Maine Office of Innovation

DECD
Maine Department of Economic and Community Development

A Science and Technology Action Plan for Maine

2005

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2005 Science and Technology Action Plan for Maine

Innovation drives a vibrant, globally competitive economy in Maine.

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

Executive Summary

Today, people, products, and ideas move across the globe more easily than our grandparents traveled across town. The economy is no longer driven by manpower or machinery, but by minds - and the knowledge, innovation, and creativity they produce.

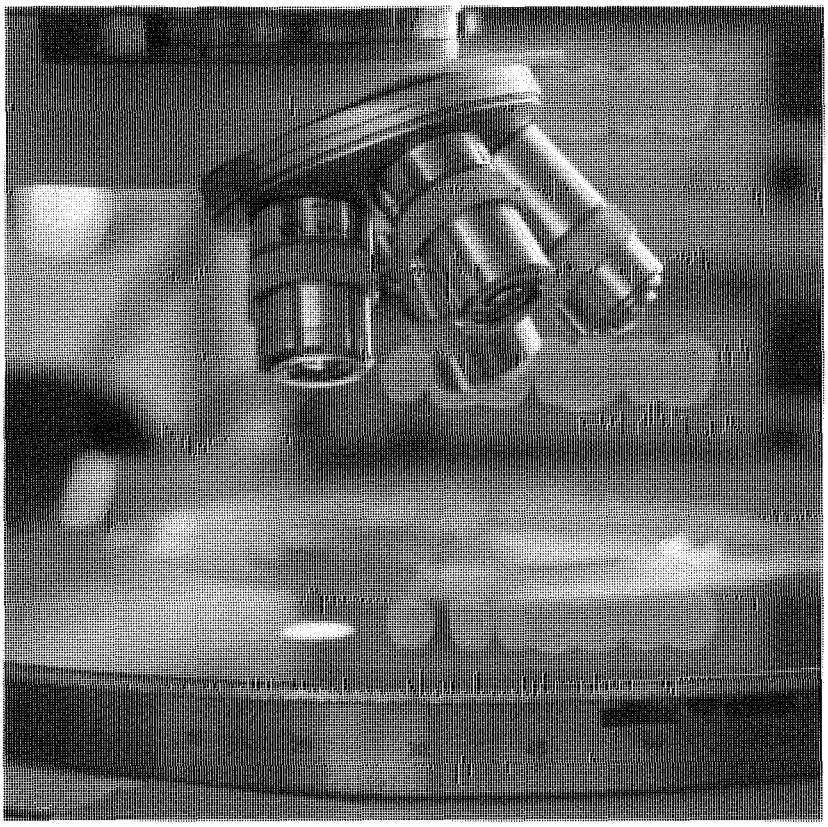
Maine's economic strength has historically depended on raw natural resources. The keys to our economic future now lie in knowledge and ideas, where wealth and job creation derive from innovation and technology embedded in all sectors of the economy, including our natural resource-based industries of forestry, marine and agriculture.

To capture the full economic benefit of innovation, Maine must develop the tools, incentives and infrastructure that will support an innovation-driven economy. Innovation is the process whereby new ideas are turned into products and processes, and it is increased productivity and the commercialization of new products and services that lead to sustainable jobs and broad-based economic prosperity.

R&D is the activity through which ideas are conceived and innovation occurs – fundamental discoveries are made; process improvements are tested and adopted; new products and services are developed and produced. R&D capacity, infrastructure and know-how comprise the key foundation on which an innovation-driven economy is built.

The 2005 Maine Science and Technology Action Plan is put forward to coordinate and promote quantifiable actions to ensure Maine cultivates an innovation-driven economy. The plan was developed with the active participation of the Maine Science and Technology Advisory Council (MSTAC) and its Executive Committee, representing a broad cross section of Maine's technology sectors, non-profit research institutions, universities and for profit companies. It creates the road map toward achieving the objective of higher per capita income set forth in the State Planning Office's "30 and 1000 Plan" created in 1998.

The 2005 Science and Technology Action Plan sets the goal of doubling the state activity in research and development to $1 billion by 2010. This goal puts Maine at the national average for state R&D activity of 3% of Gross State Product, - or roughly $1357 of R&D activity per worker.

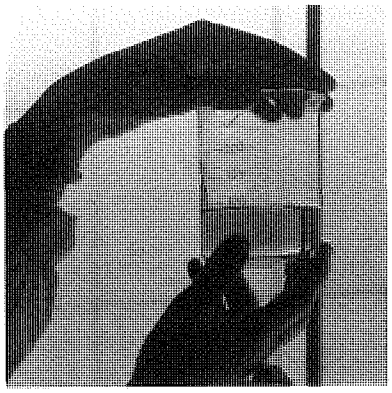


Reaching this goal will require continued, strategic expansion of Maine's entire R&D enterprise. This level of activity is required for Maine to realize even a portion of its economic potential. It is an ambitious target, but one that is achievable with the commitment of Maine's research community, business community, political leaders, the Governor and the Legislature.

This plan outlines specific actions and outcomes in the area of science and technology that are critical to moving Maine's economy forward. Some of the actions require additional targeted investment on behalf of the state; many others make better use of existing resources by building connections and collaborations between groups.

While setting forth specific steps to be taken for investments in research and development over the next few years to move Maine's economy forward, there remain critical elements that are beyond the scope of this plan, including energy costs, personal property and income tax, transportation infrastructure, wireless and broadband infrastructure and workforce development. Governor Baldacci has recognized the importance of these issues with several key initiatives addressing tax reform, and task forces to develop workable solutions for workforce preparedness and universal broadband and wireless access. The Department of Economic and Community Development will continue to work with these ongoing efforts so that these overriding issues will be addressed and the economic potential of the science and technology action plan can be realized.

A better future is within our grasp, but it will not be easy. With the continued targeting of current resources, the development of new key programs, strong leadership within state government and coordinated efforts among Maine's R&D community, all Maine people will have the economic opportunity the innovation economy promises.



ACTION PLAN: Maine will achieve $1 Billion in R&D Activity by 2010.

KEY OBJECTIVE ONE:

Maine's investments in R&D will stimulate and sustain consistent, competitive growth for Maine's economy.

1.1 Support and advocate for focused state R&D investments at levels that keep Maine competitive, nationally and internationally, in Maine's targeted technology areas:

- ☐ Biotechnology
- ☐ Composite
- ☐ Environmental
- ☐ Marine and Aquaculture
- ☐ Information
- ☐ Precision Manufacturing
- ☐ Agriculture and Forestry

1.2 Target state R&D investments to those strategic areas or clusters within the state's technology-intensive industrial sectors with the greatest potential to support jobs and competitive businesses.

2010 OUTCOME: State investment in R&D reaches $120 million per year, is focused on key strategic areas with the best potential to benefit Maine, and contains a state-sponsored R&D Seed Fund for emerging ideas and collaborative proposal development.

KEY OBJECTIVE TWO:

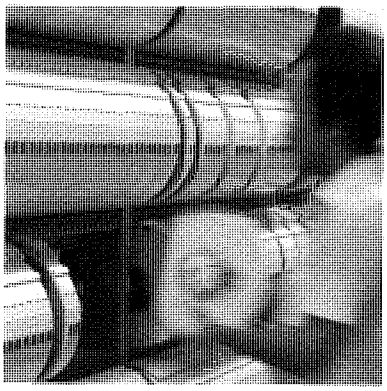
Stimulate a robust R&D enterprise by boosting academic R&D capacity, developing an educated, technically skilled workforce, broadening the impact from the nonprofit research institutions and increasing private sector R&D activity in key strategic areas important to Maine.

