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STATE OF MAINE
118TH LEGISLATURE
SECOND REGULAR AND SECOND SPECIAL SESSIONS

Final Report of the JOINT SELECT COMMITTEE ON RESEARCH AND DEVELOPMENT

(Established Pursuant to Senate Paper 831)

December 1998

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EXECUTIVE SUMMARY

The Joint Select Committee on Research and Development was created by the 118th Maine Legislature to review legislation relating to research and development and report its finding and recommendations to the Legislature.

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. Such a commitment will require leadership and vision on the part of the Legislature, the Governor and the research community. The State will achieve the most success from its investment by focusing on 7 target technology areas:

- biotechnology;
- marine sciences and aquaculture;
- composite materials engineering;
- environmental sciences and technology;
- advanced technologies for forestry and agriculture;
- information sciences and technology; and
- precision manufacturing technologies.

In developing its recommendations, the committee focused on three broad areas of need that must be addressed in order to attract and retain research and development activity in the State: a need for research and development infrastructure; a need for an educated and technically skilled workforce; and a need for business assistance. Based on these needs and the current programs and initiatives in place to support research and development in Maine, the committee supports the following 21 recommendations.

Research and Development Infrastructure

- The committee recommends increasing the University of Maine System's base funding for research and development by appropriating $10 million per year during the next biennium and eventually $20 million per year to the Maine Economic Improvement Fund.

- The committee recommends making a significant and steady investment at a level of $15 million per year for capital construction at the University of Maine System to renovate and construct research facilities.

- The committee recommends that Fogler Library at the University of Maine be designated the State Research Library for Business, Science and Technology. The committee further recommends appropriating approximately $5 million per year for

the purchase of information resources and the negotiation of statewide licenses for on-line databases, for the equipment to house the databases and for staff support to interpret the databases.

- The committee recommends creating and funding a Center for Advanced Law and Management at the University of Southern Maine with an appropriation of $200,000 per year.

- The committee recommends supporting the expansion of the Center for Technology-Based Business Development at the University of Maine.

- The committee recommends supporting the development and maintenance of the University of Maine's Internet 2 system to create a high-speed research network.

- The committee strongly supports investing $15 million per year in a program to support applied research, development and commercialization in target technology areas. The committee recommends that the Targeted Industries Committee and other interested parties develop advisory recommendations on implementing such a program and provide these to the Joint Select Committee on Research and Development in January 1999. The committee further recommends that the Joint Select Committee report out legislation to the First Regular Session of the 119th Legislature.

Educated and Technically Skilled Workforce

- The committee recommends appropriating $1 million per year to the Maine Technical College System for the initial capitalization of new or expanded catalog programs to meet the employment needs of growing high tech companies.

- The committee recommends appropriating $100,000 per year for 3 years to support expansion of the Department of Education's partnership with the National Aeronautic and Space Administration (NASA).

- The committee recommends appropriating $2 million per year for 5 years for professional development and curricular development programs to ensure that students in the K-12 system derive the maximum benefit from school-based technology.

- The committee recommends appropriating $100,000 to the Foundation for Blood Research's ScienceWorks program to provide adequate laboratory equipment in Maine high schools.

- The committee recommends appropriating $150,000 to the Maine Science and Technology Foundation for the MERITS program (Maine Research Internships for

Teachers and Students) to provide expanded internship opportunities in the public and private sectors for science and mathematics teachers and students.

- The committee recommends appropriating $750,000 per year for 3 years to the University of Maine System to provide increased opportunities for Maine high school students to learn about and experience success in post secondary math, science and engineering programs.

- The committee recommends funding the Governor's Marine Studies Fellowship Program with an annual appropriation of $50,000 to connect Maine students with Maine researchers.

- The committee recommends that the Legislature carefully consider the recommendations of the Finance Authority of Maine with regard to financial aid repayment programs for students who choose to remain in Maine and obtain employment in one of the technology target areas.

- The committee tentatively supports appropriating $50,0000 per year to support the Maine Science and Technology Foundation's education initiative.

Business Assistance

- The committee recommends that the Legislature carefully consider the recommendations of the Finance Authority of Maine with regard to increasing access to capital and assisting fledgling businesses in locating and obtaining capital.

- The committee tentatively supports appropriating $55,000 for the Maine Science and Technology Foundation (MSTF) to identify new opportunities for innovation in Maine's businesses and to convene stakeholders to identify an implementation strategy for delivering training efforts.

- The committee tentatively supports appropriating funds for commercialization initiatives, including training for SBIR service providers and grants through the Maine SBIR (Small Business Innovation Research) Assistance Program, and development of a web-based commercialization network.

- The committee tentatively supports appropriating $50,000 per year to MSTF to expand its role in identifying science and technology strategies for Maine, convene stakeholder groups to discuss implementation strategies and make recommendations to the Legislature.

Other

The committee recommends that the 119th Legislature establish a Joint Select Committee on Research and Development.

I. Introduction

The Joint Select Committee on Research and Development was created by a Joint Order of the 118th Maine Legislature in February 1998.[1] The select committee is composed of 13 legislators[2] representing seven joint standing committees of the Legislature. The Joint Order directs the committee to review all legislation relating to research and development and report its finding and recommendations to the Legislature.

The committee met in 5 different areas of the State to tour R&D facilities and gather information from industry, the university system, the technical college system and state agencies. These meetings were held in Bar Harbor, Fairfield, Portland, Presque Isle and Orono. The committee asked representatives from the biotechnology, marine biotechnology, aquaculture, agriculture, forestry, precision manufacturing, information technology, and composite materials industries to tell them about the research and development work they are doing in Maine and the challenges they face doing research and development in Maine. From this information and information gathered from the academic sector and state agencies about current programs, the committee developed a list of needs for attracting and retaining research and development activity in the State.[3] Those needs fell into three broad categories:

- a need for research and development infrastructure;
- a need for an educated and technically skilled workforce; and
- a need for business assistance, including financial programs.

The committee then met several times in Augusta and developed recommendations to address those areas of need.

Several themes have emerged during the course of the committee's work and shape its recommendations.

- ***Research and development is the foundation upon which a strong Maine economy will be built.***

- ***An educated and skilled workforce is a critical element in the development of the State's capacity to support research and development.***

- ***A strong University of Maine System is fundamental to growing research and development in the State.***

[1] Senate Paper 831. See Appendix A for the Joint Order.
[2] Rep. Thomas Shannon resigned from the committee in June 1998, leaving 12 members.
[3] See Appendix B for a list of sites visited and businesses/organizations that addressed the committee.

- *Maine has several distinguished nonprofit research institutions that are key to attracting researchers and building a critical mass of research activity in the State.*

- *The private sector plays a pivotal role in the "development" piece of research and development and in the creation of jobs. It is therefore in the State's interest to support companies that do research and development in the target technology areas.*

- *An important objective of investing in research and development is to create and retain high-skilled, high-wage jobs in the manufacturing sector through technology development and product commercialization.*

II. The Importance of R&D to the Maine Economy

Research and development will play a vital role in Maine's economic future. The Maine economy is at a crossroads, where the State remains dangerously reliant on industries that are expected to be stagnant or lose jobs over the next decade. According to the State Planning Office, Maine is 19 times more dependent than the nation as a whole on leather and leather products, 13.5 times more dependent than average on fishing services, 6.5 times more dependent on paper manufacturing, and 6 times more dependent on forestry services.[1] The State's economy is vulnerable in its dependence on these industries that for the most part are not growing.

The economy needs a boost, and several previous studies have identified research and development as a critical element in a healthy Maine economy.

The Joint Select Committee on Research and Development made the following finding in its February 1998 report:

> "**Research and Development is important to the Maine economy.** It's important for the State to support applied research and development (R&D) in Maine because R&D creates business opportunities, high-wage jobs, and tax revenues through development of new products and improvements in the current technology of existing businesses."[2]

The Commission to Study the Restructuring of the State's Fiscal Policies to Promote the Development of High-Technology Industry in Maine recognized that "The establishment of a viable research and development infrastructure is important for the expansion of the high-technology industry."[3]

One of the call statements in Maine's Science & Technology Action Plan is *A Call for Research and Development Capacity Relevant to Maine's Industries.* The plan identifies as one element of an entrepreneurial economy "a stream of innovation moving from R&D into production."[4]

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[1] These location quotients are based on 1996 earnings. A location quotient greater than 1 shows greater than average dependency on that industry.

[2] ***Final Report of the Joint Select Committee on Research and Development.*** 118th Legislature. February 1998.

[3] ***Report of the Commission to Study the Restructuring of the State's Fiscal Policies to Promote the Development of High-technology Industry in Maine.*** 118th Legislature. January 1998.

[4] ***Maine's Science & Technology Action Plan. Answering the Call for An Entrepreneurial State.*** Maine Science and Technology Foundation. 1997. See Appendix C for a copy of the Action Plan.

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.

