Maine Comprehensive Research and Development Evaluation 2007

A Report to the Maine Office of Innovation, Department of Economic and Community Development

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1. Introduction

In 2001, the Maine legislature enacted 5 MRSA §13122-J and 13122-K, which called for evaluation of Maine's public investment in R&D, the first to be completed in 2001 and every five years thereafter. This marks the second year of the second five-year cycle of this evaluation series. The Maine Office of Innovation (OOI) within the state's Department of Economic and Community Development (DECD) is responsible for overseeing this evaluation process. An advisory board, the Maine Innovation Economy Advisory Board, is charged by the state with providing guidance and input on the activities of the OOI, including the evaluation project. To conduct the R&D Evaluation, OOI has contracted with PolicyOne Research and RTI International[1] for design, data gathering, analysis, and reporting.

The evaluation is guided by "A Science and Technology Action Plan for Maine," developed in 2005.[2] The 2005 Science and Technology Action Plan for Maine includes the following goal:

Maine's R&D activity will equal $1 billion per year by 2010

As stewards of public funds, the legislature has asked for an annual evaluation of R&D programs that receive funding from the state. The evaluation of these programs is based on five primary R&D objectives:

1. Maine's investments in R&D will stimulate and sustain consistent, competitive growth for Maine's economy.
2. Stimulate a robust R&D enterprise by boosting academic R&D capacity, developing an educated, technically skilled workforce, broadening the impact from the nonprofit research institutions, and increasing private sector R&D activity in key strategic areas important to Maine.
3. Maine's Legislature and key policymakers recognize, advance, and celebrate Maine's R&D investments and strategic priorities.
4. Maine's unique R&D assets and their significance to Maine's economy are used to draw new business and investment to the state of Maine.
5. Foster growth of research-intensive companies through a comprehensive network of services and support.

[1] RTI International is a trade name of Research Triangle Institute.

[2] A full copy of "A Science and Technology Action Plan for Maine" is available at the Maine Office of Innovation's Website: http://www.maineinnovation.com/

Using the State's Plan as a guide, OOI constructed five questions to be answered by this evaluation, which focus on the R&D-related goals and objectives. They are as follows:

1. Overall, has Maine's public investment in research and development stimulated and sustained consistent, competitive growth in Maine's economy, especially when compared to other states?
2. Has Maine's investment in public and private university R&D led to increased research capacity; the development of an educated, technically skilled workforce; and increased commercialization of university technologies?
3. Are Maine's investments in nonprofit research institutions broadening their impact on Maine's economy?
4. Is Maine fostering the growth of research-intensive companies, increasing private sector R&D activity, and building a technology-based entrepreneurial community?
5. To what extent are these investments increasing the competitiveness of Maine in its key strategic technology and industry areas?

Evaluation Methodology and Use of Data

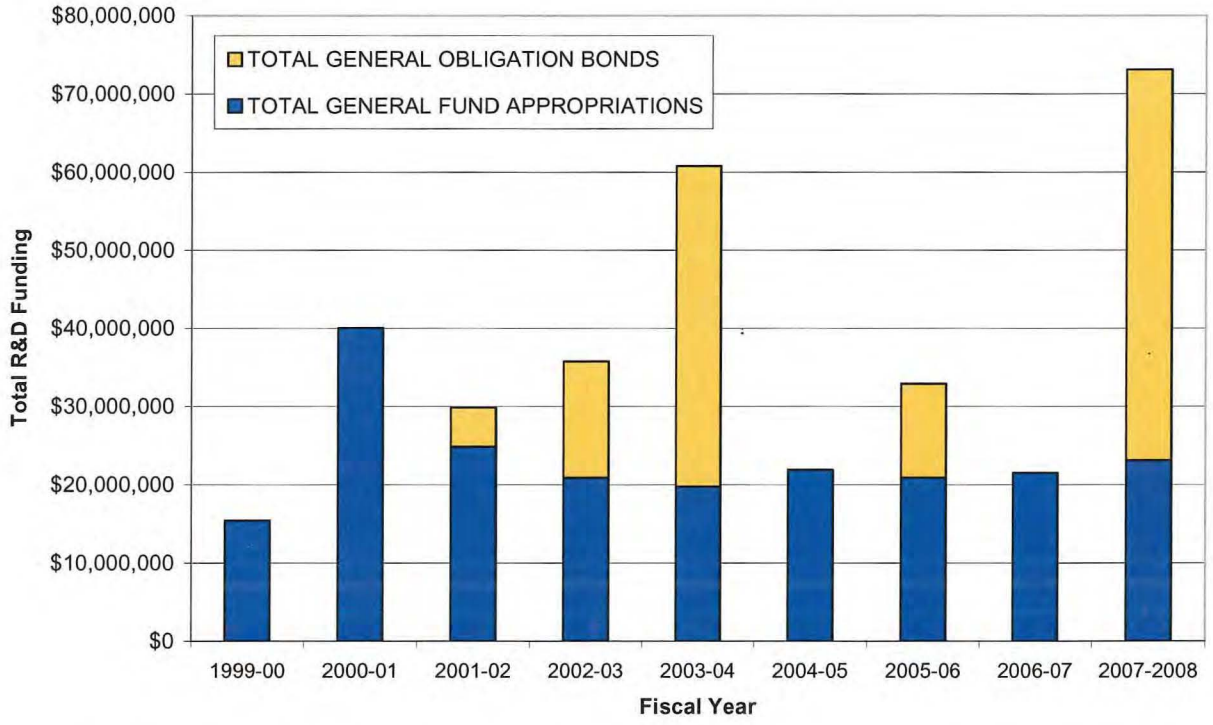
Information used in this evaluation was collected in multiple ways to enable Maine's performance to be compared to other states and to ensure consistency of longitudinal data. Federal and university technology transfer data sources were used, along with an extensive survey to the state's universities, nonprofits, and companies that receive assistance from state-supported R&D programs.

Much of the data reported by national organizations such as the National Science Foundation of the Bureau of Economic Analysis are at least one to two years old, meaning that 2005 or 2006 may be the latest year that data has been collected and reported for all states. This indicates that national comparisons almost always lag the most recent allocation of state funds. Therefore, readers of this evaluation must not correlate the most recent state budget for R&D with the indicators listed in this report.

2. Findings and Recommendations

Since 1996, the State of Maine has allocated approximately $370 million to R&D efforts: roughly $22 million of general fund dollars each year ($222,568,234 in total from 1996/97 through 2007/08 budget) and nearly $148 million in general obligation bonds. Most recently, in November 2007, Maine voters approved a $50 million bond to be used for research, development, and commercialization. The purpose of Maine's investments since 1996 is to increase the overall research and development (R&D) capacity in the state and to maximize the economic impact that research has on jobs, income, and the overall economy in Maine.

Figure 1.1. State of Maine R&D Funding – FY1999/00 – 2007/08



Source: Prepared by PolicyOne Research from data provided by the Maine Legislature, Office of Fiscal & Program Review

Overall Bottom Line: Maine is making steady progress in building R&D scale with a positive economic impact, especially in the private sector, yet is still lacking in the pace in which university and nonprofit research is being commercialized.

2.1 Findings

In the process of reaching our conclusions, our objective was to answer the five questions defined by OOI. Those answers were used as the basis for our recommendations and are shared below.

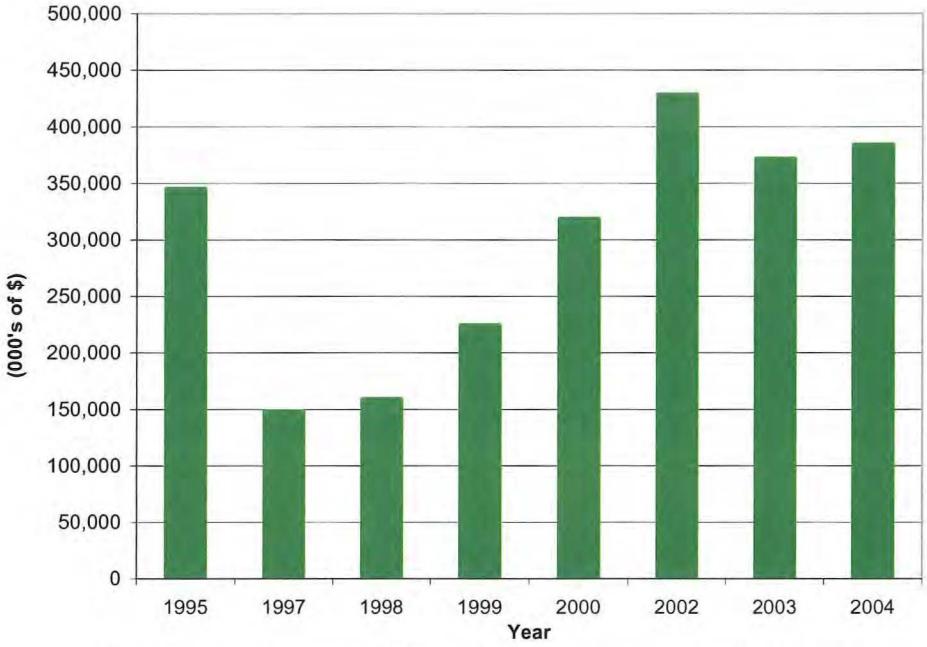
1. Overall, has Maine's public investment in research and development stimulated and sustained consistent, competitive growth in Maine's economy, especially when compared to other states?

Bottom Line: Maine appears to have increased overall R&D capacity, which has contributed to consistent growth in Maine's economy and has increased competitiveness relative to other states.

Supporting evidence: Supporting evidence in this question is divided into three categories: overall R&D capacity, data on economic growth, and comparative data to other states.

Total R&D Capacity: According to the National Science Foundation, Maine's total R&D capacity has increased from approximately $225 million in total R&D spending in 1999 to $384 million in 2004. This represents an increase of $159 million or 71% over the past five-year reporting period. During that same period, the State of Maine invested approximately $121 million of general funds into R&D efforts.

Figure 1.2. Total R&D Spending in Maine – 1995–2004



Source: Total R&D Performed – National Science Foundation/Division of Science Resources Statistics; National Patterns of R&D Resources 2002 & 2004 Data Updates, derived from four NSF surveys: Survey of Industrial R&D; Survey of R&D Expenditures at Universities and Colleges; Survey of Federal Funds for R&D; and Survey of R&D Funding and Performance by Nonprofit Organizations. http://www.nsf.gov/statistics

Note: From 1997–2000 and 2002–2004, chart portrays one-year increments; all other years are in two-year increments.

Overall Economic Growth: Maine's investment in specific private sector R&D assistance is showing very positive results and validates the state's investment in the R&D economy. The economic impact[3] on the companies served by state programs show that a $5,586,406 state investment to the private sector leveraged almost 18 times the original investment, with a direct impact of $63,199,439 and indirect impact of $19,420,596 and an induced impact of $18,217,613. Of the 435 companies responding to the state evaluation, 441 direct and 180 indirect jobs were created by companies using state assistance. While the return on public investment is high, less than 20% of all state R&D funds were directed to the private sector, and, as a result, only 800 firms or 1.6% of Maine's establishments were served.

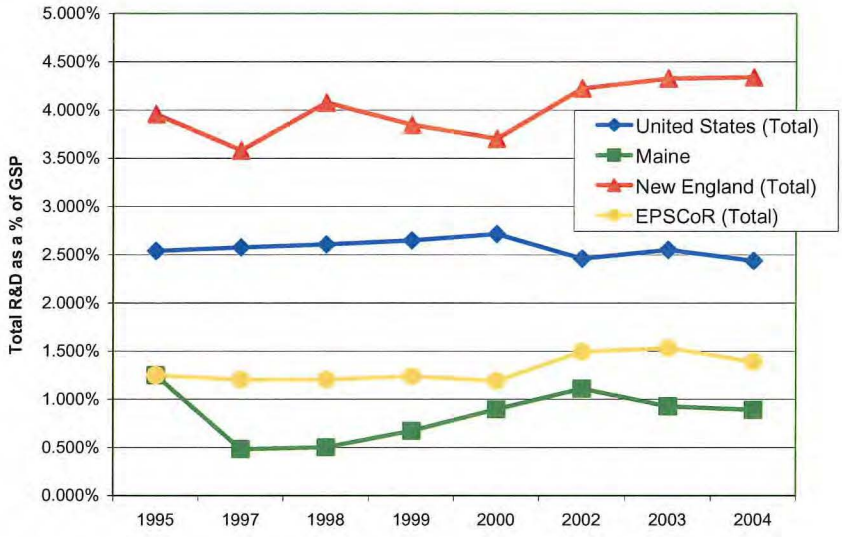
State Comparisons: Compared to other states, Maine's relative position in R&D is slowly increasing. In 1997, Maine ranked 49th among all states in total R&D as a percent of gross state product; in 2004,[4] it ranked 41st. From 2001 to 2005, Maine's industry R&D ranking moved from 35th to 32nd. In an environment where almost every state is

[3] An Economic IMPLAN model was used to calculate the leveraged impact of state investment.

[4] 2004 is the most recent year that comparative data from all states was available.

investing tens to hundreds of millions of dollars each year in R&D, shifts in relative state rankings are not easy to achieve.

Figure 1.3. Total R&D Spending as a Percent of Gross State Product – 1995–2004



Sources: Total R&D Performed – National Science Foundation/Division of Science Resources Statistics; National Patterns of R&D Resources 2002 & 2004 Data Updates, derived from four NSF surveys: Survey of Industrial R&D; Survey of R&D Expenditures at Universities and Colleges; Survey of Federal Funds for R&D; and Survey of R&D Funding and Performance by Nonprofit Organizations. http://www.nsf.gov/statistics; Gross State Product – Bureau of Economic Analysis, U.S. Department of Commerce, 1980–1996 data; and Accelerated Estimates for 2005 and Revised Estimates for 1997–2004; http://www.bea.gov/bea/regional/gsp.htm; 1997–2005 is based on NAICS while 1980–1996 is based on SIC industry classification.

Note: From 1997–2000 and 2002–2004, chart portrays one-year increments; all other years are in two-year increments.

Like most states, Maine's rankings among R&D and innovation measures are mixed. According to Maine's 2008 Innovation Index (see page 17), the state ranks 3rd in nonprofit R&D, 13th in entrepreneurial activity, and 15th in SBIR awards. Maine is 9th in science skills of students and 12th for math skills of students. Maine is among the middle of the pack for overall educational attainment, high-tech employment growth, and PhD scientists and engineers in the workforce. The state is among the lower third of all states in terms of academic R&D performance, venture capital, patents, scientists and engineers in the workforce, science and engineering graduate enrollments, and gross state product growth.

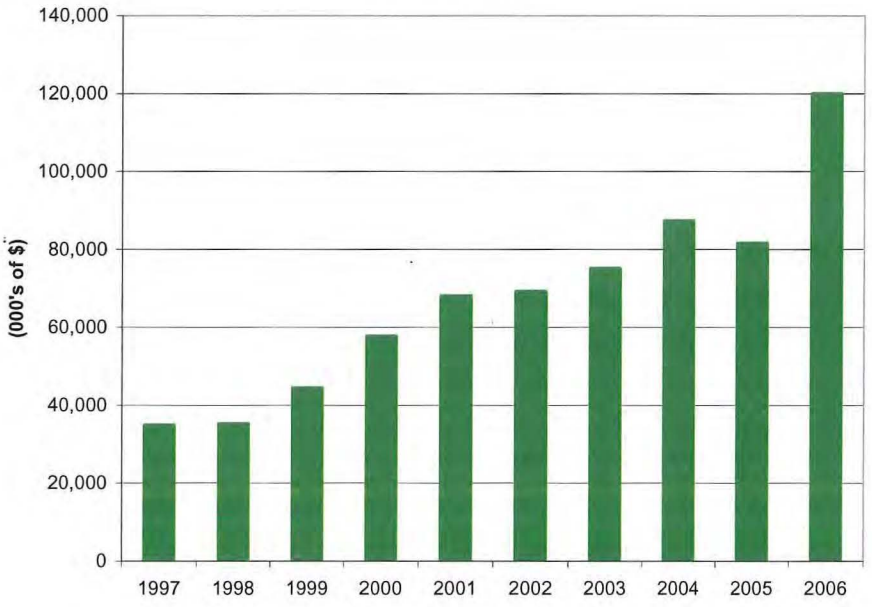
2. Has Maine's investment in public and private university R&D led to increased research capacity; the development of an educated, technically skilled workforce; and increased commercialization of university technologies?

Bottom Line: Universities have increased their total R&D, while the number of science and engineering graduates has slightly declined over five years and commercialization of research is much lower than regional and national averages.

Supporting evidence: Data for this question is categorized by university R&D capacity, workforce preparation, and commercialization of research.

University R&D Capacity: The National Science Foundation reported that university R&D in Maine jumped from approximately $70 million in 2001 to almost $120 million in 2006.[5]

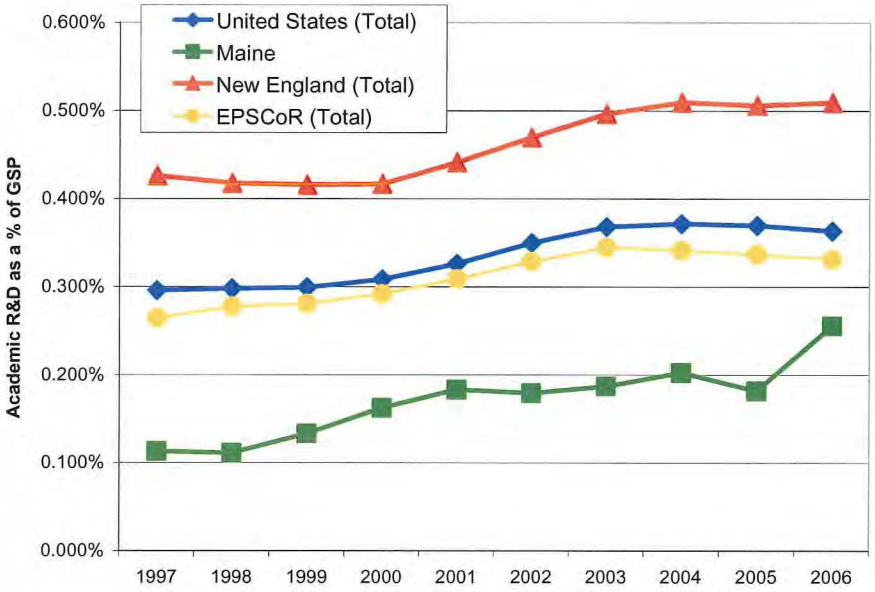
Figure 1.4. Academic R&D Spending in Maine – 1997–2006



Source; University & College R&D Performed – National Science Foundation/ Division of Science Resources Statistics; Survey of R&D Expenditures at Universities and Colleges 2003 & 2004. http://www.nsf.gov/statistics

[5] The report uses the latest data from the National Science Foundation, therefore not all data is reported for the same year.

Figure 1.5. Academic R&D Spending as a Percent of GSP – 1997–2006



Sources: University & College R&D Performed – National Science Foundation/Division of Science Resources Statistics; Survey of R&D Expenditures at Universities and Colleges 2003 & 2004. http://www.nsf.gov/statistics. Gross State Product – Bureau of Economic Analysis, U.S. Department of Commerce, 1980–1996 data; and Accelerated Estimates for 2005 and Revised Estimates for 1997—2004. http://www.bea.gov/bea/regional/gsp.htm. 1997–2005 is based on NAICS while 1980–1996 is based on SIC industry classification.

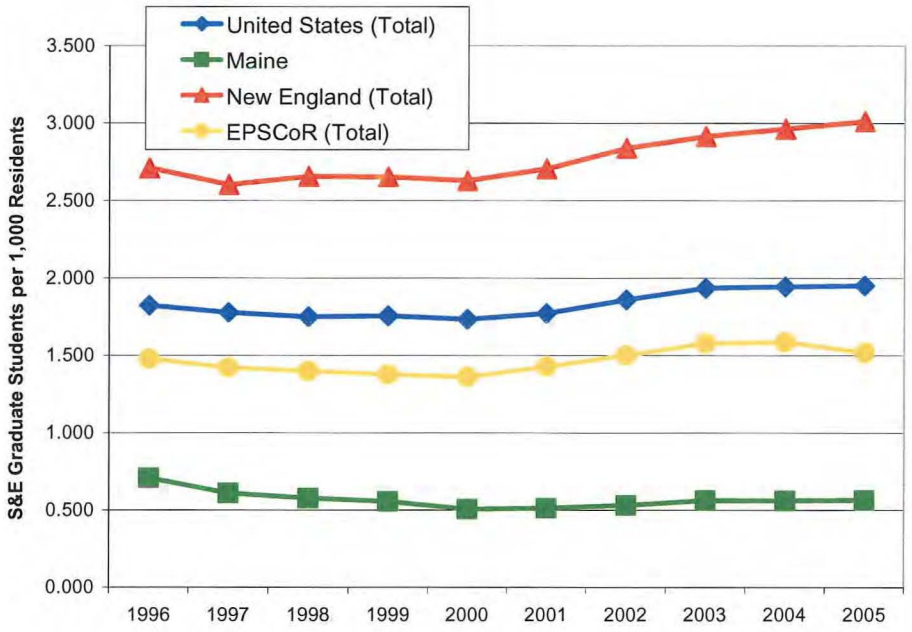
Maine universities reporting under this evaluation noted that expenditures in almost all categories were down slightly from the previous year. These universities noted just over $45 million in R&D expenditures, down 3% from last year. While the total square feet of research space rose by over 50% since 2002, universities reported an 11% decline in research space from 2006 to 2007. The number of new federal grants or contracts received increased by 4%, while the dollar value of those grants decreased by 22%. However, the number of Experimental Program to Stimulate Competitive Research (EPSCoR) awards increased in 2007.

Despite drops in R&D expenditures and federal grants, there was a significant increase in less formal types of publications (e.g., presentations, non-peer reviewed articles) and the degree of collaboration among Maine institutions, which indicates increased engagement and communication between Maine's researchers and the wider community of their peers.

Workforce Preparation: Approximately 736 graduate and 5,800 undergraduates were enrolled in science and engineering (S&E) programs, consistent with the 2006 total yet 15–24% lower than in 2002. Compared to other states, Maine's graduate level enrollment in S&E degrees is approximately 30% of the U.S. average and 40% of other EPSCoR

states. Maine has a disproportional number of S&E degrees that are concentrated at the bachelor's level.

Figure 1.6. S&E Graduate Student Enrollments per 1,000 Residents – 1996–2005



Source: S&E Graduate Students— NSF WebCASPAR Database System based on "Survey of Graduate Students and Postdoctorates in Science and Engineering," National Science Foundation and National Institutes of Health; http://webcaspar.nsf.gov. Population: 1980–1989 – Intercensal Estimates of the Total Resident Population of the States, release date Aug. 1996. 1990–1999 – Table CO-EST2001-12-00 – Time Series of Intercensal State Population Estimates: April 1, 1990 to April 1, 2000. Population Division, U.S. Census Bureau; Release Date: April 11, 2002. July 2000–July 2006 –Table 1: Annual Estimates of the Population for the United States and States, and for Puerto Rico: April 1, 2000 to July 1, 2006 (NST-EST2006-01), Population Division, U.S. Census Bureau, Release Date: December 22, 2006.

Commercialization of Research: Progress on commercialized research is underwhelming. Unfortunately, there were fewer funds from industrial contracts in 2007. The 237 university contracts with industry totaled only $2.8M, down 35% from 2006 and 22% less than 2002 levels.

Maine's research universities are below but slowly gaining ground on national averages for production of intellectual property (IP) from research. In a year when roughly $45M in R&D expenditures was reported for all of Maine's universities, 19 invention disclosures, three patents, and one start-up were recorded, which is at the lowest end of the range of average university performance.

3. Are Maine's investments in nonprofit research institutions broadening their impact on Maine's economy?

Bottom Line: The scale of research at nonprofit institutions is increasing at a steady rate, yet most research is not being commercialized or connected to Maine industry to maximize economic value to the state.

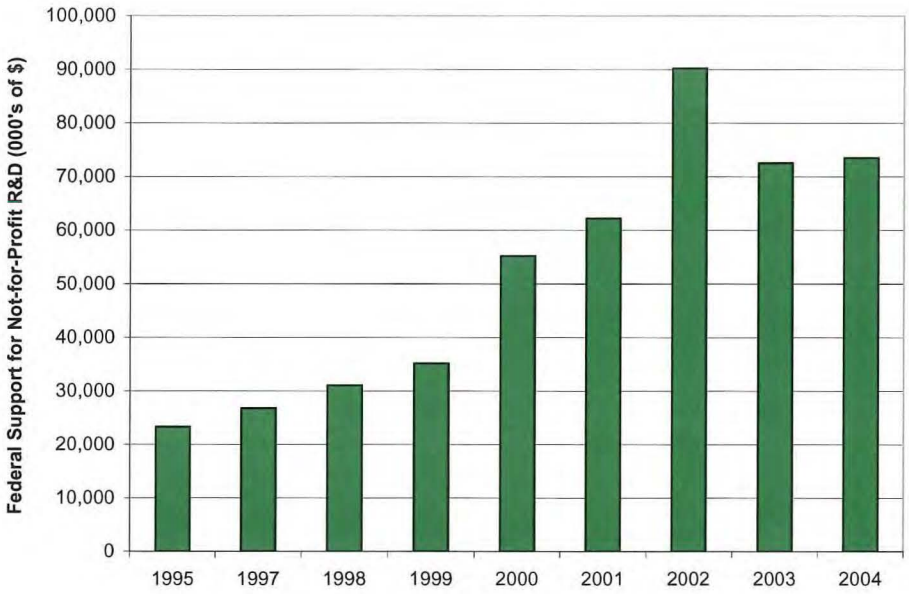
Supporting Evidence: Data for this question are divided into nonprofit R&D capacity (inputs), intermediate milestones, and R&D outcomes.

Nonprofit R&D Capacity: In 2007, the results attributable to state R&D investments in the nonprofit research institutions included $73,318,961 in expenditures for R&D, which was down slightly from last year's survey total of $77,827,420 in R&D expenditures. There was $1,189,644 in new research equipment and over 90,000 square feet of research space, both up 25% from 2006 reporting. In addition, 217 new extramural proposals were submitted for a total of $159 million, up 15% in the number of proposals and 49% in the dollar value compared to the previous year.

Intermediate Milestones: This year showed mixed progress in intermediate outcomes that relate to the initial outcomes of additional R&D capacity. In 2007, 54 research jobs were reported as a result of funding, representing a 64% increase from 2006. In addition, 76 new federal grants and contracts were received for a total of $76 million, representing an increase over 2006 of 46% in the number of awards and 131% in the dollars awarded. The most recent survey also noted some declines in intermediate outcomes. The biggest decline was in industry contracts: 33% fewer contracts and more than a 90% decrease in the amount of industry contracts. Scientific, peer-reviewed journal articles, books, and book chapters, were down 8% from 2006 levels.

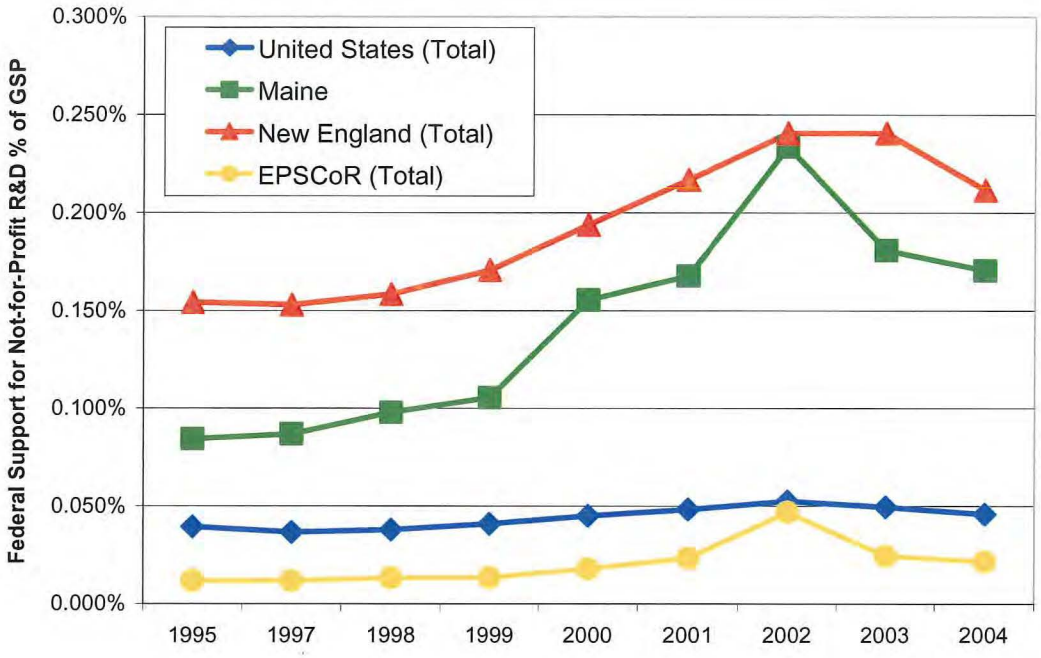
R&D Outcomes: In 2007, nonprofits reported a total of 19 invention disclosures, nine patent applications, and two patents granted, which was slightly higher than 2006 levels. Ten licenses were granted in 2007, two of which were with Maine companies. Nonprofits reported no new spin-off companies or jobs.

Figure 1.7. Federal Support for Not-for-Profit R&D Spending in Maine, 1995–2004 (000's of $)



Source: Not for Profit R&D Performed – 1987-2001 from National Science Foundation/Division of Science Resources Statistics; National Patterns of R&D Resources 2002 Data Update, derived from Survey of R&D Funding and Performance by Nonprofit Organizations; 2002 & 2003 from National Science Foundation/Division of Science Resources Statistics, Survey of Federal Funds for Research and Development: Fiscal Years 2002, 2003, 2004, and 2005; http://www.nsf.gov/statistics

Figure 1.8. Federal Support for Not-for-Profit R&D Spending, Percent of GSP – 1995–2004



Source: Not for Profit R&D Performed – 1987–2001 from National Science Foundation/Division of Science Resources Statistics; National Patterns of R&D Resources 2002 Data Update, derived from Survey of R&D Funding and Performance by Nonprofit Organizations; 2002 & 2003 from National Science Foundation/Division of Science Resources Statistics, Survey of Federal Funds for Research and Development: Fiscal Years 2002, 2003, 2004, and 2005; http://www.nsf.gov/statistics; Gross State Product – Bureau of Economic Analysis, U.S. Department of Commerce, 1980–1996 data; and Accelerated Estimates for 2005 and Revised Estimates for 1997–2004; http://www.bea.gov/bea/regional/gsp.htm; 1997–2005 is based on NAICS while 1980–1996 is based on SIC industry classification.