2.1 Using a portion of state funding (Objective 1.1), create the equivalent of a virtual Tier I[1] statewide research enterprise, encompassing research universities, institutions and private companies, that attracts scientific participation in basic research from the national research community.

2.2 Develop research universities and institutions that are hubs for entrepreneurial activity.

2.3 Build strategic alliances and research collaborations between and among Maine's research institutions, universities, entrepreneurs and companies.

[1] The Carnegie Classification for Tier One universities are those institutions that offer a full range of baccalaureate programs, are committed to graduate education through the doctorate degree, and give high priority to research. They award 50 or more doctoral degrees each year. In addition, they receive annually at least $40 million or more in federal support.



2010 Outcome: Maine's annual R&D activity will be comprised 75% ($750,000,000) of private sector R&D and 25% ($250,000,000) of research university and institution R&D.

KEY OBJECTIVE THREE:

Maine's Legislature and key policy makers recognize, advance and celebrate Maine's R&D investments and strategic priorities

3.1 Legislators are informed through frequent, precise, interesting reports.

3.2 Accurate and reliable information, data and analysis on Maine's innovation-based economy are developed and provided, promoting understanding and informing policy at the state and federal levels.

2010 OUTCOME: Strategic areas and proposals from MSTAC are a key component of the Governor's and Legislature's budget and bond proposals.

KEY OBJECTIVE FOUR:

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.

4.1 Market Maine's Science and Technology strengths and assets to existing Maine students and businesses

4.2 Maximize the benefits of Maine's proximity to leading centers of innovation and innovative businesses in the United States and Canada

2010 OUTCOME: Location and/or expansion of 8 new research-intensive businesses in Maine.

KEY OBJECTIVE FIVE:

Foster growth of research intensive companies through a comprehensive network of services and support.

5.1 Public and private funding sources are developed that support early stage research-intensive business development targeted to the capital gap between R&D funding and cash flow positive.

5.2 Build a critical mass of entrepreneurial management assistance that enables the growth of research-intensive businesses in Maine.

5.3 Develop appropriate statewide business support to shepherd research-intensive businesses throughout their unique business lifecycle.

2010 OUTCOME: Maine reaches the top 25, compared to other states as measured in the CFED Development Report Card for the states, for: venture capital investments; SBIC financing; loans to small businesses; employment growth; job growth due to new businesses; technology industry employment; and change in new companies.

A Science and Technology Action Plan for Maine, 2005

Innovation drives a vibrant, globally competitive economy in Maine.

Maine will achieve $1 Billion in R&D Activity by 2010.

Building on Maine's strengths, long-term sustainable economic opportunities will be created by:

- Adding value to Maine's niche - its natural resources
- Enhancing research, development and commercialization
- Capitalizing and building on existing spheres of world class excellence
- Nurturing business climate to stimulate business growth at all stages

Achieving this vision requires:

- Workforce: an educated and technically skilled workforce
- Investments: a robust research and development enterprise; and sustained, ongoing investments that at least equal other states' investments
- Awareness: an environment that fosters entrepreneurial innovation by building greater interaction between business, non-profit, and education communities
- Opportunity: statewide access to the latest technology infrastructure that supports and enhances research, development and commercialization

Today, people, products, and ideas move across the globe more easily than our grandparents traveled across town. The economy is no longer driven by manpower or machinery, but by minds - and the knowledge, innovation, and creativity they produce.

The US economy has achieved much of its growth through continual innovation. Maine's economy is no different. Success depends on ideas that lead to innovation. Whereas Maine has depended historically on natural resource intensive industries, the keys to our economic future now lie in knowledge and ideas, where wealth and job creation derive from new ideas, products and processes across all sectors of the economy, including our natural resource-based forestry, marine and agricultural industries. This plan outlines a strategy to leverage Maine's current assets and develop new opportunities to ensure that Maine has a vibrant, globally-competitive economy driven by innovation.

Half of the economic growth since the Great Depression has been driven by technological change. A Department of Commerce report on Technology, Economic Growth and Employment determined that innovation in manufacturing leads to higher per-capita incomes and broad-based prosperity.[i] (See box below). Increased productivity, resulting from innovative new technology adoption, drives rising wages and standards of living-- high technology jobs paid an average of $58,090 compared with the US Average $34,669.

"The fundamental impulse that sets and keeps the capitalist engine in motion comes from the new consumers, goods, the new methods of production or transportation, the new markets, the new forms of industrial organization that capitalist enterprise creates..."

— Jospeh Schumpeter,
Capitalism, Socialism and Democracy
(New York: Harper, 1975) [orig. pub. 1942], pp. 82-85

To capture the full economic benefit of innovation, Maine must develop the tools, incentives and infrastructure to support an innovation-driven economy. Innovation is the process whereby new ideas become products and processes. Increased productivity and the commercialization of new goods and services lead to sustainable jobs and broad-based economic prosperity. To create and sustain this broad-based economic prosperity and job creation all sectors of our economy -- from the arts community to tourism to manufacturing -- need to continually invest in innovation and technology.

Maine's high quality of life will continue to be one of our strongest assets. In order to attract creative workers and innovative businesses, however, Maine must also be a place where one can make money. This plan focuses on the section of the creative economy that is driven by the research and development (R&D) of new technology. R&D investment and educational attainment are strongly associated with higher income levels.[ii] Through R&D, ideas are conceived, fundamental science discoveries are made, innovation occurs, process improvements are tested and adopted, and new products and services are developed and produced. R&D capacity, infrastructure and know-how comprise the key foundation on which an innovation-driven economy is built. In 1997, Maine recognized the importance of R&D investment and began strategic investments to build a solid R&D infrastructure in Maine. These investments focused on

★ Plants that use advanced technologies tend to hire workers with more skills and these workers tend to receive higher wages regardless of where they work

★ The use of advanced technologies is associated with plant survival because these plants have higher productivity

★ The use of advanced technologies is associated with faster employment growth

★ Employment tends to shift from low-productivity plants to high-productivity plants as the latter gain market share

education and public sector R&D infrastructure, private sector basic research, and private sector R&D activity leading to commercialization. The basic underpinnings of Maine's R&D investments -- which included the Maine Economic Improvement Fund (MEIF), Maine Technology Institute (MTI), the Marine Infrastructure Fund (MIF), the Biomedical Research Fund (MBRF), the Maine Patent Program, and the Technology Centers -- were born from the work of the 118th and the 119th Legislatures' Joint Select Committee on Research and Development. These programs are the critical building blocks for R&D activity and growth in Maine and account for the 30-fold increase in R&D investments that Maine made over the last decade. As a result of these investments, Maine has shown significant improvement in key indicators of an innovation-driven economy [iii]:

- Led primarily by Maine's not-for-profit research institutions, **Maine has surpassed the national average for federal funding** – rising in national ranking from 48th in 1999 to 10th in 2003 and 2004.[iv]
- **Maine's university system has tripled the number of research awards (from 111 in 1996 to 387 in 2004) and more than doubled the amount of federal research funding received (from just over $31 million in 1996 to over $82 million in 2004).**[v]
- Partially due to the on-going activities of the Maine Patent Program and the Maine Technology Institute, **Maine has increased its ranking compared to other states for patents produced and private sector R&D activity.**[vi]

The state's ongoing and increasing investment in R&D is critical to its economic future. We are in a global economy and across the nation and around the globe, other states, regions and countries are devoting more and more resources to innovation. Maine's recent investments in R&D have barely allowed us to keep pace in some key national

Success Story:

Maine Biomedical Research Fund:

$42 million invested by the State of Maine since 2000 has:

- Attracted over $275 million in federal and private funds;
- Added over 500 jobs paying an average of $62,500 annual salary; and
- Added over 274,000 square feet of research space;

In addition to the 6:1 return realized in four years, this investment supports 176 principal scientists and 1055 technical and professional staff who pay over $6.6 million in property taxes and make over $30 million in purchases from Maine businesses.