The committee recognizes that the State must make a long-term commitment to support research and development in Maine. Maine is far behind where we need to be in funding for research and development, and it will take a significant investment to achieve long-term success. Based on 1993 data from the National Science Foundation, Maine ranks 49th in the United States on total R&D expenditures per capita, and 50th in academic R&D expenditures per capita.[1]

Improving the State's economic competitiveness will require leadership and vision on the part of the Legislature, the Governor and the research community. The committee believes that it is essential to make a continuous commitment to research and development on an annual basis through the state budget.

The State will achieve the most success from its research and development investment by focusing on 7 target technology areas that have been identified as the most likely to produce significant benefits to the State's economy.[2] These target areas are:

- biotechnology;
- marine sciences and aquaculture;
- composite materials engineering;
- environmental sciences and technology;
- advanced technologies for forestry and agriculture;
- information sciences and technology; and
- precision manufacturing technologies.

[1] ***Relative Ranking of Selected Maine Science and Technology Indicators.*** *Maine Science and Technology Foundation. Based on data from the National Science Foundation, Science and Engineering State Profiles, 1995.*

[2] The State's Economic Development Strategy, the Science & Technology Action Plan, the Maine Economic Improvement Fund statute, and the 1997 Joint Select Committee on Research and Development all identify most or all of these target areas as key to moving the economy of the State forward.

III. Key Areas of Need for Supporting R&D Activity in Maine

There is very exciting research and development activity taking place in Maine in the academic, nonprofit and private sectors. The committee traveled around the State and met with representatives from the following industries to hear about the research and development they are doing and the challenges they face: biotechnology, marine biotechnology, aquaculture, agriculture, forestry, precision manufacturing, information technology, and composite materials. The committee also heard from the University of Maine System, the Maine Technical College System, College of the Atlantic, the Department of Education, the Maine Science and Technology Foundation, the Department of Economic and Community Development, and the State Planning Office.

Out of those meetings, three broad areas of need were identified as necessary for attracting and retaining research and development activity in the State: a need for research and development infrastructure; a need for an educated and technically skilled workforce; and a need for business assistance. These needs are closely aligned with the call statements that provide the framework for the Science & Technology Action Plan:

- An Educated and Technically Skilled Workforce;
- Research and Development Capacity Relevant to Maine's Industries;
- Expanding Commercialization;
- Increasing Innovations in Maine Companies;
- A Networked Maine; and
- Improving Input of Science and Technology in Policymaking.

Some of the programs and studies that are currently working to meet these needs are discussed in section IV, but many gaps remain that the State must begin to fill.

Research and Development Infrastructure

The committee was told that the State needs leadership and a vision for its economic future. It will require a long-term commitment and strategic investment on the part of the State to develop the research capacity that will serve as the foundation for a strong state economy with quality jobs for its citizens. North Carolina was given as an example of a state that has had a long-term commitment to investing in research and development and now has a very active and dynamic research enterprise.

The State needs a research and development infrastructure with several essential elements: a critical mass of people and companies involved in conducting research and development in the target technology areas; a strong university system with the facilities and the researchers to support the target industries; a network of collaboration between the academic, nonprofit and private sectors; a good research library that provides access

to information resources to researchers statewide; research facilities with adequate laboratory space and equipment; a fair tax structure; and a state-of-the-art telecommunications network that supports the high-speed transfer of information to researchers wherever they are located in the State.

An Educated and Technically Skilled Workforce

Almost every person that appeared before the committee emphasized that an available supply of educated and skilled workers is the most significant need of companies performing research and development, and that the State must do more to ensure that the K-12 system, the University of Maine System and the Technical College System are producing students that have the education and skills that are relevant to Maine industries. In addition, Maine must do more to retain its high school and college graduates in the State and to attract quality employees to the State.

According to a recent article in the *Maine Policy Review*, Maine is suffering from a science and engineering "brain drain."[1] In a study based on 1993 data, Maine ranked among the bottom five states for retaining its science and engineering graduates. Furthermore, Maine has not been successful in attracting science and engineering graduates from other states. This has resulted in a negative net migration of educated workers. The implication of this is that Maine does not have the workforce to support research and development activity, so there is not the level of activity in Maine that would encourage recent graduates to remain in the State.

The need in Maine is for skilled workers at both the professional and technical levels. The need is especially great for science, engineering and computer professionals. Currently many high technology businesses have to recruit professionals from out of state, although they would prefer to see the University of Maine System produce the employees they need. A state university system with a good scientific and research base contributes to the strength and growth of the private sector.

Producing an educated and skilled workforce must begin with the K-12 education system. It is necessary to expose students to science and engineering to motivate them to pursue higher education opportunities in those areas, and it is necessary to prepare them with the math, science and technology skills required in post-secondary programs. To do this, teachers need to be trained in the use of the technology that is now available to help students learn in those areas.

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[1] Tornatzky, L., Gray, D., Tarant, S., and Howe, J. "Maine's Science and Engineering Brain Drain." ***Maine Policy Review*** (Fall 1998): 44-49.

Business Assistance

In order for research and development to grow the economy significantly, the private sector must be involved in innovative applied research and commercialization. The biggest need in this category cited by industry representatives is for access to capital, particularly early stage capital. The committee heard from several people that the need is for more capital and from others that capital is available but difficult to access.

The small research and development businesses in the State generally need relatively small amounts of seed and early stage venture capital to support research, start-up, product development, and to enhance the pace of commercialization. It is often difficult for these businesses to get traditional financing because of the risks involved at that stage of financing. Banks and other commercial lending institutions are often reluctant to invest in a new business or to invest small amounts of money, but this is a critical need for businesses that perform research and development.

Businesses also need other types of business assistance, such as programs to develop entrepreneurial skills, incentives to encourage product development and commercialization, tax incentives, and patent and intellectual property assistance.

IV. Current Support for R&D in Maine

As mentioned in the previous section, programs and initiatives have been put in place to meet some of the needs of the State's research and development community. The committee looked at the progress made to date in each of the identified areas of need and the following is a sample of what they found.

Research and Development Infrastructure

The State's Economic Development Strategy

The Department of Economic and Community Development developed the State's Economic Development Strategy in January of 1996 and has issued two status reports since then. The Strategy is built upon several efforts already completed, including work by the Maine Economic Growth Council and the Maine Chamber and Business Alliance. The Strategy identifies 23 targeted areas and a lead organization has been appointed to each area to be responsible for the strategic planning process and for coordinating implementation of their action plans.

University of Maine System Research

The University of Maine System has several established research programs with excellent reputations and collaborative relationships with business and nonprofit research institutions in the State. The following are just a few examples of partnerships between the university system and the nonprofit and private sectors.

The University of Maine, the University of Southern Maine, the Jackson Laboratory, the Maine Medical Center Research Institute and the Foundation for Blood Research have collaborated on several research projects in recent years. For example, the institutions are partnering to build a graduate program in biosciences that will use videoconferencing for courses between Orono, Bar Harbor and Portland. This network between Orono, Bar Harbor and Greater Portland has been termed the "research triangle."

The University of Maine's Laboratory for Surface Science and Technology is an interdisciplinary research unit with 6 faculty and 41 students. The program provides research training for undergraduates and graduate students, and two businesses have been direct spin-offs from the program and employ many of its graduates.

The University of Maine's Advanced Engineered Wood Composites Center is a national leader in developing the next generation of engineered wood composites for construction. The Center has 15 senior researchers and 38 student researchers whose research in wood composites technology will add value to Maine's forest resources and thus have a direct benefit to the economy.

The University of Southern Maine's applied immunology program is housed at the Foundation for Blood Research (FBR), and its faculty come from FBR as well as private biotechnology firms. This encourages a network of collaboration between the University, FBR and the private sector.

Maine Economic Improvement Fund

The Maine Economic Improvement Fund was established in statute in 1997.[1] The Fund, administered by the University of Maine System Board of Trustees, may be used to invest in applied research and development in 5 target areas within the University of Maine System and to support the development of private enterprise based upon research and development performed within the University of Maine System. These actions must be taken in partnership with private enterprise, the federal government or private and public research institutions. $4 million was transferred to the Fund from General Fund surpluses in 1998, and the University of Maine System is authorized to include the $4 million as part of its "current services" budget request for the 2000-2001 biennium.[2]

R&D Bond

In November 1998 Maine voters approved a $20 million bond issue to support research and development in 5 target areas: biotechnology, marine technology, software engineering and development, advanced technologies for forestry and agriculture, and advanced materials engineering and development.[3] The funds will be used as follows:

- $13.5 will be allocated to the University of Maine System for capital improvements and equipment purchases;
- $3 million will be allocated to the Maine Science and Technology Foundation for a Marine Technology Fund to enhance Internet connections among public and private marine research institutions and to enhance research and education capability in those institutions;
- $1.5 million will be allocated to the Maine Science and Technology Foundation for a Research Challenge Grants Program to enhance research and development capacity and productivity in research institutions in the for-profit, nonprofit and academic sectors; and
- $2 million will be allocated to the Department of Economic and Community Development to provide partial funding for design and construction of the Gulf of Maine Aquarium Research Facility.