Our concern with this sector remains its limited impact on Maine's economy beyond the direct jobs it provides. Since this sector has limited interactions with the private companies in the state, the opportunity for informal technology transfer is minimized. In 2007, only 2.8% of total R&D performed was with Maine companies. Yet, despite the improvements in its formal technology transfer capacity in the past few years, its production of intellectual property, licenses, and spin-off companies is limited given the large volume of research being performed.

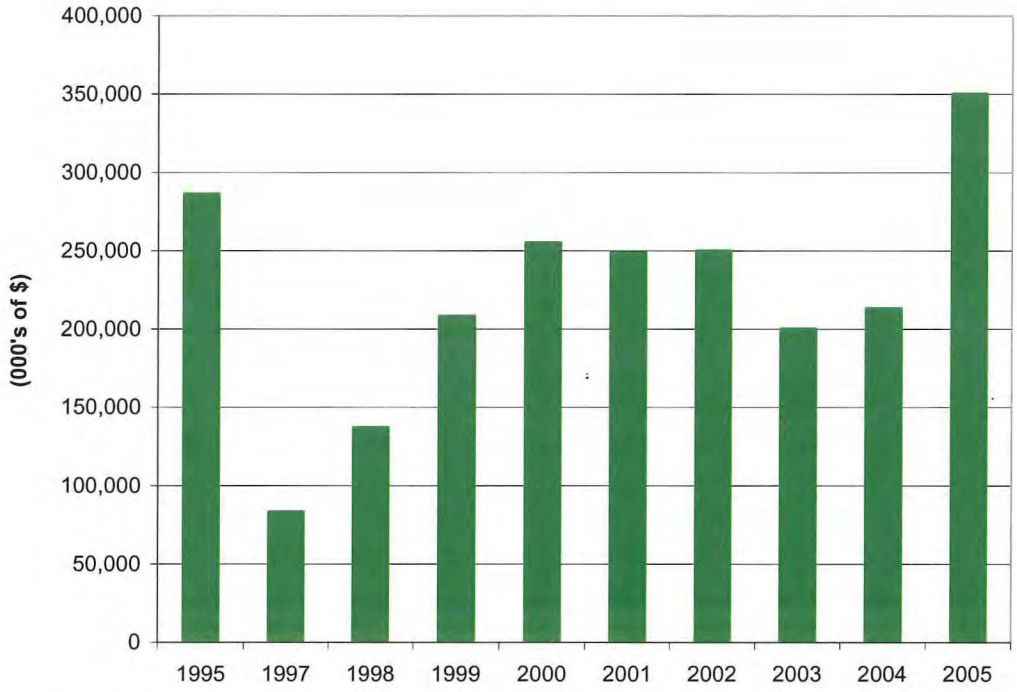
4. Is Maine fostering the growth of research-intensive companies, increasing private sector R&D activity, and building a technology-based entrepreneurial community?

Bottom Line: Maine's private sector has increased R&D capacity, and state investment in R&D has directly led to the creation of new jobs and businesses with above average wages.

Supporting evidence: Data for this question is summarized by private R&D capacity, the entrepreneurial environment, and satisfaction with state programs.

Industry R&D Capacity: The most recent industry R&D data from the National Science Foundation indicates a significant jump in private sector R&D, especially in the past several years: from approximately $250 million in 2000 to $350 million in 2005. Of the 345 companies that responded to questions about federal funding, 13 reported receiving a Small Business Innovation Research (SBIR) award from the federal government. While the percent of respondents make up only 1% of all Maine establishments, they accounted for 43% of all SBIR awards.

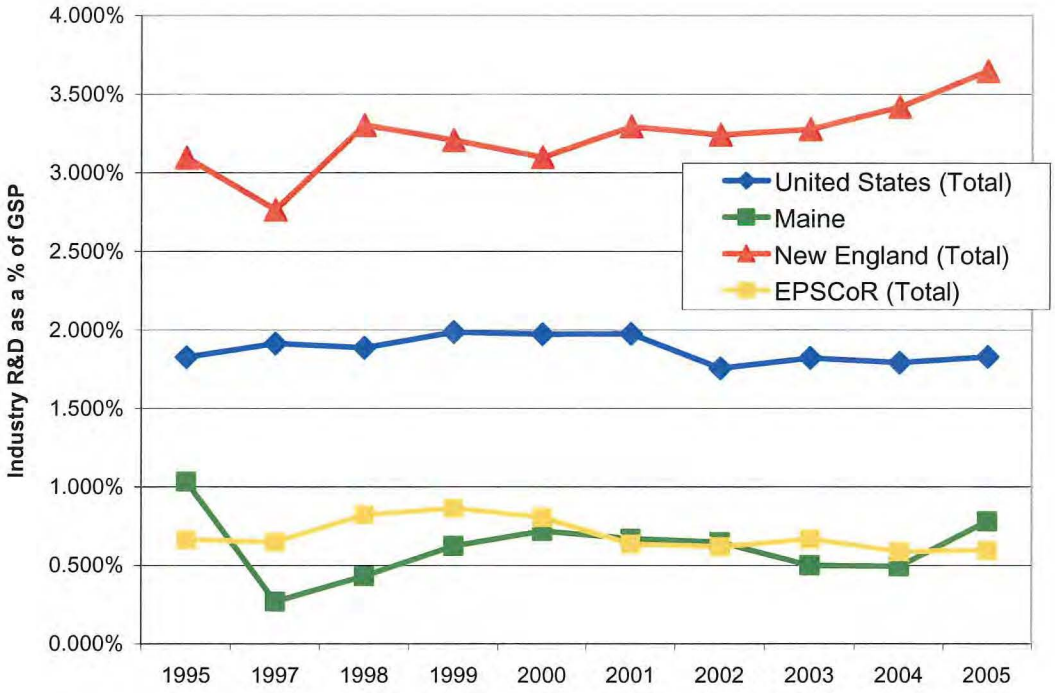
Figure 1.9. Industry R&D Spending in Maine – 1995–2005



Source: Industry R&D Performed – National Science Foundation/Division of Science Resources Statistics, Survey of Industrial Research and Development: 2001 and 2002, 2002–2003 forthcoming. http://www.nsf.gov/statistics

Note: From 1997 on, chart portrays one-year increments; prior to 1997, data is in two-year increments.

Figure 1.10. Industry R&D Spending as a Percent of GSP – 1995–2005



Source: Industry R&D Performed – National Science Foundation/Division of Science Resources Statistics, Survey of Industrial Research and Development: 2001 and 2002, 2002-2003 forthcoming; http://www.nsf.gov/statistics; Gross State Product – Bureau of Economic Analysis, U.S. Department of Commerce, 1980—1996 data; and Accelerated Estimates for 2005 and Revised Estimates for 1997–2004; http://www.bea.gov/bea/regional/gsp.htm; 1997–2005 is based on NAICS while 1980–1996 is based on SIC industry classification.

Note: From 1997 on chart portrays one-year increments; prior to 1997, data is in two-year increments.

Companies participating in state R&D programs create new wealth for Maine. More than half of participating companies had 90% or more of their sales outside the state of Maine. While almost 80% sold internationally, the majority of international sales accounted for less than 10% of total sales.

Entrepreneurial Environment: State investments in R&D and innovation are intended, among other things, to spur the formation or growth of new companies. In the survey results of private sector firms receiving awards from state R&D programs, 20% had been established from 2005–2007 and 35% from 2000–2004. This indicates a healthy growth of new firms with R&D capacity. The Kauffman foundation recently ranked Maine 13th in terms of entrepreneurial activity as measured by business starts by persons not previously owning a business.

There is specific evidence that companies using Maine R&D programs are increasing their competitive edge. Maine is attracting more venture capital in 2006 than in 2005. The number of venture capital deals increased from two to four and the total investment rose from $4.5 million in 2005 to $7.6 million in 2006. More specifically, the companies

participating in Maine R&D programs experienced the same trend. While a small percent of all companies receive equity funding (nationally, the average is less than 2-3%), approximately 7.5% of respondents received equity funding from angel, venture or state seed funds. The 21 participating companies indicating they received angel and venture funding reported that they attracted over $35,000,000 of new equity in the past year.

Satisfaction with State Programs: The firms surveyed indicated a mixed degree of satisfaction with the services they have received and the degree of importance these services were to their business. Over 75% of firms reported assistance from Maine Technology Institute (MTI) with an overwhelming degree of high satisfaction. Over 60% of firms used the UMaine system or other firms outside Maine for assistance with a higher than average degree of satisfaction. The Maine Patent Program received the third-highest satisfaction score. Due to their targeted markets, ATDC, the Technical Assistance Center, and nonprofit research institutions were the least used services. Of companies using ATDC, satisfaction with services were equally split between those satisfied and those not satisfied. All other programs, such as the Procurement Technical Assistance program, were used by 40–60% of firms with an average or slightly below average degree of satisfaction.

5. To what extent are these investments increasing the competitiveness of Maine in its key strategic technology and industry areas?

Bottom Line: R&D investments have shown a positive impact on the state's technology and industry clusters, yet could be accelerated with additional support for proven private sector programs and enhanced connections to university and nonprofit research.

Directly correlating R&D activity with specific industry clusters is difficult since much of the research is categorized by technology platforms and most clusters are aligned by products and services. For instance, research in environmental sciences or biology can have application to the State's biotechnology, environmental service, and aquaculture industries. Yet indications point to a positive correlation between the state's R&D investment and industry performance.

***Supporting Evidence*:** Data for this question are categorized by overall growth of technology industries and connections between industry and university/nonprofit research.

Growth of Technology Industries: Overall, high-tech employment and number of high-tech establishments in Maine increased by 3% and 1.6% respectively, compared to a decrease in overall employment and firms for the State of Maine. While the growth trend

was positive for both jobs and firms, it was below U.S. and EPSCoR averages for the same period.

The number of jobs, new businesses, and wealth creation due to state-funded R&D programs has been consistently growing. Over 800 companies have received assistance from entities funded by the Maine R&D investment in the last five years, and over one-third have worked with more than one of these stakeholders. Of the 435 companies that responded to the evaluation survey, the growth picture is very positive and includes the following highlights:

- The employee growth rate for those companies served by state R&D programs increased at a rate double the overall high-tech industry average for the state (5.3% compared to 2.44%) and more than five times the average for all Maine businesses, which grew at less than 1%.
- Total payroll was $332,889,968 or 26.6% higher than in the previous year. Wages for these companies averaged $37,140, approximately 15% higher than the average state wage.
- Compared to the previous year, firms reported a 9% growth in overall revenues and a 3.6% growth in revenue per employee. Almost 95% of revenues came from sales of products or services compared to grants or contracts, indicating the commercial value and potential for these companies.

Connections between Industry and University/Nonprofit Research: While industry R&D is up significantly, the interface between industry and university/nonprofit research continues to show a relative mismatch. Compared to other EPSCoR states, Maine's university research is heavily concentrated in environmental services and social sciences, 19% and 17.7% respectively, compared to 8% and 3.4% for other EPSCoR states. While Maine has a growing environmental sciences industry, it still composes a very small percent of the state's employment. On the other hand, employment in engineering-based industries (composite materials, paper and wood products, information technology, electronics and precision manufacturing) represents more than eight times the environmental industry yet accounts for less than 15% of all university research. This mix of research, combined with declining industry contracts at universities, indicate a real opportunity for improvement.

Summary of the 2008 Maine Innovation Index

In addition to the five key questions about Maine's R&D investment, the state produces an innovation index that ranks Maine against all other states in more than 20 categories. The following is a summary of the 2008 Innovation Index findings for Maine, using the latest year for which data is available.

Existing areas of strength for Maine in building and sustaining an innovation-driven economy:

Not-for-Profit Laboratory R&D Performance
SBIR/STTR Funding
Entrepreneurial Activity

Areas in which Maine showed improvement during the last five years in building and sustaining an innovation driven economy:

Industry R&D Performance
Academic R&D Performance
Not-for-Profit Laboratory R&D Performance
State R&D Funding
SBIR/STTR Funding
Science and Engineering Graduate Enrollments
Science and Engineering Degrees Awarded

Areas in which Maine outperforms its EPSCoR[6] peers:

Industry R&D Performance
Not-for-Profit Laboratory R&D Performance
SBIR/STTR Funding
Entrepreneurial Activity
Ph.D. Scientists and Engineers in the Labor Force

Existing areas requiring improvement for Maine in building and sustaining an innovation-driven economy:

Total R&D Performance
Industry R&D Performance
Academic R&D Performance
Federal R&D Obligations
Venture Capital Investments
Patents Issued
High Technology Business Establishments – % Change
S&E Occupations in the Workforce
Gross State Product – % Change

[6] EPSCoR – Experimental Program for the Stimulation of Competitive Research is a national program to assist states that have historically received lesser amounts of federal R&D funding. Currently, 21 states participate in the program.

Table 1.1. Summary of Key R&D-Related Indicators from Maine Innovation Index 2008

Indicator	Maine 1-Year Trend	Maine 5-Year Trend	Maine Compared to EPSCoR Most Current Year	Maine National Rank 1–51 with 1=best; (year)	
				5 Years Prior	Most Current Year
Total R&D Performance	↓	↑	↓	38 (2000)	41 (2004)
Industry R&D Performance	↑	↑	↑	35 (2005)	32 (2005)
Academic R&D Performance	↑	↑	↓	49 (2002)	43 (2006)
Not-for-Profit Laboratory R&D Performance	↓	↑	↑	3 (2000)	3 (2004)
Federal R&D Obligations	↑	↓	↓	13 (2000)	33 (2004)
State R&D Investments	↑	↑	N/A	N/A	N/A
SBIR/STTR Funding	↑	↑	↑	15 (2000)	15 (2004)
Venture Capital Investments	↑	↓	↔	30 (2002)	34 (2006)
Patents Issued	↔	↓	↓	40 (2002)	41 (2006)
Entrepreneurial Activity	↓	N/A	↑	N/A	13 (2005)
High Technology Employment – % Change	N/A	N/A	↓	N/A	26 (2005)
High Technology Business Establishments – % Change	N/A	N/A	↓	N/A	44 (2005)
S&E Occupations in the Workforce	N/A	N/A	↓	N/A	45 (2003)
Ph.D. Scientists and Engineers in the Labor Force	↑	↔	↑	29 (1999)	29 (2003)
Science and Engineering Graduate Enrollments	↔	↑	↑	51 (2001)	51 (2005)
Science and Engineering Degrees Awarded	↑	↑	↓	35 (2001)	30 (2005)

Ranking is among all states plus District of Columbia, with 1=best. Latest year is in parentheses.

Key:

↑ = Improving Trend or Higher
↓ = Decreasing or Lower
↔ = No Change or Equal
N/A = Not Applicable or Data Not Available

2.2 Recommendations

Overall, Maine's investments have improved the state's position in science and technology. Our recommendations are based on the goals set out in the Science and Technology Plan, best practices in innovation-based economic development, and deficiencies in the current implementation.

To achieve these objectives, the state will need to support programs and efforts that are focused on the following elements:

- **Scale**: the total amount of R&D being conducted in the State of Maine (how much)
- **Pace:** the speed and degree in which research is commercialized into tradable goods and services (how fast)
- **Value**: the broader economic impact of R&D, including direct and indirect jobs, new businesses, increased exports, and wealth generation (how well)

It is unlikely that each state-supported effort contributes all three elements; however, the combination of all state R&D efforts should result in an effective blend of the elements. Therefore, the evaluation of state funding will not only include the question of how much R&D has increased; it will also assess to what degree the R&D is making a difference to the Maine economy.

Scale: Continue to invest in overall R&D capacity

Continue to support R&D and innovation investments and increase investments in proven models. Maine needs to continue to invest in R&D and, in fact, needs to accelerate its investment in order to meet the goal of $1 billion in R&D by 2010 and improve its relative position in the innovation economy. Multiple state-supported programs have consistently produced positive research and economic outcomes for the state. This is especially true for the private sector where economic impact from R&D investment is high. The level of funding for these programs with high leverage should be expanded to more rapidly increase R&D results.

Enhance the quality of the science & engineering workforce. There are two key issues relating to the workforce: the pipeline of new technology workers and the ability to replace technology workers who are increasingly retiring from their fields. Specifically, the state should expand the number of students, especially graduate-level students, enrolled in science, technology, engineering, and mathematics (STEM). In addition, industry-led workforce efforts aimed at targeted clusters should be expanded to help emerging and existing industries maintain and build their workforce.

Pace: Accelerate the rate of commercialization

Increase the focus of university and nonprofit R&D support on commercialized research outcomes. While the state has logically invested in increasing the total volume of research at universities and nonprofit research centers, there appears to be a timely opportunity to also begin a targeted effort to commercialize more research. Future investments from the state should require more commercialization outcomes from R&D funding to universities and nonprofits. These entities should be encouraged to perform more industry-sponsored R&D and to increase support for efforts that move an invention disclosure more quickly through the commercialization pipeline to produce patents, licenses, and spin-off companies. Specific recommendations include:

- Ensuring that an adequate portion of R&D funds are used for a proof of concept fund that accelerates commercial uses of research. These are typically grants of $25,000–75,000 that move an invention disclosure or patent application closer to the final stages of commercialization that result in spin-off companies or active licenses.
- Recognizing the efforts placed on technology transfer and applied research through the university culture and reward system of faculty, including an adequately supported technology transfer office.
- Providing funds to recruit eminent scholars and research faculty with a strong track record of technology transfer to build strength in the state's research fields that offer a high degree of commercial potential.

Enhance programs that help businesses access and secure federal research funds. A portion of industry R&D comes from the use of federal funds to develop commercial products. There are three areas in which Maine might enhance the amount of federal research dollars received by companies:

- Spur and support companies' efforts to access federal R&D funds from agencies to which Maine currently lacks sufficient access, such as the Environmental Protection Agency and Department of Energy. The Maine Procurement Center is an underutilized possibility to provide some of this assistance. The state has had success in accessing federal SBIR grants and should build on this as a model.
- Enhance the long-term impact of SBIR awards. While the number and the amount of SBIR awards continue to increase in Maine, there is opportunity for more funding from these sources. States like Kentucky and Oklahoma offer matching funds for companies that receive SBIR awards, using an existing and rigorous vetting process to leverage state investments in companies. Matching SBIR funds help to bridge the gap between product development and the stages in which private capital sources are likely to contribute.

- Continue tax credits but realize that they only benefit profitable companies, and many R&D technology and R&D companies are not profitable in the short run as they develop technology.

Enhance opportunities to align university and nonprofit with industry and federal research. Currently a large portion of university and nonprofit research is focused on areas where Maine has a small percent of its employment. Other states have strengthened connections between industry and universities/nonprofits by funding industry-driven research collaboratives where an industry association or a group of companies works with research institutions. Other states encourage industry-university connections through industry-led grants that provide a company matching research funds for efforts involving universities and nonprofit institutions in the state. Both types of programs are led by the industry rather than the university.

Value: Increase the economic benefit resulting from R&D investments

Enhance support for entrepreneurial development activities that span from business creation through early stages of growth. The state should ensure that programs directed at the private sector have targeted services at each stage of business development so that companies can more quickly develop products and enter commercial markets. The most critical stage of a company is the early start-up where considerable time and resources have been put into developing product or service, but the business has not yet established a deep market presence. These services range from incubating start-ups, to helping with patent protection, to providing access to growth capital, especially as venture capital moves toward later-stage investments, leaving a gap in early-stage funding. Specific recommendations include:

- Provide increased financial assistance to established companies that are progressing on the commercialization of their research. One way to accomplish this is by providing reduced paybacks for companies that meet economic benchmarks at the MTI Development Award phase.
- Enhancing the amount of start-up capital available to companies that bridge the gap between product development funds (e.g., grants provided by MTI) and venture capital investments. This tends to be funding in the $500,000 to $2,000,000 range that is typically too small for most syndicated venture deals. Angel network development and state-supported seed funds are the most common programs used by other states. It would also be prudent to ensure that a portion of the proposed fund of funds legislation would be used for seed stage and early-growth companies.
- Ensuring that the incubation of companies provides start-up space and focused business development services that build the business savvy and experience of local entrepreneurs. The Maine Small Business Development Center provides

some limited support to technology companies but also to all sectors. It appears that more effort is needed to specifically help technology and R&D companies become established and grow. Existing technology-focused efforts include the state's Applied Technology Development Centers as well as past programs such as Maine Technology Institute's Tech Tracker program.

Enhance the economic impact from existing companies. While Maine's high-tech firms represent 5.9% of all firms, compared to 6.63% nationally, high-tech employment is only 3.5% of total state employment, compared to 7.15% nationally. This indicates a healthy start-up climate yet smaller than average number of employees per established firm. In addition, current levels of funding only allow less than 1.5% of Maine establishments to access state programs. While the state should continue its efforts to foster new start-ups, it also has a significant opportunity to grow existing technology businesses. Specifically, more effort is needed to serve the companies in the 25–50 employee size. Future investments in R&D should include a larger percentage for the programs that support the private sector. Investments in programs that provide technical assistance in commercialization have been shown here, and in other states, to increase the economic impact substantially compared to investment in research capacity alone.

3. Evaluation Results

This section details the answer to each of the five questions posed by this report and discusses the evidence obtained from the annual private sector survey, the survey of the R&D institutions, the case study on industry R&D, and the 2008 Innovation Index.[7]

Based on available information, the overall goal of reaching $1 billion in R&D activity by 2010, as stated in the 2005 Science and Technology Action Plan for Maine, is quite a stretch, given the current rate of growth. As noted in the Plan, considerable additional state investment will be required to reach the goal, especially in programs that are showing direct economic impact and leverage of other resources. In addition to the scale of R&D in Maine, the pace of progress and the resulting economic value will also need to increase in order to make the most out of our public investment.

3.1 Maine's Competitive Position

Overall, has Maine's public investment in research and development stimulated and sustained consistent, competitive growth in Maine's economy, especially when compared to other states?

Bottom Line: Maine appears to have increased overall R&D capacity, which has contributed to consistent growth in Maine's economy and has increased competitiveness relative to other states.

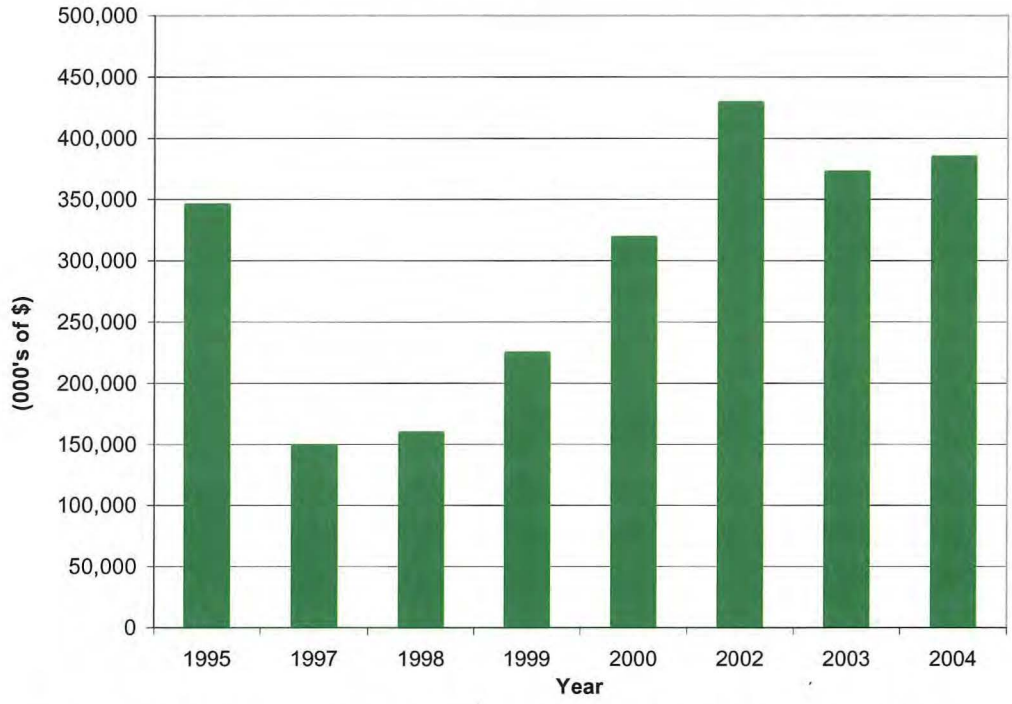
Supporting evidence: Supporting evidence in this question is divided into three categories: overall R&D capacity, data on economic growth, and comparative data to other states.

Total R&D Capacity: According to the National Science Foundation, Maine's total R&D capacity has increased from approximately $225 million in total R&D spending in 1999 to $384 million in 2004. This represents an increase of $159 million or 71% over the past five-year reporting period. During that same period, the State of Maine invested approximately $121 million of general funds into R&D efforts.

[7] The private sector survey instrument is included as **Attachment A** and the complete findings as **Attachment B**. The R&D Institutions Survey is included as **Attachment C** and the data as **Attachment D**. The case study is in **Section 5** of this report. The Innovation Index for 2008 is under separate cover.

Figure 3.1 shows progress toward this goal through 2004, the latest data available from the National Science Foundation.

Figure 3.1. Total R&D Spending in Maine, 1995–2004

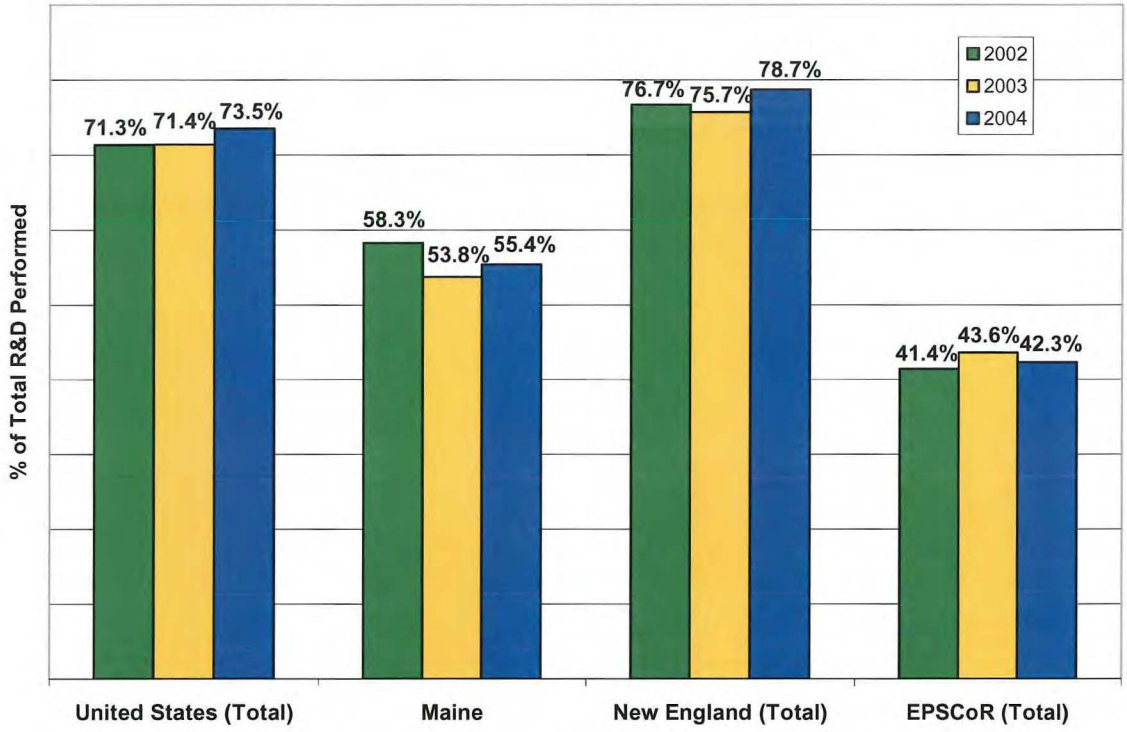


Sources: Total R&D Performed – National Science Foundation/Division of Science Resources Statistics; National Patterns of R&D Resources 2002 & 2004 Data Updates, derived from four NSF surveys: Survey of Industrial R&D; Survey of R&D Expenditures at Universities and Colleges; Survey of Federal Funds for R&D; and Survey of R&D Funding and Performance by Nonprofit Organizations. http://www.nsf.gov/statistics

Note: From 1997–2000 & 2002–2004, chart portrays one-year increments; all other years are in two-year increments.

Maine's R&D environment is unusual in that a large portion of the R&D is performed by nonprofit research institutions. **Figures 3.2** through **3.4** show the relative importance of the three types of R&D performers in Maine. Industry has a larger role in the state's R&D than in other EPSCoR states but lower than the United States and New England as a whole.