Success Story:

University of Maine System:

Since 2000, Maine has invested over $90 million in the University system through bonds and MEIF, resulting in:

- attraction of over $300 million in federal grants and contracts;
- over 2500 baccalaureate and 560 graduate science and engineering degrees conferred;
- over 20 patent applications and 9 new patents; and
- 6 new companies supporting 16 jobs in 2003.

Success Story:

Maine Technology Institute:

$25 million invested by Maine since 2000 has:

- Been matched by an additional $35 million in federal and private funding; and
- Funded 495 projects in over 300 Maine-based companies who have;
  - o Attracted nearly $200 million in federal and private funding by the Maine businesses; and
  - o Created over 600 new jobs paying 12% higher wages ($33,500) than average Maine businesses.

indices; in fact, Maine still lags the nation on many key innovation measures according to the Corporation for Enterprise Development's (CFED) annual report card. [vii]

Maine is:

- 50th in university research
- 50th in science and engineering graduates
- 33rd in PhD scientists and engineers in the workforce
- 33rd in Small Business Innovation Research (SBIR) awards
- 45th in royalties and licenses granted
- 40th in patents produced; and
- 42nd for university spin-outs.

More and sustained state investment is required, just to keep pace let alone get ahead. Yet while state investment is critical, government alone cannot improve Maine's economy. Realizing the true promise of an innovation-driven economy requires effective partnerships and collaboration at all levels of government and between the public and private sectors. Strong research institutions and universities generate ideas, invent technologies and train the workforce. They also generate sustainable jobs and create direct economic benefits. For-profit companies do their part by developing the ideas and employing the educated workforce, building the businesses and creating jobs that remain competitive through continual innovation.

The increasing competitiveness of innovation-driven economies makes even more urgent the need to strategically target R&D investments and activities in areas that have the potential for the greatest economic impact. Without bold action Maine will lose out to other states and, more significantly, other countries, leading to stagnant wages, continued loss of high wage jobs and declining prosperity.

It is in this context that we put forward Maine's 2005 Science and Technology Action Plan as a guide to coordinate and promote quantifiable actions over the next two years. The plan was developed with the active participation of the Maine Science and Technology Advisory Council (MSTAC) and its Executive Committee. The MSTAC was created by an executive order of the Governor and consists of 30 members and seven executive committee members, representing a broad cross section of Maine's technology sectors, non-profit research institutions, universities and for profit companies.[viii]

This is the first State Science and Technology Action Plan developed by the Office of Innovation (OOI) within the Department of Economic and Community Development (DECD). From 1992 to 2002 the Maine Science and Technology Foundation produced Maine's state science and technology action plans biennially. The 2005 plan builds on that previous work and creates the road map toward achieving the objective of higher per capita income set forth in the State Planning Office's "30 and 1000 Plan" and echoed in Governor Baldacci's 2004 Economic Development Strategy.
The 2005 Science and Technology Action Plan sets a goal for doubling the state's

activity in R&D to $1 billion by 2010, positioning Maine within the national average for R&D activity at about 3% of gross state product, or an average of *$1357* in R&D activity per worker. Maine's current R&D activity is about 1% of GSP, or approximately $430 million ($365 per worker). Even though most of this activity needs to derive from the private sector, (in 2001, 84.1% of national R&D expenditures were from industry) this goal does require doubling the state investment in R&D over the next five years. It is an ambitious target, but one that is achievable with the commitment of Maine's research community, business community, political leaders, the Governor and the Legislature.

This plan specifies actions for the next 5 years which focus Maine's limited resources into areas of strength and potential competitiveness. These actions will make the best use of Maine's limited and unique human, financial and natural resources. Some of the actions require additional targeted investment by the state; many others make better use of existing resources by building connections and collaborations between groups. The bottom line remains unchanged: **for Maine to reach the goal of $1 billion in R&D activity by 2010, continued, strategic expansion of Maine's entire R&D enterprise is required.**

In order to move from ideas to impact, this plan must lead to real action - things happening on the ground. To judge the success of this process, the plan includes measurable outcomes for 2007 and for 2010. Over the next two years, MSTAC will work with the universities, private colleges, alumni, non-profit research institutions, industry and policy makers at the state and national levels to implement the actions and objectives this plan sets forth.

A better future is within our grasp, but it will not be easy. With the continued targeting of current resources, the development of new key programs, strong leadership within state government and coordinated efforts among Maine's R&D community, all Maine people will have the economic opportunity the innovation economy promises.

Per Capita Income:
National: $32,937
Maine: $30,566 (30th)
http://www.bea.gov/bea/newsrel archive/2005/spi0305.pdf

Action Plan

GOAL: Maine will achieve $1 Billion in R&D Activity by 2010.

The following five objectives are designed to drive Maine toward the primary goal.

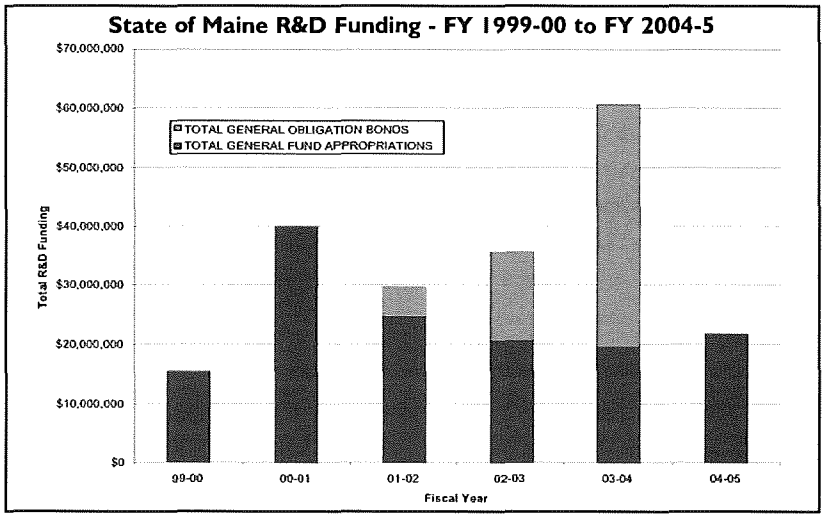
KEY OBJECTIVE ONE:

Maine's investments in R&D will stimulate and sustain consistent, competitive growth for Maine's economy.