[1] 10 MRSA c. 107-C
[2] PL 1997, Chapter 643, Part LL
[3] PL 1997, Chapter 718

An Educated and Technically Skilled Workforce

Learning Results

In 1996 the Legislature established a statewide system of Learning Results,[1] to be implemented by the Department of Education in consultation with the State Board of Education. Learning Results consists of content standards and performance indicators for all public school students. The goal and intent of the Legislature in establishing the learning results is "to ensure that the State's schools will enable today's students to gain the knowledge and skills necessary to be effective parents, citizens, workers and adults."[2]

MERITS

Since 1992, the Maine Research Internships for Teachers and Students (MERITS) program has provided teachers and students with research opportunities by placing them in internships with businesses and non-profit laboratories around the state. The program allows math and science teachers and students to work hands-on with scientists and engineers in research institutions such as Bigelow Laboratory for Ocean Sciences, Maine Medical Center Research Institute, Bowdoin College, National Semiconductor and the Department of Marine Resources.

Maine Quality Centers

The Maine Quality Centers were established by the Legislature in 1994 under the Maine Technical College System. Their mission is "to meet the workforce education and training needs of new and expanding businesses in the State and provide new employment and career advancement opportunities for Maine people."[3] The Quality Centers program offers customized education and training for new or expanding businesses at no cost to the business or the trainee. To participate, businesses must create a minimum of 8 full-time jobs with benefits. As of June 1998, over 50 companies have utilized the program, creating jobs with an average wage of $10.53 per hour. The program's goal is for employment resulting from each project to produce a return on investment within 36 months. As of June 30, 1998 the return on investment was estimated at 17 months.

Establishment of Ph.D. Programs

The Chancellor of the University of Maine System is charged with identifying the high-technology disciplines that would be the most productive for the establishment of Ph.D. programs to provide educational and professional opportunities for Maine students.

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[1] PL 1995, chapter 649
[2] 20-A MRSA §6208
[3] 20-A MRSA §12725

The Chancellor will report to the Legislature in January 1999 with a plan for the establishment of Ph.D. programs in a timely manner.[1]

Financial Aid Programs

The Finance Authority of Maine (FAME) is required to review existing financial aid programs for supporting students pursuing high-technology courses of study and report to the Legislature in January 1999 with recommendations for providing additional resources to support such students.[2]

Business Assistance

Maine Science and Technology Foundation

The Maine Science and Technology Foundation (MSTF) is a nonprofit institution established in statute for the following purpose:

> "[to] encourage, promote, stimulate and support: research and development of relevance to the State; technology transfer activities that increase the competitiveness of businesses and public institutions of higher education in the State; effective and efficient application of technologies in the public and private sectors; scientific and technological education and training; the development of new commercial products and the fabrication of such products in the State; and cooperative efforts among government, the private sector and universities and colleges for the purposes outlined in this chapter."[3]

MSTF administers several programs that provide assistance to high-technology businesses in the State.

Experimental Program to Stimulate Competitive Research (EPSCoR): Maine EPSCoR[4] is a cooperative federal-state initiative administered by MSTF and managed by the Research Capacity Committee. EPSCoR is designed to strengthen the State's science and engineering infrastructure by supporting research with funds from the National Science Foundation and the Department of Energy.

Maine SBIR Assistance Program: The federal Small Business Innovation Research (SBIR) program grants approximately $1 billion annually to qualifying small businesses to develop and commercialize new technologies that address the expressed needs of various government agencies. The Maine SBIR Assistance Program[5] provides technical

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[1] PL 1997, chapter 784
[2] PL 1997, chapter 784
[3] 5 MRSA §13122-B
[4] 5 MRSA §13124-B
[5] 5 MRSA §13124-C

assistance to Maine's small businesses to help them develop competitive SBIR grant proposals and to commercialize the products they develop. The goals of the program are to expand the number of Maine SBIR applicants, to increase the competitiveness of the Maine SBIR applicants, and to increase the number of commercialized SBIR projects. The Maine SBIR Assistance Program was awarded the U.S. Small Business Administration's 1998 Tibbetts Award which recognizes firms, groups or individuals involved with the SBIR program.

Maine Technology Investment Fund (MTIF): The Maine Technology Investment Fund was established in 1995 by the 117th Legislature to strengthen employment opportunities in the State by increasing the science and technology investment level..."[1] The Fund may be used for two purposes: to provide matching funds for federal, private and foundations awards; and to invest directly in small to mid-sized business with promising technology at the pre-commercialization stage. Investments must be in target technology areas and range from $25,000 to $100,000 with a 1:1 cash match required. $1.6 million has been appropriated to the Fund through FY 1998-99, and MSTF is encouraging private sector investment in the Fund.

Small Enterprise Growth Fund

The Small Enterprise Growth Fund was established in 1996 by the 117th Legislature and funded with a $5 million bond issue. The Fund, administered by the Finance Authority of Maine (FAME) and overseen by the Small Enterprise Growth Board, is a patient source of investment capital for small businesses that demonstrate the potential for high growth and public benefit. The Fund invests in early stage companies with promising projects needing less than $300,000. The maximum investment is $150,000 per loan and the investment must be matched with other financial resources. As of July 1998, the Fund had invested a total of approximately $1 million in 14 Maine businesses. FAME expects to recommend to the 119th Legislature that the maximum investment be increased to $500,000 per business.

Analysis of Access to Capital

FAME is required to analyze the availability of capital for business start-up and development to determine if sufficient capital is available for high-technology business needs. FAME will report to the Legislature in January 1999 with recommendations for increasing capital, if necessary, and for assisting fledgling businesses in locating and obtaining capital.[2]

Analysis of Tax Incentives

The Bureau of Revenue Services (BRS) is required to gather and analyze data regarding businesses taking advantage of tax incentives affecting research and

[1] 5 MRSA §13131
[2] PL 1997, chapter 784

development and high-technology investments. The Department of Economic and Community Development (DECD) is required to examine that information and determine whether the tax incentives are effective means of promoting the growth of high-technology businesses in the State. BRS and DECD will report to the Legislature in January 1999 with any recommendations.[1]

R&D / High-tech Clearinghouse

MSTF is required to work with several other groups to establish a statewide clearinghouse for information and assistance to persons seeking to conduct research and development and to develop high-technology businesses in the State. MSTF will report to the Legislature in September 1999 with a progress report.

[1] PL 1997, chapter 784

V. Recommendations

The Joint Select Committee on Research and Development supports the following recommendations, divided into three categories: research and development infrastructure, educated and technically skilled workforce and business assistance.

Research and Development Infrastructure

The committee recommends that state government invest in two paths to strengthen and support the research and development infrastructure in the State. The first path is an increased and ongoing investment in the University of Maine System and the second path is an investment in applied research, development and commercialization in target technology areas.

University of Maine System

1. The committee recommends increasing the University of Maine System's base funding for research and development by appropriating $10 million per year during the next biennium and eventually $20 million per year to the Maine Economic Improvement Fund.

In 1998, the Legislature authorized the transfer of $4 million from the General Fund surplus to the Maine Economic Improvement Fund (MEIF). The MEIF, administered by the University of Maine System Board of Trustees, was established by the 118th Legislature to support research and development in 5 target areas (aquaculture and marine sciences and technology, biotechnology, composite materials engineering, environmental sciences and technology, and information sciences and technology). The Fund can be used by the University of Maine System to invest in applied R&D in the target areas and to support the development of private enterprise based upon the research and development performed within the University System.

The committee's long-term plan for R&D envisions an annual investment of $20 million in base funding for research and development at the University of Maine System. With this level of investment, the University of Maine System expects to attract $100 million per year in federal R&D funding. The investment will be used in 5 target areas as operating funds to hire new research faculty and technical support, to provide a pool of matching funds for research grants, and to provide funds for graduate assistantships. Appropriating $10 million annually during the 2000-2001 biennium, increasing to $15 million annually during the following biennium, and reaching the long-term target investment of $20 million annually in FY 2003-04 will allow time for the expansion of facilities to accommodate new researchers and research activities.

2. The committee recommends making a significant and steady investment at a level of $15 million per year for capital construction at the University of Maine System to renovate and construct research facilities.

Modern university research facilities will enhance the State's research and development capabilities. Without major expansion of laboratory space on the university campuses, it will be difficult to bring additional researchers to the University System. Research space is extremely tight on the campuses, and the University of Maine has found itself needing to lease trailers to house researchers. Major investments must be made now to construct the high quality research space that will make the State's university system a world class research institution.

