MAINE COMPREHENSIVE RESEARCH & DEVELOPMENT EVALUATION & MAINE INNOVATION INDEX

OVERVIEW & FINDINGS – 2007

Prepared for:

Joint Standing Committee on Business, Research and Economic Development

Presented by:

PolicyOne Research

March 8, 2007

From work prepared by:

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For the

MAINE OFFICE OF INNOVATION

OVERVIEW OF R&D EVALUATION

- Legislatively mandated evaluation. (5 MSRA §13108) started in 2001 and done annually since then
- Done in parallel with the MTI evaluation (same survey instrument)
- Done in accordance to detailed evaluation plan which was updated in 2006-07
- 2006-07 Evaluation prepared by the team of PolicyOne Research, RTI International, and Burgess Computer
- Full report available at http://www.maineinnovation.com/

Includes the Programs Of:

- Maine Technology Institute
- Applied Technology Development Center's
- Center for Law and Innovation - Maine Patent Program
- Small Enterprise Growth Fund
- Seed Capital Tax Credit Program
- Maine Biomedical Research Fund
- Maine Marine Research Fund
- State EPSCoR Matching Funds
- State R&D bonds
- State R&D funding to the university system

Includes Recipients of Support from R&D Related Programs Receiving State Support including:

- Business and Individuals
- Maine State Funded the Research Institutions including:
  - 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

Purpose is to Answer Five Key Questions:

1. Overall, has Maine's public investment in R&D stimulated & sustained consistent, competitive growth in Maine's economy, especially when compared to other states?
2. Has Maine's investment in public & private university R&D led to increased research capacity; the development of an educated, technically skilled workforce; & 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, & building a technology-based entrepreneurial community?
5. To what extent are these investments increasing the competitiveness of Maine in its key strategic technology & industry areas?

Methods:

- Annual Web survey of all recipients of support from Maine's R&D related programs (recipients are surveyed for 5 years following award/service)
    - Company & individual survey
    - Research institution survey
- Case studies – subject matter changes annually
- Innovation Index – annual statewide indicator trends and benchmarks report

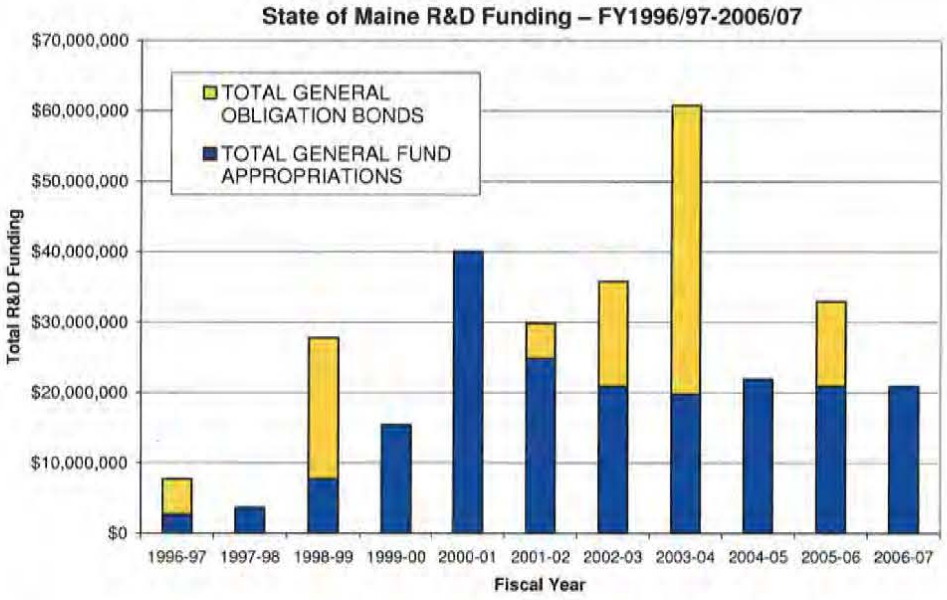
OVERVIEW OF MAINE INNOVATION INDEX

- Compilation of 24 indicators and related sub indicators measuring Maine's capacity and progress toward competing in an innovation-driven economy. The indicators are organized into five categories:
    - Research and Development Capacity
    - Innovation Capacity
    - Employment & Output Capacity
    - Education Capacity
    - Connectivity Capacity
- Maine is compared to US, New England, and other EPSCoR states
- Full report available at http://www.maineinnovation.com/

MAJOR FINDINGS OF EVALUATION & INDEX

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?