Why?

State investment is required to address economic transition, capitalize on R&D activity, improve the competitiveness of existing businesses, diversify the economy and build an entrepreneurial culture. These investments create the environment and provide the infrastructure that attracts researchers and seeds research, increasing the competitiveness and sustainability of Maine's research institutions, universities and businesses. State funding must be focused to ensure the ability to build critical mass in areas that capitalize on Maine's natural, physical and intellectual resources, while being flexible enough to respond quickly and strategically to emerging opportunities. Support for R&D in Maine has wavered in the past two years . The decrease in funding has

Research and development will play a vital role in Maine's economic future, but the State currently lags far behind where it needs to be in funding research and development. Investment in research and development is now a threshold requirement for the economic well-being of the State and it is crucial that state government make a long-term commitment to significant and steady funding for research and development through the state budget.
— Joint Select Committee on Research and Development, 118th Legislature



prevented Maine from capitalizing on opportunities and realizing the economic benefits attained through sustained investment. State investments are particularly critical in areas where neither federal funds nor private capital exist: lab space and equipment, funds to recruit top level researchers and graduate students, and private and public sector early-stage R&D.

2010 OUTCOME: State investment in R&D reaches $120 million per year, is focused on key strategic areas with the best potential to benefit Maine, and contains a state-sponsored R&D Seed Fund for emerging ideas and collaborative proposal development.

2007 Benchmarks:

- State investment in R&D tops $75 million annually, including $35 million in on-going general fund support and $40 million in bonds for infrastructure development and expansion.
- Key strategic areas for targeted investments are defined and an objective process created to make funding recommendations for budget and bond initiatives.

Sub-objective 1.1

Support and advocate for focused state R&D investments at levels that keep Maine competitive, nationally and internationally, in the following target technology areas:

Biotechnology
Composites
Environmental
Information
Marine and Aquaculture
Precision Manufacturing
Agriculture and Forestry

1.1 Actions:

By the fall of 2006:

a. MSTAC will recommend the capitalization of a state fund to provide matching money for non-state sources of funding.
b. OOI will work with the Legislature to create a seed research fund for early stage data generation and project planning that will lead to federal or private funding proposals, including large, collaborative projects.
c. MSTAC will investigate and make recommendations for the creation of a dedicated revenue source for R&D investments to fund current R&D programs, including MEIF, MTI, MBRF, MIF and other initiatives to achieve the overall R&D goal.

...State leaders can set aside pots of money to be matched by federal, university or private funds to support the specialized research capabilities that advance the state's economic base . . .

— A Governor's guide to Building State Science and Technology Capacity, 2002 - National Governor's Association

Sub-objective 1.2

Target State R&D investments to those strategic areas or clusters within the state's technology-intensive industrial sectors with the greatest potential to support jobs and competitive businesses.

1.2 Actions:

a. By spring 2006, MSTAC will define key strategic areas for targeted investments in R&D based on the convergence of:
   - Maine's identified seven technology-intensive sectors;
   - Maine's natural, intellectual and physical strengths;
   - Benefits to Maine's economy;
   - Existing research excellence;
   - Federal funding priorities;
   - Private sector funding or market potential;
   - Potential return on investment on state funds; and
   - Other critical factors.

b. By 2007, MSTAC will evaluate proposed state-funded R&D projects to recommend strategic investments that:
   - Target key strategic areas;
   - Require collaboration;
   - Are based on scientific/technical merit; and
   - Provide a measurable return on investment, based on a broad set of economic and other criteria.

c. Research institutions and universities will develop faculty and student recruitment to include key strategic areas by 2007.

The most common pitfall for state policy makers is to attempt to create new clusters where there are no preexisting advantages to be built upon.

— A Governor's guide to Building State Science and Technology Capacity, 2002 - National Governor's Association

KEY OBJECTIVE TWO:

Maine will boost academic R&D capacity, develop an educated, technically skilled workforce, broaden the impact from the nonprofit research institutions, and increase private sector R&D activity in key strategic areas important to Maine.

Why?

Maine needs to capitalize on the foundation laid by past investments to align its innovation-driven economy with the national averages.

- In 2001, Maine's private sector accounted for only 65.6% of R&D activity; nationally the average was 84.1%.[xiv] The data demonstrate the importance for Maine to capitalize on market opportunities that are driven by the private sector. The marketplace can drive R&D through collaborations between university research, non-

The role of universities in the development of innovative capacity cannot be overstated. Universities educate and train new generations of talent, perform research and development critical to a state's economy and provide independent sources of information and analysis on issues critical to the nation....Without an expanded commitment to strengthening research activities at universities, critical capacity in innovation cannot be achieved.

Millennium Science Initiative, IAC Report, Executive summary http://www.interacademycouncil.net/Object.File/Master/6/727/0.pdf

profit research and the private sector. Thus, it continues to be critical to align the strengths of Maine's research institutions with the needs of the private sector.

- While Maine is top 10 in the nation for nonprofit R&D, our low rankings for license and royalty revenues, patents produced, PhDs and engineers in the workforce and spin-off companies suggest that our nonprofit research institutions are not well-connected to Maine's private sector research-intensive businesses.[xv]
- Even though on a per research faculty basis Maine does well attracting federal and other funds for research, Maine continues to rank last for academic R&D activity, largely because of the low number of research faculty. [xvi]

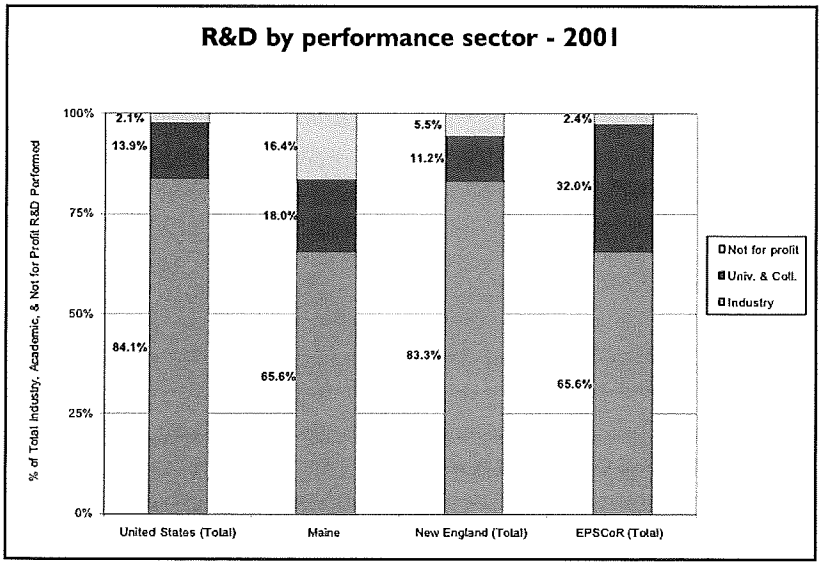
2010 OUTCOME: Maine's annual R&D activity will be comprised 75% ($750,000,000) of private sector R&D and 25% ($250,000,000) of university and research institution R&D.