During the first 5 years of this investment in capital construction, the University of Maine would construct an engineering research facility to provide laboratory space for approximately 30 researchers, and a marine and biological sciences research facility to provide laboratory space for 30 researchers. Construction costs are estimated based on $250 per square foot for the engineering building, with an estimated total project cost of approximately $25 to $30 million, and $175 per square foot for the marine and biological sciences building, with an estimated total project cost of approximately $30 to $35 million.

The University of Southern Maine would use the new capital investment to construct an addition to the Mitchell Center on the Gorham campus to allow consolidation of the Departments of Computer Science and Physics with Electrical Engineering and Industrial Technology. Construction costs are estimated based on $250 per square foot with an estimated total project cost of approximately $3.625 million, which includes a telecommunications system. USM would also complete space in the Science Building on the Portland campus to provide an additional 30,000 square feet of research and teaching laboratories for the biosciences. Construction costs for this building are estimated based on $200 per square foot with an estimated total project cost of approximately $9.2 million.

These priority projects are critical to enhancing research and development activities at the University of Maine and the University of Southern Maine. Such a significant level of investment is necessary to provide the modern research and development infrastructure that will increase the number of research grants and contracts, increase the productivity of existing researchers, attract exceptional researchers and students, and give students vigorous research training.

3. The committee recommends that Fogler Library at the University of Maine be designated the State Research Library for Business, Science and Technology. The committee further recommends appropriating approximately $5 million per year for the purchase of information resources and the negotiation of statewide licenses for on-line databases, for the equipment to house the databases and for staff support to interpret the databases.

Being designated the State Research Library will allow Fogler Library to negotiate licenses for databases that will authorize the library to make those resources available to the statewide research community. The additional funding will allow the library to expand its electronic databases and its periodical subscriptions to meet the needs of researchers statewide.

It is anticipated that the total annual costs of a statewide research library will drop over the next 5 years, due to decreases in personnel and equipment costs as the library moves from setting up new information systems to simply managing them. The appropriation will therefore decrease somewhat over time. Although it is not possible to predict the future costs of electronic databases and journal subscriptions because they are too new to know how inflation will affect their cost, the library expects to institute cost recovery programs to help cover inflationary costs.

4. The committee recommends creating and funding a Center for Advanced Law and Management at the University of Southern Maine with an appropriation of $200,000 per year.

Appropriating $200,000 per year to the University of Southern Maine to support a Center for Advanced Law and Management will strengthen the competitive advantage of Maine firms and entrepreneurs by creating a forum through which lawyers, businesses and university faculty can work to address the many complex issues involving intellectual property, patent law, trade law, marketing and venture capital that impact technology-based businesses. The Center will be a joint effort of the University of Southern Maine's schools of law and business.

5. The committee recommends supporting the expansion of the Center for Technology-Based Business Development at the University of Maine.

The Center for Technology-Based Business Development was created with a grant from the National Science Foundation (NSF). The Center will be a pro-active technology transfer office with business development expertise. It will provide an entrepreneurial environment for faculty, student and industry interaction, and provide shared laboratories, equipment and incubation space for small technology-based start-up companies. This will allow the University of Maine to take a leading role in technology transfer-related economic development.

Beginning July 1, 1998, NSF is funding the start-up costs for the first two budget years of the Center at a level of $184,229 for the first year and $315,341 for the following year. The award expires on June 31, 2000. If NSF funding is not continued beyond that date, the committee recommends that the Legislature appropriate $500,000 per year beginning in FY 2000-01. Of this appropriation, $300,000 per year would be used for operating expenses and $200,000 per year would be used for intellectual property protection. This level of funding will allow the Center to expand its activities to the

University of Maine System and other Maine research institutions. The University of Maine anticipates that revenues from the licensing of intellectual property should cover the Center's operating costs within 10 years.

6. The committee recommends supporting the development and maintenance of the University of Maine's Internet 2 system to create a high-speed research network.

Building upon the high-speed Internet 2 system will increase the capacity for collaborative research and development in the State. The Internet 2 system is restricted to institutions that are conducting very specialized research that requires transmissions of very large data sets or very high speed transmissions of data in which immediate delivery is essential. Currently the University of Maine is the only institution in the State that is authorized to be part of this new system. The University anticipates that in the near future several nonprofit research institutions will receive permission from the National Science Foundation to connect to the Internet 2 system. The committee supports the connection of these institutions to the system and the collaboration that this will nurture. The committee encourages the university and the institutions to seek funding for the initial hardware costs and the annual connect charges for joining the Internet 2 system.

Investment in Technology

7. The committee strongly supports investing $15 million per year in a program to support applied research, development and commercialization in target technology areas. The committee recommends that the Target Industries Committee and other interested parties develop advisory recommendations on implementing such a program and provide these to the Joint Select Committee on Research and Development in January 1999. The committee further recommends that the Joint Select Committee report out legislation to the First Regular Session of the 119th Legislature.

A significant state investment is needed to promote job creation in the target technology areas through applied research, development, and product commercialization. The committee supports an ongoing investment of $15 million per year through the state budget, to be made available on a competitive basis to all 7 target technology areas (biotechnology, marine sciences and aquaculture, composite materials engineering, environmental sciences and technology, advanced technologies for forestry and agriculture, information sciences and technology, and precision manufacturing technologies).

A structure and process for ensuring the efficient and direct distribution of this investment must be developed with the input of all interested parties. The committee therefor recommends that the Target Industries Committee,[1] with added representation as

[1] The Target Industry Committee was established by the Maine Science and Technology Foundation (MSTF) to assist companies within 6 target areas with issues related to workforce training, access to capital, technology transfer, growth and innovation. The committee has members from each of the target industries

needed, quickly work together to develop a proposal for the 119th Legislature's Joint Select Committee on Research and Development regarding such a structure and process. The group shall look at a minimum at the following issues:

- governance;
- administration;
- distribution of funds;
- returns on investment;
- ongoing evaluation, measurement and oversight;
- commercialization activities;
- incubators;
- a plan for further refining the distribution to target technologies; and
- a timeline for implementation by July 1, 1999.

In addressing these issues, the group shall base its decisions on the intended outcome of high wage jobs. The proposal must ensure access initially for all 7 target technologies to a fair and competitive process.

The Target Industries Committee shall present its advisory recommendations by January 15, 1999 to the Joint Select Committee on Research and Development, which shall invite comment, develop final recommendations and report out legislation to the full Legislature.

Educated and Technically Skilled Workforce

8. The committee recommends appropriating $1 million per year to the Maine Technical College System for the initial capitalization of new or expanded catalog programs to meet the employment needs of growing high tech companies.

The Maine Technical College System (MTCS) currently serves about 20,000 Maine residents in credit and non-credit courses. The Maine Quality Centers is an economic development initiative administered by the MTCS that has responded to the needs of new and expanding high tech firms in Maine since 1993 by providing customized education and training at no cost. Maine Quality Centers projects are early indicators of new technical occupation and skill areas in which certificate, diploma or associate degree level education is needed.

With the additional $1 million per year appropriation, the MTCS will fund new or expanded catalog programs at the technical colleges that serve new and emerging high tech industries. The technical colleges will propose to the System President and Board of Trustees the introduction of new or the expansion of existing diploma, certificate or associate degree programs, as driven by business demand for existing and new workers.

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plus members representing the Research Capacity Committee, MSTF, the Department of Economic and Community Development, the State Planning Office and the Legislature.

The technical colleges will be required to provide evidence of ongoing demand from industry for workers with the skills provided by the program. The MTCS expects to serve 180-200 new students each year through programs supported by the additional appropriation.

The State appropriation will fund start-up costs for the new or expanded programs, including new equipment, faculty and curriculum development The tuition revenues generated during the start-up period will be set aside to help sustain the program after the initial capitalization has concluded. Businesses will need to commit to a partnership to support ongoing costs for the program after the initial capitalization.

9. The committee recommends appropriating $100,000 per year for 3 years to support expansion of the Department of Education's partnership with the National Aeronautic and Space Administration (NASA).

The Department of Education and the Maine Mathematics and Science Alliance have received two grants from NASA that have enabled Maine to build a strong NASA educational presence through intensive teacher training and access to NASA resources. Maine is poised to become a demonstration state in the use of NASA materials and technology to impact teaching and learning. With $100,000 in state funding, the Department of Education and the Maine Mathematics and Science Alliance will oversee and deliver NASA academies for professional development, teacher and student internships, curriculum materials development and dissemination and ATM broadcast of NASA videoconferences. The initial state financial support and the collaboration by state agencies that work with NASA are key to showing NASA and other federal agencies that science and technology are a major emphasis in Maine and securing additional funds to support this work long-term.

10. The committee recommends appropriating $2 million per year for 5 years for professional development and curricular development programs to ensure that students in the K-12 system derive the maximum benefit from school-based technology.