Maine has invested nearly $300 million in state funds to R&D between FY 1996-97 and FY 2006-07. Substantial increases were made from 1997-1998 through 2003-04 but have since declined.

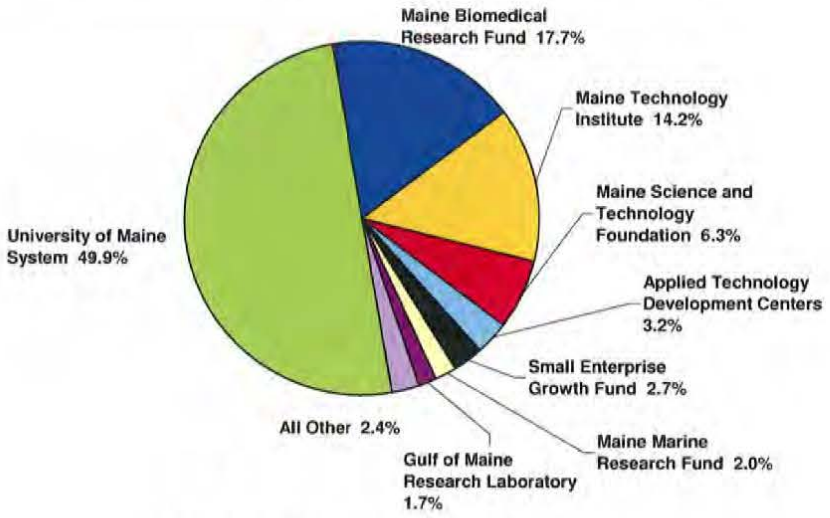


Maine's investment has contributed to consistent growth in Maine's economy, and has increased competitiveness relative to other states.

- In per capita income between 1996 and 2005 Maine has been gaining on the other EPSCoR states and on the United States.
- The private sector recipients of the state's investments are reporting higher job growth (6.8%) than the average Maine economy (0.5%) and much higher average wages ($38,825).
- The recipients of support from the state funded R&D programs agree that the assistance they have received has been very important to their growth.
- Maine's production of knowledge has grown because - Maine residents have been issued patents at a slightly increased rate over the period; Maine has continued to see increases in the past few years when national patent production went down.

There is, however, a serious mismatch between the investment in R&D and the resulting performance.

Maine State Funding for R&D by Program FY1996/97-FY2006/07

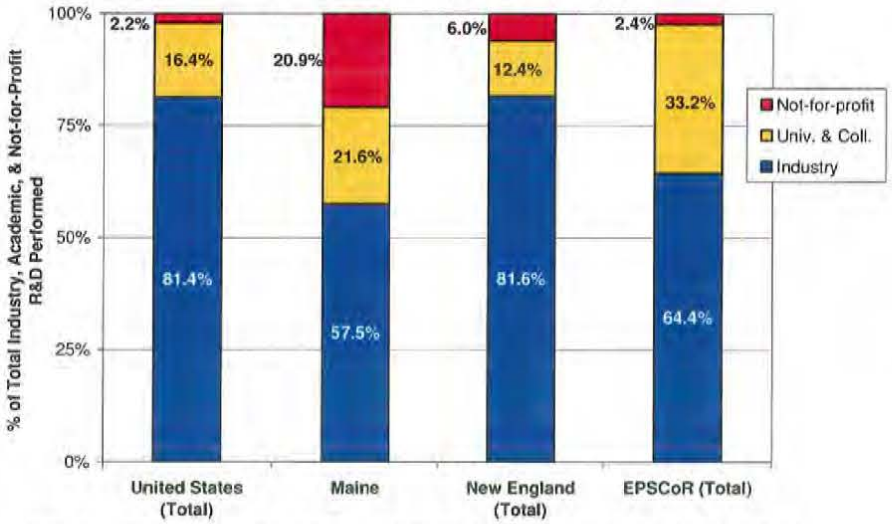


Total State Funding for R&D = $296,755,590

- The net effect of the state's investment has been to increase the academic and nonprofit share of R&D, while decreasing industry's share substantially.
- The academic and nonprofit sectors are not commercializing very much of the new knowledge acquired through the state-funded R&D, while industry is commercializing at a high rate. Therefore, the state's investment is not creating the maximum possible impact.

Industry R+D trend has been flat in State but as a ratio of State's economy it has gone down.

R&D by Performance Sector – 2003



Note: not for profit includes only that which is federally funded and therefore the contribution by this sector is understated

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?