In 2004, Maine's research institutions and universities:

- **Awarded just over 200 graduate degrees in science and engineering;**
- **Supported 1600 principal investigators;**
- **Attracted $132.5 million in federal research funding.**

In 2004, Maine's research institutions and universities:

- **Realized over $350,000 from licensing revenue;**
- **Executed 6 licensing agreements;**
- **Filed for 7 patents;**
- **Received 9 new patents.**



2007 Benchmarks:

- In 2007 Maine universities award 250 graduate degrees in science and engineering, while universities and research institutions support 2000 principal investigators, and attract over $150,000,000 in research funding.
- Research institutions and universities collectively achieve $400,000 in funding from licensing revenue, and file 15 patent applications per year.
- All institutions requesting state funding will demonstrate collaborative multi-institutional efforts and at least one collaborative proposal for federal funding will be submitted from Maine-based institutions.
- MTI will have at least one applicant for its technology transfer fund that includes a partnership between a private company and a research institution.

Investment in basic and applied research is the critical first step in the innovation process; it creates cutting edge technologies that fuel job and wealth creation. Investment in infrastructure is equally important - state-of-the-art research demands modern research facilities.
— A Governor's guide to Building State Science and Technology Capacity, 2002 - National Governor's Association

Sub-objective 2.1

Using a portion of state funding (Objective 1.1), create the equivalent of a Tier I[xvi] statewide research enterprise, encompassing universities, research institutions and private companies, that attracts scientific participation from the international research community to raise Maine's national ranking in academic research.

2.1 Actions:

a. MSTAC will work with the universities and research institutions to actively promote and pursue EPSCoR and other opportunities to match state R&D funds for building research infrastructure, submitting two collaborative, multi-institutional proposals each year.
b. The universities and research institutions will report to MSTAC regarding the competitiveness of Maine's faculty start-up and incentive packages and proposals for improvement to national average by 2006.
c. The universities will work in collaboration with the biomedical research institutions to complete the formation of the Graduate School of Biomedical Sciences as a multi-institutional graduate school program that supports competitive graduate student stipends and provides graduate training and degree opportunities by the end of 2007.
d. OOI will work with Maine's private colleges to develop a program to target their students to consider graduate school in Maine starting with the class of 2008.
e. The universities and research institutions will ensure graduate stipends are competitive nationally to attract more graduate students beginning in fall 2008.
f. OOI will work with Maine's universities to investigate creating additional graduate degree programs in key strategic areas by the fall of 2007.
g. OOI will work with the community colleges and universities to align curricula with the needs of high-growth R&D intensive enterprises, as identified by trade associations and business representatives, and report to MSTAC by the fall of 2007.

Although knowledge creation is a critical first step in the wealth creation process, knowledge creates no wealth unless used. Technology transfer must become a key element in a university's culture and mission. Often called a contact sport - tech transfer only succeeds when a network of linkages is established between university researchers and the business community throughout the research cycle.
— A Governor's guide to Building State Science and Technology Capacity, 2002 - National Governor's Association

h. The University System will increase its research faculty in areas identified as critical to the state's economy starting in the fall of 2008.

Sub-objective 2.2

Develop universities and research institutions that are hubs for entrepreneurial activity.

2.2 Actions:

a. MSTAC will recommend a competitive fund for the creation of Innovation Hubs -- a collaborative world class research, development and commercialization initiative -- for the FY07-08 bond package.
b. By the end of 2007, universities and research institutions will minimize institutional barriers that are disincentives for researchers to work with private industry, pursue licensing opportunities and industrial research contracts, and develop and spin off new technologies.
c. MSTAC will continue to encourage Maine's universities and research institutions to institutionalize and reward technology transfer activities to foment the interface between institutions and private companies to commercialize new ideas.
d. Maine's business schools will assist the science and engineering departments, research institutions, and research-intensive business community to develop business and marketing plans for technologies developed at the research institutions by the fall of 2007.

Sub-objective 2.3

Build strategic alliances and research collaborations between and among Maine's research institutions, universities, entrepreneurs and companies.

2.3 Actions:

a. Research institutions and universities will identify any remaining institutional barriers to inter-institutional collaboration and work to remove them by the end of 2006.
b. Research institutions and universities receiving state funding will seek to establish reliable, easy-to-use, compatible connections for teleconferencing by the end of 2007.
c. OOI will investigate web based information sharing and develop a central site for posting science and technology information by the end of 2007.
d. Research institutions and universities will host or support at least 5 topical workshops annually that bring together scientists and entrepreneurs from multiple institutions, the public and private sectors, within and outside of Maine.
e. Maine's research institutions will develop, standardize, update, and promote technology transfer processes by the end of 2007.
f. MTI will evaluate and develop a specific technology transfer fund and/or increase the ability of MTI programs to fund technology transfer projects by the end of FY07.

Thomas Friedman, in The World is Flat, 2005, quotes IBM's vice president for technical strategy and innovation, "This emerging era is characterized by the collaborative innovation of many people working in gifted communities, just as innovation in the industrial era was characterized by individual genius."

Research and development is now a threshold requirement for the well-being of the State. It is not a discretionary activity; it is as important as education, transportation and other state priorities.

— Joint Select Committee on Research and Development, 118th Legislature

KEY OBJECTIVE THREE:

Maine's Legislature and key policy makers recognize, advance and celebrate Maine's R&D investments and strategic priorities .

Why?

R&D investment must be a key component of Maine's economic development strategy, which requires ongoing investment and a long-term commitment. Therefore, key policy-makers and political leaders must be informed and excited about R&D in Maine, the state's unique science and technology assets, and the real, positive impact and economic returns that R&D investments have had, and will continue to have, for Mainers across the state.

2010 OUTCOME: Strategic areas and proposals from MSTAC are a key component of the Governor's and Legislature's budget and bond proposals.

2007 Benchmarks:

- A minimum of 30 key legislators articulate, champion and endorse the R&D strategies recommended by MSTAC, attend the annual R&D Day and the bi-annual ME Tech Show.
- The Innovation Index and R&D Evaluation results are presented to a minimum of 30 key legislators and leadership staffers.

Sub-objective 3.1

Legislators are informed through frequent, precise, interesting reports.

3.1 Actions:

a. OOI will host annual "R&D" informational day seminars for legislators, starting in Spring 2006, with presentations from the authors of the "Evaluation of Maine's Public Investments in Research & Development."
b. OOI will work with the Maine Development Foundation to create a specific R&D investment tour for legislators beginning in 2006.
c. OOI will work directly with House and Senate Leadership to create a Legislative R&D day as part of legislative orientation beginning in the fall of 2006.
d. OOI and MSTAC will develop and implement an outreach strategy targeted at current and prospective legislators by the fall of 2006.
e. OOI will work with the research institutions, universities, R&D stakeholders and research-intensive businesses to present a coherent, unified message to legislators on the importance of R&D to the state's economic future focusing on the importance of: (i) R&D investment in general; (ii) long-term, growing support; and (iii) targeted investments, by the spring of 2006.

Sub-objective 3.2

Provide accurate and reliable information, data and analysis on Maine's innovation driven economy that promotes understanding and informs policy at the state and federal levels.

3.2 Actions:

a. OOI will annually publish and distribute the Innovation Index.
b. OOI will annually publish and distribute the "Evaluation of Public Investments in Research & Development" and discuss results with Legislators, MSTAC, and the public.
c. OOI will present and make available other reports and studies as requested and outlined in this plan.