In 1995 Maine voters approved a $15 million bond issue to fund capital costs for telecommunications infrastructure and classroom technology equipment to enhance student learning opportunities in the State's schools. The $2 million annual appropriation will be used by the University of Maine System to implement professional development programs to train K-12 teachers to effectively use technology in the classroom, particularly as it relates to math and science instruction. The University System will collaborate with the Department of Education, the technical colleges and the regional education partnerships to provide professional development in the use of technology in curriculum, instruction and assessment by offering teacher training, summer workshops and other learning opportunities.

11. The committee recommends appropriating $100,000 to the Foundation for Blood Research's ScienceWorks program to provide adequate laboratory equipment in Maine high schools.

Over the last three years, the Foundation for Blood Research's (FBR) *ScienceWorks* for ME equipment donation project has provided $2 million worth of recycled science equipment to secondary schools throughout the State. FBR solicits used, surplus and outdated equipment from industry, hospitals, laboratories and other sources and then distributes lists of available equipment to the State's high school science teachers. FBR tries to fill at least one request from each school.

In 1998 FBR received $25,000 from the Maine Science and Technology Foundation, which was the first State money appropriated to the program. With increased and ongoing funding, FBR will be able to expand the program to reach more schools with more equipment.

12. The committee recommends appropriating $150,000 to the Maine Science and Technology Foundation for the MERITS program (Maine Research Internships for Teachers and Students) to provide expanded internship opportunities in the public and private sectors for science and mathematics teachers and students.

The MERITS program provides research internship opportunities for K-12 teachers and high school and college students. The Foundation for Blood Research administers the program for the Maine Science and Technology Foundation. Last year the program was funded with $40,000 in federal EPSCoR money and matched with a $40,000 in-kind contribution from FBR. Additional funding will allow the program to continue and expand the number of students and teachers able to participate in this program.

13. The committee recommends appropriating $750,000 per year for 3 years to the University of Maine System to provide increased opportunities for Maine high school students to learn about and experience success in post secondary math, science and engineering programs.

The University of Maine System currently funds several programs designed to motivate high school students to pursue post secondary education in science and engineering, including the Math-4-ME program and the Expanding Horizons program for high school girls. These programs have reached many high school students, but more needs to be done to encourage and prepare students to pursue degrees in science and engineering.

The $750,000 per year appropriation for 3 years will be used by the University of Maine System to develop, pilot and assess accelerated learning programs. These programs will enable high school seniors to take university math, science and technology courses on campus or through technology-based options, to participate in summer

learning programs and to maintain connections with university faculty via the Internet. After the 3-year pilot period, the programs that have proven to be most effective and most easily replicable statewide will be maintained and replicated within the University System either without state support or with a significantly reduced level of state funding. Alternative funding sources will also be explored during the pilot period.

These accelerated programs should motivate and better prepare high school students to succeed in post secondary education, and they will benefit the State by increasing the rate at which the University System can produce scientists and engineers for Maine's high tech industries and teachers of science and math for Maine's schools.

14. The committee recommends funding the Governor's Marine Studies Fellowship Program with an annual appropriation of $50,000 to connect Maine students with Maine researchers.

The Governor's Marine Studies Fellowship Program was created in 1997 to encourage the study of disciplines important to the conservation, management and utilization of marine resources. The program was not funded. The Department of Marine Resources, the State Planning Office and the University of Maine System are collaborating on developing guidelines for the program. State funds must be matched 2:1 with non-state dollars.

The committee recommends funding the program with $50,000 per year to provide support for undergraduate and graduate students enrolled in Maine-chartered colleges or universities to work with Maine researchers in academic institutions, marine industries or marine industry associations.

15. The committee recommends that the Legislature carefully consider the recommendations of the Finance Authority of Maine with regard to financial aid repayment programs for students who choose to remain in Maine and obtain employment in one of the technology target areas.

An Act to Implement the Recommendations of the Commission to Study the Restructuring of the State's Fiscal Policies to Promote the Development of High-technology Industry in Maine (P.L. 1997, Chapter 784) requires the Finance Authority of Maine to review and make recommendations regarding financial aid programs for supporting students pursuing high-tech courses of study. The report is due to the Legislature on January 1, 1999.

16. The committee tentatively supports appropriating $50,0000 per year to support the Maine Science and Technology Foundation's education initiative.

MSTF's education initiative would provide staff support to work with the Department of Education, the Department of Labor, the University of Maine System, and the Maine Technical College System to facilitate cooperative initiatives and to build

working relationships between Maine's technology-intensive companies and its education and training communities.

The committee supports this initiative in concept, but recommends that the Legislature delay action until the Joint Select Committee on Research and Development receives an update from MSTF in January 1999 on its revised role and budget requests.

Business Assistance

17. The committee recommends that the Legislature carefully consider the recommendations of the Finance Authority of Maine with regard to increasing access to capital and assisting fledgling businesses in locating and obtaining capital.

An Act to Implement the Recommendations of the Commission to Study the Restructuring of the State's Fiscal Policies to Promote the Development of High-technology Industry in Maine (P.L. 1997, Chapter 784) requires the Finance Authority of Maine to analyze the availability of capital for business start-up and development and to develop strategies for increasing capital, if necessary, and for assisting businesses in locating and obtaining capital. The report is due to the Legislature on January 1, 1999.

18. The committee tentatively supports appropriating $55,000 for the Maine Science and Technology Foundation (MSTF) to identify new opportunities for innovation in Maine's businesses and to convene stakeholders to identify an implementation strategy for delivering training efforts.

MSTF would conduct a Best Practices study on how to innovate and work with a consultant to assemble case studies on how small organizations in Maine innovate. MSTF would also convene stakeholders in the state to identify who might best implement a program to run workshops for industry to learn how to innovate and to use the case studies to assist organizations in innovating internally.

The committee supports this initiative in concept, but recommends that the Legislature delay action until the Joint Select Committee on Research and Development receives an update from MSTF in January 1999 on its revised role and budget requests.

19. The committee tentatively supports appropriating funds for commercialization initiatives, including training for SBIR service providers and grants through the Maine SBIR (Small Business Innovation Research) Assistance Program, and development of a web-based commercialization network.

Through the Maine SBIR Assistance Program, MSTF provides technical assistance and grants to small businesses in the State to assist them in applying for federal SBIR (Small Business Innovation Research program) funds. Under this proposed initiative, MSTF would convene potential SBIR service providers and train them to bring SBIR awareness and one-on-one technical assistance to an increased number of Maine

businesses. The funding would also provide $100,000 per year for 2 years in grants to first-time applicants, to be awarded by the SBIR statewide advisory panel with the goal of increasing the number of successful new SBIR proposals. After two years, MSTF would evaluate SBIR activity and make recommendations to the Joint Select Committee on Research and Development regarding ongoing service delivery and potential service providers. This proposal would be funded at a level of $225,000 per year for 2 years.

MSTF would also convene commercialization stakeholders to seek input on the ongoing development of a web-based commercialization network, which provides Maine businesses that are seeking commercialization assistance with referrals to in-state service providers. MSTF would contract with an outside agency to house and update the clearinghouse. This proposal would be funded at a level of $75,000 per year.

The committee supports these initiative in concept, but recommends that the Legislature delay action until the Joint Select Committee on Research and Development receives an update from MSTF in January 1999 on its revised role and budget requests.

20. The committee tentatively supports appropriating $50,000 per year to MSTF to expand its role in identifying science and technology strategies for Maine, convene stakeholder groups to discuss implementation strategies and make recommendations to the Legislature.

The committee supports this initiative in concept, but recommends that the Legislature delay action until the Joint Select Committee on Research and Development receives an update from MSTF in January 1999 on its revised role and budget requests.

Other

21. The committee recommends that the 119th Legislature establish a Joint Select Committee on Research and Development.

The Joint Select Committee on Research and Development was established to review all legislation relating to research and development; it expires upon the convening of the 119th Legislature. The previous R&D Committee was established to review the current policies and programs within the State in support of applied research and development in 5 target areas and to develop a plan for the support of research and development in those 5 target areas.

An ongoing legislative committee will provide the Legislature with continuity in overseeing issues relating to research and development. Research and development issues fall under the jurisdictions of many of the joint standing committees, and it is important to have one umbrella committee with representatives from the various policy committees to review research and development issues and coordinate R&D policy in the State.

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APPENDIX A

Joint Order creating the
Joint Select Committee on Research and Development

STATE OF MAINE

In Senate February 19, 1998

ORDERED, the House concurring, that the Joint Select Committee on Research and Development is established. The select committee consists of 3 members from the Senate, to be appointed by the President of the Senate and 10 members from the House of Representatives to be appointed by the Speaker of the House. The first named members appointed from each body are cochairs of the committee. The members must include at least one member from each of the following joint standing committees: the Joint Standing Committee on Agriculture, Conservation and Forestry; the Joint Standing Committee on Appropriations and Financial Affairs; the Joint Standing Committee on Business and Economic Development; the Joint Standing Committee on Education and Cultural Affairs; the Joint Standing Committee on Marine Resources; the Joint Standing Committee on Natural Resources; and the Joint Standing Committee on Taxation. The select committee shall review all legislation relating to research and development and report its findings and recommendations to the Legislature.