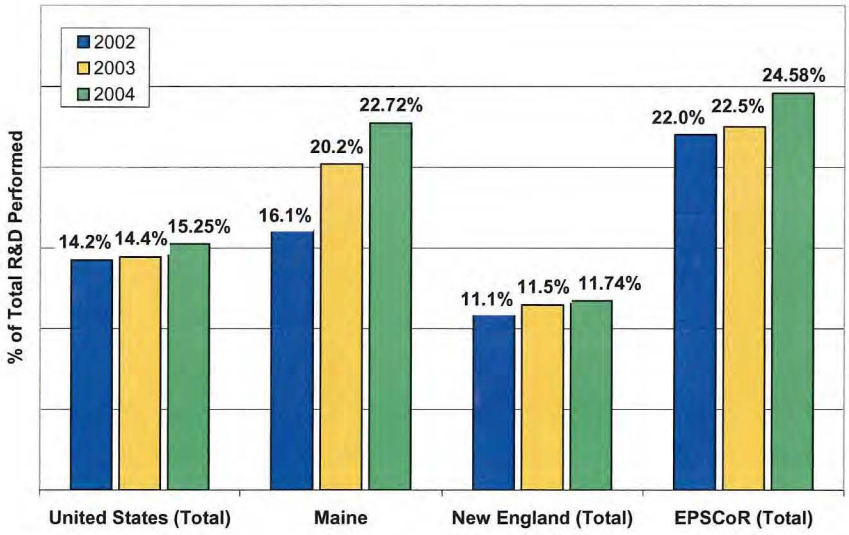
Figure 3.2. Industry R&D as a Percent of R&D Performed, 2002–2004



Source: Industry R&D Performed – National Science Foundation/Division of Science Resources Statistics, Survey of Industrial Research and Development: 2001 and 2002, 2002–2003 forthcoming. http://www.nsf.gov/statistics

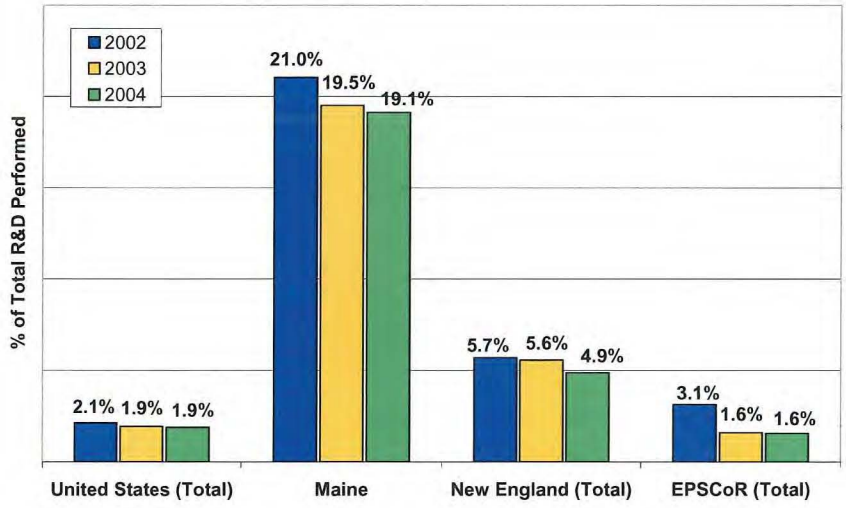
Figure 3.3 shows a faster increase in Academic R&D as a percent of total R&D, especially when compared to the rate of growth experienced in the United States or in the other EPSCoR states. **Figure 3.4** indicates the importance of nonprofit R&D to Maine. While the total percent of nonprofit R&D has declined over the past several years, it still is approximately eight times greater than the U.S. or EPSCoR average.

Figure 3.3. Academic R&D as a Percent of R&D Performed, 2002–2004



Source: National Science Foundation/Division of Science Resources Statistics; Survey of R&D Expenditures at Universities and Colleges 2003 & 2004; http://www.nsf.gov/statistics.

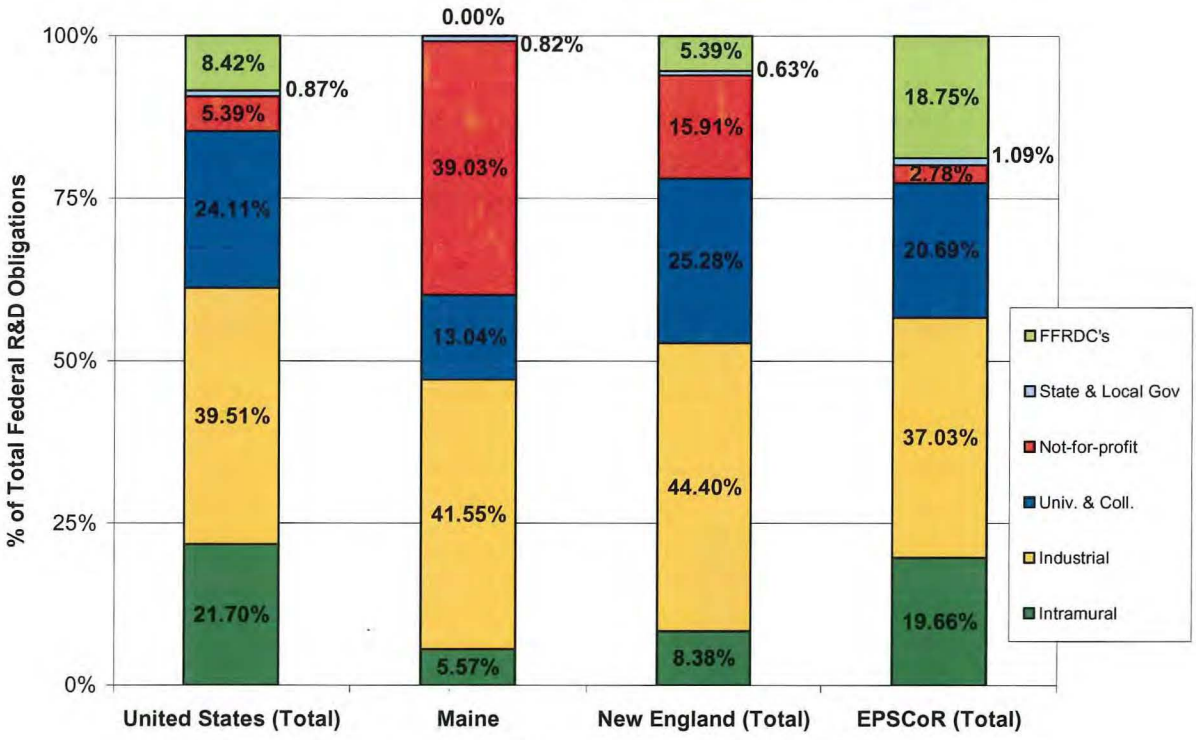
Figure 3.4. Nonprofit R&D as a Percent of R&D Performed, 2002–2004



Source: Not for Profit R&D Performed – 1987–2001 from National Science Foundation/Division of Science Resources Statistics; National Patterns of R&D Resources 2002 Data Update, derived from Survey of R&D Funding and Performance by Nonprofit Organizations; 2002 & 2003 from National Science Foundation/Division of Science Resources Statistics, Survey of Federal Funds for Research and Development: Fiscal Years 2002, 2003, 2004, and 2005. http://www.nsf.gov/statistics

The federal government is a major funder and plays a critical role in spurring R&D. **Figure 3.5** illustrates how federal R&D dollars are distributed among various sectors. Again, nonprofit R&D received a disproportionate share of federal funds compared to other states, and Maine industry received slightly more than the U.S. and EPSCoR averages.

Figure 3.5. Federal Obligations by Performance Sector, 2004



Source: Federal R&D Obligations – National Science Foundation/Division of Science Resources Statistics; Survey of Federal Funds for Research and Development: Fiscal Years 2003, 2004, and 2005. http://www.nsf.gov/statistics

From 2002 through 2006, Maine invested $173 million in R&D. **Table 3.1** shows how these investments support industry, university, and nonprofit R&D in the state over a five-year period from 1999–2004[8], and compares these figures with the growth in each R&D sector. The performance of all R&D sectors in Maine outpaced the national growth in R&D during that same period.

While Maine has invested 53% of new R&D in the universities in this five-year period, the universities are still only 22% of the total R&D. Conversely, while the state has invested 22% in industry R&D through private sector-focused programs, industry performs over 55% of the state's R&D. The nonprofit sector receives 25% of funding and accounts for 19% of the total research.

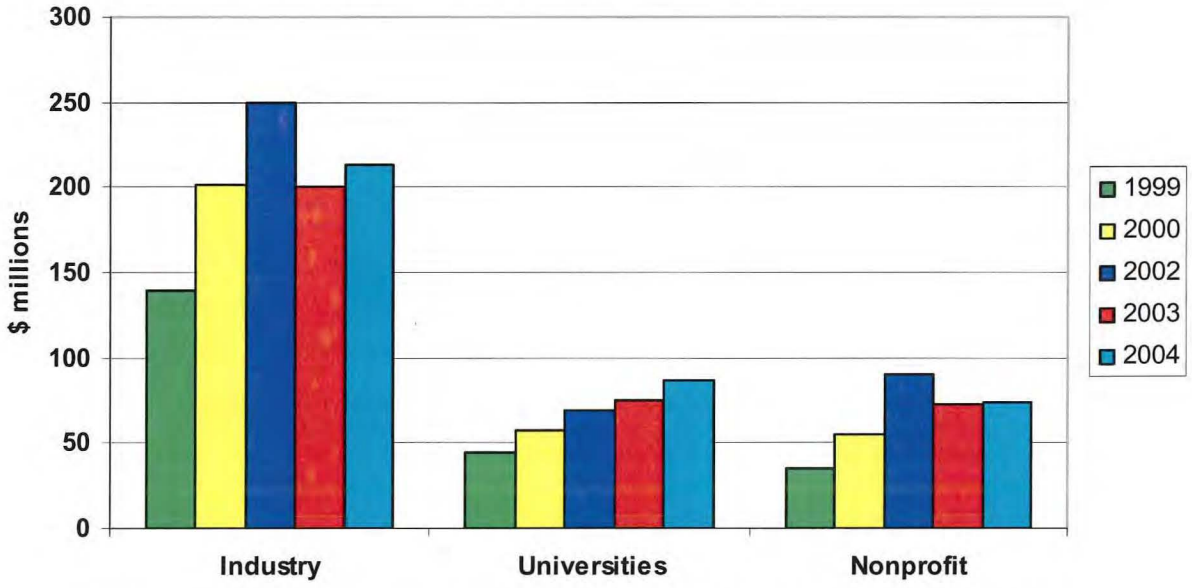
[8] 2004 was the last year that the National Science Foundation reported R&D performance by state; therefore, state budgets for the same period were used to consistently compare data.

Table 3.1. Five-Year Comparison of Public Investment (1999–2004) and Performance of R&D (1999–2004)

	% of Maine Public Investment in R&D 1999–2004	% of Performance of R&D, 2004	Maine % Change in Performance of R&D, 1999–2004	U.S. % Change in Performance of R&D, 1999–2004
Industry	22%	55.4%	56%	3%
Academia	53%	22%	96%	37%
Nonprofit	25%	19.1%	111%	40%

While it is hard to directly correlate investment and performance in each sector, survey results from companies, universities, and nonprofits indicate that state investment assisted their gains in R&D performance. A summary of the most recent five-year growth is shown in **Figure 3.6**.

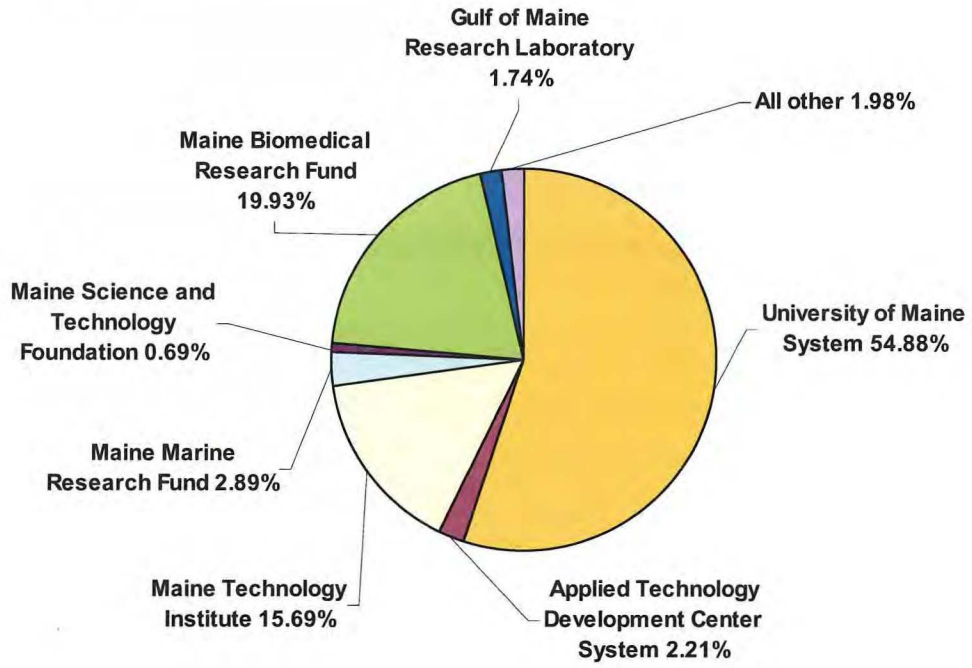
Figure 3.6. Maine's Five-Year R&D Trend by Sector



Sources: Total R&D Performed – National Science Foundation/Division of Science Resources Statistics; National Patterns of R&D Resources 2002 & 2004 Data Updates, derived from four NSF surveys: Survey of Industrial R&D; Survey of R&D Expenditures at Universities and Colleges, Survey of Federal Funds for R&D, and Survey of R&D Funding and Performance by Nonprofit Organizations. http://www.nsf.gov/statistics

Figure 3.7 shows the distribution of R&D investments by major program areas over the past five years. While some programs serve a combination of industry, university, and nonprofit clients, most are concentrated on one primary sector. The University of Maine receives the most funding, followed by the Maine Technology Institute and the Biomedical Research Fund.

Figure 3.7. Maine State Funding for R&D by Program FY2002/03 – FY2006/07



Source: PolicyOne Research from data provided by the Maine Legislature, Office of Fiscal & Program Review. National Science Foundation/Division of Science Resources Statistics; National Patterns of R&D 1999–2004; http://www.nsf.gov/statistics. Data for 2001 was not available.

Economic Growth: The economic growth of R&D investments can be evaluated directly through the companies served by state R&D investment and by national statistics used to evaluate innovation and R&D performance. Using data collected from the companies receiving services from state-supported programs, Maine's investment in specific private sector R&D assistance is showing very positive results and validates the state's investment in the R&D economy.

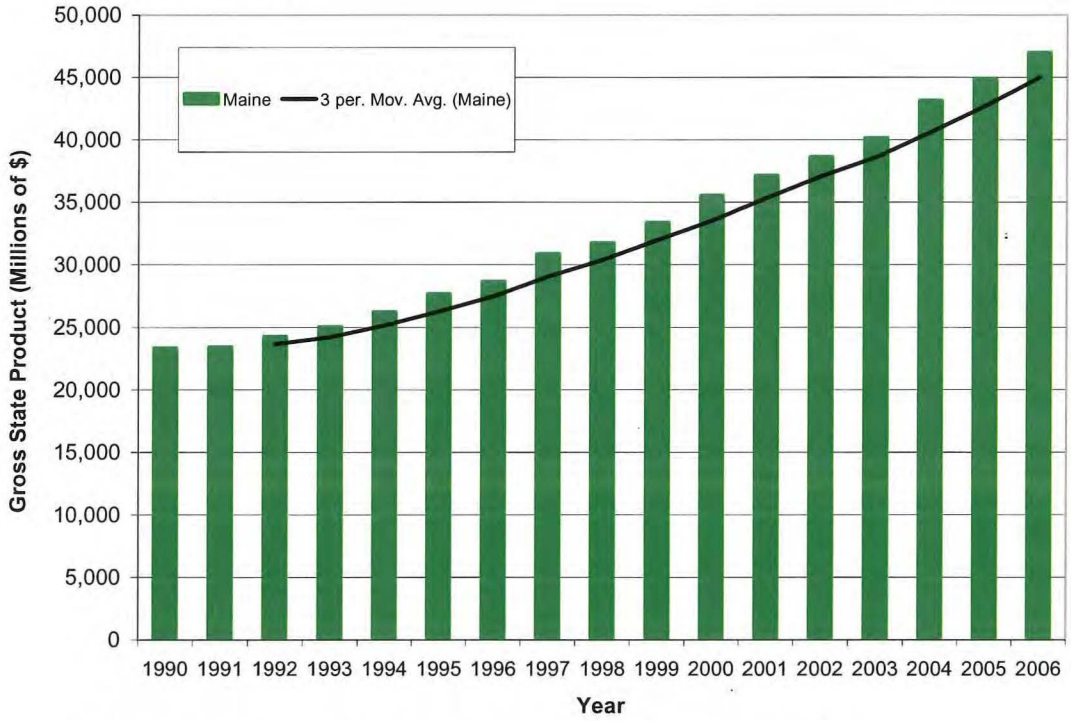
An economic impact[9] study on the companies served by state programs shows that state R&D investment was leveraged almost 18 times. Maine invested $5,586,406 in 2007 in 800 private grants that leverage $63,199,439 of direct impact, as well as $19,420,596 in indirect impact and $18,217,613 of induced impact for a total of over $100 million. In addition, 441 direct and 180 indirect jobs were created by companies receiving state

[9] An Economic IMPLAN model was used to calculate the leveraged impact of state investment.

assistance. While the return on public investment is high, only 20% of all state R&D funds were directed to the private sector and, as a result, only 800 firms or 1.6% of Maine's establishments were served.

National data on economic growth. One way to understand the impact of these investments is to compare Maine's overall economic progress relative to the other EPSCoR states and the rest of the United States. **Figure 3.8** shows the growth in Maine gross state product (GSP), with a steady increase of 52.16% from 1996–2006. This growth rate is slightly higher than the overall GSP growth for New England (51.88%) during the same period, yet is below the 59.45% growth rate for EPSCoR states and the 59.61% growth rate for the United States. From 2005–2006, however, Maine experienced a growth rate of only 4.6% while New England GSP grew at 5.24%, EPSCoR states at 6.67%, and the United States at 6.2%.

Figure 3.8. Gross State Production in Maine – 1990–2006 (millions of current dollars)

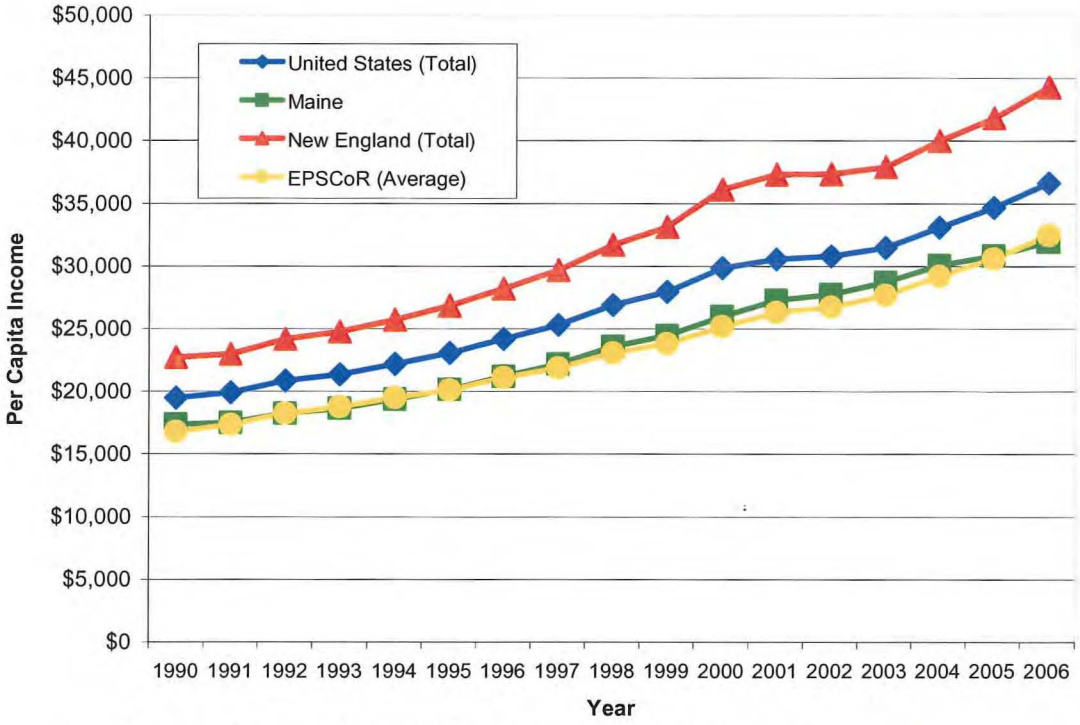


Source: Bureau of Economic Analysis, U.S. Department of Commerce, 1980–1996 data; and Revised Estimates for 1997–2006; http://www.bea.gov/regional/gsp/; 1997–2006 is based on NAICS while 1980-1996 is based on SIC industry classification.

An essential indicator of economic growth is per capita income. Yet the overall state investment for R&D is a small fraction of the total state budget and economic activity of the state, making it difficult to correlate this investment with per capita income changes. With that said, tracking per capita income is still important. In 2006, Maine's average per

capita income was $31,931, which fell slightly below the EPSCoR states' level of $32,476 and below the U.S. average of $36,629. **Figure 3.9** shows per capita income in Maine as compared to the United States, EPSCoR states, and the other New England states. Maine and other EPSCoR states have shared an almost identical trend line for the past 10 years, with an average income approximately 88% of the U.S. average. While the gap between the U.S. and Maine income began to close in 2002 through 2004, the past few years indicate a slight widening of that gap.

Figure 3.9. Per Capita Income 1990–2006 (actual dollars)

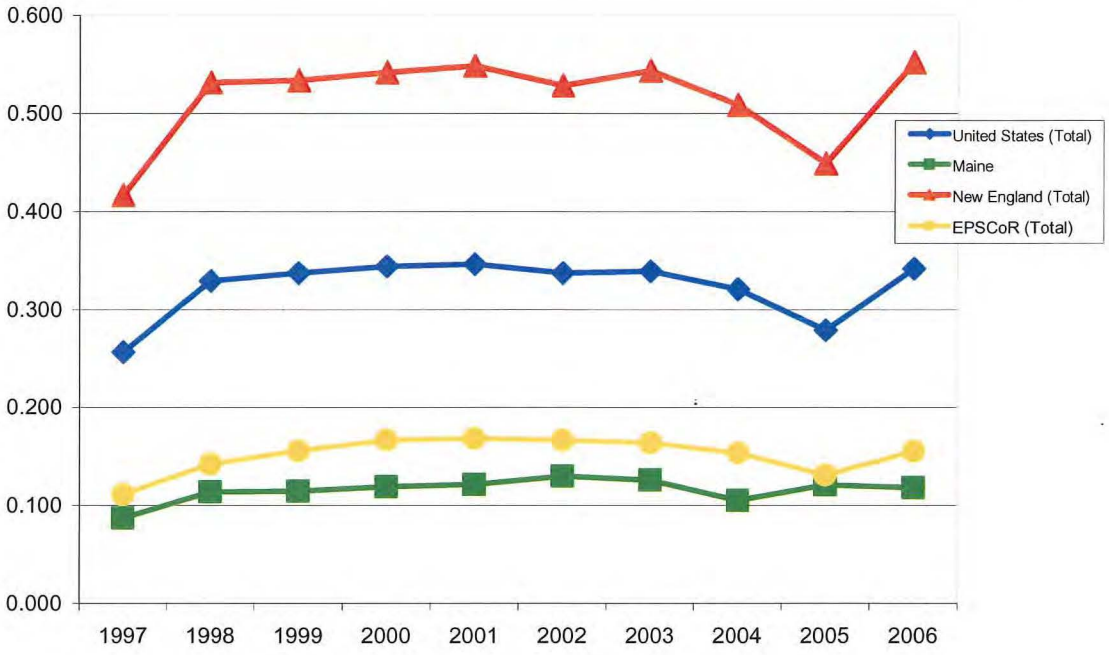


Source: Bureau of Economic Analysis, U.S. Department of Commerce; http://www.bea.gov

Note: All dollar estimates are in current dollars (not adjusted for inflation). Revised state personal income estimates for 2004–2006 were released September 20, 2007.

Patents are often used as one measure of knowledge creation. In 2006, 156 patents were issued to Maine individuals and organizations, with four of those patents issued to the University of Maine. The total number of patents has decreased slightly from 2005 levels (159 patents) and 2002 levels (168 patents). **Figure 3.10** shows that in the past 10 years, the trend line for patents has been relatively flat with a decrease in patents in 2004 and 2005. This has held true for the United States, New England, EPSCoR states, and Maine, except in 2005 when Maine patents per 1,000 residents increased while others decreased. In 2006, the United States and New England saw a significant increase in patents issued while Maine patent production remained constant.

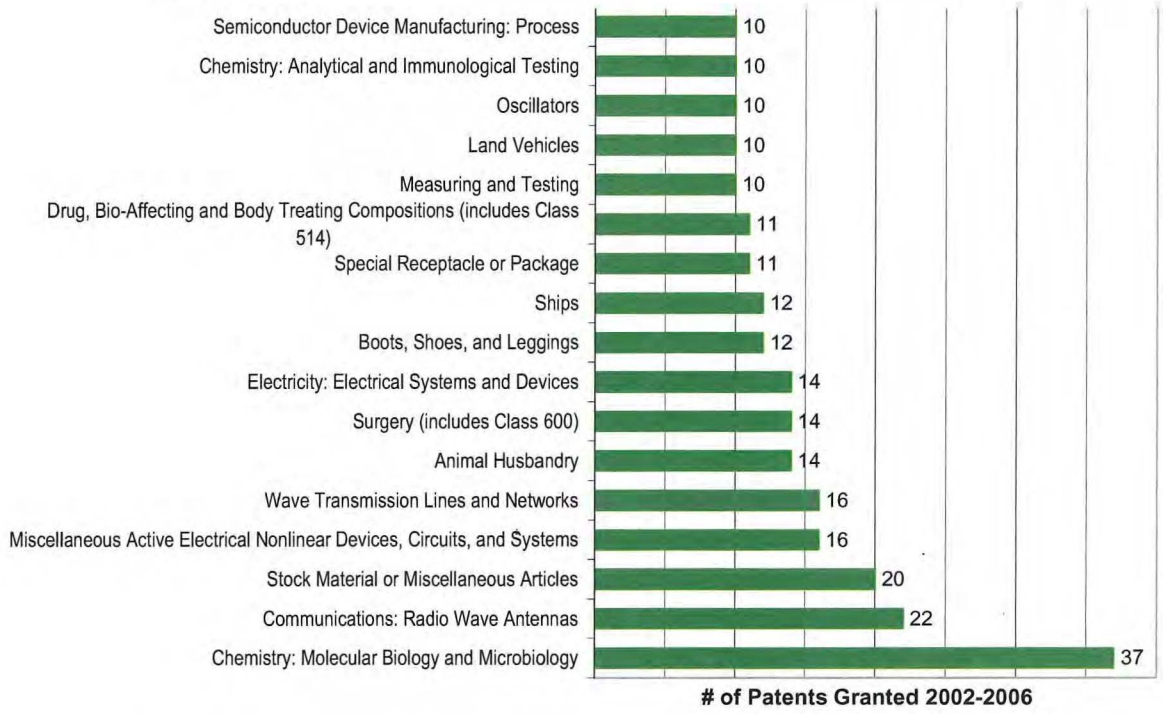
Figure 3.10. Patents Issued per 1,000 Residents in Maine 1997–2006



Source: Patents – Patent Counts by Country/State and Year, All Patents, All Types, January 1, 1977–December 31, 2006; by Calendar Year; US Patent and Trade Mark Office, August 2006. http://www.uspto.gov/

Our understanding of the growth of knowledge in Maine is enhanced by a review of the classes of patents issued in the state in the past four years. As shown in **Figure 3.11**, most patents were issues in areas related to electronics and biology and environmental technologies, with a smaller percent to transportation and consumer products. The number of patents in Chemistry, Molecular Biology, and Microbiology (37), a category that crosses multiple Maine industries, far exceeds the numbers in any other category.

Figure 3.11. Utility Patents Issued by Technology Class in Maine – 2002–2006



Source: Patenting by Geographic Region (State and Country), Breakout by Technology Class, 2002–2006 Utility Patent Grants by Calendar Year of Grant, US Patent and Trademark Office; www.uspto.gov

3.2 Maine's University Research Capacity

Has Maine's investment in public and private university R&D led to increased research capacity; the development of an educated, technically skilled workforce; and increased commercialization of university technologies?

Bottom Line: Universities have increased their total R&D, while the number of science and engineering graduates has slightly declined over five years and commercialization of research remains lower than national averages.

Over the past five years (since the 2002/03 budget), Maine has allocated over $101 million or 55% of state R&D investments in universities. The universities funded by

Maine R&D programs and included in the annual evaluation survey consist of the following institutions:

- Maine Maritime Academy
- University of Maine, Machias
- University of Maine, Orono
- University of New England
- University of Southern Maine

The R&D capacity in Maine jumped significantly in totals reported to the National Science Foundation, growing from approximately $75 million in 2002 to almost $120 million in 2006.[10] However, Maine universities reporting under this evaluation noted that many specific categories were down slightly from the previous year.

- Universities noted just over $45 million in R&D expenditures, down 3% from last year's $46 million R&D total.
- While the total square feet of research space rose by more than 50% from 2002 to 2006, universities reported an 11% decline in research space from last year's evaluation of the same institutions: 968,321 square feet reported this year, compared to 1,088,821 a year ago.
- The number of new federal grants and contracts received increased by 4%, while the dollar value of those awards decreased by 22%.
- Fewer industry grants and contracts were reported despite long-term trends indicating that the number and value of industrial and new foundation grants was steadily increasing since 2002. This year's survey reported an industry contract total of $2.79 million compared to $4.32 million last year.
- On the positive side, the number of EPSCoR awards increased from one award in last year's survey to four awards this year.

The specific metrics attributable to state R&D investment reported by the universities in 2007 also had mixed results when compared to the previous year.