KEY OBJECTIVE FOUR:

Using Maine's unique R&D assets and their significance to Maine's economy, the state will attract new business and investment.

Why?

Maine has made great strides in several key innovation indicators over the last decade and has other extraordinary assets, such as quality of life. To take advantage of our assets, and enhance Maine's innovation driven economy, Maine needs to retain its talented young people and attract businesses and creative entrepreneurs from other parts of the world.

2010 OUTCOME: Location and/or expansion of 8 new research-intensive businesses in Maine.

2007 Benchmarks:

- Maine's graduating college and university seniors and alumni learn and routinely inquire about the state's burgeoning R&D enterprise.
- Attendance at ME Tech Show reaches 750.
- Three new research-intensive businesses locate and/or expand operations in Maine.

Sub-objective 4.1

Market Maine's Science and Technology strengths and assets to existing Maine students and businesses.

4.1 Actions:

a. OOI will develop fact sheets describing: (i) Maine's science and technology assets; (ii) key strategic areas and opportunities for research-intensive business development and growth; (iii) prototypical costs of doing business comparisons; and (iv) real estate, workforce and research availabilities and cost, by fall of 2006.

b. OOI will promote internship opportunities for Maine high school students at Maine's universities, research institutions and technology-based businesses.

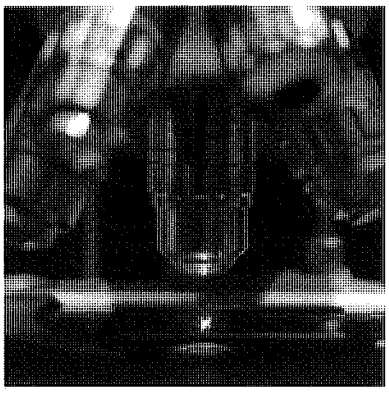
c. OOI will showcase Maine's R&D community at five job fairs, science and technology-based conferences and business forums held in Maine.

d. OOI will annually promote opportunities in Maine's innovation-based economy to graduates of Maine's colleges and universities through alumni associations.

e. OOI will work to promote the biannual Maine Tech Show as a showcase for Maine's entire R&D enterprise.

The presence of a company's headquarters and R&D operation may result in a much stronger and longer term commitment to the area rather than just an expansion operation.

— Centers for Innovation in the United States, Moran, Stahl & Boyer, LLC, 2005.



Sub-objective 4.2

Maximize the benefits of Maine's proximity to leading centers of innovation and innovative businesses in New England and Canada to promote the location and expansion of R&D intensive companies.

4.2 Actions:

a. The state will create a business development and attraction fund for R&D-intensive commercial enterprise with substantial and immediate economic impacts for implementation in 2007.

b. Assist and encourage the association between Maine businesses and other similar businesses on an international basis.

c. OOI will provide information to industry trade associations for national trade conferences, newsletters and other events starting in 2007.
d. OOI will work with the trade associations and Maine and Company[xviii] to follow-up on possible leads beginning in 2006.
e. OOI will sponsor or host a booth at one regional or national trade show per year targeting research-intensive business, starting in 2007.
f. OOI or MSTAC will present Maine marketing material at one international science-based conference per year, starting 2007.
g. OOI will work with the Office of Tourism to enhance the tourism marketing message by including Maine's economic opportunities in targeted science and technology areas for the 2008 campaign.

KEY OBJECTIVE FIVE:

Maine will foster growth in research intensive companies to become world-class enterprises through a comprehensive network of services and support.

Why?

Maine ranks high nationally for new companies started, but these companies do not grow as fast as other companies nationwide.[xix] Maine is a state of mostly small companies and a few large firms.[xx] The lack of mid-sized and large firms, especially research intensive companies, creates a critical skills gap for growing small technology companies. There is not a sufficient pool of experienced management professionals to provide the real know-how to move a small firm with one or two products to larger production and exponential growth. Consequently, while employment growth in Maine's small innovative companies is faster than average Maine business growth (particularly among firms funded by MTI which have experienced an 11% increase in employment), many of these firms lack the management experience to take their business to the next level that will generate the jobs and economic prosperity their presence portends.

2010 OUTCOME: Maine reaches the top 25, compared to other states as measured in the CFED 2004 Development Report Card for the states, for: venture capital investments; Small Business Investment Corporation (SBIC) financing; loans to small businesses; employment growth; job growth due to new businesses; technology industry employment; and change in new companies.

2007 Benchmarks:

- Maine's funding continuum includes an investment fund designed to provide working capital for early stage research-intensive companies.
- A network of 10 experienced entrepreneurs actively participate in offering advice, time and guidance to Maine's research-intensive companies.

CFED's 2004 Development Report Card for the States reported that Maine ranked:

26th for Venture Capital Investments;
27th for SBIC Financing;
41st for Loans to Small Business;
21st for Employment Growth;
42nd for Job Growth Due to New Businesses;
34th for Technology Industry Employment;
45th for Change in New Companies.

- DECD has business support personnel and services dedicated to and knowledgeable about research-intensive ventures.

Sub-objective 5.1

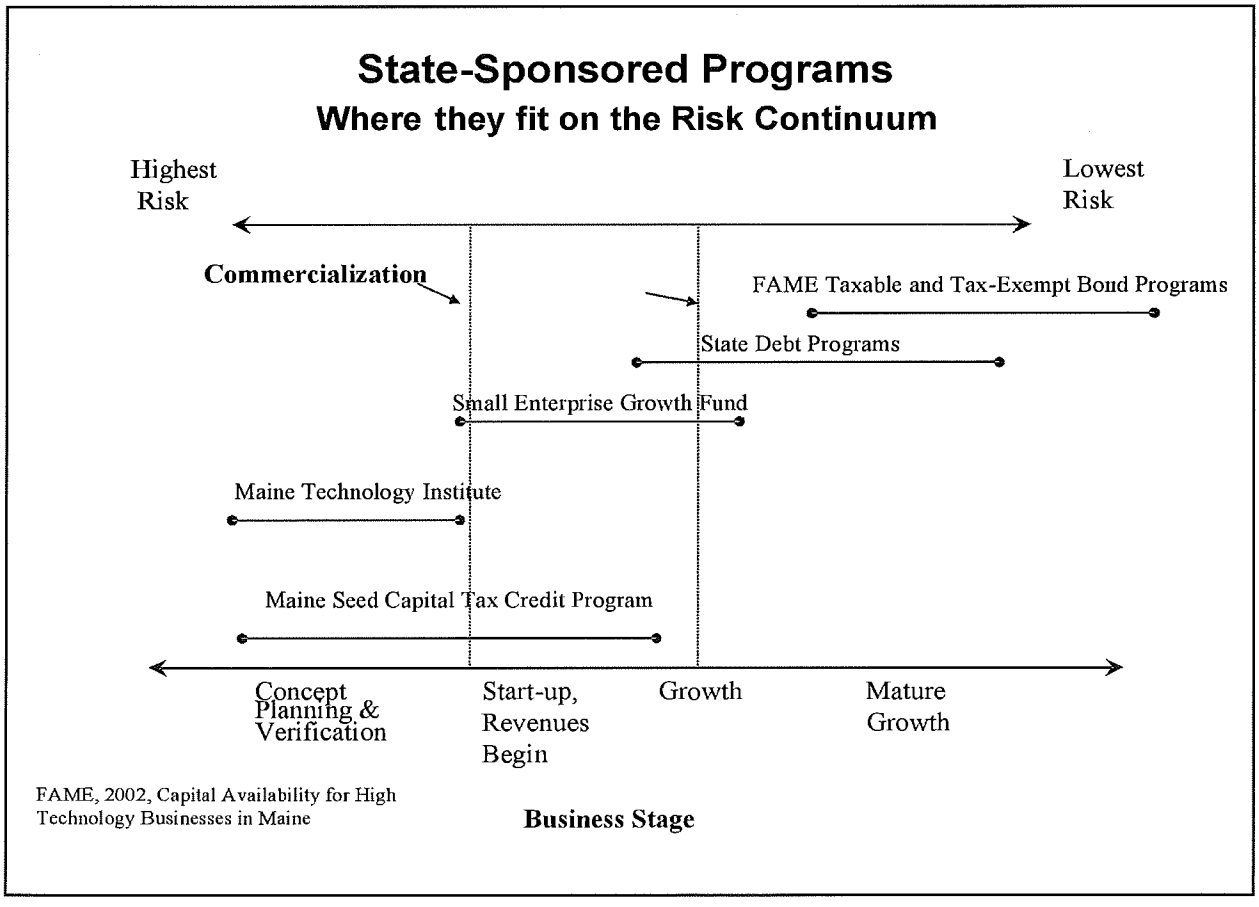
Public and private funding sources are developed that support early stage research-intensive business development targeted to the capital gap between R&D funding (such as by SBIR, MTI) and cash flow positive.