SPONSORED BY: Mark W. Lawrence
(Senator LAWRENCE)

COUNTY: York

APPENDIX B

List of sites visited and businesses/organizations
that addressed the committee

Research Institutions Visited by the Joint Select Committee on Research and Development

The Jackson Laboratory, Bar Harbor
College of the Atlantic, Bar Harbor
Mount Desert Island Biological Laboratory, Salsbury Cove
AquaBio Products Sciences, Salsbury Cove
Kennebec Valley Technical College, Fairfield
University of Southern Maine, Portland
University of Maine at Presque Isle, Presque Isle
University of Maine, Orono
Sensor Research and Development Corporation, Orono

Businesses / Organizations / Agencies that Addressed the Joint Select Committee on Research and Development

The Jackson Laboratory, Bar Harbor
Hancock County Cooperative Extension
Mount Desert Island Biological Laboratory, Salsbury Cove
AquaBio Products Sciences, Salsbury Cove
College of the Atlantic, Bar Harbor
Kennebec Valley Technical College, Fairfield
Dr. Tom Long
Binax NEL
Atlantic Salmon, Waterville
Avian Farms, Waterville
Maine Biological Labs, Waterville
Johnny's Selected Seeds, Albion
Maine Biological Services, Portland
Artel, Westbrook
Phylogix, Kennebunkport
Binax, Portland
IDEXX Laboratories, Westbrook
Kennebec Tool & Die Company, Augusta
Fairchild Semiconductor, South Portland
D&G Machine Products, Westbrook
Technology Systems, Wiscasset
EnvisioNet, Augusta
Terralink Software Systems, South Portland
DeLorme, Yarmouth
Bell Atlantic - Maine
NatureMark Potatoes, Island Falls
Aroostook Research Farm, Presque Isle
McCain Foods, Easton

Atlantic Custom Processors, Fort Fairfield
ATX Forms, Washburn
Applied Fibers Systems, Fort Fairfield
Houlton Photonics, Houlton
Fraser Paper, Ashland
Sensor Research and Development Corporation, Orono
Bath Iron Works, Bath
Control Devices, Standish
Foundation for Blood Research, Scarborough
Center for Innovation in Biotechnology
Maine Aquaculture Innovation Center
Maine Software Developers Association
Center for Environmental Enterprise
Environmental Business Council of Maine
Maine Potato Board
Northern Maine Development Commission
Eastern Maine Development Corporation
Sunrise County Economic Council
Southern Maine Economic Development District
Androscoggin Valley Council of Governments
Maine Manufacturing Extension Partnership
Department of Economic and Community Development
Department of Education
University of Maine System
Maine Technical College System
Maine Quality Centers
State Planning Office
Maine Science and Technology Foundation

APPENDIX C

Maine's Science & Technology Action Plan

Answering The Call For An Entrepreneurial State

High Quality Jobs Through Investment In Science And Technology

MAINE IN 2005

- 500 new internationally competitive high technology firms
- 10,000 new high skilled jobs paying 50% above the average employment wage
- Approximately 15,000 additional jobs in other sectors of Maine's economy
- A high technology sector that contributes 15% to the Gross State Product
- A research and development enterprise that infuses $400 million a year into Maine's economy
- A robust manufacturing sector competing globally on cost and quality

MAINE'S
SCIENCE
TECHNOLOGY
ACTION
PLAN

PREPARED BY THE MAINE SCIENCE AND TECHNOLOGY FOUNDATION

Answering The Call For An Entrepreneurial State

THE VISION: 2005

Maine has a stark choice to make. In one option the citizens find themselves in a state falling ever farther behind in economic opportunities. In the other option, Mainers create and benefit from a vibrant, balanced economy. Our vision is the latter.

In the year 2005 Maine is an entrepreneurial state, building on a history of Yankee ingenuity and high quality. A place where business, government and educational institutions work together as partners in creating a skilled workforce employed at good jobs in successful businesses. A state with a robust manufacturing sector competing successfully on cost and quality, where mature industries take full advantage of technological advances and emerging industries find an encouraging environment. A place where high school graduates demonstrate a measurable competency in core skills and go on in record numbers to higher education at vocational, undergraduate and graduate levels.

Investments in science and technology have enabled Maine's entrepreneurial econo my to create about 10,000 high wage jobs paying one and a half times the average employment wage, 500 companies that have emerged in the last 8 years from Maine's hig technology sector and roughly 15,000 additional jobs in other sectors of Maine's economy through a ripple effect. The high technology sector now contributes 15% of the Gross State Product - twice its contribution in 1997!

A CALL For An Educated and Technically Skilled Workforce

To ensure an educated and technically skilled workforce, Maine must have a coordinated, customer-focused, high performance-based educational system.

ACTIONS

Fully support and implement Learning Results in every public school in Maine (1997).

The Governor should appoint a task force to make recommendations to create a collaborative educational system focused on the needs of Maine's citizens (1999).

MAINE ECONOMIC GROWTH COUNCIL (MEGC) MEASURES IMPACTED:

Fundamental Performance Measures
Innovative Businesses
Skilled and Educated Workers
Vital Communities
Efficient Government
State-of-the-Art Infrastructure
Healthy Natural Resources

A CALL For Research And Development Capacity Relevant To Maine's Industries

To stimulate growth in key sectors, Maine must have a critical mass of intellectual resources and modern equipment and facilities. Developing and maintaining these resources requires that Maine secure a significantly larger share of the $9 billion worth of federally-sponsor research opportunities. In Maine, the public sector must invest in science and technology resources to ensure a supportive environment f our target industries to capitalize on potential niches in biotechnolo information technology, marine science & technology, composite materials and environmental technology.

ACTIONS

The Governor should call for a comprehensive audit of Maine's science and technology assets to determine the proper arenas for investment of resources and the best approaches to capitalizing on market driven technologies such as marine biotechnology, high-speed networking and pollution control. The audit will examine existing and needed resources in a way that makes clear that industry, educational, and governmental resources will be treated as an integrated system to benefit the entire state. The American Association for the Advancement of Science (AAAS) will provide technical advice in this effort (1997).

Based on the outcomes of the audit:

- Expand, in 1997, state investment in the publicly-supported Maine Technology Capacity Fund as the state's vehicle for matching federal R&D opportunities and for seeding private/public research partnerships in key technology areas identif in the audit. The Fund must leverage federal, industry and participant investm at a 3:1 ratio. Total leveraged investment should reach $50 million per year by 2002. State investment in the Fund should ramp-up to a $10 million per yea operating level by 2002.
- Invest in the University of Maine System's infrastructure to support the ta industries and technology areas (1997).
- Send to Maine voters a bond issue for capital facilities and equipment fo colleges which fit the target areas (1998).

MEGC MEASURES IMPACTED

Fundamental Performance Measures
Innovative Businesses
Skilled and Educated Workers
Vital Communities

Maine's scientific and business communities function as an integrated cluster and have become one of the hot spots for venture capitalists to look for promising ideas. The state boasts a base of experienced entrepreneurs in high growth companies, a base of Ph.D. scientists and engineers trained and employed in Maine and its own seed and venture capital industry.

An achievable dream! One in which science and technology investments made now will yield significant returns in the future. The Maine Science and Technology Action Plan spells out the steps to be taken and the investments to be made to achieve this vision for 2005.

THE CONTEXT: AN ENTREPRENEURIAL ECONOMY

Technology is an engine of economic growth, creating high wage jobs, building new industries and accounting for as much as two-thirds of national productivity since the Depression. An entrepreneurial environment in which technology enhances economic growth will enable Maine to take advantage of the opportunities ahead. The elements of an entrepreneurial economy are:

- a well-educated and technically skilled workforce to produce higher value added products and services;
- firms that are high performance-based, invest in themselves, are modern, able to compete globally on cost and quality and provide high-wage employment;
- a stream of innovation moving from R&D into production; and
- fiscal policies and regulations that encourage growth and creation of companies.

THE WORK OF MANY

This vision of Maine's future did not develop in isolation. It began with a joint venture between the Maine Alliance and the Maine Chamber of Commerce and Industry proposing an image of Maine as an entrepreneurial state. That work led to "The Course For 1995 and Beyond," a series of recommendations necessary in furthering this image.

A CALL For Expanding Commercialization

The lack of early investment capital is a significant impediment to the creation and growth of high technology firms in Maine. Developing private sector sources of investment money is crucial. Equally important is improving access to existing sources of seed and venture capital. Maine also needs a highly aggressive effort to collaboratively bring all appropriate resources together in support of developing high tech companies and jobs.

ACTIONS

Capitalize, with private sector support, the Maine Technology Investment Fund to make direct investments in early stage technologies and product development (1998).

Provide access to ACEnet to link entrepreneurs with venture capitalists via the Internet (1997).