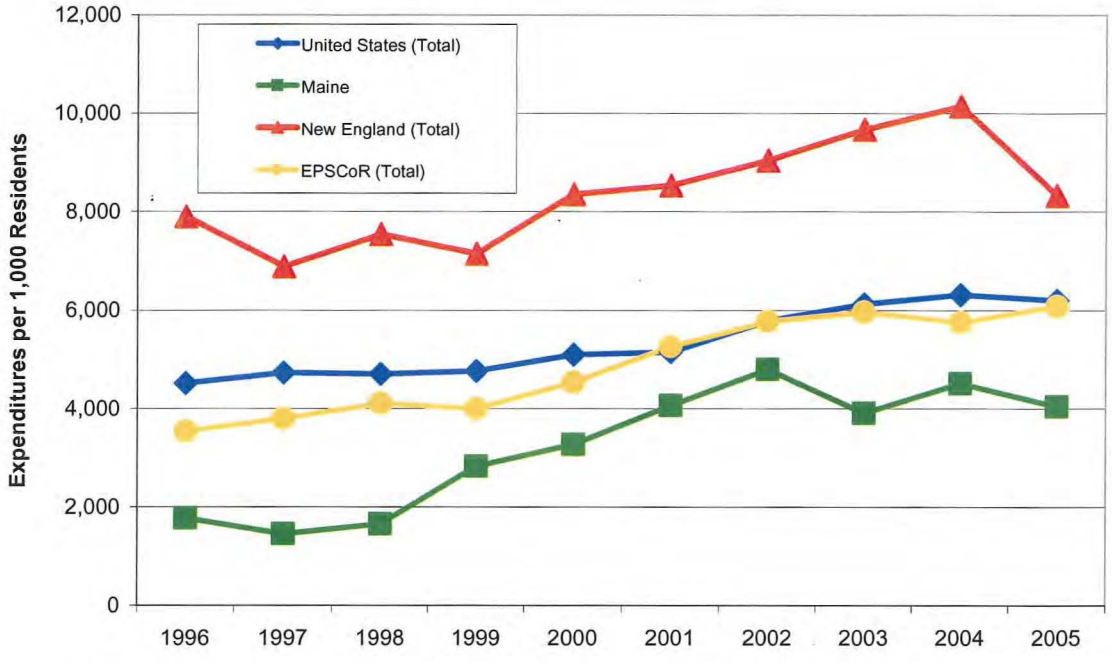
- In 2007, 622 science graduate students and 3,784 undergraduate students enrolled, compared to 530 graduate and 2,675 undergraduate students reported in the 2006 evaluation.
- In 2007, $2,404,052 in new major research equipment, compared to $2,807,857 in 2006
- Peer-reviewed publications were generally down over 20% from the previous year.

[10] The report uses the latest data from the National Science Foundation; therefore, not all data is reported for the same year.

- The number of federal research grants and contracts was up 56% over last year, and the dollar amount of $56,156,000 was an increase of almost 40% over 2006 levels.
- 18 disclosures, 10 patents applied for, and 3 patents awarded, which was on par with previous years. Yet licenses and license revenues rose to four new licenses and $500,000 in license reviews.

Building R&D capacity at universities requires investment in facilities and infrastructure. **Figure 3.12** tracks the research equipment expenditure at universities and colleges. From 1997 through 2002, Maine's investment in R&D equipment outpaced the United States and EPSCoR states. Yet over the past several years, Maine's research equipment investment has experienced slight ups and downs. In 2005, Maine invested $4,000 per 1,000 residents in research equipment while the United States and EPSCoR states invested $6,000 per 1,000 residents.

Figure 3.12. Research Equipment Expenditures at Universities and Colleges per 1,000 Residents, 1996–2005



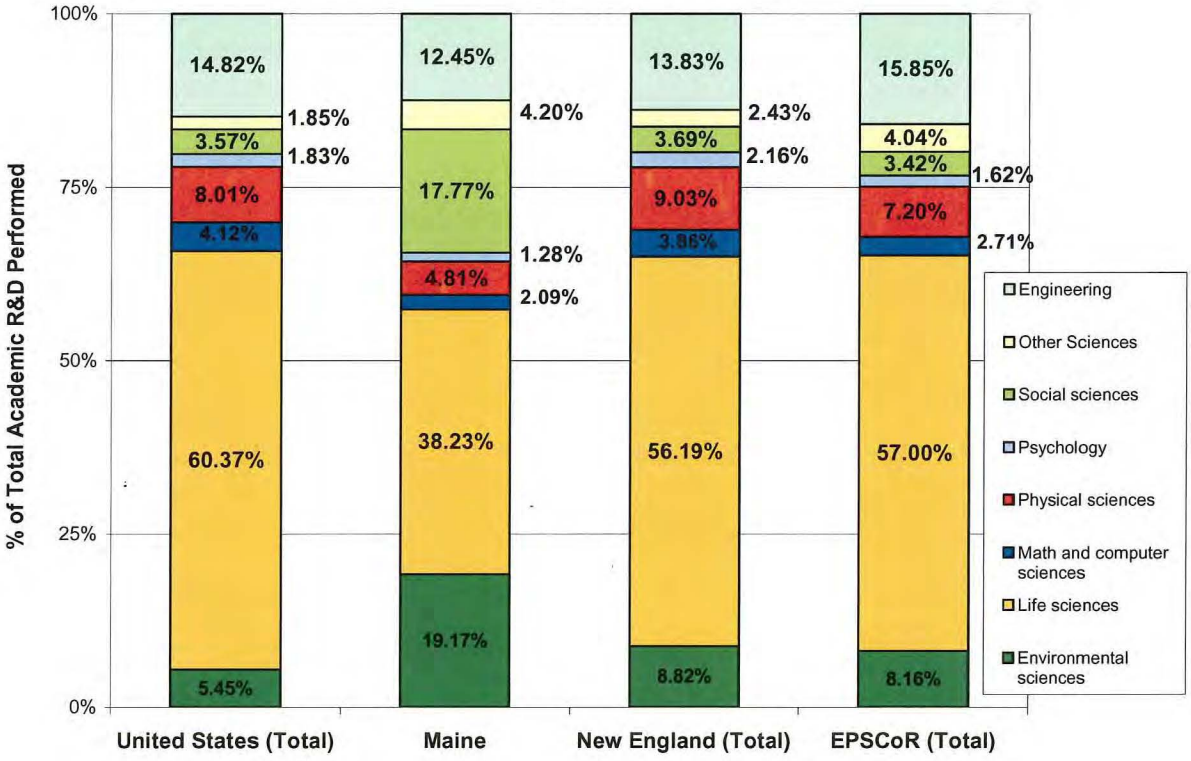
Source: Research Equipment Expenditures – National Science Foundation, WebCASPAR Database System from "Survey of Research and Development Expenditures at Universities and Colleges," http://webcaspar.nsf.gov.

A state's academic research tends to be clustered in specific fields, much like industry clusters that are unique to states and regions. Therefore, comparison of research fields with other states is less about performance and more about unique specialization that could be a precursor to new economic activity. **Figure 3.13** shows that Maine's academic research is much more concentrated in environmental sciences and social sciences than

other comparative regions. Since Maine is actively pursuing industry growth in environmental and energy industries, connecting this research to commercial undertakings will be critical.

While life sciences remains the largest filed of study, it is a smaller percent of all research when compared to the United States or other EPSCoR states. Computer science and engineering research fields have smaller concentrations than other states, which does not correspond with the high concentration of Maine's technology industries in this field.

Figure 3.13. Academic R&D by Field of Study, 2006



Source: University & College R&D Performed – National Science Foundation/Division of Science Resources Statistics; Survey of R&D Expenditures at Universities and Colleges 2006. http://www.nsf.gov/statistics

Commercialization of research: Maine's research universities are below but slowing gaining ground on national averages for production of intellectual property (IP) from research. In this year's survey to universities, 19 invention disclosures, three patents, and one start-up were recorded, which is within the lowest end of the range of average university technology transfer performance.

Table 3.2 projects the levels of commercialization that might occur in Maine if universities were performing at the same level as the average for the 189 universities that report technology transfer activity to the Association of University Technology Managers

(AUTM). The table takes AUTM averages and predicts performance based on two sets of data: the total reported to the National Science Foundation for all Maine universities and the subset of R&D reported through the evaluation surveys each year.

Data indicate that the universities underperform for both sets of predicted results, suggesting that while overall R&D is increasing, the commercialization of research had not kept pace with this level of growth. AUTM and other national research has demonstrated that the level of technology transfer outcomes (e.g., patents, licenses, and revenues) is directly correlated with a systematic focus on technology transfer and the amount of budget allocated to staff and patent expenses.[11]

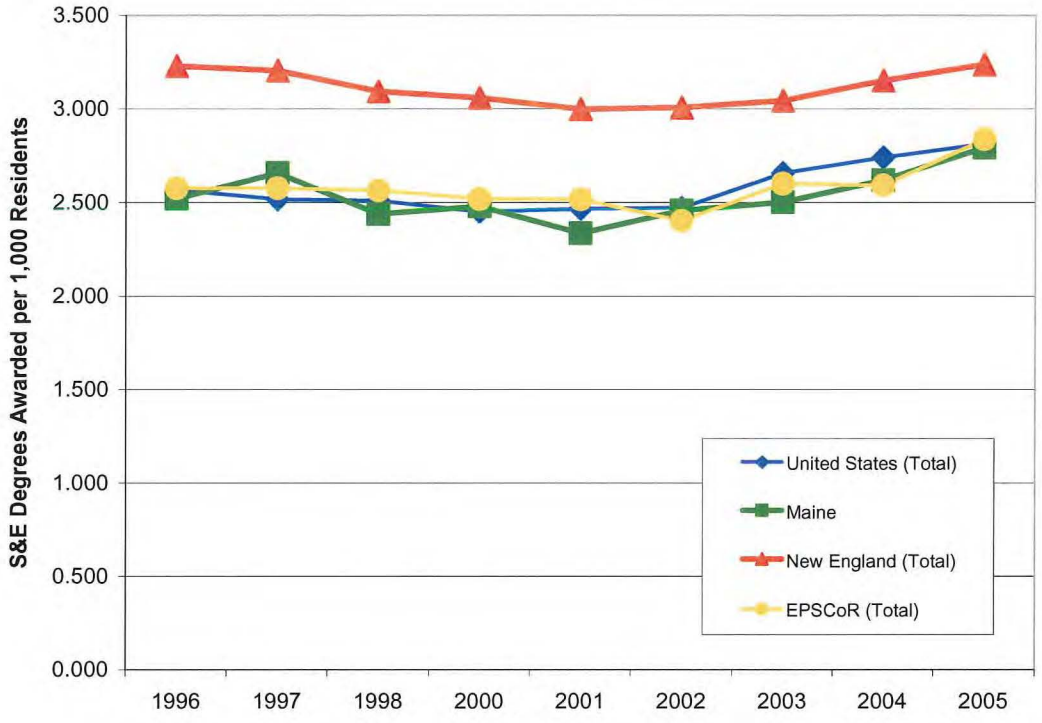
Table 3.2. Predicted and Actual Technology Transfer Metrics for Maine Universities

	Average U.S. for universities, hospitals, and nonprofit inst.	Predicted for all Maine universities based on NSF data reported for universities	Predictions based on the total R&D reported in evaluation survey to universities	Actual for Maine based on evaluation survey totals
Invention disclosures	$2.4m in R&D expenditure per disclosure	50 disclosures	21 disclosures	18
Patents filed	$2.8m in R&D expenditure per filed patent	42 patents	16 patents	6
Licenses	$9.14m in R&D expenditure per license	13 licenses based on survey reporting	5 licenses	4
Start-ups	$82m in R&D expenditure per start-up	1.5 start-ups per year	<1 start-up	1

Maine's science and engineering workforce: Universities contribute to the skills and education of the workforce in many ways. One contribution is the preparation of students to enter science and engineering fields that drive the innovation of most industries. In 2005, Maine awarded 3,681 degrees in science and engineering fields, with master's degree or doctorate representing 15% of those degrees. When the number of degrees per 1,000 residents is compared to EPSCoR and the United States, Maine is very competitive **(Figure 3.14).**

[11] Siegel, D., D. Waldman, and A. Link.2003. "Assessing the impact of organization practices on the relative productivity of university technology transfer offices: An exploratory study." *Research Policy* 32: 27-43.

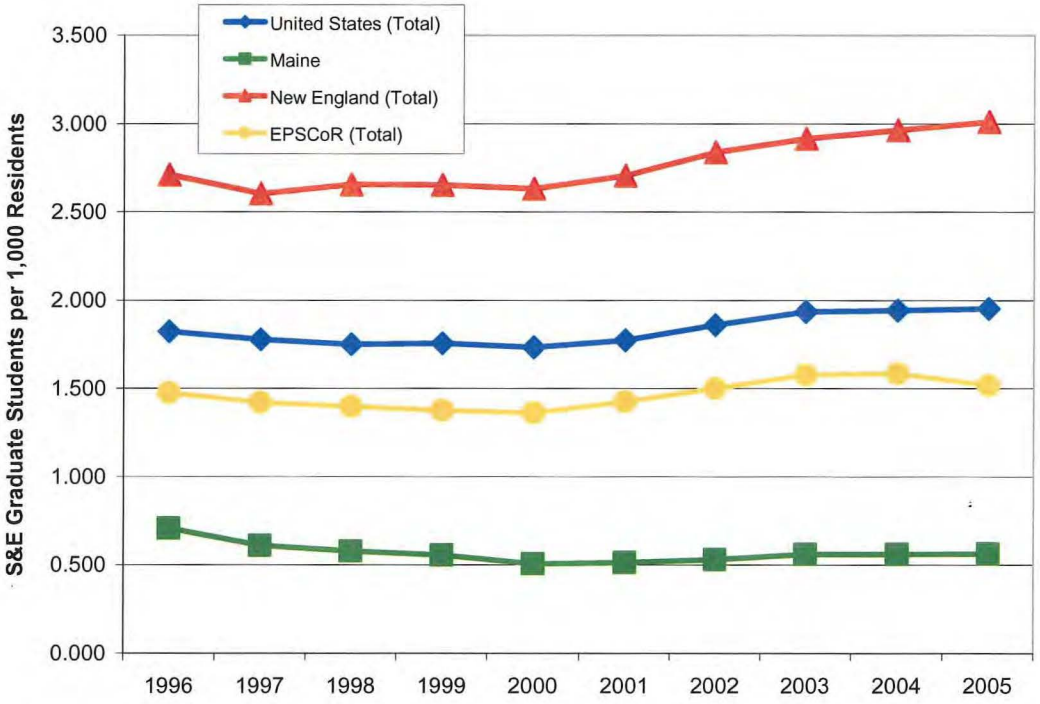
Figure 3.14. S&E Degrees Awarded per 1,000 Residents 1996–2005



Source: S&E Degrees Awarded – Extracted from NSF WebCASPAR Database System, http://webcaspar.nsf.gov, based on the Higher Education General Information Survey and Integrated Post-Secondary Education Data System, National Center for Education Statistics, U.S. Department of Education, www.nces.ed.gov. (Data for 1999 was unavailable.)

While Maine's overall science and engineering enrollment is competitive with other states, graduate-level study is much less competitive than other states. As shown in **Figure 3.15**, the number of students enrolled in graduate-level science and engineering fields has remained flat over recent years and at levels two to three times lower than EPSCoR or U.S. averages. The number of degrees awarded rose to 533 in 2005, yet was only a 5% increase over 2002 levels.

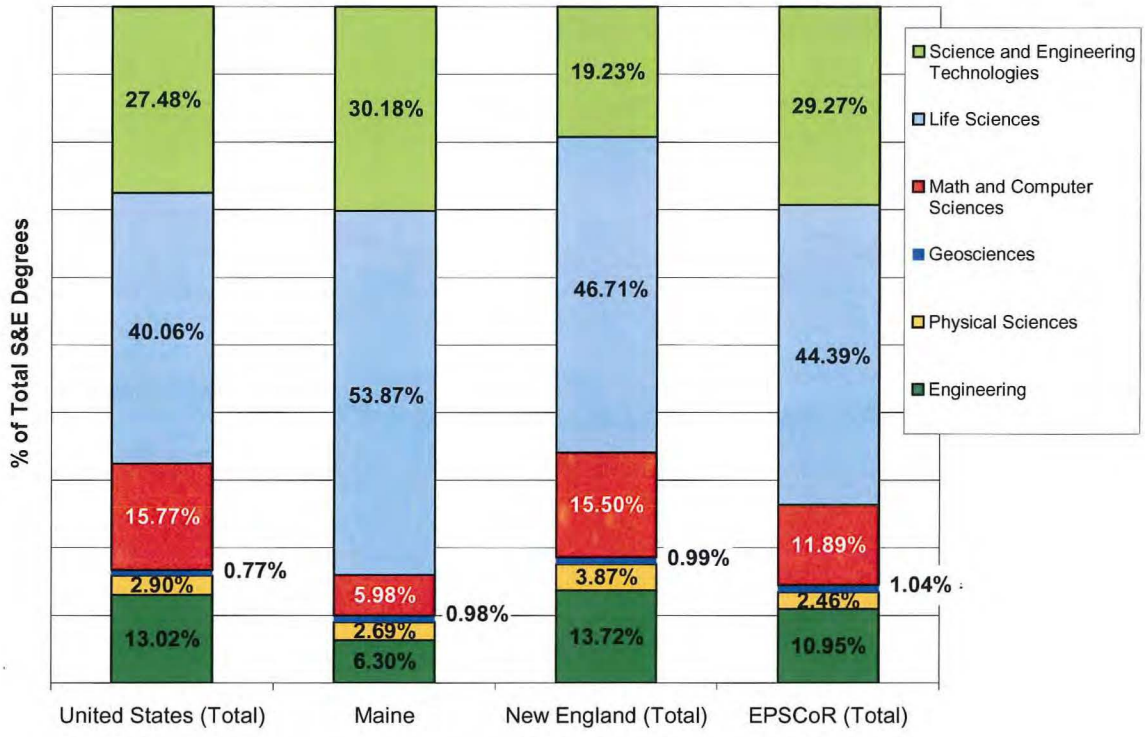
Figure 3.15. Science and Engineering Graduate Enrollments per 1,000 Residents, 1996–2005



Source: S&E Graduate Students – NSF WebCASPAR Database System based on "Survey of Graduate Students and Postdoctorates in Science and Engineering," National Science Foundation and National Institutes of Health. http://webcaspar.nsf.gov

Preparation for Maine's workforce can be enhanced when science and engineering degrees are consistent with the types of industries employing these graduates. **Figure 3.16** indicates that Maine is producing a large number of life sciences graduates, but a small number of engineers, mathematicians, and computer scientists. This is problematic given the strength of the engineering and information technology sectors in the state.

Figure 3.16. Science & Engineering Degrees by Discipline, 2005



Source: S&E Degrees Awarded – Extracted from NSF WebCASPAR Database System, http://webcaspar.nsf.gov, based on the Higher Education General Information Survey and Integrated Post-Secondary Education Data System, National Center for Education Statistics, U.S. Department of Education, www.nces.ed.gov. (Data for 1999 was unavailable.)

3.3 Maine's Nonprofit Research Institutions

Are Maine's investments in nonprofit research institutions broadening their impact on Maine's economy?

In the past five years, Maine has invested $35,000,000 in nonprofit institutions, representing about 24% of all state R&D investment. The following institutions received funds from various state-supported programs and were included in the survey to nonprofit institutions:

- Bigelow Laboratory
- Downeast Institute for Applied Marine Research

- Foundation for Blood Research
- Gulf of Maine Research Institute
- Jackson Laboratory
- Maine Institute for Human Genetics and Health
- Maine Medical Center Research Institute
- Mount Desert Island Biological Laboratories
- Wells National Estuarine Research Reserve

Maine's investment in this sector continues to benefit the institutions involved, but has not made the hoped-for broader impacts on Maine's technology industry. Inputs into nonprofit research (dollars, facilities, and people) continue to increase, while the outcomes (industry contracts, intellectual property, spin-off companies) have been slower to develop.

In 2007, the results attributable to state R&D investments to the nonprofit research institutions included the following:

- $73,318,961 in R&D expenditures, which is comparable to the amount reported the previous year
- $1,189,644 in new research equipment and over 90,000 square feet of research space, both up 25% from 2006 reporting
- 217 new extramural proposals submitted for a total of $159 million, up 15% in the number of proposals and 49% in the dollar value compared to the previous year
- 54 research jobs, representing a 64% increase from 2006
- 218 scientific, peer-reviewed journal articles, books, and book chapters, down 8% from 2006 levels
- 76 new federal grants and contracts received for a total of $76 million, representing an increase over 2006 of 46% in the number of awards and 131% in the dollars awarded
- Industry contracts down significantly: 33% fewer contracts and more than 90% decrease in the amount of industry contracts
- 19 disclosures, nine patents applied for, and two patents granted, which was slightly higher than 2006 levels
- 10 licenses granted in 2007, which was a 400% increase over 2006, yet only two of those licenses were with Maine companies
- No new spin-off companies or jobs

Our concern with this sector remains its limited impact on Maine's economy beyond the direct jobs it provides. Since this sector has limited interactions with the private, research-intensive companies in the state (only 42 research projects with Maine companies reported this year for $4.1 million, 4% of total R&D performed this year), the opportunity for informal technology transfer is minimized. Similarly, although the sector has made some improvements in its formal technology transfer capacity, its production of invention disclosures, patents, and spin-off companies is extremely limited given the large volume of research being performed. This is shown in **Table 3.3**.

Table 3.3. Predicted and Actual Technology Transfer Metrics for Maine Nonprofit Research Laboratories

	Average U.S. for Universities, Hospitals & Nonprofit Inst.	Predicted for all Maine universities & nonprofits based on NSF data for Maine nonprofits	Predictions based on the total R&D reported in evaluation survey to nonprofits	Actual for Maine based on evaluation survey totals
Invention disclosures	$2.4m in R&D expenditure per disclosure	31 disclosures	38 disclosures	19
Patents filed	$2.8m in R&D expenditure per filed patent	26 patents	33 patents	9
Licenses	$9.14m in R&D expenditure per license	8 licenses	10 licenses	10
Start-ups	$82m in R&D expenditure per start-up	1 start-ups	1 start-up	0

Source: AUTM 2006 survey data was used to calculate U.S. averages for university, hospital, and nonprofit institutions. Predictions for Maine were calculated using AUTM averages and reported R&D expenditures in the current survey of nonprofits ($93 m) and the total reported to NSF ($74 m). Actual for Maine was determined by the same survey results.

3.4 Maine's Research-intensive Companies

Is Maine fostering the growth of research-intensive companies, increasing private sector R&D activity, and building a technology-based entrepreneurial community?

Bottom Line: Maine's private sector has increased R&D capacity, and state investment in R&D has directly led to the creation of new jobs and businesses with above average wages.

In the past five years, Maine's investment in private sector programs has been approximately $31 million or nearly 20% of state funding. The majority of funds have been allocated to three programs:

- Maine Technology Institute (MTI)
- Maine Biomedical Research Fund
- Maine Patent Program

In addition, previous state appropriations continue to help private sector companies through:

- Advanced Technology Development Centers (ATDC)
- Finance Authority of Maine (FAME)
- Maine Aquaculture Innovation Center (MAIC)
- Maine Space Grant Consortium (MSGC)
- Small Enterprise Growth Fund (SEGF).

The private sector survey data reveal that Maine continues to support the growth of research-intensive companies through these programs. Eight hundred companies have received assistance from one of these entities in the last five years, and 36.7% have worked with more than one of these stakeholders. Fifty-four percent of the companies responded to the annual survey.[12]

As in previous years, the respondent companies are primarily small (63% have less than 10 employees), with 16% started in the last several years and almost 50% since 2000. They are close to evenly distributed by sector, ranging from 10.7% in environmental technology to 20.6% precision manufacturing. The companies are located in all counties in Maine, with the predominant number in southern Maine (37.9%). Most of the companies who responded (57.4%) have annual revenues of less than $500,000.

Companies participating in state R&D programs create new wealth for Maine. More than half of participating companies had 90% or more of their sales outside the state of Maine. While almost 80% sold internationally, the majority of international sales accounted for less than 10% of total sales.

Entrepreneurial Environment: State investments in R&D and innovation are intended, among other things, to spur the formation or growth of new companies. In the survey results of private sector firms receiving awards from state R&D programs, 20% had been established from 2005–2007 and 35% from 2000–2004. This indicates a healthy growth of new firms with R&D capacity. The Kauffman foundation recently ranked Maine 13th

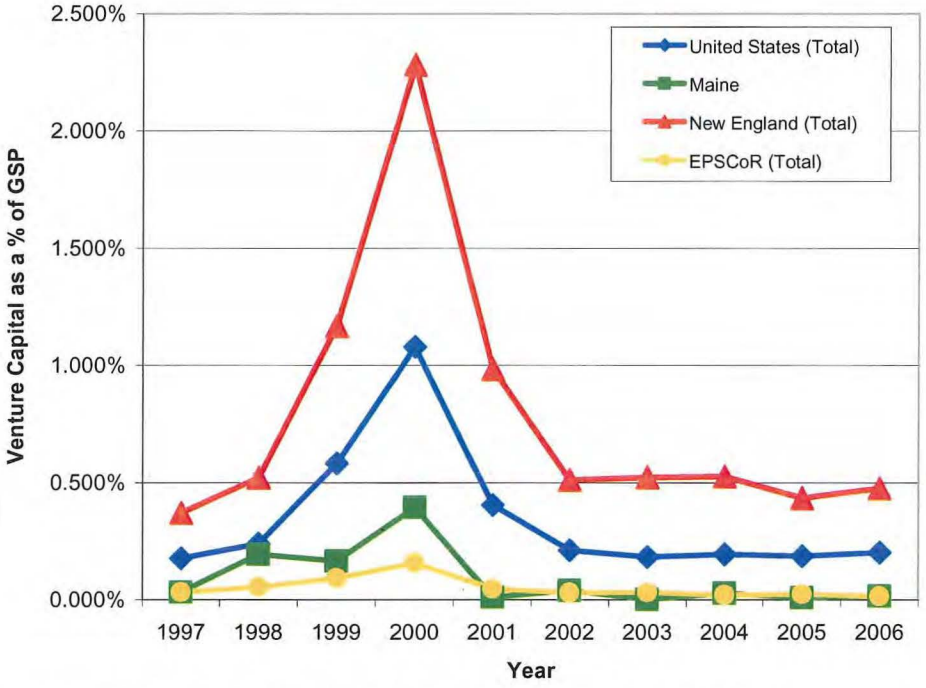
[12] The survey instrument itself and complete findings from the survey are included in **Attachments A** and **B**, respectively.

in terms of entrepreneurial activity as measured by business starts by persons not previously owning a business.

Another measure of the viability of the research-intensive sector in Maine is the ability of the companies to attract new capital, either debt or equity. There is specific evidence that companies using Maine R&D programs are increasing their competitive edge. Maine is attracting more venture capital in 2006 than in 2005. The number of venture capital deals increased from two to four and the total investment rose from $4.5 million in 2005 to $7.6 million in 2006. More specifically, the companies participating in Maine R&D programs experienced the same trend. While a small percent of all companies receive equity funding (nationally, the average is less than 2–3%), approximately 7.5% of survey respondents received equity funding from angel, venture, or state seed funds. The 21 participating companies indicating they received angel and venture funding reported that they attracted over $35,000,000 of new equity in the past year.

Figure 3.17 indicates the level of venture capital investment in Maine companies as reported to the MoneyTree Venture Capital Survey. The performance of venture financing by states like Maine, tend to be a fraction of the U.S. average since the national average is skewed by a small fraction of states receiving the vast majority of venture funding. In 2007, two software, one bioscience, and one financial service deal were funded through venture capital firms tracked by MoneyTree.

Figure 3.17. Venture Capital Invested as a Percent of Gross State Product – 1997–2006

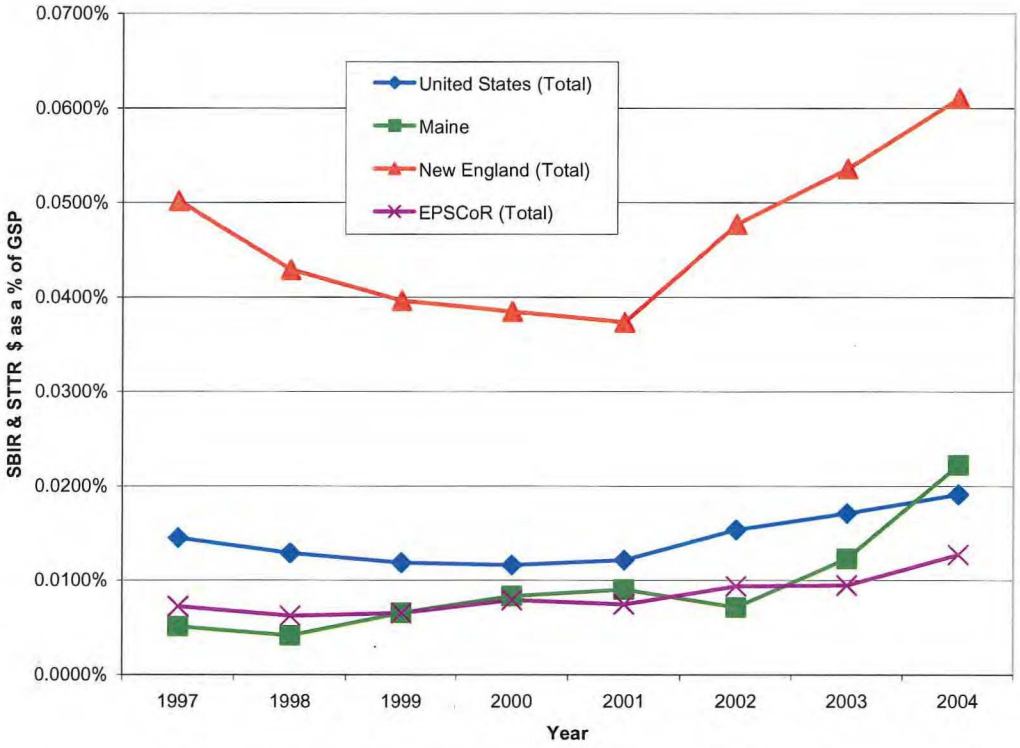


Source: Venture Capital – MoneyTree Venture Capital Profiles by State; based on PricewaterhouseCooper/Venture Economics/National Venture Capital Association Surveys; http://www.ventureeconomics.com/vec/stats/2006q1/0MAINMENU.html; Data Current as of April 2006; Gross State Product – Bureau of Economic Analysis, U.S. Department of Commerce, 1980–1996 data; and Accelerated Estimates for 2005 and Revised Estimates for 1997–2004; http://www.bea.gov/bea/regional/gsp.htm; 1997–2005 is based on NAICS while 1980–1996 is based on SIC industry classification.

The federal government provides grants to small businesses performing R&D through its Small Business Innovation Research (SBIR) program. In 2000, Maine received just $3,000,000 in SBIR awards, and in 2004 (the last year reported), that number jumped more than 224% to $9,600,000. This funding went to 27 different Maine companies to commercialize research.

Figure 3.18 shows that Maine's share of SBIR/STTR funds as a percent of gross state product has increased since the MTI programs began in 1998 and grew past the U.S. average in 2004.

