manufacturing | 3119 | Forest Products & Agriculture |
| Beverage manufacturing | 3121 | Forest Products & Agriculture |
| Computer systems design and related services | 5415 | Information Technology |
| Software publishers | 511210 | Information Technology |
| Wired telecommunications carriers | 517110 | Information Technology |
| Wireless telecommunications carriers (except Satellite) | 517210 | Information Technology |
| All other telecommunications | 517919 | Information Technology |
| Data processing and related services | 518210 | Information Technology |
| Internet publishing and broadcasting and Web search portals | 519130 | Information Technology |
| Animal aquaculture | 1125 | Marine Technology & Aquaculture |
| Search, detection, and navigation instruments | 334511 | Marine Technology & Aquaculture |
| Fabricated metal product manufacturing | 332 | Precision Manufacturing |
| Machinery manufacturing | 333 | Precision Manufacturing |
| Computer and electronic product manufacturing | 334 | Precision Manufacturing |

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