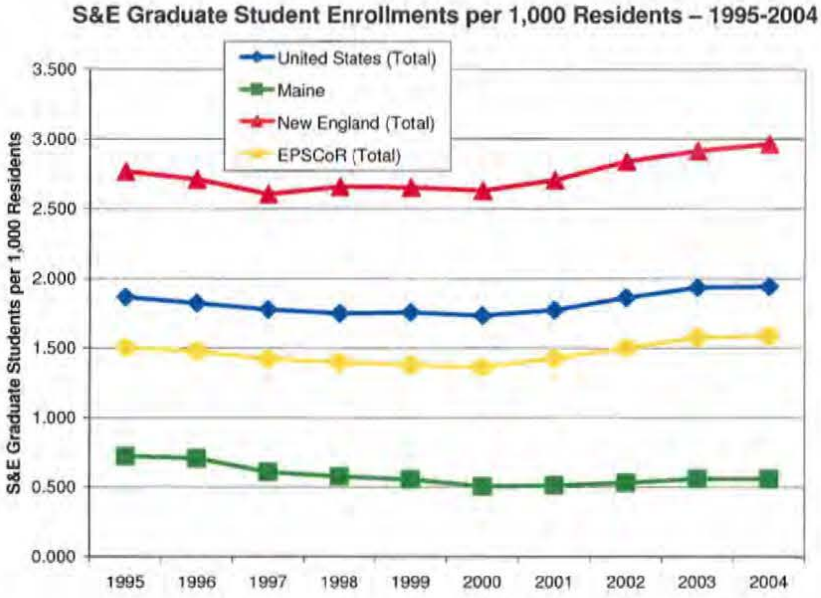
The results indicate that the universities are building their research capacity and contributing to an educated workforce.

The specific metrics attributable to state R&D investment reported by the universities in 2006 are as follows:

- 530 enrolled science undergraduates
- 155 science and engineering graduate students
- $2,807,857 in new major research equipment
- 527 research and related support jobs
- 953 scientific peer-reviewed journal articles, book chapters, and books
- 268 new federal research awards totaling $41,089,533
- $7,868,725 in R&D expenditures this year
- 19 disclosures, 10 patents applied for, and 3 patents awarded
- 2 spin-off companies and 6 jobs

However, there are several areas of concern regarding this question:

- While the university results overall are quite positive, those attributable to the state's investment have diminished over time.
- While some research centers are obviously working extremely well with industry, notably the Advanced Engineered Wood Composites Center (AEWC), the overall volume across all research centers is underwhelming.
- A look at the academic fields where Maine professors are conducting research reveals a mismatch with Maine's technology community: Environmental technology is a large percentage of university research, especially as compared to the United States and other regions, while life science is relatively smaller.
- Maine's research universities trail national averages for production of intellectual property (IP) from research.
- While the number of science and engineering degrees awarded is up over the past ten years, there has also been a drop in enrollments in science and engineering programs over the past ten years.
- A large portion of students at the universities are earning degrees in life sciences, but there are few in engineering, mathematics, or computer science, fields of interest to several of Maine's targeted clusters.



Therefore, the answer to the question is that Maine's investment in its universities is increasing research capacity and making progress in the production of an educated workforce, but not as consistently as would be hoped, and the investment is producing disappointing results in terms of commercialization of university technology.

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

In 2006, the results attributable to state R&D investments to the nonprofit research institutions included the following:

- $301,992 in new research equipment
- 33 research and support jobs
- 248 scientific, peer-reviewed journal articles, books, and book chapters
- $32,965,792 for 48 new federal research grants (multi-year)
- $73,083,281in expenditures for R&D
- 18 disclosures, 6 patents applied for, and 1 granted
- License income from past agreements totally $136,472
- 1 new spin-off company with 2.5 jobs.

Jackson Laboratory continues to be the largest nonprofit research entity in the state and, with its high ranking among National Institutes of Health (NIH) research institutes (#7 in 2005), brings prestige and federal funding to the state.

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 in the past few years, its production of intellectual property, licenses, and spin-off companies is extremely 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?

It is fair to say that Maine's private sector is growing in importance and competitiveness due in some part to Maine's investments in support of R&D.