Figure 3.18. Total SBIR and STTR $ as a Percent of Gross State Product – 1997–2004



Source: U.S. Small Business Administration, www.sba.gov/SBIR

The survey respondents spent $49,512,716 in R&D, which was more than 15 times the amount of state R&D assistance provided to these companies. The firms that responded to the survey are producing and protecting their IP. Thirty-two percent of the respondents report that they plan to file or have filed patent protection for the innovations developed through state funding. Thirty-two companies reported that they were granted a total of 90 U.S. patents in 2007. Another 50 foreign patents were granted to the respondent companies this year. Fifty-one of the companies surveyed had registered for trademark protection in 2007; 41 have registered copyrights. Seven companies have used other forms of IP protection. Eighty-four of the responding companies reported that they have licensed or intend to license their IP.

Table 3.4 highlights patents reported by various industry sectors. Biotechnology, Marine and Aquaculture, and Precision Manufacturing have the highest number of new patents granted in 2007 (with 46, 40, and 26 respectively).

Table 3.4. Patent Data by Industry Sector, 2007 Private Sector Survey

	Patents Granted
Advanced Materials & Composites	5
Advanced Technologies for Forestry & Agriculture	6
Biotechnology	46
Environmental Technology	9
Information Technology	13
Marine Technology & Aquaculture	40
Precision Manufacturing	26

Source: 2007 Private Sector Survey of Maine Companies served by state-supported R&D programs

Satisfaction with State Programs: The firms surveyed indicated a mixed degree of satisfaction with the services they have received and the degree of importance these services were to their business. Over 75% of firms reported assistance from MTI with an overwhelming degree of high satisfaction. Over 60% of firms used the UMaine system or other firms outside Maine for assistance with a higher than average degree of satisfaction. The Maine Patent Program received the third-highest satisfaction score. Due to their targeted markets, ATDC, the Technical Assistance Center, and nonprofit research institutions were the least used services. Of companies using ATDC, satisfaction with services were equally split between those satisfied and those not satisfied. All other programs, such as the Procurement Technical Assistance program, were used by 40–60% of firms with an average or slightly below average degree of satisfaction.

3.5 Competitiveness of Maine's Strategic Technology Industries

To what extent are these investments increasing the competitiveness of Maine in its key strategic technology and industry areas?

Bottom Line: R&D investments have shown a positive impact on the state's technology and industry clusters yet could be accelerated with additional support for proven private sector programs and enhanced connections to university and nonprofit research.

Directly correlating R&D activity with specific industry clusters is difficult since much of the research is categorized by technology platforms and most clusters are aligned by products and services. For instance, research in environmental sciences or biology can have application to the State's biotechnology, environmental service, and aquaculture

industries. However, indications point to a positive correlation between the state's R&D investment and industry performance.

Growth of Technology Industries: In 2006, high-tech employment and number of high-tech establishments in Maine increased by 3% and 1.6% respectively, compared to a decrease in overall employment and firms for the State of Maine. While the growth trend was positive for both jobs and firms, it was below U.S. and EPSCoR averages for the same period.

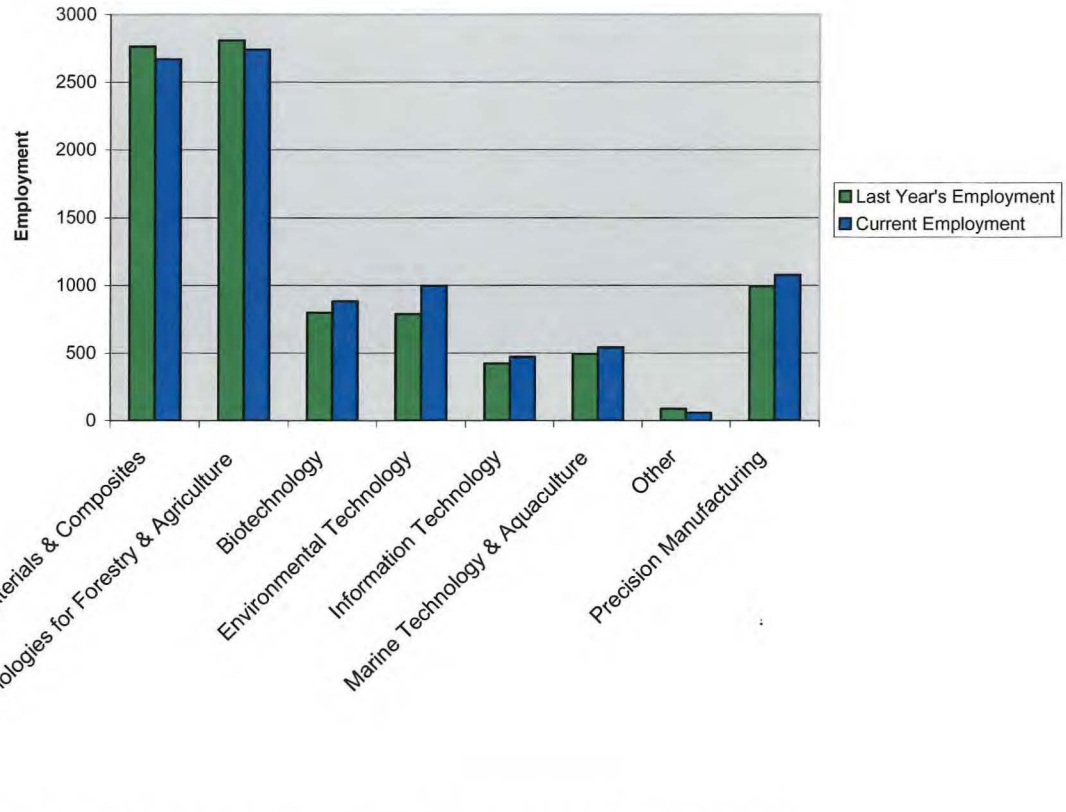
The number of jobs, new businesses, and wealth creation due to state-funded R&D programs has been consistently growing. Over 800 companies have received assistance from entities funded by the Maine R&D investment in the last five years, and over one-third have worked with more than one of these stakeholders. Of the 435 companies that responded to the evaluation survey, the growth picture is very positive and includes the following highlights:

- The job growth rate for those companies served by state R&D programs increased at a rate double the overall high-tech industry average for the state (5.3% compared to 2.44%) and more than five times the average for all Maine businesses, which grew at less than 1%.
- Total payroll was $332,889,968 or 26.6% higher than in the previous year. Wages for these companies averaged $37,140, approximately 10% higher than the average state wage of $33,794.[13]
- Compared to the previous year, firms reported a 9% growth in overall revenues and a 3.6% growth in revenue per employee. Almost 95% of revenues came from sales of products or services compared to grants or contracts, indicating the commercial value and potential for these companies.

[13] 2006 state wage of $33,794 reported by the Bureau of Labor Statistics, Quarterly Census of Employment and Wages

In terms of strategic industry clusters, we provide a snapshot of their relative strengths based on the respondents to the annual survey. Environmental technology, biotechnology, and precision manufacturing had the largest gains in employment in 2007. This is shown in **Figure 3.19**.

Figure 3.19. Employment by Respondents by Industry Sector

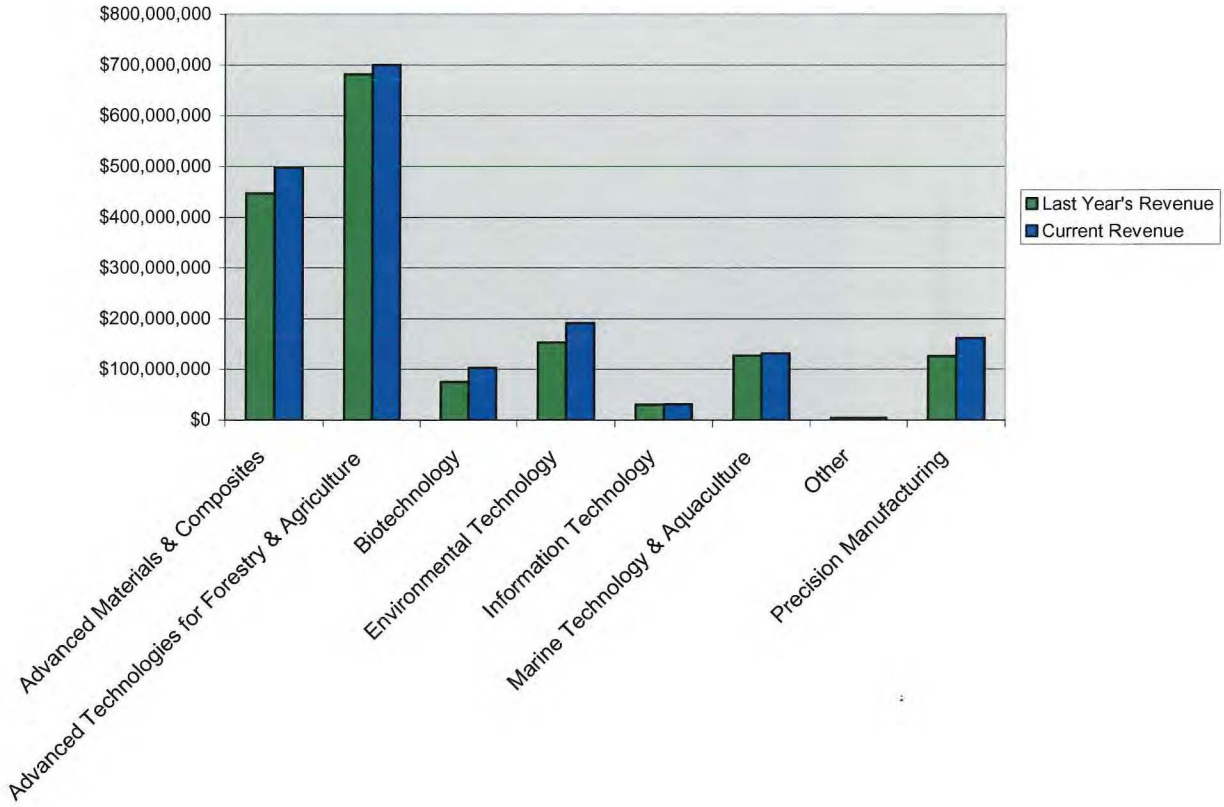


Source: RTI calculations based on respondents to 2007 annual survey. Employment totals may add up to more than the actual total because some companies were coded in more than one sector.

Different from last year, the revenue gains among respondents were strongest where employment gains were also the strongest. Environmental technology, biotechnology, and precision manufacturing experienced revenue gains of 24.8%, 36.9%, and 27.8%, respectively. Revenues from companies receiving state support increased by 9%. Overall, companies reported revenues of $1,691,811,030, compared to $1,551,887,770 last year.

Figure 3.20 shows revenue gains by the various sectors reported in the survey. All sectors reported revenue gains over the previous year.

Figure 3.20. Revenue Gains by Respondents by Industry Sector



Source: RTI calculations based on respondents to 2007 annual survey. Revenue totals may add up to more than the actual total because some companies were coded in more than one sector.

Connections between Industry and University/Nonprofit Research: While industry R&D is up significantly, the interface between industry and university/nonprofit research continues to show a relative mismatch. Compared to other EPSCoR states, Maine's university research is heavily concentrated in environmental services and social sciences, 19% and 17.7% respectively, compared to 8% and 3.4% for other EPSCoR states. While Maine has a growing environmental sciences industry, it still composes a very small percent of the state's employment. On the other hand, employment in engineering-based industries (composite materials, paper and wood products, information technology, electronics, and precision manufacturing) represent more than eight times the environmental industry yet account for less than 15% of all university research. This mix of research, combined with declining industry contracts at universities, indicates a real opportunity for improvement.

Attachment A

Private Sector Survey Instrument

2007 Private Sector Maine R&D Evaluation Report

You can print this worksheet and use it to gather the information that you will need to complete the report. DO NOT SUBMIT THIS DOCUMENT BY MAIL. Unless you have permission from DECD or MTI, your report must be completed electronically at http://www.mainerdsurvey.org.

Section A -- *covers all of your State-funded awards:*

Year	Grant Program	Amount
2007 (awarded)	Maine Patent Program CLI Cheeta	Not on file

*Relates different MTI awards on the same research project

A2. **Indicate the type of entity/individual you are responding for.**

- ○ Corporation
- ○ Partnership
- ○ LLC
- ○ Sole Proprietorship
- ○ Not a business but an individual

Check one that best applies.

If 'Not a business but an individual', go to Question #A36

A3. **Is your company/business still in business today?** ○ Yes ○ No

Note: In answering the questions that follow, "your company/business" refers to your business organization, whether sole proprietorship, corporation, or other.

If 'Yes', go to Question #A6

A4. **What year did your company go out of business?**

Indicate calendar year

A5. **As a result of your state funded award(s) or assistance, has your company produced proprietary or potentially proprietary intellectual property?** ○ Yes ○ No

Note: For MTI award recipients, please note your answer to this question will be provided to MTI if your award requires potential reimbursement to MTI following creation of intellectual property.

After answering the above question, go to Question #A62

A6. In the last completed fiscal year, has your company

a) Been acquired? ○Yes ○No

b) Purchased other companies? ○Yes ○No

c) Had an Initial Public Offering (IPO)? ○Yes ○No

d) Had other change in organizational structure. If so explain:

A7. Where is your company's headquarters located?

a) City

b) County

c) State/Province

d) Country

View State Abbreviations

A8. Does your company operate in any locations beyond your headquarters? ○Yes ○No

If 'No', go to Question #A12

A9. How many locations/establishments/places of business does your company currently have in Maine?

A10. How many locations/establishments/places of business does your company currently have outside of Maine, but in the U.S.?

A11. How many locations/establishments/places of business does your company currently have outside the U.S.?

A12. What year was your company first organized?

Note: Use the year of incorporation, partnership, formation, or a comparable year. Requires 4 digits for year.

A13. Employees, Wages, and Salaries:

a) How many employees did your company have last month, including the owner (include yourself if individual or sole proprietorship)?

b) How many employees did your company have twelve months ago, including the owner (include yourself if individual or sole proprietorship)?

c) What was the total dollar value of wages and salaries paid to your employees (excluding the employer share of benefits) in the last full fiscal year?

A14. What were your company's total revenues in the last completed fiscal year from all sources including research grants?

a) What is the approximate dollar amount of revenues from the sales of products or services?

b) What is the approximate dollar amount of revenues from grants and contracts?

c) What is the approximate dollar amount of revenues from all other sources?

d) What were your company's total revenues in the year **prior to** the last completed fiscal year?

Note: The total of (a), (b), and (c) should approximately equal the dollar amount of your total revenues in the last completed fiscal year.

A15. What is the approximate dollar value that your company expended on R&D in the last completed fiscal year?

Definition of R&D

A16. How much corporate income tax did your company pay to the State of Maine for the last tax year?

Note: Please enter '0' if you did not pay any Maine corporate income taxes in the last tax year.

A17. Did your company claim any Maine R&D Tax Credits in the last completed tax year? ○ Yes ○ No

A18. What percentage of your company's sales for your last completed fiscal year were made to customers

a) In Maine?

b) Outside of Maine, but in the U.S.?

c) Outside of the U.S.?

Note: Please enter a number between 0 and 100 with no percent sign. The total of a)-c) should equal 100. Estimate as closely as possible.

A19. Did you receive any new debt financing in the last completed fiscal year? ○Yes ○No

If 'No', go to Question #A21

A20. Please indicate the dollar amount from each source of all new debt financing you received in the last completed fiscal year.

a) Bank

b) Small Business Administration Guaranteed Loans

c) Friends and Family

d) Other

e) If other, please describe:

Note: Please enter 0 for those categories from which you did not receive any financing.

A21. Did you receive any new equity funding in the last completed fiscal year? ○Yes ○No

If 'No', go to Question #A23

A22. Please indicate the dollar amount from each source of all new equity financing you have received in the last completed fiscal year.

a) Venture Capital Firms

b) State Seed Capital Funds (e.g., Small Enterprise Growth Fund)

c) Angel Investors

d) Friends and Family

e) Other

f) If other, please specify:

Note: Please enter 0 for those categories in which you did not receive any financing.

A23. In total, including those supported by your R&D funding, how many products or services are currently offered for sale or licensed to a commercialization partner by your company?

A24. In the last completed fiscal year, did you receive any Federal grants for R&D (for example SBIR, STTR, etc.)? ○ Yes ○ No

If 'No', go to Question #A36

A25. In the last completed fiscal year, did you receive a Federal R&D grant from the NIST Advanced Technology Program (ATP)? ○ Yes ○ No

If 'No', go to Question #A27

A26. What was the total award amount for your NIST ATP grant(s)?

A27. In the last completed fiscal year, did you receive a Federal R&D grant from the Small Business Innovation Research (SBIR) Program, either Phase I or II? ○ Yes ○ No

If 'No', go to Question #A29

A28. What was the total award amount for your SBIR Phase I and II grant(s)?

A29. In the last completed fiscal year, did you receive a Federal R&D grant from the Small Business

Technology Transfer Research (STTR) Program? ○ Yes ○ No

If 'No', go to Question #A36

A30. What was the total award amount for your STTR grant(s)?

A36. For discoveries related to any of the above project(s), did you or do you plan to file for patent protection in the U.S. or abroad?

○ Yes
○ No
○ Not sure

If 'No', go to Question #A41
If 'Not sure', go to Question #A41

A37. For discoveries related to any of the above project(s), did you or do you plan to file for U.S. patent protection?

○ No
○ Intend to file
○ Have filed
○ Patent granted
○ Not sure

If 'No', go to Question #A39
If 'Not sure', go to Question #A39

A38. How many U.S. patents for discoveries related to the above project(s):

a) Have been filled?

b) Do you intend to file?

c) Have been granted?

Note: The sum of (a), (b), and (c) must be greater than zero but if none in a category then enter "0" for that category.

A39. For discoveries related to any of the above project(s), did you or do you plan to file for foreign patent protection?

○ No
○ Intend to file
○ Have filed
○ Not sure

If 'No', go to Question #A41
If 'Not sure', go to Question #A41

A40. How many foreign patents related to the above project(s):

a) Have been filed?

b) Do you intend to file?

c) Have been granted?

Note: The sum of (a), (b), and (c) must be greater than zero but if none in a category then enter "0" for that category.

A41. Did you or do you plan to protect your intellectual property from any of the above project(s) using trade secrets?

- ○ Yes
- ○ No
- ○ Not sure

A42. Did you or do you plan to register your intellectual property from any of the above project(s) by copyright?

- ○ No
- ○ Have registered
- ○ Intend to register
- ○ Not sure

A43. Did you or do you plan to enter into a licensing agreement for the production or use of the technology from any of the above project(s)?

- ○ Yes
- ○ No
- ○ Not sure

If 'No', go to Question #A45
If 'Not sure', go to Question #A45

A44. Are the licensees located in Maine?

- ○ None are
- ○ All are
- ○ Some are
- ○ Not sure

A45. Did you or do you plan to register any trademarks related to any of the above project(s)?

- ○ No
- ○ Yes, filed, not yet registered
- ○ Yes, registered
- ○ Yes, intend to file within 12 months
- ○ Not sure

A46. Did you or do you plan to utilize any other form of intellectual property protection (such as Plants Rights) for any of the above project(s)(other than patent, trade secrets, copyrights, licensing, and trademarks)?

- ○ No
- ○ Have filed
- ○ Intend to file
- ○ Not sure

A51. With respect to your research and development activities, using the scale where 1="completely unimportant" to 5="critically important", please indicate the importance of the services offered by each of the following organizations. If you do not use the services offered by a listed organization, please select "0".

	<< No Usage				Critically Important >>
	0	1	2	3	4	5

		0	1	2	3	4	5
a)	Any campus of the University of Maine System (UMS)	○	○	○	○	○	○
b)	Any other educational institution in Maine	○	○	○	○	○	○
c)	Any non-profit research institution in Maine	○	○	○	○	○	○
d)	Trade associations in Maine	○	○	○	○	○	○
e)	Other Maine firms in your industry	○	○	○	○	○	○
f)	Maine Technology Institute (MTI)	○	○	○	○	○	○
g)	Maine Manufacturing Extension Partnership (MEP)	○	○	○	○	○	○
h)	Maine's Applied Technology Development Centers (ATDC)	○	○	○	○	○	○

		<< No Usage					Critically Important >>
		0	1	2	3	4	5
i)	Maine Patent Program (MPP)	○	○	○	○	○	○
j)	Maine Small Business Development Centers (MSBDC)	○	○	○	○	○	○
k)	Maine Procurement Technical Assistance Center (formerly the Market Development Center)	○	○	○	○	○	○
l)	Educational or research institutions, outside Maine	○	○	○	○	○	○
m)	Other firms in your industry, outside Maine	○	○	○	○	○	○
n)	Trade associations outside Maine	○	○	○	○	○	○

A52. **Did you license any technology from any of the MAINE sources mentioned in the previous question, as a result of your interactions?** ○ Yes ○ No

A53. **Considering all of the State R&D assistance you received in the last completed fiscal year, how important has this assistance been?**

- ○ Critically important
- ○ Very important
- ○ Frequently important
- ○ Occasionally important
- ○ Not important

A54. **Considering all of the State R&D assistance you received in the last completed fiscal year, how satisfied have you been?**

- ○ Very satisfied
- ○ Satisfied
- ○ Somewhat satisfied
- ○ Unsatisfied
- ○ Very unsatisfied

A55. Please select the NAICS code from the menu that best describes your business by clicking on "Pick". Pick

Note: If not a business, then skip to next question

A60. Are you or your company still actively engaged in inventing for any products or services?

- ○ Yes
- ○ No
- ○ Not applicable

This question is for clients of the Maine Patent Program

A61. If you were to need patent assistance in the future, how likely would it be that you would return to the Maine Patent Program for assistance?

- ○ Not likely to return
- ○ Uncertain
- ○ Likely to return
- ○ Not applicable

This question is for clients of the Maine Patent Program

A62. If you have additional comments, please enter them here.

Attachment B

Data from Private Sector Survey

Findings from Private Sector Survey, 2007[14]

1. Survey Response

The total number of companies/entities surveyed is 800. 435 companies/entities have responded for a response rate of 54.4%.

2. Maine R&D Program Affiliation

The 800 total entities surveyed represented 1,080 programs, and the 435 total respondents to the survey represented 700 programs. Entities can receive assistance from multiple programs. The sample is biased toward MTI clients.

	All Respondents		All Surveyed	
State R&D Programs	Number	Percent	Number	Percent
ATDC	65	9.3%	104	9.6%
MAIC	22	3.1%	33	3.1%
EPSCOR	1	0.1%	1	0.1%
MPP	190	27.1%	485	44.9%
MSCTCP	42	6.0%	56	5.2%
MSGC	1	0.1%	1	0.1%
SEGF	9	1.3%	12	1.1%
MTI	370	52.9%	388	35.9%
Total	700	100%	1080	100%

3. Company Headquarters

Of the 363 companies who responded to the question, 336 or 93% are headquartered in Maine. Among those, 261 reported having just one location for their company. Of the 75 companies with multiple locations, 41 reported having operations in multiple locations in Maine; 34 reported having operations in multiple locations outside of Maine (but in the U.S.); and 8 reported having operations outside of the U.S.

22 companies are headquartered in the U.S. but outside of Maine. The other states represented are CA, CT, FL, GA, ID, IA, MA, NC, NE, NH, OH, PA, and VA.

Three companies reported being headquartered outside of the U.S. – one is located in Canada and two are in the United Kingdom.

[14] Data reported herein are only for the questions that were asked of all respondents. Data for questions that were asked of only MTI clients are reported in the MTI evaluation report. For this reason, question numbers in this section do not correspond directly to question numbers in the survey itself.

4. Geographic Breakdown

County Breakdown	All Respondents Number	Percent
No County Listed	77	17.7%
Androscoggin	13	3.0%
Aroostook	9	2.1%
Cumberland	131	30.1%
Franklin	5	1.1%
Hancock	18	4.1%
Kennebec	19	4.4%
Knox	12	2.8%
Lincoln	17	3.9%
Oxford	8	1.8%
Penobscot	34	7.8%
Piscataquis	2	0.5%
Sagadahoc	9	2.1%
Somerset	7	1.6%
Waldo	7	1.6%
Washington	8	1.8%
York	34	7.8%
Other State / Country	25	5.7%
Total	435	100.0%

Regional Breakdown	All Respondents Number	Percent
No County Listed	77	17.7%
Central	77	17.7%
Eastern	26	6.0%
North	9	2.1%
South	165	37.9%
Western	56	12.9%
Other State / Country	25	5.7%
Total	435	100.0%

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

5. Industry Breakdown

Industry Sector	All Respondents		All Surveyed	
	Number	Percent	Number	Percent
Advanced Materials and Composites	46	12.0%	49	10.5%
Advanced Technologies for Forestry and Agriculture	42	11.0%	53	11.4%
Biotechnology	42	11.0%	46	9.9%
Environmental Technology	41	10.7%	47	10.1%
Information Technology	70	18.3%	95	20.4%
Marine Technology	56	14.6%	67	14.4%
Precision Manufacturing	79	20.6%	88	18.9%
Other Sector or Unknown	7	1.8%	20	4.3%
Total	383	100.0%	465	100.0%

The 800 total entities surveyed represented 465 sector instances; the 435 total respondents to the survey represented 383 sector instances. Entities can be classified within more than one industry sector. Sectors were assigned by the research team based on information provided by the entities, Website research, project categories, etc.

6. Restructuring Events

During the last fiscal year, six responding companies were acquired; eight purchased other companies; zero offered an IPO; and 35 others reported some sort of change in their organizational structure.

7. Year Organized

Years	All Respondents	
	Number	Percent
Pre-1980	26	6.0%
1980-1984	23	5.3%
1985-1989	24	5.5%
1990-1994	32	7.4%
1995-1999	56	12.9%
2000-2004	128	29.4%
2005-2007	71	16.3%
Organize in the Future	0	0.0%
Not Coded	75	17.2%
Total	435	100.0%

8. Number of Employees (including employer)

Number of Employees	All Respondents Number	Percent
1-10	275	63.2%
11-20	29	6.7%
21-30	10	2.3%
31-40	9	2.1%
41-50	4	0.9%
51-100	11	2.5%
101-499	15	3.4%
500+	4	0.9%
Not Coded	78	17.9%
Total	435	100.0%

Total number of employees this year: 8,963
Total number of employees last year: 8,514
Change in employment: 5.3 % / 449 employees

9. Wages

Total wages and salaries paid this year: $332,889,968
Total wages and salaries paid last year: $263,005,517
Change in total wage and salary: 26.6 % / $69,884,451

Average wage and salary per employee this year: $37,140
Average wage and salary per employee last year: $30,891
Change in average wage and salary per employee: 20.2 % / $6,250

10. Revenues

Company Revenues	All Respondents Number of Companies	Percent
$0	80	18.4%
$1 – 49,999	81	18.6%
$50,000 – 99,999	25	5.7%
$100,000 – 499,999	64	14.7%
$500,000 – 999,999	24	5.5%
$1 million – 4,999,999	43	9.9%
$5 million +	34	7.8%
Not Coded	84	19.3%
Total	435	100.0%

Company revenues earned this year: $1,691,811,030
Company revenues earned last year: $1,551,887,770
Change in company revenue: 9.0 % / $139,923,260

Revenue per employee this year: $188,755
Revenue per employee last year: $182,275
Change in revenue per employee: 3.6 % / $6,480

11. Sources of Revenue

Revenues	All Respondents Dollars	Percent of Total
Sales of Products and Services	$1,614,644,419	94.3%
Grants and Contract	$76,859,475	4.5%
All other Sources	$20,611,734	1.2%
Total	$1,712,115,628*	100.0%

*The total here does not match total revenue reported above because the respondents answered these questions differently. The more important data is the percent breakdown of the revenue sources.

12. R&D Expenditures

The respondents spent $49,512,716 in R&D in the reporting period.

13. Corporate Income Tax Paid

The respondents paid $639,176 in Maine corporate income tax.

14. Tax Credits Claimed

Maine R&D Tax Credits Claimed?	All Respondents Number	Percent of Total
Yes	20	4.6%
No	326	74.9%
N/A	89	20.5%
Total	435	100.0%

15. Where are Your Customers?

Percent of Sales in Maine	All Respondents Number	Percent of Total
0-10	219	50.3%
11-25	24	5.5%
26-50	24	5.5%
51-75	13	3.0%
76-100	64	14.7%
N/A	91	20.9%
Total	435	100.0%

Percent of Sales Outside of Maine, In U.S.	All Respondents	
	Number	Percent of Total
0-10	167	38.4%
11-25	16	3.7%
26-50	27	6.2%
51-75	36	8.3%
76-100	98	22.5%
N/A	91	20.9%
Total	435	100.0%

Percent of Sales outside of U.S.	All Respondents	
	Number	Percent of Total
0-10	298	68.5%
11-25	18	4.1%
26-50	20	4.6%
51-75	2	0.5%
76-100	6	1.4%
N/A	91	20.9%
Total	435	100.0%

16. Debt Financing

58 companies or 16.8% (58 out of the 345 respondents who answered that question) accessed new debt financing during their most recently completed fiscal year.

Sources	All Respondents		
	Number of Transactions	Dollars of New Debt	Percent of Total New Debt
Bank	25	$14,985,129	57.1%
SBA loans	1	$150,000	0.6%
Friends and family	12	$1,564,001	6.0%
Other	24	$9,558,350	36.4%
Total	62*	$26,257,480	100.0%

*Total adds to more than 58 companies because there were multiple transactions at some companies.

17. Equity Financing

39 companies or 11.3% (39 out of the 345 respondents who answered that question) accessed new equity financing during their most recently completed fiscal year.

Sources	All Respondents		
	Number of Transactions	Dollars of New Equity	Percent of Total New Equity
Venture capital	8	$28,032,145	68.6%
State seed funds	5	$806,410	2.0%
Angel investors	13	$7,114,515	17.4%
Friends and family	15	$2,413,658	5.9%
Other	10	$2,505,562	6.1%
Total	51	$40,872,290	100.0%

*Total adds to more than 39 companies since there were multiple transactions at some companies.

18. Federal Awards

23 or 6.7% (23 out of 345 respondents who answered that question) of respondents received some type of federal award during their most recently completed fiscal year.

Federal Award	All Respondents	
	Number of Awards	Total $ of Awards
Advanced Technology Program	0	0
SBIR Phase I or Phase II	13	$3,883,521
STTR	1	$149,906
Total	14	$4,033,427

19. Intellectual Property

Copyrights:
Have you registered or do you intend to register for a copyright?