5.1 Actions:

a. OOI and MTI will investigate successful state and private programs for high risk financing and MSTAC will develop recommendations for developing a high risk funding program for the fall of 2006.

b. MTSAC will seek to increase Maine's banking and lending institutions' understanding and financing of research intensive companies.

c. OOI will convene meetings of private and public financial institutions, endowments and retirement funds to consider models and develop a funding pool for early stage, pre-profit, minimal asset research-intensive companies in 2006.



Sub-objective 5.2

Build a critical mass of entrepreneurial management assistance that enables the growth of research-intensive businesses in Maine.

5.2 Actions:

a. OOI will investigate successful state programs for entrepreneurial management recruitment and development, recommend programs for development in Maine, and report back to MSTAC by the fall of 2006.

b. OOI will work with existing resources such as Entrepreneurship Working Group, MTI Maine Tech Trackers, Small Enterprise Growth Board, Technology Centers (business incubators), trade associations and business schools to contact and recruit Maine's retiree community, existing successful entrepreneurs, and business school alumni clubs for entrepreneurial expertise by the fall of 2007.

> *"To ultimately produce innovations, it takes a combination of dreamer to conceive, technical know-how to bring into reality, and entrepreneurial spirit to launch into economic opportunities."*
>
> — Centers for Innovation in the United States, Moran, Stahl & Boyer, LLC, 2005.

Sub-objective 5.3

Develop appropriate statewide business support to shepherd research-intensive businesses throughout their unique business lifecycle.

5.3 Actions:

a. OOI will investigate other state's models for intensive, focused business assistance to develop a proposal for review by MSTAC and DECD by the fall of 2007.

b. OOI will participate with the Entrepreneurship Working Group to ensure technology intensive businesses' needs are addressed through the development of the "business first" model currently being used as a pilot program in the Mid-Coast region.

c. Research institutions and universities will identify internal road blocks to evaluating technologies for commercialization or licensing potential and directing those technologies into opportunities with the greatest potential for sustained success by the fall of 2007.

External Forces Critical To Economic Prosperity

The creation of sustainable businesses and jobs for Maine people depends on an economic climate that is, in perception and reality, conducive to business. Maine's companies which have innovation and technology rooted in their business model are crucial to Maine's economic future. These companies are not immune to the economic forces that affect all businesses in Maine. Four issues were raised continually by the MSTAC, as well as by citizens throughout the state, as vitally important for Maine to address in order to fully realize the economic benefits of an innovation based economy. Because these are broad economic issues that impact much more than innovation-driven companies, they require solutions that are beyond the scope of this focused science and technology plan. Their importance to the R&D segment of the economy cannot be overstated and only serves to emphasize their importance for all sectors of Maine's economy.

Cost of Doing Business

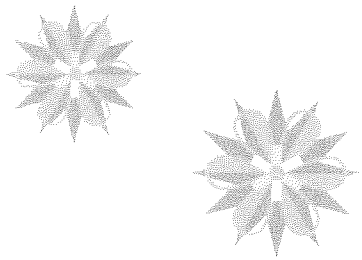
While recent reports, including that of the Milken Institute, have found that the overall cost of doing business in Maine is less than in our neighboring states, two components comprising the cost of doing business in Maine are seen as major barriers to the growth of innovative businesses here — high energy costs and a relatively high tax burden.

(i) High electricity costs and other energy costs, relative to other states, hinders business growth and development for many innovative businesses especially as they begin to develop manufacturing processes. High electricity costs become a market barrier when they are factored into the product costs. Delivery charges in Maine have declined over the past several years, but the supply price continued to rise for medium to large electricity customers.
(ii) Personal property tax and high personal income tax act as disincentives to innovation based firms. High state income tax, especially compared to our neighboring state, is cited by innovative businesses as a barrier to their ability to attract top management. Personal property tax levied on capital equipment purchases often hits start-up businesses at a particularly difficult time – as they are scaling up for production, but not yet producing. We agree with "Measures for Growth"[xxi] that restructuring Maine's tax burden is critically important to achieving sustainable economic growth and development.

Transportation

Maine businesses need speedy connections and better access to global markets. Quality, timely, and affordable transportation is a critical element of doing business in Maine. Innovative businesses are global in nature - national and international meetings, international sales, and working with international partners all require smooth air transportation. While the Portland Jet Port and Bangor International provide connections to those markets, it is not easy or smooth. Getting to other parts of the state (Northern, Central or Eastern Maine) takes extraordinary efforts and is often prohibitively expensive.

Transportation of goods also requires speedy, reliable, and cost effective transportation, such as solid roads and rail connections. Maine needs a strong, efficient ground transportation network that connects suppliers to customers, and makes transportation cheaper. This will gives Maine manufacturers greater economies of scale, and lower their cost of doing business. While Maine's basic transportation infrastructure is adequate, east-west routes and rail need continued investment and improvement for businesses in rural Maine to be able to have the same access to world markets as their competitors.



Wireless Telecommunication and Broadband Infrastructure

Creating synergistic connections, seamless telecommunications and technology infrastructure that enable instant communication is no longer a luxury. In a global economy driven by knowledge, the ability to transfer data and communicate with remote business locations around the world at any hour of the day is now standard business operation. The technology infrastructure that will provide "universal broadband access by 2010"[xxii] in Maine is crucial for innovative businesses and research institutions to thrive. The lack thereof is already limiting our competitiveness. Data generated by research instruments may be terabytes per day and the ability to transfer, share and discuss such data is instrumental for building world class innovation-based businesses and institutions. Moreover, multi-institutional collaborations require the ability to teleconference readily and easily.