Establish a virtual, private/public technical assistance collaborative among current service providers to enhance the pace of technology commercialization and improve the effectiveness of recruitment of entrepreneurs into Maine (1997).

MEGC MEASURES IMPACTED

Fundamental Performance Measures
Innovative Businesses
Vital Communities
Healthy Natural Resources

A CALL For Increasing Innovations In Maine Companies

To realize growth in the high technology sector, companies must invest in themselves, and state policies should foster such behavior. Adoption of productivity enhancement tools, such as information technology, is a key strategy for successfully competing in the 21st century. Existing private/public partnerships that deliver productivity enhancement tools, such as the Centers for Innovation and the Maine Manufacturing Extension Partnership, are indispensible to Maine's science and technology strategy. Their successes and lessons learned should be applied across Maine's entire economy. Synergy among all service providers should be pursued in order to maximize scarce resources with a renewed focus on improving competitiveness of Maine companies across all sectors.

ACTIONS

The Governor and Legislature should conduct a comprehensive review of Maine's fiscal policies and regulations with the specific goal of increasing entrepreneurship and incentives for investments. This review should identify and recommend specific actions to remove barriers to growth and development of high technology industry (1998).

Establish an extension service for the 21st century which reaches out to every sector of Maine's economy (1998).

MEGC MEASURES IMPACTED

Fundamental Performance Measures
Innovative Businesses
Skilled and Educated Workers
Vital Communities
Efficient Government
Healthy Natural Resources

At the same time, the Maine Economic Growth Council was developing perfomance measures and benchmarks for achieving Maine's long term economic goals. This effort complemented the Alliance and Chamber work by measuring and articulating progress towards a similar vision. The Growth Council's report outlines 13 goals for achieving that vision, and describes 57 performance measures and benchmarks to measure progress. The benchmark for Technology Resources states that Maine's rank among the 50 states on technology resources will improve from 43rd in 1995 to 35th by 2005.

Maine's Department of Economic and Community Development (DECD) tied all this work together by describing where the state should focus attention and investment during the coming years. The DECD also identified specific industries to serve as focal points for Maine's job creation efforts. Specific agencies and organizations were charged with developing Action Plans in their areas of expertise to keep the initiative moving forward.

A PLAN FOR SCIENCE AND TECHNOLOGY

In response to its legislative mandate and responsibility under DECD's Economic Development Strategic Outline, the Maine Science and Technology Foundation developed this Action Plan to improve the state's technology resources to achieve an entrepreneurial economy through private and public investments in targeted areas. Critical to the effort is increasing the competitiveness of Maine's manufacturing sector and establishing new emerging-technology business in the state. Building on the 1992 state science and technology plan and the work of our partners, this Action Plan developed with assistance from the Science and Technology Plan Steering Committee and numerous focus group participants.

WHAT NEEDS TO BE DONE

The Maine Science and Technology Action Plan describes 18 actions necessary for moving target sectors forward towards the future. These sectors include: biotechnology, composite materials, software, precision manufacturing, marine science, environmental sciences and technology, telecommunications, and the broad sector o manufacturing. The Plan clearly describes each action, a timetable for implementation, and the impact on the Maine Economic Growth Council's measures. Each step completed moves Maine closer to a brighter future.

A CALL For A Networked Maine

To establish a level playing field and to ensure Maine's place in the global economy, our telecommunications infrastructure must be continuously expanded and upgraded.

ACTIONS

Continue to invest in the creation of, and access to, a 21st century information infrastructure. A key step is for Maine to invest in developing and accessing the next generation of Internet through the University of Maine System (1997).

Challenge every Maine community and every Maine business to establish its own World Wide Web page (1998).

Challenge each Maine school and library to make its information technology resources available to its community by opening its facilities at times in which they traditionally are not used, and to create proactive community outreach programs for nontraditional students to make them aware of the free information technology public resources available and help them to utilize the facilities (1998).

MEGC MEASURES IMPACTED

Innovative Businesses
Skilled and Educated Workers
Vital Communities

[illegible] Science Advice

The complexity of science and technology challenges confronting the state requires a competent and accessible source of technical advice.

ACTIONS

Create the Maine Academy of Science and Engineering, modeled after the National Academy of Sciences, to provide technical scientific advice to the Legislature and the Executive Branch upon request. Maine's recent experiences with bioengineered milk products and Reformulated Gasoline would have benefited from such an organization (1997).

Establish a science and technology coordinating committee comprising state agencies to ensure S&T issues are addressed in the broadest possible forum within the Executive Branch (1997).

Establish an ad hoc legislative committee on science and technology to coordinate science and technology input to all policy committees within the Legislature (1998).

MEGC MEASURES IMPACTED

Efficient Government

esting in science and technology

WHY INVEST IN SCIENCE AND TECHNOLOGY ?

Investments made in science, technology, education and associated forms of infrastructure make Maine citizens partners in a vibrant, balanced economy, and beneficiaries of the significant economic improvements that follow.

Maine residents have always looked to the forests and sea for their livelihoods. Those resources have been, and will remain, essential parts of our economy. But the world and its demand for our products is changing. Bright spots of entrepreneurial innovation and budding technology exist all over Maine, but not in sufficient numbers to move our citizens and state successfully into the future. Maine must explore new ways of adding value to its natural resource assets and capitalize on emerging technology opportunities.

Economic development and the best paying jobs depend upon technology resources. In turn, technology resources depend on higher education and industries willing to innovate and take risks for economic gain. Innovation and risk-taking require a business climate that nurtures such action. Maine can create such a climate, and this Science and Technology Action Plan outlines the strategies and actions necessary for reaching that goal.

Key to this success will be collaboration and cooperation among Maine's industries, its educational institutions, research institutions and state government. The choice is ours to make. Maine can be at the forefront, or lag further behind. The responsibility for action lies with each of us, and the time for that action is NOW. There is an enormous cost if Maine does not seize this best opportunity for investment.

The Challenge

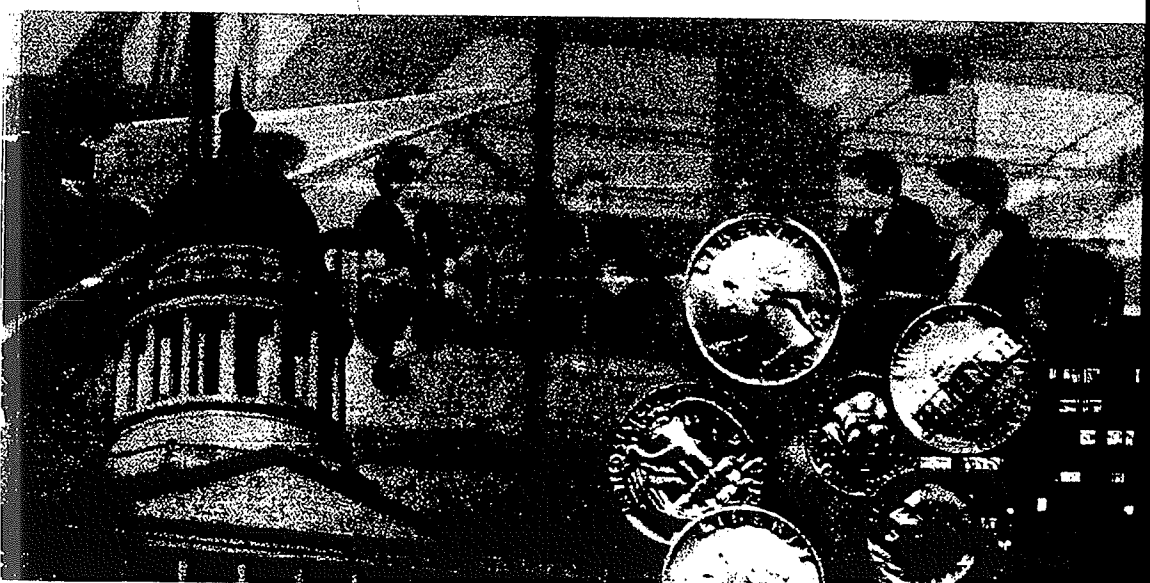
We challenge Maine's leaders and policymakers to move forward with the vision of this plan. The choice is simple and ours to make. There is much to be gained by making choices and investments delineated in the plan.

We challenge Maine's agencies, businesses and individuals to implement the action items and to begin the process collaboratively. The responsibility for action lies with each of us, and the time for that action is now. Each step completed moves Maine closer to a brighter future.

We challenge the people of Maine to organize a Marine Science and Technology Congress and Exposition in the year 2002 to showcase to the world our progress in achieving our vision to make Maine a quality place to live, obtain a quality education and run a profitable business.

ACTION

The Maine Science and Technology Foundation will facilitate implementation of the Maine Science and Technology Plan and work with lead partners to develop and present specific implementation steps, based on the comprehensive audit of Maine's science and technology assets, at a Conference on High Quality Jobs Through Science and Technology (1997).