Copyright Registration	All Respondents	
	Number of Companies	Percent
Have Registered	41	9.4%
Intend to Register	37	8.5%
No	187	43.0%
Not Sure	131	30.1%
Not Coded	39	9.0%
Total	435	100.0%

Licenses:
Have you entered or do you plan to enter into a licensing agreement?

	All Respondents	
Licensing Agreements	**Number of Companies**	**Percent**
No	149	34%
Not Sure	160	37%
Yes	84	19%
Not Coded	42	10%
Total	435	100%

License Locations	**Number of Companies**	**Percent (out of 435)**
All in Maine	10	2.3%
Some in Maine	13	3.0%
None in Maine	41*	9.4%
Not Sure	20*	4.6%
Total	84	19.3%

*Excluded one "None in Maine" response and two "Not Sure" responses where the responder had not answered previous question (Q43).

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

	All Respondents	
Responses	**Number**	**Percent**
No	165	37.9%
Not Sure	83	19.1%
Yes	148	34.0%
Not Coded	39	9.0%
Total	435	100.0%

Filed for U.S. patent protection:

U.S. Patent Protection	**Number of Companies**	**Percent (out of 435)**
Have Filed	72	16.6%
Intend to File	33	7.6%
Granted	32	7.5%
Total	137	31.5%

U.S. Patent Protection	Number of Patents
Filed	252
Intend to File	100
Granted	101

Filed for foreign patent protection:

Foreign Patent Protection	Number of Companies	Percent (out of 435)
Have Filed	42	9.7%
Intend to File	30	6.9%
Granted	0	0%
No/Not Sure	72	16.6%
Total	144	33.1%

*Excluded one "No" response where the responder had not answered previous question (Q36). Total number of companies is less than the 148 responders that answered yes to Q36 because 4 responders did not answer this question.

Foreign Patent Protection	Number of Patents
Filed	122
Intend to File	157
Granted	50

Trademarks:
Have you registered or do you intend to register for a trademark?

	All Respondents	
Trademark Registration	Number of Companies	Percent
Yes, Registered	51	11.7%
Filed not Registered	19	4.4%
Intend to File	51	11.7%
No	147	33.8%
Not Sure	127	29.2%
Not Coded	40	9.2%
Total	435	100.0%

Trade Secrets:
Do you use or intend to use trade secrets?

	All Respondents	
Trade Secret Usage	**Number of Companies**	**Percent**
No	155	35.6%
Not Sure	119	27.4%
Yes	121	27.8%
Not Coded	40	9.2%
Total	435	100.0%

Other Intellectual Property:
Do you intend to utilize other forms of intellectual property?

	All Respondents	
Utilization of other Intellectual Property	**Number of Companies**	**Percent**
Have Filed	7	1.6%
Intend to File	9	2.1%
No	245	56.3%
Not Sure	134	30.8%
Not Coded	40	9.2%
Total	435	100.0%

20. Support Organizations

Over 70% of the respondents who answered this question received some level of support from MTI during the survey period and half of those recipients found that assistance to be "most critical" in their success. Moreover, MTI received the highest mean score at 3.91.

This table shows the support organizations that were used and a ranking of how important the services were to the participating companies (1–least critical, 5–most critical).

	All Respondents						
		Degree of Importance					
Support Organization	**Didn't Use**	**1**	**2**	**3**	**4**	**5**	**Mean Score**
MTI	105	22	32	38	52	143	3.91
ATDC	287	21	16	31	16	21	3.00
Other firms outside Maine	169	22	44	44	58	55	3.36
Maine Patent Program	190	24	34	37	37	71	3.48
Other Maine Firms	186	24	44	57	47	34	3.11
UMaine System	176	21	26	43	48	78	3.63
Educational/Research outside Maine	237	16	37	36	32	34	3.20
Trade Associations outside Maine	233	24	29	51	35	20	2.99
MSBDC	219	33	27	44	29	40	3.09
Maine Procurement Technical Assistance Center (formerly Market Development Center)	298	26	18	23	11	16	2.71
Nonprofit Research Institutes in Maine	268	22	25	36	25	16	2.90
MEP	256	27	27	41	22	19	2.85
Maine Trade Associations	214	37	34	52	40	15	2.79
Other Educational Institutions in Maine	269	30	21	33	24	15	2.78

21. Licensing from Maine Support Entity

Eleven (2.5%) of the respondents licensed a technology from a Maine source such as a university or nonprofit research laboratory.

22. Importance of Assistance

The mean score for importance of assistance received was 3.0, or Frequently Important.

	All Respondents	
How important?	**Number of companies**	**Percent**
Critically important (5)	96	22.1%
Very important (4)	90	20.7%
Frequently important (3)	34	7.8%
Occasionally important (2)	65	14.9%
Not important (1)	108	24.8%
Not Coded	42	9.7%
Total	435	100.0%

23. Satisfaction with Assistance

The mean score for satisfaction with assistance received was 3.96, or very close to satisfied. Additionally, two-thirds of respondents indicated that they were either satisfied or very satisfied.

	All Respondents	
How satisfied?	**Number of companies**	**Percent**
Very satisfied (5)	149	34.3%
Satisfied (4)	138	31.7%
Somewhat satisfied (3)	68	15.6%
Unsatisfied (2)	16	3.7%
Very unsatisfied (1)	22	5.1%
Not Coded	42	9.7%
Total	435	100.0%

Attachment C

R&D Institution Survey

2007 SURVEY FOR RESEARCH INSTITUTION RECIPIENTS OF MAINE STATE R&D FUNDING

For the Evaluation of Maine's Investments in Research and Development
Conducted for the Maine Office of Innovation
Response Due: October 12, 2007

1. Name of Research Institution: _____
2. Name of Person Completing Survey: _____
   Position: _____
   Phone: _____
   Email: _____
3. Date of Response: _____

GENERAL INSTRUCTIONS:

If your fiscal year is other than July 1 to June 30, please indicate at the top of page 5 your fiscal year starting and ending dates and use the most recent year for which you have complete data in place of FY07.

On the left side, enter the total amount for each category for your institution in FY07.

On the right hand side, list only the FY07 amounts attributable to the state R&D funding sources listed below. For instance, if state R&D funding was used to hire a faculty member, all his/her activity would count, even if that person is now funded by other sources. If a building or laboratory was built with the R&D funding, all activity in the building would count. The possible sources of state R&D funding for research institutions that are relevant for this evaluation are:

- State Research and Development Bonds
- Funding from the State for Capital Improvements to Support Research
- EPSCOR State Matching Funds for DOE, NSF, DEPSCoR or NASA
- Maine Economic Improvement Fund
- Maine Technology Institute
- Maine Biomedical Research Fund
- Marine Research Funds, Marine Technology Fund, and Marine Connectivity Funds
- Maine Aquaculture Innovation Center
- Center for Innovation in Biomedical Technology
- Maine Space Grant Consortium Prior to 2004
- Research Challenge Grants
- Strategic Technology Initiative

Answer by taking into account specific programs, research activities, personnel, buildings and equipment funding by these sources. Where necessary, estimate as best as possible.

The answers to all questions will be kept confidential and will only be reported in the aggregate. If you have a question, please contact Sara Lawrence of RTI by email: slawrence@rti.org or phone: (919) 990-8680. When complete either email results to Sara or mail it to her at:

Sara Lawrence
RTI International
3040 Cornwallis Road
Post Office Box 12194
Research Triangle Park, NC 27709-2194

SPECIFIC INSTRUCTIONS:

Question 4: Institutional Capacity

If you are an accredited educational institution, enter the number of students enrolled, degrees conferred, and total number of degree programs in **4 A-D**. Note that **4D** refers to undergraduates. This should be the official headcount for Fall Semester.

The total square footage available for research and development should be entered in **4G**. This is defined as research laboratories, controlled environment space such as clean or white rooms; technical support space such as carpentry and machine shops; space for laboratory animals, such as animal production colonies, holding rooms, isolation and germ-free rooms; faculty and staff offices to the extent that they are used for research; department libraries, to the extent that they are used for research; fixed equipment, such as fume hoods and benches; single pieces of non-fixed equipment each costing at least $1 million, such as MRI equipment; and leased space. It does not include: space that is designated as federally funded research and development centers (FFRDCs); space used by faculty but not administered by the institution; and space administered by the institution but leased to others for their use. Square footage is measured from the inside faces of walls.

The current value of facilities and fixed equipment should be the depreciated value of these assets. Enter in **4H**. However, **4I** requests only the total value of all major moveable research equipment purchased this year. Major is defined as having a purchase price of >$50,000 for each item.

In **4J**, enter the number of positions (headcount) you have in each of these categories. Faculty include tenured and tenure-track professors. Research (non-tenure track) faculty includes other senior scientists that are principal investigators. Professional refers to those exempt employees directly engaged in research and development activities. Students would include any research and development positions held by undergraduate or graduate students. Classified employees include technicians, clerical and administrative positions that are paid hourly and/or subject to overtime.

Question 5: Research and Development Outcomes

5A, Publications, refers to all articles, books and reports published in the reporting period. If the research supporting the publications was done substantially at your institution, e.g., during a summer, or by an adjunct faculty member, you should include it.

5B, Research Proposals, counts all extramural research proposals officially submitted by your institution. Proposals made by individuals associated with your institution on their own behalf are not included. Maine institutions mean any institution headquartered or chartered in Maine, or with substantial operations in Maine. The Maine campus of an institution headquartered elsewhere would be a Maine institution.

For value, enter the face value of the proposal, the total value of all costs for all years proposed, including option years.

5C, Research Awards, asks about the contracts awarded to the institution during the year. The start date of the contract does not have to be in the year. Include all costs including overhead.

- For **5C1**, enter the total value of the award, including all costs for all years, including option years.

- For **5C2**, enter the number of awards and their total value of awards under the EPSCOR program.

- In **5C3**, earmarked means that the award was the result of a legislative action by the U.S. Congress where an agency was directed to support a specific institution or project with a specific amount of funding. Do not include formula grants for land grant institutions, or funding for national programs such as Agricultural Extension, Manufacturing Extension, Sea Grant, etc.

- Under **5C4**, should include all expenditures at your institution for R&D in FY07. In the second section, break these expenditures out by the type of organization that gave you the contract. If you have a subcontract from a company that has federal contracts, enter this as industry.

- **5C5** should include all grants, contracts and subcontracts awarded to your institution by industry. Industry is defined as for-profit organizations (corporations, partnerships, sole proprietorships, etc). This does not include not-for-profit entities such as educational institutions, elements of state, federal or local government or foundations. Enter the total, face value of the contract, including all costs for all years, including option years. Please include subcontracts from companies that have Federal contracts – the intent of this question is to ascertain the level of interaction between research institutions and industry, not the source of that funding.

- In **5C6**, Maine company is defined as a company headquartered in Maine or with substantial operations in Maine. (BIW is a Maine company, although it is owned by a company outside of Maine.)

- In **5C7**, on the left, enter all foundation grants and gifts related to research and development. On the right, enter only those foundation grants and gifts enabled by the state R&D support. Include both conditional and unconditional amounts. Enter the full amount of the grant or gift, including all costs for all years.

Intellectual Property, Question **5D**. Count the number of items in each category. For patents awarded, **D3**, include provisional awards. For **5D8**, Show the total license income received in the fiscal year, including royalties and cashed-in equity.

Spin-off Companies, **5E**. Please indicate the number of new companies formed based on intellectual property licensed from your institution. Date of incorporation should be within this fiscal year. Include the number of jobs in these companies at spin-off. (Future growth in these companies will be captured in the private company survey.)

4. Institutional Capacity

Your fiscal year, if different: _____, 20__ to _____, 20__

FY 07	***Total for your institution***	***Attributable to State R&D Funding***
a. Number (headcount) of enrolled science and engineering graduate students in Fall semester.		
b. Number of science and engineering graduate degrees conferred.		
c. deleted.		
d. Number (headcount) undergraduate students enrolled in science and engineering majors in Fall semester.		
e. Number of undergraduate students science and engineering degrees conferred.		
f. deleted		
g. Total R&D space	Sq ft	Sq ft
h. Current, depreciated, value of facilities and fixed equipment	$	$
i. Major (purchase price >$50,000) research equipment purchased this year.	$	$
j. Number of positions supported (headcount) • Faculty • Research Staff (non faculty) • Professional staff • Students • Classified personnel (e.g., technicians, clerical)	_____ _____ _____ _____ _____	_____ _____ _____ _____ _____

5. Research and Development Outcomes

FY 07	***Total for your institution***	***Attributable to State R&D Funding***
A. Publications		
1. Number of scientific peer-reviewed journal articles published.		
2. Number of scientific peer-reviewed book chapters published.		
3. Number of scientific peer-reviewed books published.		
4. Number of other scientific papers published.		
5. Number of other scientific papers not published (e.g. research reports for industry).		
B. Research Proposals		
1a. Number extramural research proposals submitted.		
1b. Dollars Requested on these proposals (face value)	$	$
2a. Number of these proposals submitted jointly with other Maine institutions only		
2b. Dollar Value of these proposals (face value)	$	$
3a. Number of these proposals submitted jointly with non-Maine institutions only		
3b. Dollar Value of these proposals (face value)	$	$
4a. Number of these proposals submitted jointly with both Maine and non-Maine institutions.		

4b. Dollar Value of these proposals (face value)	$	$
C. Research Awards		
1a. Number of new Federal research grants, contracts, subcontracts awarded (total value for all costs and all years)		
1b. Dollar value of these awards (face value)	$	$
2a. Number of these awarded under EPSCOR		
2b. Dollar value of these awards (total value for all costs and all years)	$	$
3a. Number of these awards that were earmarked (total value for all costs and all years)		
3b. Dollar value of these awards (face value)	$	$
4a. Total expenditures for research and development for FY07	$	$
4b: Sources of funds for R&D expenditures:	Federal: $ State: $ Industry: $ Individuals and Foundations:$	Federal: $ State: $ Industry: $ Individuals and Foundations:$
5a. Number of industrial research grants, contracts and subcontracts awarded		
5b. Value of these awards (total value for all costs and all years)	$	$
6a. Number of these industrial research grants, contracts and subcontracts awarded by Maine companies		

6b. Value of these awards (total value for all costs and all years)	$	$
7a. Number of new foundation grants and/or gifts for research		
7b. Value of these grants and/or gifts (total value for all costs and all years)	$	$
D. Intellectual Property		
1. Number of disclosures made.		
2. Number of patents applied for.		
3. Number of patents awarded.		
4. Number of copyrights obtained.		
5. Number of plant variety protection rights obtained.		
6. Number of licensing agreements signed this year.		
7. Number of licensing agreements signed this year with Maine companies.		
8. License income received this year.		
E. Spin-off Companies		
1. Number of new companies formed.		
2. Number of jobs in these companies at spin-off.		

6. Additional Information

Please feel free to add any additional information that you feel we may need to fully appreciate the contributions of your institution to economic development in Maine in the past year. This can be attached documents, e.g., annual report, or free-form narrative below. Take as much space as you need:

Thank You!

Please respond by October 12, 2007

Attachment D

R&D Institutions Survey Data 2002–2007

2007 Combined University and Nonprofit Results

Research Institutions Capacity Survey	**2007**	
2007	Total for all Institutions	Attributable to State R&D Funding
Institutional Capacity		
a. Number (FTE) of enrolled science and engineering graduate students	742	624
b. Number of science and engineering graduate degrees awarded	181	176
c. Number of degree programs (deleted 2006)	0	0
d. Number (FTE) undergraduate students enrolled in science and engineering majors	5,909	3,784
e. Number (FTE) of undergraduate students participating in science and engineering programs	1,090	689
f. Number (FTE) of graduate students participating in science and engineering programs(Deleted in 2006)	0	0
g. R&D space	1,339,202	1,037,454
h. Current, depreciated, value of facilities and fixed equipment	$510,450,062	$243,396,285
i. Major (purchase price >$50,000) research equipment purchased this year.	$5,063,595	$3,593,696
j. Number of positions FTE	997	54
Faculty	794	93
Non-faculty PIs	558	54
Technical and professional staff	1,043	52
Students	224	55
Support personnel	1,519	14
Administrative	0	0
Total FTEs	0	0
Research and Development Outcomes		
A. Publications		
1. Number of scientific peer-reviewed journal articles published	1009	794
2/ Number of scientific peer-reviewed book chapters published	118	101
3. Number of scientific peer-reviewed books published	28	27
4. Number of other papers published	770	732
5. Number of other papers not published (e.g. research reports for industry)	2178	2163
B. Research Proposals		
1. Number of peer-reviewed and/or competitive research proposal submitted	1211	276
2. Dollar Value	$468,204,705	$179,485,204
3. Number of these proposals submitted jointly with other main institutions	77	36
Dollar Value	$32,139,055	$19,009,405
4. Number of these proposals submitted jointly with non-Maine institutions only	87	52

Research Institutions Capacity Survey	**2007**	
2007	Total for all Institutions	Attributable to State R&D Funding
Dollar Value	$67,443,064	$58,726,820
5. Number of these proposal submitted jointly with both Maine and non-Maine institutions	79	78
Dollar Value	$62,638,458	$62,437,099
C. Research Awards		
1. Number of new Federal research grants, contracts, subcontracts	538	484
Dollar Value	$152,102,995	$78,086,624
2. Number of these awarded under EPSCOR	4	4
Dollar Value	$2,430,067	$2,430,067
3. Number of these that were earmarked	15	14
Dollar Value	$8,541,940	$5,349,940
Total Expenditures for R&D in the Fiscal Year	$138,218,289	$75,137,949
Federal sources of funds for R&D expenditures	$102,918,499	$67,238,027
State sources of funds for R&D expenditures	$2,220,803	$1,629,566
Industry sources of funds for R&D expenditures	$2,915,180	$627,751
Individual and Foundations sources of funds for R&D expenditures	$13,416,080	$10,996,150
5. Number of industrial research grants, contracts and subcontracts awarded	270	211
Dollar Value	$5,419,854	$2,784,261
6. Number of these industrial research contracts awarded by Maine companies	194	160
Dollar Value	$1,671,186	$1,248,633
7. Number of new foundation grants and gifts	130	81
Dollar Value	$17,621,471	$6,336,909
D. Intellectual Property		
1. Number of disclosures made	49	37
2. Number of patents applied for	22	19
3. Number of patents awarded	5	5
4. Number of copyrights obtained	2	2
5. Number of plant breeder's rights obtained	0	0
6. Number of licensing agreements signed	17	14
7. Number of licensing agreements signed with Maine companies	5	3
8. License income received this year	$985,027	$950,000
E. Spin-off Companies		
1. Number of new companies formed	1	1
2. Number of jobs in these companies at spin-off	2	2

Research Institutions Capacity Survey	**2007**	
2007	Total for all Institutions	Attributable to State R&D Funding
Cautions: Numbers attributable to State R&D Funding in 2002 survey may not be accurate. Ten entities responded to FY 2003 survey; five responded to FY 2002. UMaine, Jackson Labs, University Southern Maine, Maine Maritime, MMCRI, Foundation for Blood Research, MDIBL, UMaine Machias, Wells, UNE Osteopathic Medicine. FY 2004 respondents : Bigelow, Maine Medical Centers, University Southern Maine, Wells, University of New England, UMaine Orono, Jackson Lab, MDIBL, Maine Maritime, Gulf of Maine, Downeast Institute(combined with U Maine Machias), FBR. Questions change significantly from 2002-2006 The figure was headcount, changed to FTE's		

University Survey Results, 2002–2007

	University Research-based Institutions				
	2007 Total for University Institutions	**2006 Total for University Institutions**	**2002 Total for University Institutions**	**2006-2007 %Change for Universities**	**2002-2007 %Change for Universities**
Institutional Capacity					
a. Number (headcount) of enrolled science and engineering graduate students in fall Semester	735	2,736	1,099	-73%	-33%
b. Number of science and engineering graduate degrees conferred	176	171	207	3%	-15%
c. DELETED (Number of degree programs)	0	0			
d. Number (headcount) undergraduate students enrolled in science and engineering majors in Fall Semester	5,784	5,811	7,565	0%	-24%
e. Number of undergraduate students science and engineering degrees conferred	1,065	882		21%	
f. DELETED (Number (FTE) of graduate students participating in science and engineering programs)	0	0			
g. Total R&D space	968,321	1,088,821	633,778	-11%	53%
h. Current, depreciated, value of facilities and fixed equipment	$317,769,678	$303,934,880	$126,755,600	5%	151%
i. Major (purchase price >$50,000) research equipment purchased this year.	$2,404,052	$2,807,857	$17,833,583	-14%	-87%
j. Number of positions					
FTE	667	527	0	27%	0%
Faculty	583	577	846	1%	-31%

	University Research-based Institutions				
	2007 Total for University Institutions	**2006 Total for University Institutions**	**2002 Total for University Institutions**	**2006-2007 %Change for Universities**	**2002-2007 %Change for Universities**
Research staff (non-faculty)	26	20		33%	
Professional staff	702	712	937	-1%	-25%
Students	125	134	671	-7%	-81%
Classified personnel	911	946	650	-4%	40%
Research and Development Outcomes					
A. Publications					
1. Number of scientific peer-reviewed journal articles published	617	860	639	-28%	-3%
2/ Number of scientific peer-reviewed book chapters published	102	123	21	-17%	386%
3. Number of scientific peer-reviewed books published	27	38	70	-29%	-61%
4. Number of other scientific papers published	680	655	277	4%	145%
5. Number of other scientific papers not published (e.g. research reports for industry)	2,147	938	619	129%	247%
B. Research Proposals					
1.a. Number of extramural research proposal submitted	859	859	715	0%	20%
1b. Dollars requested	$208,550,708	$227,979,548	$175,226,589	-9%	19%
2.a. Number of these proposals submitted jointly with other Maine institutions	47	39	37	21%	27%
2.b. Dollar Value	$13,014,375	$13,768,968	$4,832,025	-5%	169%
3.a. Number of these proposals submitted jointly with non-Maine institutions only	35	23	61	52%	-43%
3.b.Dollar Value	$10,899,706	$10,876,307	$5,697,830	0%	91%

	University Research-based Institutions				
	2007 Total for University Institutions	**2006 Total for University Institutions**	**2002 Total for University Institutions**	**2006-2007 %Change for Universities**	**2002-2007 %Change for Universities**
4. Number of these proposal submitted jointly with both Maine and non-Maine institutions	4	4	0	0%	added 4
4.b. Dollar Value	$1,073,919	$3,209,241	$0	-67%	added $1.07M
C. Research Awards					
1. Number of new Federal research grants, contracts, subcontracts (total value for all costs and years)	442	424	428	4%	3%
Dollar Value	$63,990,437	$81,740,683	$48,988,610	-22%	31%
2. Number of these awarded under EPSCOR	4	1	4	300%	0%
Dollar Value	$2,430,067	$2,300,000	$15,256,911	6%	-84%
3. Number of these that were earmarked	13	27	0	-52%	added 13
Dollar Value	$4,104,424	$9,962,906	$0	-59%	added $4M
4.a. Total expenditures for research and development for FY06	$45,112,566	$46,568,767		-3%	
4.b. Sources of funds for R&D expenditures: federal	$29,169,510	$38,398,285		-24%	
4.b. State	$270,296	$2,497,880		-89%	
4.b.Industry	$6,423	$325,825		-98%	
4.b. Individuals and foundations	$626,609	$4,165,814		-85%	
5. Number of industrial research grants, contracts and subcontracts awarded	237	7	1	3286%*	23600%
Dollar Value	$2,790,365	$4,316,474	$3,561,681	-35%	-22%
6. Number of these industrial research contracts awarded by Maine companies	185	4	0	4525%	added 185
Dollar Value	$1,282,848	$377,843	$0	240%	added $1.28M

	University Research-based Institutions				
	2007 Total for University Institutions	**2006 Total for University Institutions**	**2002 Total for University Institutions**	**2006-2007 %Change for Universities**	**2002-2007 %Change for Universities**
7. Number of new foundation grants & gifts	64	85	13	-25%	392%
Dollar Value	$4,902,023	$5,666,283	$2,049,096	-13%	139%
D. Intellectual Property					
1. Number of disclosures made	19	22	10	-14%	90%
2. Number of patents applied for	11	11	8	0%	38%
3. Number of patents awarded	3	3	0	0%	
4. Number of copyrights obtained	0	0	1	0%	-100%
5. Number of plant breeder's rights obtained	0	0	0	0%	0%
6. Number of licensing agreements signed	4	2	0	100%	added 4
7. Number of licensing agreements signed with Maine companies	2	2	0	0%	added 2
8. License income received this year	$500,027	$285,000	$0	75%	added $500k
E. Spin-off Companies					
1. Number of new companies formed	1	2	0	-50%	added 1
2. Number of jobs in these companies at spin-off	2	6	0	-67%	added 2
*anomaly: UME did not report this total in 2006					
Gray areas = no data or data question has changed significantly					
Questions shift over time, so cannot analyze over time					
Universities					
Univ of Southern Maine					
Univ of New England					
UMaine Orono					
UMaine Machias					
Maine Maritime					

Nonprofit Institutions Survey Results, 2002–2007

	Nonprofit Research Institutions				
	2007 Total Nonprofit Institutions	**2006 Total Nonprofit Institutions**	**2002 Total Nonprofit Institutions**	**2006-2007 Percent Change for Nonprofits**	**2002-2007 Percent Change for Nonprofits**
Institutional Capacity					
a. Number (headcount) of enrolled science and engineering graduate students in fall Semester	7	0	3	0%	133%
b. Number of science and engineering graduate degrees conferred	5	0	0	0%	0%
c. DELETED (Number of degree programs)	0	0			
d. Number (headcount) undergraduate students enrolled in science and engineering majors in Fall Semester	125	133	0	-6%	added 125
e. Number of undergraduate students science and engineering degrees conferred	25	19		32%	
f. DELETED (Number (FTE) of graduate students participating in science and engineering programs)	0	0			
g. Total R&D space	370,881	354,335	203,882	5%	82%
h. Current, depreciated, value of facilities and fixed equipment	$192,680,384	$180,690,425	$150,360,110	7%	28%
i. Major (purchase price >$50,000) research equipment purchased this year.	$2,659,543	$6,861,374	$4,798,467	-61%	-45%
j. Number of positions FTE	330	81	0	307%	added 85
Faculty	211.3	60	58	255%	267%
Research staff (non-faculty)	532	479		11%	
Professional staff	341	361	897	-5%	-62%
Students	99	120	3	-18%	3197%

	Nonprofit Research Institutions				
	2007 Total Nonprofit Institutions	**2006 Total Nonprofit Institutions**	**2002 Total Nonprofit Institutions**	**2006-2007 Percent Change for Nonprofits**	**2002-2007 Percent Change for Nonprofits**
Classified personnel	608	707	257	-14%	137%
Research and Development Outcomes					
A. Publications					
1. Number of scientific peer-reviewed journal articles published	392	334	222	17%	77%
2/ Number of scientific peer-reviewed book chapters published	16	16	20	0%	-20%
3. Number of scientific peer-reviewed books published	1	3	0	-67%	added 1
4. Number of other scientific papers published	90	77	1	17%	8900%
5. Number of other scientific papers not published (e.g. research reports for industry)	31	24	2	29%	1450%
B. Research Proposals					
1.a. Number of extramural research proposal submitted	352	338	134	4%	163%
1b. Dollars requested	259653996.5	$182,368,973	$106,590,869	42%	144%
2.a. Number of these proposals submitted jointly with other Maine institutions	30	27	6	11%	400%
2.b. Dollar Value	$19,124,680	$11,961,116	$2,170,689	60%	781%
3.a. Number of these proposals submitted jointly with non-Maine institutions only	52	44	22	18%	136%
3.b.Dollar Value	56,543,358	$22,855,275	$11,559,016	147%	389%
4. Number of these proposal submitted jointly with both Maine and non-Maine institutions	75	51	24	47%	213%
4.b. Dollar Value	$61,564,539	$26,926,106	$13,093,005	129%	370%

	Nonprofit Research Institutions				
	2007 Total Nonprofit Institutions	**2006 Total Nonprofit Institutions**	**2002 Total Nonprofit Institutions**	**2006-2007 Percent Change for Nonprofits**	**2002-2007 Percent Change for Nonprofits**
C. Research Awards					
1. Number of new Federal research grants, contracts, subcontracts (total value for all costs and years)	96	81	64	19%	50%
Dollar Value	$88,112,558	$40,869,436	$66,049,383	116%	33%
2. Number of these awarded under EPSCOR	0	0	1	0%	-100%
Dollar Value	$0	$2,000,000	$600,000	-100%	-100%
3. Number of these that were earmarked	2	2	5	0%	-60%
Dollar Value	$4,437,516	$2,245,516	$3,851,260	98%	15%
4.a. Total expenditures for research and development for FY06	$93,105,723	$94,372,486			
4.b. Sources of funds for R&D expenditures: federal	$73,748,989	$77,827,420		-5%	
4.b. State	$1,950,507	$1,466,652			
4.b.Industry	$2,908,757	$663,190			
4.b. Individuals and foundations	$12,789,471	$8,517,583			
5. Number of industrial research grants, contracts and subcontracts awarded	33	42	33	-21%	0%
Dollar Value	$2,629,489	$4,138,477	$2,176,807	-36%	21%
6. Number of these industrial research contracts awarded by Maine companies	9	10	0	-10%	added 9
Dollar Value	$388,338	$179,826	$0	116%	added $388k
7. Number of new foundation grants and gifts	66	86	11	-23%	500%
Dollar Value	$12,719,448	$13,008,472	$1,140,484	-2%	1015%
D. Intellectual Property					
1. Number of disclosures made	30	23	6	30%	400%
2. Number of patents applied for	11	6	4	83%	175%

	Nonprofit Research Institutions				
	2007 Total Nonprofit Institutions	**2006 Total Nonprofit Institutions**	**2002 Total Nonprofit Institutions**	**2006-2007 Percent Change for Nonprofits**	**2002-2007 Percent Change for Nonprofits**
3. Number of patents awarded	2	2		0%	
4. Number of copyrights obtained	2	1	1	100%	100%
5. Number of plant breeder's rights obtained	0	0	0	0%	0%
6. Number of licensing agreements signed	13	3	2	333%	550%
7. Number of licensing agreements signed with Maine companies	3	0	0	added 3	added 3
8. License income received this year	$485,000	$206,972	$150,000	134%	223%
E. Spin-off Companies					
1. Number of new companies formed	0	1	0	-100%	0%
2. Number of jobs in these companies at spin-off	0	2.5	0	-100%	0%