Advanced wireless telecommunications infrastructure enables people to use wireless communications for a wide array of applications, including high-speed access to the internet over cell phones. We affirm the importance of telecommunications technology infrastructure, seen in several state initiatives, including the Public Utilities Commission, Public Advocate's Office and by Governor Baldacci, who proclaimed that broadband access and cell phone coverage is "critical in order for Maine's continued economic development and competitiveness in a global marketplace"[xxiii]The Office of Innovation will continue to represent the interests of the R&D community on the Governor's task force for broadband access.

Human Resources

This plan does offer actions steps to address the lack of three key human resources: highly trained science and engineering graduates, PhD-level principal investigators, and management expertise to grow small firms into larger ones. It does not address two other key human resource gaps: (i) the mismatch between the skills of the current workforces and the needs of innovative businesses; and (ii) the need to expand k-12 science and math education. Both are fundamental to the creation of a sustainable innovation driven economy. The latter increases the pipeline of students to become tomorrow's innovators and the potential workers at the firms that populate Maine's vibrant, globally-competitive economy. Matching the skills and training of the current workforce to the needs of Maine's growing innovative firms is needed now for these firms to succeed and prosper.

Another workforce challenge is Maine's aging demographics. Between 1990 and 2000, there was a statewide decline of 22 percent among the population of 20 to 34 year olds - and in some towns that figure was 40 percent.[xxiv] While this problem is not unique to Maine, it will have a major impact on Maine's economy and quality of life. Young adults go where there is economic opportunity, and unless Maine continues to modernize its economic base, it will be difficult to attract and retain the talent needed to sustain an innovation based economy.

Maine has many advantages including high national ranking in science and math, the laptop initiative, and Governor Baldacci's leadership in the creation of the Community College Initiative. These solid steps forward must be continually supported and advanced. Governor Baldacci has also created the Workforce Cabinet -- consisting of the Commissioners of Labor, Dept. of Economic and Community Development, Education, and the Chancellor of the University System and the President of the Maine Community College System -- to address these and other issues of workforce training and skills. The Office of Innovation will work to integrate the needs of the R&D intensive enterprises with the Workforce Cabinet's actions and recommendations.

END NOTES

[i] Lewis Alexander, Technology, Economic Growth and Employment: New Research from the Department of Commerce, U.S. Department of Commerce, Economics and Statistics Administration, Office of the Chief Economist, December 1994.

[ii] 30 and 1000 -How to build a knowledge-based Economy in Maine, Maine State Planning Office - November 2001. The plan set a goal of 30% of Maine's adults with a 4 year college degree and $1000 in R&D activity per worker to raise Maine's per capita income to the national average by 2010. http://www.maine.gov/spo/pubs/origpdf/pdf/30and1000.pdf.

[iii] 2005 Innovation Index, Department of Economic and Community Development http://www.maineinnovation.com/resources/default.asp.

[iv] In 2001, Maine's federal support for not-for-profit R&D was 0.168% of GSP, compared to 0.048% nationally, 0.217% for New England and 0.023% for other Experimental Program to Stimulate Competitive Research (EPSCoR) States, 2005 Innovation Index, DECD.

[v] 2005 Comprehensive Research and Development Evaluation survey, DECD.

[vi] 2004 Development Report Card For the States, Corporation for Enterprise Development, http://drc.cfed.org/grades/maine.html.

[vii] 2004 Development Report Card For the States, CFED,

[viii] Executive Order 14, May 2003 and Executive Order 43, June 2005.

[ix] The Office of Innovation was created in 2003, to encourage and coordinate the State's research and development activities to foster collaboration among the State's higher education and nonprofit research institutions and the business community. 5 MRSA §13105.

[x] 2005 Innovation Index, DECD.

[xi] 2005 Innovation Index, DECD.

[xii] 30 and 1000 -How to build a knowledge-based Economy in Maine, Maine State Planning Office - November 2001.

[xiii] Governor's Economic Development Strategy for Maine, January 2004 http://www.econdevmaine.com/announcements/details.asp?PressID=4.

[xiv] 2005 Innovation Index, DECD.

[xv] Rita Heimes, From Laboratory to Marketplace: The Capacity of Maine's Research Institutions for Innovation and Technology Transfer - Technology Law Center, University of Maine Law School, 2004.

[xvi] Draft, Strategic Implementation Plan for Enhancement of Research, Scholarship and Creative Activity, University Research Council July 2005, internal document.

[xvii] The Carnegie Classification for Tier One universities are institutions that offer a full range of baccalaureate programs, are committed to graduate education through the doctorate degree, and give high priority to research. They award 50 or more doctoral degrees each year. In addition, they receive annually at least $40 million or more in federal support.

[xviii] Maine and Company is a private sector organization that seeks to attract new business investment to Maine.

[xix] 2004 Development Report Card For the States, CFED.

[xx] Small Business Profile, Maine, 2005, US Small Business Administration, Office of Advocacy.

[xxi] Measures of Growth In Focus, 2005, Maine Development Foundation

[xxii] Executive Order 41, May 6, 2005, Office of the Governor, http://www.maine.gov/governor/baldacci/news/executive-orders/index.htm.

[xxiii] Executive Order 41, May 6, 2005, Office of the Governor.

[xxiv] Maine's Changing Population, A Summary of Structural Changes, Mobility and Regional Variations, Maine State Planning Office, April 2004, http://www.maine.gov/spo/economics/economics/pdf/youthwhitepaper.pdf.

About the Office of Innovation:

The Office of Innovation was established within the Department of Economic and Community Development by the Legislature in 2003. It was created to encourage and coordinate the State's research and development activities to foster collaboration among the State's higher education and nonprofit research institutions and the business community.

The Office is required to develop the State Science and Technology Action Plan to improve the State's position in the global economy. The action plan must be based on the State's overall economic development strategy as determined by the commissioner.

Additionally, the Office is charged with developing an annual report card, and a comprehensive evaluation of state research and development investments. The Office also serves as the State EPSCoR Office.

European Innovation Policy

A wide variety of sources were used in developing this plan and determining the correct goal for Maine. In that research, we came upon the following from the European Union's Innovation Plan. The similarity to Maine's goal ($1 billion of R&D activity - or about 3%of GSP) is striking enough that we thought to include it here.

Innovation Action Plan

Europe needs more innovation to reach the Lisbon targets. Therefore DG Enterprise is working on a new Innovation Action Plan to be adopted by the Commission in summer 2004. The first Action Plan for Innovation (1996) had a significant impact on the interaction between research and innovation and on the promotion of high-tech start-ups. The 3% Action Plan of DG Research (increase combined public and private research spending to 3 % of GDP) follows the approach of that first Plan.

To broaden the impact of innovation policy, also in view of enlargement, the new Action Plan goes beyond the focus on research and the development of new technology. It will also address the large scale diffusion of existing technology in particular to the huge number of smaller enterprises in all sectors that were not in the focus of earlier actions. Action plan will include activities to foster non-technological innovation, i.e. organisational (new business models, innovation management techniques), presentational and service innovation which are necessary prerequisites to increased competitiveness and also to the full exploitation of technological innovation. To achieve this, new actions will be taken, existing activities reoriented and other policy areas mobilised (e.g. research, regional, education) to improve the innovation framework, including its regulatory aspects (e.g. State aids and better regulation). http://www.europa.eu.int/comm/enterprise/innovation/index_en.htm