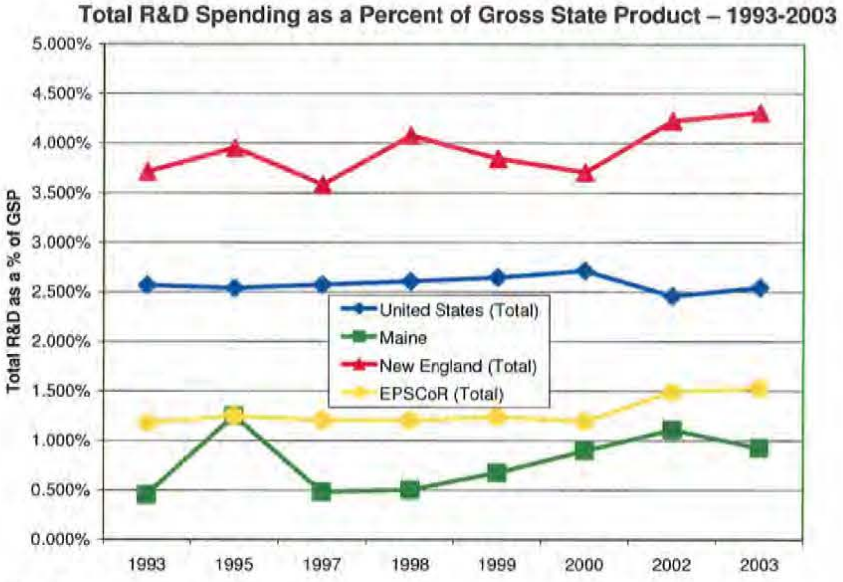
- Maine's private sector, represented by the 363 companies that responded to this survey, is growing faster than the rest of the Maine economy, paying wages that are 25% higher and contributing almost $87 million to Maine's economy. These companies receive 80% of the venture capital invested in the state and account for almost 60% of the patents.
- The respondents reported a net gain of 437 employees, or 6.8% of their workforce, in 2006. (Employment growth in Maine overall in 2006 was 0.5% in 2005.) They had a total of 6,774 employees whom they paid $263,005,517 in wages and salaries.
- The respondents reported $1,439,990,135 in revenue in 2006, an increase of $221,813,149 (18.2 %) over their prior year's revenue.

However as indicated previously in the assessment of the Evaluation's other key questions, the overall level of industry R&D among the mix of total R&D remains a concern.

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

The case study shows that the composites sector is a growing area in Maine, reflecting the national and international trends. A large market for civil infrastructure and construction applications is emerging, largely dependent on bio-based composites. This is good news for Maine's composite sector, with its predominant research asset being the AEWC.

Overall, the sectors in Maine, represented by their companies, are making progress as indicated by these metrics. They are all growing faster (both employment and revenues) with higher wages than the average Maine company.



Note: From 1997-2000 & 2002-2003 chart portrays one-year increments; all other years are in two-year increments.

RECOMMENDATIONS

1. There is strong evidence in both the Evaluation and Innovation Index that it is time for Maine to again prime the pump with increased investments in R&D. Progress was made since the mid 1990's, however, several indicators are pointing to diminished returns. Maine needs to continue to invest in R&D, and in fact, needs to accelerate its investment in order to (a) meet the goal of $1 billion in R&D by 2010 and (b) improve its relative position in the innovation economy. While the past investments have proven to be fruitful, investments must continue to be made to keep pace with the other states and the rest of the world.

2. 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. Future R&D investments should require more commercialization outcomes from universities and nonprofit-performed R&D. These entities should be encouraged to perform industry-sponsored R&D, to protect IP, and to license IP to in-state companies, both start-ups and established firms. Other commercialization outcomes which are significant include attracting related industry to locate in Maine, contributing to specific workforce training for industry and the development of new products, processes and/or services.

4. The workforce needs of Maine's research-intensive industries should be studied and specific recommendations made for curriculum enhancements at Maine universities and community colleges.

5. The technology transfer capacities of the universities and nonprofit research institutions should be assessed again (a report was done by USM in 2001), issues identified, and actions recommended to increase technology transfer outcomes. Models to consider include shared technology transfer capacity that can support institutions without sufficient R&D to support their own technology transfer staff such as currently provided by the CLI. The provision of adequate staff and patent funds has been demonstrated to be correlated with technology transfer outcomes such as patents, licenses and start-ups.

6. To support the composites sector, we recommend a variety of initiatives that encourage academic and industrial research, intra-sector collaboration, commercialization, and workforce preparation. We recommend that similar types of programs support other critical sectors in Maine's economy.

About PolicyOne Research
Since 2003 PolicyOne has annually produced Maine's Innovation Index and managed Maine's Evaluation of State Investments in Research and Development. PolicyOne leverages the principals' broad experience in core research and analysis techniques to provide clients with a full range of services within the areas of economic and community development, science and technology based economic development, program and service evaluation, state and local government fiscal analysis, and survey design and analysis (including PolicyOne's own online survey system).

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