Gray areas = no data or data question has changed significantly

Questions shift over time, so cannot analyze over time

Non Profit

Bigelow
Maine Medical Center
Wells National
Jackson
MDIBL
Gulf of Maine
Downeast Institute
Maine Inst of Human Genetics and Health
Foundation for Blood Research

University Results Attributable to State Investment, 2002–2007

	University Research-based Institutions				
	2007 Total Attributable to State Funding	**2006 Total Attributable to State Funding**	**2002 Total Attributable to State Funding**	**2006-2007 Percent Change for Universities**	**2002-2007 Percent change for Universities**
Institutional Capacity					
a. Number (headcount) of enrolled science and engineering graduate students in fall Semester	622	530	1,056	17%	-41%
b. Number of science and engineering graduate degrees conferred	175	155	209	13%	-16%
c. DELETED (Number of degree programs)	0				
d. Number (headcount) undergraduate students enrolled in science and engineering majors in Fall Semester	3,784	2,675	7,258	41%	-48%
e. Number of undergraduate students science and engineering degrees conferred	689	535		29%	
f. DELETED (Number (FTE) of graduate students participating in science and engineering programs)	0				
g. Total R&D space	947,336	1,067,836	606,258	-11%	56%
h. Current, depreciated, value of facilities and fixed equipment	$223,449,446	$218,605,846	$121,251,600	2%	84%
i. Major (purchase price >$50,000) research equipment purchased this year.	$2,404,052	$2,807,857	$16,074,033	-14%	-85%
j. Number of positions FTE	0	527	0	-100%	0%
Faculty	20	13	432	54%	-95%
Research staff (non-faculty)	0	0	23	0%	-100%
Professional staff	25	16	352	56%	-93%
Students	36	20	198	80%	-82%
Classified personnel	2	2	207	0%	-99%

	University Research-based Institutions				
	2007 Total Attributable to State Funding	**2006 Total Attributable to State Funding**	**2002 Total Attributable to State Funding**	**2006-2007 Percent Change for Universities**	**2002-2007 Percent change for Universities**
Research and Development Outcomes					
A. Publications					
1. Number of scientific peer-reviewed journal articles published	576	798	527	-28%	9%
2/ Number of scientific peer-reviewed book chapters published	98	119	30	-18%	227%
3. Number of scientific peer-reviewed books published	26	36	64	-28%	-59%
4. Number of other scientific papers published	674	653	332	3%	103%
5. Number of other scientific papers not published (e.g. research reports for industry)	2,147	927	768	132%	180%
B. Research Proposals					
1.a. Number of extramural research proposal submitted	59	51	574	16%	-90%
1b. Dollars requested	$19,810,377	$20,121,229	$130,232,919	-2%	-85%
2.a. Number of these proposals submitted jointly with other Maine institutions	10	7	43	43%	-77%
2.b. Dollar Value	$5,218,508	$7,054,933	$9,943,894	-26%	-48%
3.a. Number of these proposals submitted jointly with non-Maine institutions only	6	10	66	-40%	-91%
3.b.Dollar Value	$4,761,382	$7,898,786	$10,482,110	-40%	-55%
4. Number of these proposal submitted jointly with both Maine and non-Maine institutions	3	2	0	50%	added 3
4.b. Dollar Value	$872,560	$1,676,366	$0	-48%	added $872k

	University Research-based Institutions				
	2007 Total Attributable to State Funding	**2006 Total Attributable to State Funding**	**2002 Total Attributable to State Funding**	**2006-2007 Percent Change for Universities**	**2002-2007 Percent change for Universities**
C. Research Awards					
1. Number of new Federal research grants, contracts, subcontracts (total value for all costs and years)	414	268	429	54%	-3%
Dollar Value	$56,156,164	$41,089,533	$44,879,959	37%	25%
2. Number of these awarded under EPSCOR	4	1	6	300%	-33%
Dollar Value	$2,430,067	$2,300,000	$2,278,125	6%	7%
3. Number of these that were earmarked	13	19	0	-32%	added 13
Dollar Value	$4,104,424	$7,868,725	$0	-48%	added $4.1M
4.a. Total expenditures for research and development for FY06	1818988	3950999			
4.b. Sources of funds for R&D expenditures: federal	$1,725,842	$2,699,906			
4.b. State	2419500	446909			
4.b.Industry	76151	0			
4.b. Individuals and foundations	804184	804184			
5. Number of industrial research grants, contracts and subcontracts awarded	207	0	0	added 207	added 207
Dollar Value	$2,609,261	$3,757,734	$1,916,817	-31%	36%
6. Number of these industrial research contracts awarded by Maine companies	158	0	0	added 158	added 158
Dollar Value	$1,173,633	$0	$0	added $1.17M	added $1.17M
7. Number of new foundation grants and gifts	54	57	2	-5%	2600%
Dollar Value	$2,005,462	$2,321,942		-14%	added $2M
D. Intellectual Property					
1. Number of disclosures made	18	19	$6	-5%	200%
2. Number of patents applied for	10	10	4	0%	150%

	University Research-based Institutions				
	2007 Total Attributable to State Funding	**2006 Total Attributable to State Funding**	**2002 Total Attributable to State Funding**	**2006-2007 Percent Change for Universities**	**2002-2007 Percent change for Universities**
3. Number of patents awarded	3	3		0%	Added 3
4. Number of copyrights obtained	0	0	0	0%	0%
5. Number of plant breeder's rights obtained	0	0	0	0%	0%
6. Number of licensing agreements signed	4	2	0	100%	added 4
7. Number of licensing agreements signed with Maine companies	2	2	0	0%	added 207
8. License income received this year	$500,000	$285,000	$0	75%	added $500k
E. Spin-off Companies					
1. Number of new companies formed	1	2	0	-50%	added 1
2. Number of jobs in these companies at spin-off	2	6	0	-67%	added 2

Gray areas = no data or data question has changed significantly

Questions shift over time, so cannot analyze over time

Non Profit
Bigelow
Maine Medical Center
Wells National
Jackson
MDIBL
Gulf of Maine
Downeast Institute
Maine Inst of Human Genetics and Health
Foundation for Blood Research

Universities
Univ of Southern Maine
Univ of New England
UMaine Orono
UMaine Machias
Maine Maritime

Nonprofit Results Attributable to State Investment, 2002–2007

	Nonprofit Research Institutions				
	2007 Attributable to State Funding	**2006 Attributable to State Funding**	**2002 Attributable to State Funding**	**2006-2007 Percent Change for Nonprofits**	**2002-2007 Percent Change for Nonprofits**
Institutional Capacity					
a. Number (headcount) of enrolled science and engineering graduate students in fall Semester	2	0	0		
b. Number of science and engineering graduate degrees conferred	1	0	0		
c. DELETED (Number of degree programs)					
d. Number (headcount) undergraduate students enrolled in science and engineering majors in Fall Semester	0	0	0	0%	0%
e. Number of undergraduate students science and engineering degrees conferred	0	0		0%	0%
f. DELETED (Number (FTE) of graduate students participating in science and engineering programs)					
g. Total R&D space	90,118	72,249	9,755	25%	824%
h. Current, depreciated, value of facilities and fixed equipment	$19,946,839	$15,895,815	$33,631,300	25%	-41%
i. Major (purchase price >$50,000) research equipment purchased this year.	$1,189,644	$301,992	$320,000	294%	272%
j. Number of positions FTE	54	33	0	64%	added 35
Faculty	73	0	0	added 5	added 5
Research staff (non-faculty)	54	19	0	180%	added 54
Professional staff	27	26	52	4%	-49%
Students	19	22	0	-14%	added 19
Classified personnel	12	27	9	-55%	31%
Research and Development Outcomes					
A. Publications					
1. Number of scientific peer-reviewed journal articles published	218	238	153	-8%	42%

	Nonprofit Research Institutions				
	2007 Attributable to State Funding	**2006 Attributable to State Funding**	**2002 Attributable to State Funding**	**2006-2007 Percent Change for Nonprofits**	**2002-2007 Percent Change for Nonprofits**
2/ Number of scientific peer-reviewed book chapters published	3	9	11	-67%	-73%
3. Number of scientific peer-reviewed books published	1	1	1	0%	0%
4. Number of other scientific papers published	58	61	0	-5%	added 58
5. Number of other scientific papers not published (e.g. research reports for industry)	16	21	0	-24%	added 16
B. Research Proposals					
1.a. Number of extramural research proposal submitted	217	188	106	15%	105%
1b. Dollars requested	$159,674,827	$107,147,465	$92,252,970	49%	73%
2.a. Number of these proposals submitted jointly with other Maine institutions	26	20	1	30%	2500%
2.b. Dollar Value	$13,790,897	$8,014,193	$8,218,269	72%	68%
3.a. Number of these proposals submitted jointly with non-Maine institutions only	46	39	20	18%	130%
3.b.Dollar Value	$53,965,438	$20,298,484	$35,698,533	166%	51%
4. Number of these proposal submitted jointly with both Maine and non-Maine institutions	75	50	21	50%	257%
4.b. Dollar Value	$61,564,539	$26,523,231	$43,916,802	132%	40%
C. Research Awards					
1. Number of new Federal research grants, contracts, subcontracts (total value for all costs and years)	70	48	41	46%	71%
Dollar Value	$76,226,898	$32,965,792	$47,176,309	131%	62%
2. Number of these awarded under EPSCOR	0	0	0	0%	0%
Dollar Value	$0	$2,000,000	$0	-100%	added $2M
3. Number of these that were earmarked	1	1	0	0%	added 1
Dollar Value	$1,245,516	$245,516	$0	407%	added $1.25M
4.a. Total expenditures for research and development for FY06	$73,318,961	$73,083,281			

	Nonprofit Research Institutions				
	2007 Attributable to State Funding	**2006 Attributable to State Funding**	**2002 Attributable to State Funding**	**2006-2007 Percent Change for Nonprofits**	**2002-2007 Percent Change for Nonprofits**
4.b. Sources of funds for R&D expenditures: federal	$65,512,185	$64,574,156			
4.b. State	1620066	1359703			
4.b.Industry	627751	330596			
4.b. Individuals and foundations	10191966	7306191			
5. Number of industrial research grants, contracts and subcontracts awarded	4	6	2	-33%	100%
Dollar Value	$175,000	$1,935,742	$175,604	-91%	0%
6. Number of these industrial research contracts awarded by Maine companies	2	4	0	-50%	added 2
Dollar Value	$75,000	$170,826	$0	-56%	added $75k
7. Number of new foundation grants and gifts	27	35	20	-23%	35%
Dollar Value	$4,331,447	$7,957,902		-46%	added $4.3M
D. Intellectual Property					
1. Number of disclosures made	19	18	$2	6%	850%
2. Number of patents applied for	9	6	0	50%	added 9
3. Number of patents awarded	2	1		100%	added 2
4. Number of copyrights obtained	2	0	0	added 2	added 2
5. Number of plant breeder's rights obtained	0	0	0	0%	0%
6. Number of licensing agreements signed	10	2	0	400%	added 10
7. Number of licensing agreements signed with Maine companies	1	0	0	added 1	added 1
8. License income received this year	$450,000	$136,472	$0	230%	added $450k
E. Spin-off Companies					
1. Number of new companies formed	0	1	0	-100%	0%
2. Number of jobs in these companies at spin-off	0	2.5	0	-100%	0%

Gray areas = no data or data question has changed significantly

Questions shift over time, so cannot analyze over time

	Nonprofit Research Institutions				
	2007 Attributable to State Funding	**2006 Attributable to State Funding**	**2002 Attributable to State Funding**	**2006-2007 Percent Change for Nonprofits**	**2002-2007 Percent Change for Nonprofits**
Nonprofit					
Bigelow					
Maine Medical Center					
Wells National					
Jackson					
MDIBL					
Gulf of Maine					
Downeast Institute					
Maine Inst of Human Genetics and Health					
Foundation for Blood Research					

Attachment E

Case Study: Understanding Maine's Private Sector R&D

Case Study: Understanding Maine's Private Sector R&D

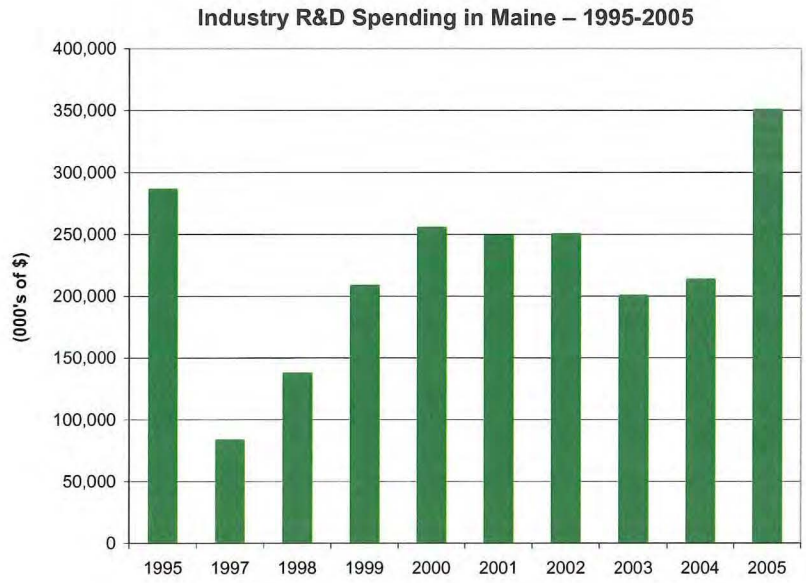
Since industry R&D composes the vast majority of the nation's total R&D investments, R&D by this sector is integral to growing the state's R&D capacity. Industry R&D drives state economic growth by creating high-paying jobs for the performance of R&D, increasing productivity and generating commercialization of new products and services. Industry R&D is particularly important for transforming and growing Maine's economy, which has been historically reliant on traditional, natural resource-based industries. R&D can both strengthen these industries as well as create opportunities for new industries in the state.

Key Questions:

- How much private sector R&D are we doing in Maine and how has that changed over the past ten years?
- What are the sources of funds for private R&D?
- What industries and companies are conducting private sector R&D in Maine?
- What services and networks are important to companies supported by state-funded programs and services?

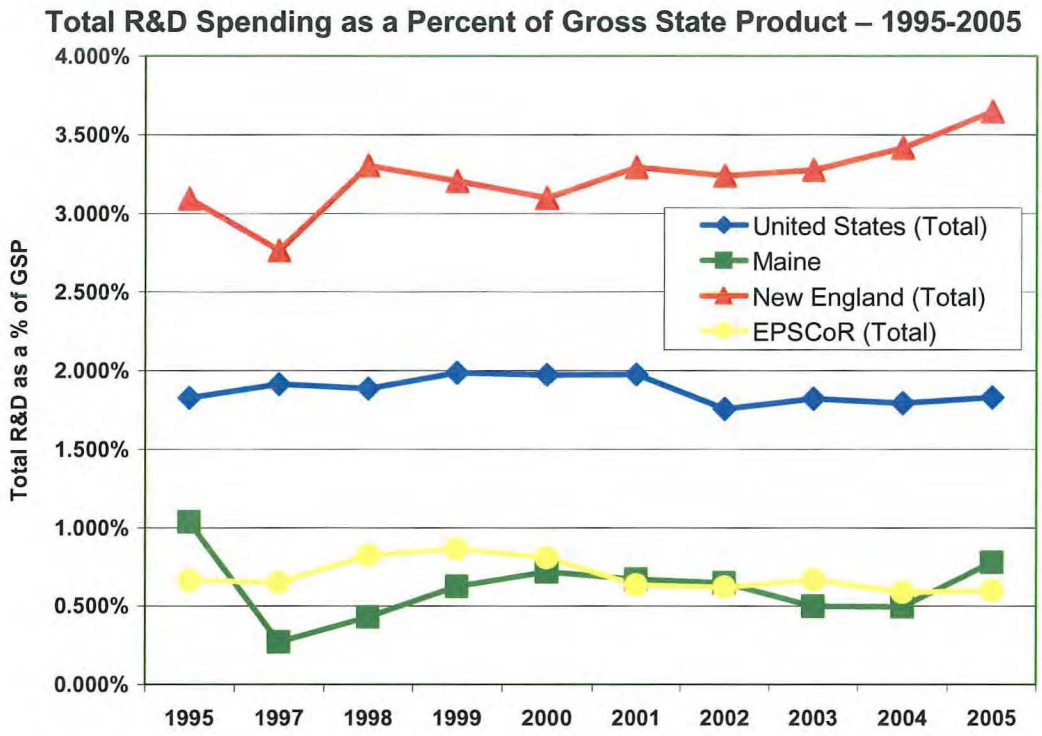
How Much Private Sector R&D Are We Doing in Maine and How Has That Changed over the Past Ten Years?

For 2005, the latest year for which comparable data is available, Maine experienced a significant increase in industry R&D performed. In 2005, industry R&D in Maine equaled $350 million. This was higher than any level performed since 1987 and represented a 41% increase since 2001 and an increase of 64% from the 2004 level of $213 million. In 2005, this R&D in Maine was performed by 164 companies.



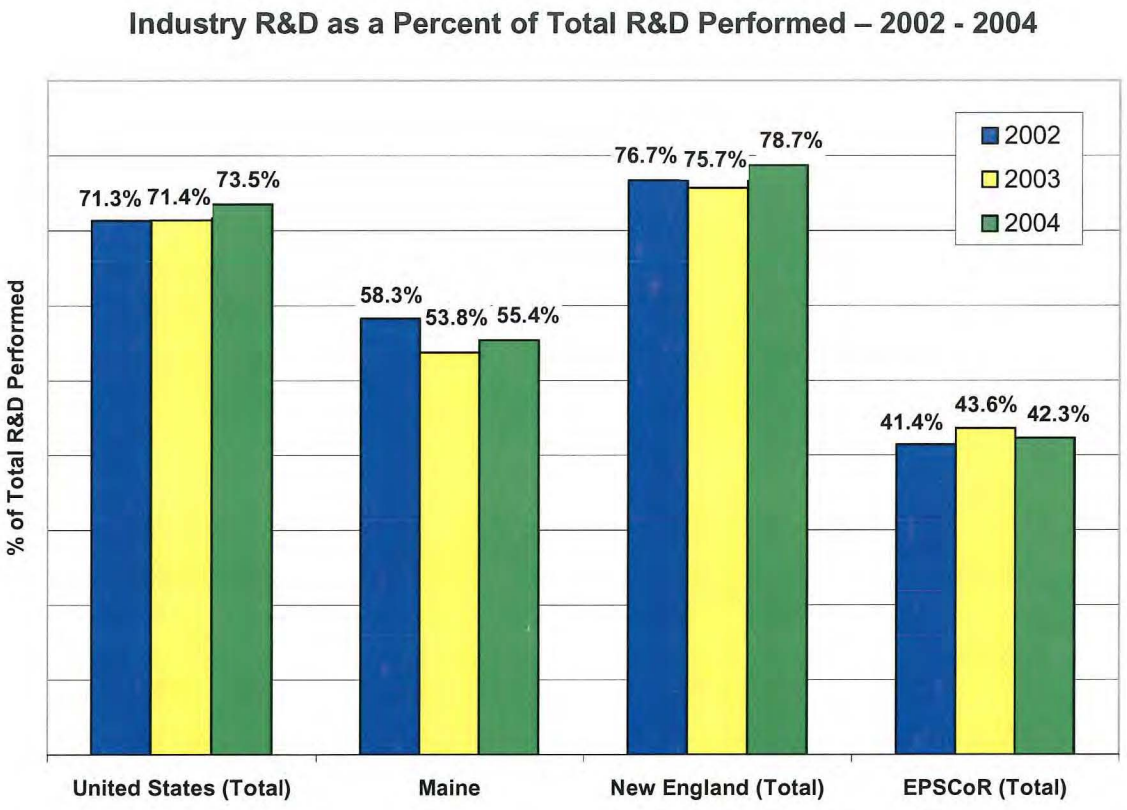
Source: Industry R&D Performed – National Science Foundation/Division of Science Resources Statistics, Survey of Industrial Research and Development: 2001 and 2002, 2002–2003 forthcoming. http://www.nsf.gov/statistics

Maine's $350 million in R&D in 2005 represented 0.78% of gross state product (GSP). This was higher than that of the EPSCoR level of 0.60 but lower than the U.S. at 1.83 and New England at 3.65. **Maine's recent increase on this industry R&D indicator moved it from ranking 40th in the nation in 2004 to 32nd in 2005.**



Source: Industry R&D Performed – National Science Foundation/Division of Science Resources Statistics, Survey of Industrial Research and Development: 2001 and 2002, 2002–2003 forthcoming; http://www.nsf.gov/statistics; Gross State Product – Bureau of Economic Analysis, U.S. Department of Commerce, 1980–1996 data; and Revised Estimates for 1997–2006; http://www.bea.gov/regional/gsp/; 1997–2006 is based on NAICS while 1980–1996 is based on SIC industry classification.

Maine's proportion of R&D that was performed by industry has historically been higher than the EPSCoR states as a whole but lower than that of the United States and New England. A recent annual increase in industry R&D will likely improve Maine's position on this indicator. Prior to the 2005 increase in Maine's private sector R&D, Maine's percentage of industry R&D performed relative to total R&D performance ranged between 54% and 58%. This was higher than the level of EPSCoR states combined but lower than the level for New England and the United States as a whole. The 2005 increase in industrial R&D in Maine should help increase this percentage, but total R&D numbers for 2005 are not yet available for analysis.



Source: Industry R&D Performed – National Science Foundation/Division of Science Resources Statistics, Survey of Industrial Research and Development: 2001 and 2002, 2002–2003 forthcoming; http://www.nsf.gov/statistics

What Are the Sources of Funds for Private R&D?

The primary source of funding for industry R&D has historically been private investment by the industries. This private investment is also supported by federal funds for industry R&D performance, which is the second-largest source of funding. Most states also provide direct and indirect funding for industry R&D.

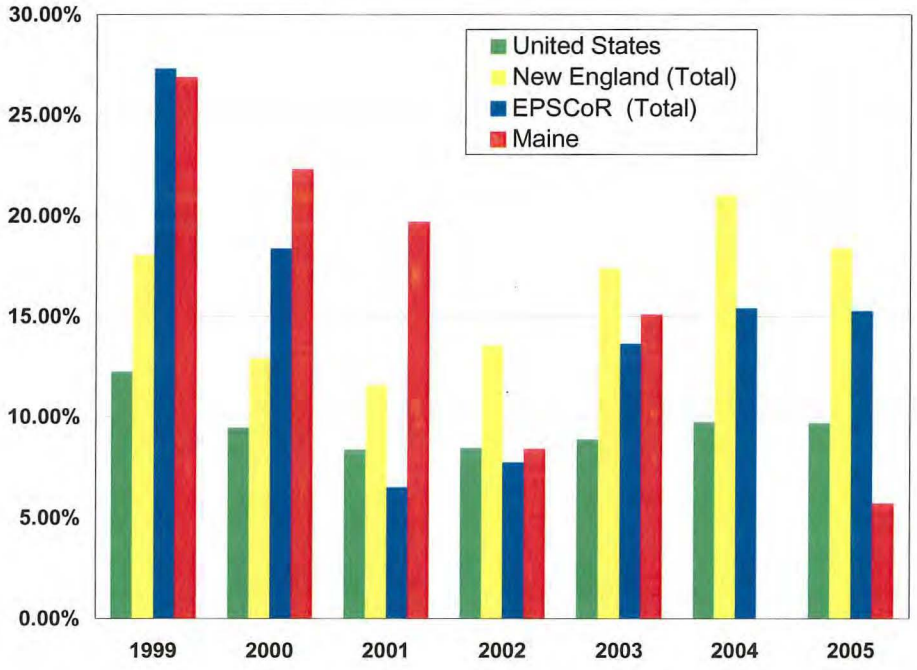
Since 1999, Maine has experienced annual decreases in the percent of industry R&D performed that is funded by the federal government. In 2005, 5.7% of Maine's industry R&D was funded by federal sources, representing a significant decrease from the 1999 level of 26.9%. Maine's 2005 level of 5.7% was lower than all the benchmarks, with federal sources representing 9.7% of industry R&D for the U.S. as a whole, 18.4% for New England, and 15.2% for the EPSCoR states.

Industrial R&D Performance by State and % of Fund Company vs. Federal: 1999–2005							
Federal as Percent of Total							
	1999	2000	2001	2002	2003	2004	2005
United States	12.24%	9.47%	8.37%	8.46%	8.87%	9.73%	9.69%
New England (Total)	18.05%	12.93%	11.61%	13.58%	17.40%	21.02%	18.41%
EPSCoR (Total)	27.29%	18.35%	6.50%	7.74%	13.62%	15.40%	15.23%
Maine	26.87%	22.28%	19.68%	8.41%	15.08%	D	5.70%
Company and All Other as Percent of Total							
	1999	2000	2001	2002	2003	2004	2005
United States	87.76%	90.53%	91.63%	91.54%	91.13%	90.27%	90.31%
New England (Total)	81.95%	87.07%	88.39%	86.42%	82.60%	78.98%	81.59%
EPSCoR (Total)	72.71%	81.65%	93.50%	92.26%	86.38%	84.60%	84.77%
Maine	73.13%	77.72%	80.32%	91.59%	84.92%	D	94.30%

Notes: D = suppressed to avoid disclosure of confidential information; Beginning with 2001, statistics for all and federally funded industrial R&D exclude federally funded research and development centers. Includes data reported on Form RD-1 that were not allocated to a specific state. Data reported on the Form RD-1A were allocated to the state in the address on the company's survey form, which is usually the company's headquarters; The R&D in this table is the industrial R&D performed within company facilities funded from all sources. The funds are the company's own; funds from outside organizations, such as other companies, research institutions, universities and colleges, nonprofit organizations, and state governments; and funds from the federal government. Excludes R&D not performed within the company (e.g., R&D performed by other organizations) and R&D not performed within the 50 U.S. states or D.C. (e.g., R&D not performed on U.S. soil by foreign subsidiaries or other foreign organizations). Company source includes company and all other non-federal sources.

Source: National Science Foundation/Division of Science Resources Statistics, Survey of Industrial Research and Development: 2005; http://www.nsf.gov/statistics

Percent of Industrial R&D Performed from Federal Sources of Funds as Percent of Total - 1999-2005



Source: National Science Foundation/Division of Science Resources Statistics, Survey of Industrial Research and Development: 2005; http://www.nsf.gov/statistics

Maine provides support to companies for R&D and related commercialization through several state-funded programs in the form of grants, loans, equity financing, tax credits, and technical assistance. **Since 1996, more than 725 companies have received support from Maine's R&D and commercialization programs.**

State funding for the programs designed to provide direct support to companies totaled more than $370 million between fiscal year 1996-97 and 2007-08. These data exclude Maine tax credits for research and development for which recent data was not available (representing approximately $3 million annually) and exclude support for R&D to the academic and nonprofit sector, some of which further supports private sector R&D.

State of Maine Research and Development Funding To Support Private Sector R&D FY 1996/97 – 2007/08		
	Total All Years	
Research and Development Category	**$**	**% of All State R&D**
Maine Technology Institute	$ 98,444,972	26.57%
Applied Technology Development Centers	$ 9,599,980	2.59%
Small Enterprise Growth Fund	$ 8,000,000	2.16%
Maine Patent Program	$ 1,868,120	0.50%
Total State R&D Support for Private Sector R&D	***$ 117,913,072***	***31.83%***
TOTAL R&D-APPROPRIATIONS & BONDS	**$ 370,486,234**	

Notes: Appropriations have been adjusted for curtailments; Some of MTI funds are provided to academic and not-for-profit research institutions; however, for this analysis they are included here as they are typically related to support for private sector R&D in partnership with those institutions. 2007–08 includes $50,000 R&D Bond passed by Maine voters in June 2007; funds will be Administered by MTI and are in addition to MTI's ongoing grant programs. Funds will be awarded on a competitive basis for R&D commercialization to Maine private and public entities.

Source: Prepared by PolicyOne Research from data provided by the Maine Legislature, Office of Fiscal & Program Review

Trends in R&D Tax Credits in Maine, 1996-2002 Tax Years						
	Research Expense		Super Credit for R&D		High Tech Investment	
Year	# Claims	Total $	# Claims	Total $	# Claims	Total $
1996	10	$251,390	n/a	n/a	n/a	n/a
1997	15	$937,765	n/a	n/a	n/a	n/a
1998	10	$251,390	3	$57,339	n/a	n/a
1999	8	$808,947	2	$1,176	n/a	n/a
2000*	41	$441,116	22	$1,285,441	53	$2,297,892
2001*	59	$631,926	35	$1,085,747	50	$922,939
2002*	55	$302,662	34	$1,121,904	50	$1,395,906

Notes: 1996 was the first year of the Research Expense Tax Credit; 1998 was the first year of the Super Credit for R&D and High-Technology Investment Tax Credit. *Tax year 2000 figures and later include individual claims; prior to 2000, individual credits were not separately recorded. 2000 and 2002 data for the super R&D credit represent a maximum; actual data were suppressed for confidentiality reasons.

Source: Maine Revenue Services

What Size of Companies, Industries, and Specific Companies Are Conducting Private Sector R&D In Maine?

Size of Companies

Maine has a larger percentage of its industrial R&D being performed by its smaller companies compared to the benchmark areas. Based on the 2005 industrial R&D performance data, 16% of Maine's industry R&D is performed by companies between 5 and 49 employees. This compares to 7% for the United States as a whole, 5% for New England, and 11% for the EPSCoR states.

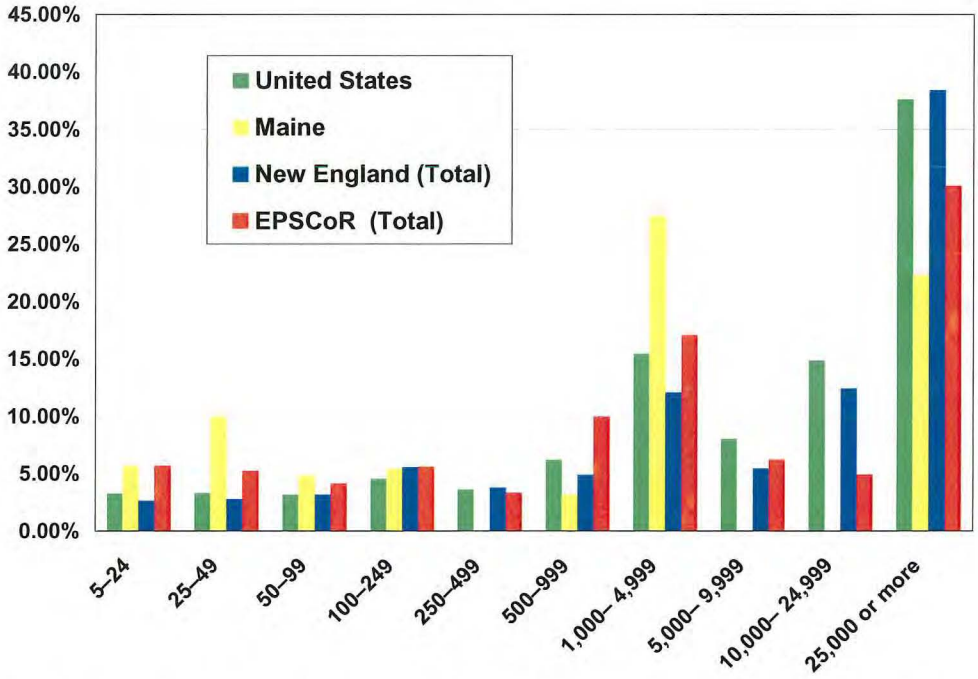
Percent of Industrial R&D Performed by Size of Company Category: 2005

	Company Size – Employment									
Geographic Area	**5–24**	**25–49**	**50–99**	**100–249**	**250–499**	**500–999**	**1,000–4,999**	**5,000–9,999**	**10,000–24,999**	**25,000 or more**
United States	3.26%	3.31%	3.16%	4.57%	3.60%	6.19%	15.46%	8.03%	14.84%	37.58%
Maine	5.71%	10.00%	4.86%	5.43%	D	3.14%	27.43%	D	D	22.29%
New England (Total)	2.61%	2.78%	3.15%	5.55%	3.78%	4.90%	12.09%	5.45%	12.40%	38.39%
EPSCoR (Total)	5.67%	5.23%	4.11%	5.60%	3.29%	9.94%	17.08%	6.19%	4.89%	30.04%

Notes: D = suppressed to avoid disclosure of confidential information; detail does not add to total because of rounding or suppression. Excludes federally funded research and development centers. Includes data reported on Form RD-1 that were not allocated to a specific state. Data reported on the Form RD-1A were allocated to the state in the address on the company's survey form, which is usually the company's headquarters. The R&D in this table is the industrial R&D performed within company facilities funded from all sources. The funds are the company's own; funds from outside organizations, such as other companies, research institutions, universities and colleges, nonprofit organizations, and state governments; and funds from the federal government. Excludes R&D not performed within the company (e.g., R&D performed by other organizations) and R&D not performed within the 50 U.S. states or D.C. (e.g., R&D not performed on U.S. soil by foreign subsidiaries or other foreign organizations).

Source: National Science Foundation/Division of Science Resources Statistics, Survey of Industrial Research and Development: 2005; http://www.nsf.gov/statistics

Percent of Industrial R&D Performed by Size of Company Category: 2005



Source: National Science Foundation/Division of Science Resources Statistics, Survey of Industrial Research and Development: 2005; http://www.nsf.gov/statistics

The relative small size of companies conducting R&D is even more dramatic for companies that have received state support for R&D and commercialization in Maine.

R&D Expenditures by State Supported Companies by Employment Size -				
Employment Size	**Number of Companies**	**Percent of Companies**	**Total R&D Performed**	**%of Total R&D Performed**
1–4	128	52.9%	$6,542,486	13.2%
5–24	76	31.4%	$11,848,112	23.9%
25–49	15	6.2%	$4,876,307	9.8%
50–99	10	4.1%	$5,604,434	11.3%
100–249	7	2.9%	$7,411,589	15.0%
250–499	3	1.2%	$5,543,287	11.2%
500–999	2	0.8%	$1,986,500	4.0%
1,000– 4,999	1	0.4%	$5,700,000	11.5%
Total	**242**	**100.0%**	**$49,512,715**	100.0%
Maine R&D Survey 2007 - Represents companies that reported some level of R&D expenditures for 2007				

Source: 2007 R&D Institute Survey

Of the 346 companies that responded to the 2007 Maine R&D survey, 242 reported some level of R&D expenditures for that year. Those 242 companies reported a total of $49.5 million in R&D expenditures for 2007. Of the total R&D expenditures reported, 34% was performed by companies with between 5 and 49 employees. Another 13% was performed by companies with fewer than 5 employees.

The data on company size suggest two points for further consideration. First, to enhance economic impacts, Maine may want to increase its efforts to support company growth, helping existing R&D companies grow as opposed to starting very small new companies. Second, small companies likely have service needs that are different from larger companies. For example, entrepreneurial support services are likely in higher demand by smaller companies.

Industry Sectors

In 2005, Maine's largest R&D performing industry sector (3-digit NAICS [North American Industry Classification Systems]) was chemical manufactures (performing 32% of Maine's industry R&D), and more specifically (4-digit NAICS sub-sector) pharmaceuticals and medicines manufactures (29% of industry R&D). Other major sub-sectors (4-digit NAICS) included manufactures of semiconductor and other electronic components (12%) and architectural, engineering, and related services (6%). Other major sectors (3-digit NAICS) included newspaper, periodical, book, directory, and software publishing (23%). Relative to the country as a whole, Maine had R&D high concentrations (as measured by location quotient) in the sectors/sub-sectors of pharmaceuticals and medicines manufactures; manufactures of semiconductor and other electronic components; newspaper, periodical, book, directory, and software publishing; and architectural, engineering, and related services.

Industrial R&D Performance by Industry: Maine and U.S. 2005

		U.S.		Maine		
NAICS codes	**Industry and company size**	**R&D $**	**% of Total R&D**	**R&D $**	**% of Total R&D**	**Maine Location Quotient**
21–23, 31–33, 42, 44–81	**All industries**	**226,159**		**350**		
31–33	**Manufacturing industries**	**158,190**	**69.9%**	**202**	**57.7%**	**0.83**
322, 323	Paper, printing, and support activities	D	D	17	4.9%	n/a
325	Chemicals	42,995	19.0%	111	31.7%	1.67
3254	Pharmaceuticals and medicines	34,839	15.4%	103	29.4%	1.91
334	Computer and electronic products	D	D	46	13.1%	n/a
3344	Semiconductor and other electronic components	18,724	8.3%	41	11.7%	1.41

Industrial R&D Performance by Industry: Maine and U.S. 2005							
		U.S.		Maine			
NAICS codes	Industry and company size	R&D $	% of Total R&D	R&D $		% of Total R&D	Maine Location Quotient
21–23, 42, 44–81	**Nonmanufacturing industries**	**67,969**	**30.1%**	**148**		**42.3%**	**1.41**
51	Information	23,836	10.5%	88		25.1%	2.39
511	Publishing(newspaper, periodical, book, directory, software)	17,747	7.8%	79		22.6%	2.88
54	Professional, scientific, and technical services	32,021	14.2%	45		12.9%	0.91
5413	Architectural, engineering, and related services	4,687	2.1%	21	i	6.0%	2.90
5415	Computer systems design and related services	13,592	6.0%	10	e	2.9%	0.48
5417	Scientific R&D services	12,299	5.4%	12	e	3.4%	0.63

Notes: D = suppressed to avoid disclosure of confidential information; e = estimated; more than 50% of cell value is imputed due to raking of state data; i = more than 50% of the value is imputed. a Estimates for management of companies and enterprises (NAICS 55), formerly shown separately, now are included in other nonmanufacturing. Detail does not add to total because of rounding or suppression. The method used to assign industry classifications has changed; industry-specific estimates are not directly comparable with those for years prior to 2004.

Excludes federally funded research and development centers. Includes data reported on Form RD-1 that were not allocated to a specific state. Data reported on the Form RD-1A were allocated to the state in the address on the company's survey form which is usually the company's headquarters. The R&D in this table is the industrial R&D performed within company facilities funded from all sources. The funds are the company's own; funds from outside organizations, such as other companies, research institutions, universities and colleges, nonprofit organizations, and state governments; and funds from the federal government. Excludes R&D not performed within the company (e.g., R&D performed by other organizations) and R&D not performed within the 50 U.S. states or D.C. (e.g., R&D not performed on U.S. soil by foreign subsidiaries or other foreign organizations)

Sources: National Science Foundation/Division of Science Resources Statistics, Survey of Industrial Research and Development: 2005; http://www.nsf.gov/statistics

Both the U.S. and Maine data on industry R&D performance and employment by sector reveal that high R&D concentration does not equate to high employment concentration. However, it is worth noting that in one sub-sector, manufactures of semiconductor and other electronic components, Maine had a high concentration of R&D relative to the country and an employment concentration that was slightly higher than that of the country. This might also be true for the paper, printing, and support activities in which Maine had a relatively high employment concentration; however, R&D performance at the national level for this industry was non-disclosable.

Employment within Maine Industries Performing R&D: 2005						
		U.S.		Maine		
NAICS codes	Industry and company size	Employment	% of Total Employment	Employment	% of Total Employment	Maine Location Quotient
21–23, 31–33, 42, 44–81	**All industries**	**121,194,236**		**556,485**		
31–33	**Manufacturing industries**	**14,231,887**	**11.7%**	**65,748**	**11.8%**	**1.01**
322, 323	Paper, printing, and support activities	1,132,216	0.9%	11,984	2.2%	2.31
325	Chemicals	872,421	0.7%	1,552	0.3%	0.39
3254	Pharmaceuticals and medicines	288,155	0.2%	1,046	0.2%	0.79
334	Computer and electronic products	1,308,291	1.1%	3,479	0.6%	0.58
3344	Semiconductor and other electronic components	446,503	0.4%	2,211	0.4%	1.08
21–23, 42, 44–81	**Nonmanufacturing industries**	**106,962,349**	**88.3%**	**490,737**	**88.2%**	**1.00**
51	Information	3,200,126	2.6%	11,753	2.1%	0.80
511	Publishing(newspaper, periodical, book, directory, software)	903,317	0.7%	3,579	0.6%	0.86
54	Professional, scientific, and technical services	7,171,705	5.9%	22,993	4.1%	0.70
5413	Architectural, engineering, and related services	1,369,488	1.1%	4,504	0.8%	0.72
5415	Computer systems design and related services	1,202,832	1.0%	3,041	0.5%	0.55
5417	Scientific R&D services	606,290	0.5%	1,846	0.3%	0.66

Notes: The method used to assign industry classifications has changed; industry-specific estimates are not directly comparable with those for years prior to 2004. Excludes federally funded research and development centers. Includes data reported on Form RD-1 that were not allocated to a specific state. Data reported on the Form RD-1A were allocated to the state in the address on the company's survey form, which is usually the company's headquarters. The R&D in this table is the industrial R&D performed within company facilities funded from all sources. The funds are the company's own; funds from outside organizations, such as other companies, research institutions, universities and colleges, nonprofit organizations, and state governments; and funds from the federal government. Excludes R&D not performed within the company (e.g., R&D performed by other organizations) and R&D not performed within the 50 U.S. states or D.C. (e.g., R&D not performed on U.S. soil by foreign subsidiaries or other foreign organizations).

Source: National Science Foundation/Division of Science Resources Statistics, Survey of Industrial Research and Development: 2005; http://www.nsf.gov/statistics

Industrial R&D Performance and Employment Concentration by Industry: Maine and U.S. 2005								
		U.S.		Maine				
NAICS codes	Industry and company size	R&D % of Total	Employment % of Total	R&D % of Total		Employment % of Total	R&D Location Quotient	Employment Location Quotient
21–23, 31–33, 42, 44–81	**All industries**							
31–33	**Manufacturing industries**	**69.9%**	**11.7%**	**57.7%**		**11.8%**	**0.83**	**1.01**
322, 323	Paper, printing, and support activities	D	0.9%	4.9%		2.2%	n/a	2.31
325	Chemicals	19.0%	0.7%	31.7%		0.3%	1.67	0.39
3254	Pharmaceuticals and medicines	15.4%	0.2%	29.4%		0.2%	1.91	0.79
334	Computer and electronic products	D	1.1%	13.1%		0.6%	n/a	0.58
3344	Semiconductor and other electronic components	8.3%	0.4%	11.7%		0.4%	1.41	1.08
21–23, 42, 44–81	**Nonmanufacturing industries**	**30.1%**	**88.3%**	**42.3%**		**88.2%**	**1.41**	**1.00**
51	Information	10.5%	2.6%	25.1%		2.1%	2.39	0.80
511	Publishing(newspaper, periodical, book, directory, software)	7.8%	0.7%	22.6%		0.6%	2.88	0.86
54	Professional, scientific, and technical services	14.2%	5.9%	12.9%		4.1%	0.91	0.70
5413	Architectural, engineering, and related services	2.1%	1.1%	6.0%	i	0.8%	2.90	0.72
5415	Computer systems design and related services	6.0%	1.0%	2.9%	e	0.5%	0.48	0.55
5417	Scientific R&D services	5.4%	0.5%	3.4%	e	0.3%	0.63	0.66

Notes: D = suppressed to avoid disclosure of confidential information; e = estimated; more than 50% of cell value is imputed due to raking of state data; i = more than 50% of the value is imputed.; The method used to assign industry classifications has changed; industry-specific estimates are not directly comparable with those for years prior to 2004. Excludes federally funded research and development centers. Includes data reported on Form RD-1 that were not allocated to a specific state. Data reported on the Form RD-1A were allocated to the state in the address on the company's survey form, which is usually the company's headquarters. The R&D in this table is the industrial R&D performed within company facilities funded from all sources. The funds are the company's own; funds from outside organizations, such as other companies, research institutions, universities and colleges, nonprofit organizations, and state governments; and funds from the federal government. Excludes R&D not performed within the company (e.g., R&D performed by other organizations) and R&D not performed within the 50 U.S. states or D.C. (e.g., R&D not performed on U.S. soil by foreign subsidiaries or other foreign organizations).

Source: National Science Foundation/Division of Science Resources Statistics, Survey of Industrial Research and Development: 2005; http://www.nsf.gov/statistics

When the industrial R&D performance data are examined in terms of major U.S. performance sectors, Maine has concentrations in pharmaceuticals and medicines manufactures; manufactures of semiconductor and other electronic components; and newspaper, periodical, book, directory and software publishing.

U.S. Industrial R&D Performance by Industry 2005				Maine's R&D as % of Maine Total
Industry	**NAICS codes**	**$ in Millions**	**% of Total**	
All industries	**21–23, 31–33, 42, 44–81**	**226,159**		
Manufacturing industries	**31–33**	**158,190**	**69.95%**	**57.71%**
Chemicals	325	42,995	19.01%	31.71%
Pharmaceuticals and medicines	3254	34,839	15.40%	29.43%
Semiconductor and other electronic components	3344	18,724	8.28%	11.71%
Navigational, measuring, electromedical, and control instruments	3345	15,204	6.72%	1.14%
Aerospace products and parts	3364	15,005	6.63%	D
Nonmanufacturing industries	**21–23, 42, 44–81**	**67,969**	**30.05%**	**42.29%**
Information	51	23,836	10.54%	25.14%
Publishing(newspaper, periodical, book, directory, software)	511	17,747	7.85%	22.57%
Software	5112	16,926	7.48%	D
Professional, scientific, and technical services	54	32,021	14.16%	12.86%
Computer systems design and related services	5415	13,592	6.01%	2.86%
Scientific R&D services	5417	12,299	5.44%	3.43%

Notes: D = suppressed to avoid disclosure of confidential information; e = estimated; more than 50% of cell value is imputed due to raking of state data; i = more than 50% of the value is imputed. The method used to assign industry classifications has changed; industry-specific estimates are not directly comparable with those for years prior to 2004.; Excludes federally funded research and development centers. Includes data reported on Form RD-1 that were not allocated to a specific state. Data reported on the Form RD-1A were allocated to the state in the address on the company's survey form, which is usually the company's headquarters. The R&D in this table is the industrial R&D performed within company facilities funded from all sources. The funds are the company's own; funds from outside organizations, such as other companies, research institutions, universities and colleges, nonprofit organizations, and state governments; and funds from the federal government. Excludes R&D not performed within the company (e.g., R&D performed by other organizations) and R&D not performed within the 50 U.S. states or D.C. (e.g., R&D not performed on U.S. soil by foreign subsidiaries or other foreign organizations).

Source: National Science Foundation/Division of Science Resources Statistics, Survey of Industrial Research and Development: 2005; http://www.nsf.gov/statistics

Specific Companies

Data on specific companies performing R&D in Maine is limited in availability. A survey of private companies that receive state support for R&D-related activities is conducted annually for the ongoing Comprehensive R&D Evaluation. The data for this survey are reported in the aggregate and are confidential at the company level. Data reported by the National Science Foundation as part of their Survey of Industrial R&D are also confidential at the aggregate level.

Detailed financial data, including R&D expenditures, are available for publicly traded companies through the U.S. Securities Exchange Commission. Four publicly traded companies that are R&D-related are headquartered in Maine: Fairchild, Idexx, I-Many, and ImmuCell. In 2006, these four companies reported $175 million in R&D expenditures in 2006, representing 7% of their revenues in that year. Beyond the limited

number of Maine R&D companies that are publicly traded, a further limitation of this data is that it is reported for the company as a whole and not broken out by specific locations/states for companies with multiple locations, and therefore overstates the level of R&D conducted in one state.

R&D Expenditures Reported by Maine's Publicly Traded Companies

Company	Company Description	Annual R&D Expenditure	Expenditure Year	Total Revenue	Employees
Fairchild Semiconductor Intl, Inc.	Focused on developing, manufacturing and selling power analog, power discrete and certain non-power semiconductor solutions to a wide range of end market customers	$107,500,000	2006	$1,651,100,000	9,344
IDEXX Laboratories, Inc.	Develop, manufacture and distribute products and provide services primarily for the veterinary and the food and water testing markets	$53,617,000	2006	$739,117,000	3,900
I-many, Inc.	Provide software and related professional services that allow our clients to manage important aspects of their contract-based, business-to-business relationships	$12,600,000	2006	$29,575,000	52
ImmuCell Corp.	Biotechnology company serving veterinarians and producers in the dairy and beef industries with innovative and proprietary products that improve animal health and productivity	$965,926.00	2006	$4,801,270	30

Source: EDGAR database, U.S. Securities and Exchange Commission; http://www.sec.gov/edgar.shtml

As part of an assessment of Maine's technology clusters in process at the time of this case study, a listing of R&D-intensive companies in Maine was produced by the Battelle Institute based on databases that include listings of patents, publications, journals, and R&D. Fifteen companies in Maine produced four or more patents from 2002–2007. Seven companies had 20 or more records in the dataset. Again, a limitation of this data is that it includes companies with a Maine presence but all of the R&D activity is not necessarily conducted in Maine.

Maine-Based Companies with Four or More Patents

Maine-Based Companies	Number of Maine Patents, 1/2002 – 5/2007
Fairchild Semiconductor Corporation	45
IDEXX Laboratories, Inc.	28
MariCal, Inc.	17
Imagineering, Inc.	9
Vishay Sprague, Inc.	7
Tex Tech Industries, Inc.	6
Bath Iron Works Corporation	5
Neutar, LLC	5
Steag HamaTech, Inc.	5
RF Technologies Corporation	4
Riley Medical, Inc.	4
Sagoma Plastics Corporation	4
Thos. Moser Cabinetmakers	4
Tibbetts Industries, Inc.	4
Stillwater Scientific Instruments	4

Source: Battelle Calculations

Maine Companies with 20 or More Records in the Input Dataset

Organization	Records
Fairchild Semiconductor Corporation	70
IDEXX Laboratories, Inc.	45
National Semiconductor Corporation	45
SPX Corporation	43
Fiber Materials, Inc.	36
MariCal, Inc.	23
Sensor Research & Development Corporation	20
United Technologies Corp./Pratt & Whitney	20

Source: Battelle Calculations

Maine offers three R&D-related tax credit programs: the Research Expense Tax Credit, Super R&D Tax Credit, and High Technology Investment Tax Credit. These tax credits were part of a detailed case study conducted for the R&D evaluation in 2002. The following table shows companies that have received a Maine Research Expense Tax Credit between 1999 and 2002.

Companies Receiving More than $10,000 for the Maine Research Expense Tax Credit between 1999 and 2002

Company	City	State	Amount of Credit Received	Calendar Year
Auto Europe	Delray Beach	FL	$14,043	1999
Cambrex Bio Science Rockland Inc.	East Rutherford	NJ	$35,101	2000
Champion International	Memphis	TN	$204,930	1999
Commnav Engineering Inc.	Portland	ME	$14,489	2001
Control Devices	Standish	ME	$193,632	2000
Control Devices	Standish	ME	$235,984	2002
Fairchild Semiconductor Corp.	So. Portland	ME	$88,425	2001
Forum Financial Group LLC	Portland	ME	$84,490	2001
Idexx Lab Inc.	Westbrook	ME	$469,266	2000
Idexx Lab Inc.	Westbrook	ME	$96,772	2001
Idexx Lab Inc.	Westbrook	ME	$309,471	2002
Intelligent Controls Inc.	Saco	ME	$11,163	2000
John Keefer & Mary Jo Walters	Cumberland	ME	$84,490	2002
Kady International	Cape Porpoise	ME	$17,700	2002
Loftware Inc	Cape Neddick	ME	$24,325	2000
Loftware Inc	Cape Neddick	ME	$14,085	2002
Mega Industries	Gorham	Me	$90,935	2001
Mega Industries	Gorham	Me	$63,727	2002
Pfizer Inc	New York	NY	$18,219	2001
Pfizer Inc	New York	NY	$11,226	2002
Province Automation	Sanford	ME	$10,762	1999

Source: Maine Department of Economic and Community Development, compiled from the Annual Economic Development Incentive Report

There are three primary limitations of the Maine R&D tax credit data. First, the data are only available for companies receiving more than $10,000 annually in tax credits. Second and related is that in order to receive tax credits a company must have been profitable and paid taxes. Many R&D companies, particularly in their early stages, are not profitable and do not pay corporate taxes as any profits are spent on further R&D. Third, regarding data reported by Maine Revenue Services in the past few years, the department has failed to report company-level data in time for the R&D analysis.

What Services and Networks Are Important to Companies Supported by State-Funded Programs and Services?

The final issue examined as part of this case study is understanding the importance of services and networks for Maine companies conducting R&D. Maine's annual R&D survey of companies receiving state support provides some data for to use in examining this issue. As part of the survey, respondents that reported some level of annual R&D expenditures were asked to indicate the importance of the services and activities (some that are state-supported and others that are not) offered by various entities. The ratings were provided only by companies that actually reported using or participating in the services and activities. Several findings from that data are pertinent to this case study.

First, on average, most of the services and activities received a rating that was at or above average (3.0 or higher) in terms of importance to the R&D (on a scale where 1 = "completely unimportant" to 5 = "critically important").[i] The overall average for all services and all company sizes was 3.18. The programs of Maine Technology Institute rate particularly high (4.04), which is not surprising as they provide direct grants and loans for company R&D. The campuses of the University of Maine also rate relatively high (3.79). This is somewhat surprising and encouraging in that past economic analyses of Maine, including those conducted by this author, identified the need to foster increased relationships between businesses and higher education. The 2007 private R&D survey data indicates that Maine's public university system is providing programs and services that are very important to Maine's R&D businesses.

One area where more focus on R&D support may be warranted is with regard to industry associations, which received slightly lower than average importance ratings. Though trade associations do not typically provide R&D funding, they do provide networking, information, and advocacy, which can be crucial to building industry clusters. A previous study of Maine's technology industry clusters[ii] found many of Maine's technology trade associations to be relatively weak. While improvements have likely been made since the time of the initial cluster study, the 2007 R&D survey data indicate that there is still room for increased and improved activities of trade associations. Maine companies gave trade associations an average importance rating of 2.79, which is lower than the rating of industry associations outside of Maine (3.05), suggesting that there may be opportunities for Maine's associations to become better networked with their national peers.

When examining service importance to R&D activities by company size, an interesting trend emerges: On average, importance ratings were higher on the low and high ends of the company size scale and lower for companies in the middle of the size scale. Companies with between 1–4 employees reported an average importance level of 3.28, and companies with 50 or more employees (the high end of the size scale) reported an

average importance level of 3.30. Companies with 5–24 employees reported an average satisfaction level of 3.06, and those with 25–49 employees a rating of 2.82.

The data on service and activity usage by companies reporting R&D also revealed an interesting trend for this case study. On average, less than 50% of companies reported using the services or activities. Additionally, service and activity usage was on average lowest for companies between 25and 49 employees. These data suggest that additional outreach and expanded service capacity to Maine's R&D community may be warranted.

Importance of Various Services to Companies Reporting R&D Expenditures					
	Company Size (Employment)				
	1–4	5–24	25–49	50+	All
Number of Companies	126	75	15	23	239
Service	*Mean Score (1=completely unimportant to 5=critically*				
Any campus of the University of Maine System (UMS)	4.07	3.42	3.00	3.93	3.79
Any other educational institution in Maine	2.90	2.83	2.60	2.62	2.82
Any non-profit research institution in Maine	3.11	3.00	2.25	2.86	3.01
Trade associations in Maine	2.83	2.70	2.67	3.00	2.79
Other Maine firms in your industry	3.41	3.21	2.33	3.23	3.26
Maine Technology Institute (MTI)	4.18	3.93	3.77	3.83	4.04
Maine Manufacturing Extension Partnership (MEP)	2.98	2.74	2.83	2.92	2.87
Maine's Applied Technology Development Centers (ATDC)	3.13	2.91	3.60	3.50	3.11
Maine Patent Program (MPP)	3.50	3.22	2.60	3.50	3.36
Maine Small Business Development Centers (MSBDC)	3.20	2.78	2.50	3.75	3.06
Maine Procurement Technical Assistance Center	2.74	2.48	2.50	2.83	2.65
Educational or research institutions, outside Maine	3.39	3.12	2.89	3.36	3.27
Other firms in your industry, outside Maine	3.49	3.40	3.00	3.63	3.44
Trade associations outside Maine	2.98	3.10	3.00	3.27	3.05
Average all services	**3.28**	**3.06**	**2.82**	**3.30**	**3.18**
Average Maine based services	**3.28**	**3.02**	**2.79**	**3.27**	**3.16**
Respondents were asked the following specific question: With respect to your research and development activities, using the scale where 1="completely unimportant" to 5="critically important", please indicate the importance of the services offered by each					
Maine R&D Survey 2007 - Represents companies that reported some level of R&D expenditures for 2007 and provided responses to the service usage question; number of companies is the total companies some may not have used the specific service					

Source: 2007 R&D Institute Survey

Usage of Various Services to Companies Reporting R&D Expenditures					
	Company Size (Employment)				
	1–4	5–24	25–49	50+	All
Number of Companies	126	75	15	23	239
Service	*Percent of Companies Reported Using Service*				
Any campus of the University of Maine System (UMS)	59.5%	57.3%	53.3%	60.9%	58.6%
Any other educational institution in Maine	33.3%	30.7%	33.3%	56.5%	34.7%
Any non-profit research institution in Maine	34.9%	33.3%	26.7%	30.4%	33.5%
Trade associations in Maine	46.0%	57.3%	40.0%	52.2%	49.8%
Other Maine firms in your industry	57.9%	64.0%	60.0%	56.5%	59.8%
Maine Technology Institute (MTI)	84.9%	89.3%	86.7%	78.3%	85.8%
Maine Manufacturing Extension Partnership (MEP)	31.7%	45.3%	40.0%	52.2%	38.5%
Maine's Applied Technology Development Centers (ATDC)	31.0%	30.7%	33.3%	17.4%	29.7%
Maine Patent Program (MPP)	52.4%	54.7%	33.3%	26.1%	49.4%
Maine Small Business Development Centers (MSBDC)	54.8%	49.3%	26.7%	17.4%	47.7%
Maine Procurement Technical Assistance Center	27.8%	28.0%	26.7%	26.1%	27.6%
Educational or research institutions, outside Maine	44.4%	44.0%	60.0%	60.9%	46.9%
Other firms in your industry, outside Maine	66.7%	69.3%	80.0%	69.6%	68.6%
Trade associations outside Maine	38.9%	54.7%	60.0%	47.8%	46.0%
Average all services	**47.4%**	**50.6%**	**47.1%**	**46.6%**	**48.3%**
Average Maine based services	**46.8%**	**49.1%**	**41.8%**	**43.1%**	**46.8%**
Respondents were asked the following specific question: With respect to your research and development activities, using the scale where 1="completely unimportant" to 5="critically important", please indicate the importance of the services offered by each					
Maine R&D Survey 2007 - Represents companies that reported some level of R&D expenditures for 2007 and provided responses to the service usage question; number of companies is the total companies some may not have used the specific service					

Source: 2007 R&D Institute Survey

Survey respondents were also asked to report overall importance and satisfaction levels with all state R&D assistance combined. On average, the survey respondents that reported conducting R&D reported higher than average importance and satisfaction levels for state assistance. In terms of company size, overall importance and satisfaction levels were lowest for the largest company size categories.

Importance of Various Services to Companies Reporting R&D Expenditures					
	Company Size (Employment)				
	1–4	5–24	25–49	50+	All
Number of Companies	126	75	15	23	239
	Mean Score (0=not important to 4=critically important)				
Importance of All State R&D Assistance	2.47	2.12	1.73	1.65	2.23
	Mean Score (0=very unsatisfied to 4=very satisfied)				
Satisfaction with All State R&D Assistance	3.06	3.07	3.07	2.83	3.04
Respondents were asked the following specific question: Considering all of the State R&D assistance you received in the last completed fiscal year, how important has this assistance been? and Considering all of the State R&D assistance you received in th					
Maine R&D Survey 2007 - Represents companies that reported some level of R&D expenditures for 2007 and provided responses to these questions					

Source: 2007 R&D Institute Survey

[i] In fairness to those involved in delivering the services and activities examined, most have missions, programs, and activities that extend well beyond supporting industry R&D.

[ii] Colgan and Baker, Maine Center for Business and Economic Research, 2002