INVESTMENT STRATEGIES

- Expansion of a publicly supported Maine Technology Capacity Fund as Maine's vehicle for federal R&D opportunities and for seeding private/public research partnerships in key areas.
- Capitalization of the Maine Technology Investment Fund with private sector support.
- Investment in the University of Maine System's research and development infrastructure to support target industries and technology areas.
- A bond issue for capital facilities and equipment for Maine's colleges.

KEY TARGET AREAS

Biotechnology

Composite materials

Software

Precision manufacturing

Marine science

Environmental sciences and technology

Telecommunications

Broad sector of manufacturing

MAINE'S SCIENCE TECHNOLOGY ACTION PLAN

FOR MORE INFORMATION

For more information concerning the State of Maine Science and Technology Action Plan, or to obtain a copy of the detailed Action Plan, please contact:

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Henry Bourgeois, *Maine Development Foundation*

Dana Connors, *Maine Chamber and Business Alliance*

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The Science and Technology Plan Steering Committee

Approximately 70 focus group participants

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The Center for Technology Transfer

The Center for Innovation in Biomedical Technology

The Maine Aquaculture Innovation Center

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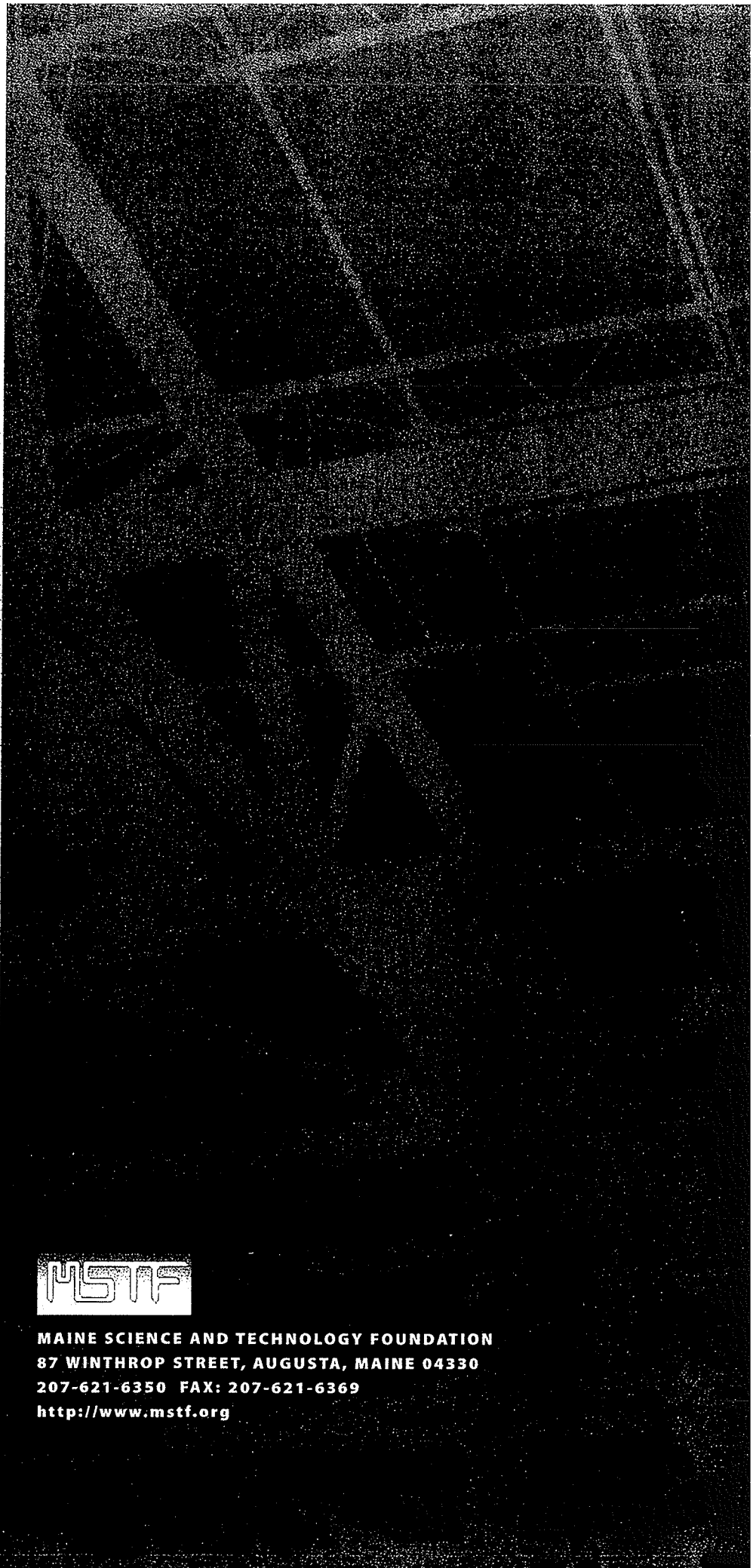
The many other groups and individuals who contributed to this effort.



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APPENDIX D

Proposed Legislation

Title: An Act to Implement a Recommendation of the Joint Select Committee on Research and Development Relating to Funding the Maine Economic Improvement Fund

Be it enacted by the People of the State of Maine as follows:

Sec. 1. Appropriation. The following funds are appropriated from the General Fund to carry out the purposes of this Act.

	1999-00	2000-01
UNIVERSITY OF MAINE SYSTEM, BOARD OF TRUSTEES OF THE		
Maine Economic Improvement Fund		
All Other	$10,000,000	$10,000,000
Provides funds for the first biennium of a long-term funding strategy for the Maine Economic Improvement Fund, to be used to fund applied research and development in the University of Maine System.		

SUMMARY

This bill implements one of the recommendations of the Joint Select Committee on Research and Development. It appropriates funds to the Maine Economic Improvement Fund, administered by the University of Maine System Board of Trustees, to support applied research and development and product innovation in target areas within the University of Maine System.

Title: An Act to Implement a Recommendation of the Joint Select Committee on Research and Development Relating to Capital Improvements to Support Research and Development in the University of Maine System

Be it enacted by the People of the State of Maine as follows:

Sec. 1. Appropriation. The following funds are appropriated from the General Fund to carry out the purposes of this Act.

	1999-00	2000-01
UNIVERSITY OF MAINE SYSTEM, BOARD OF TRUSTEES OF THE		
Board of Trustees of the University of Maine System		
All Other	$15,000,000	$15,000,000
Provides funds for capital improvements to support research and development in the University of Maine System.		

SUMMARY

This bill implements one of the recommendations of the Joint Select Committee on Research and Development. It appropriates funds for capital construction in the University of Maine System to renovate and construct research facilities for use by university researchers and students, research collaborators and private sector partners.

Title: Resolve, to Designate and Fund a State Research Library for Business, Science and Technology

Sec. 1. State Research Library for Business, Science and Technology. Resolved: That the Raymond H. Fogler Library at the University of Maine is designated the State Research Library for Business, Science and Technology. The purpose of the library is to serve the people of the State by providing research and development information services in the areas of business, science and technology; and be it further

Sec. 2. Appropriation. Resolved: That the following funds are appropriated from the General Fund to carry out the purposes of this resolve.

	1999-00	2000-01
UNIVERSITY OF MAINE SYSTEM, BOARD OF TRUSTEES OF THE		
Board of Trustees of the University of Maine System		
All Other	$5,000,000	$4,900,000
Provides funds for the purchase of information resources, equipment and staff support for the State Research Library for Business, Science and Technology.		

SUMMARY

This resolve implements one of the recommendations of the Joint Select Committee on Research and Development. It designates the Raymond H. Fogler Library at the University of Maine as the State Research Library for Business, Science and Technology. It also appropriates funds to the University of Maine System for the purchase of information resources, equipment and staff support for the State Research Library for Business, Science and Technology.

Title: An Act to Implement a Recommendation of the Joint Select Committee on Research and Development to Establish a Center for Advanced Law and Management

Be it enacted by the People of the State of Maine as follows:

Sec. 1. Appropriation. The following funds are appropriated from the General Fund to carry out the purposes of this Act.

	1999-00	2000-01
UNIVERSITY OF MAINE SYSTEM, BOARD OF TRUSTEES OF THE		
Board of Trustees of the University of Maine System		
All Other	$200,000	$200,000
Provides funds to create and operate a Center for Advanced Law and Management at the University of Southern Maine.		

SUMMARY

This bill implements one of the recommendations of the Joint Select Committee on Research and Development. It appropriates funds to create and support a Center for Advanced Law and Management at the University of Southern Maine. The Center will strengthen the competitive advantage of Maine firms and entrepreneurs by creating a forum to address many of the complex issues that impact technology-based businesses.

Title: An Act to Implement a Recommendation of the Joint Select Committee on Research and Development Relating to the Employment Needs of Growing High-technology Companies

Be it enacted by the People of the State of Maine as follows:

Sec. 1. Appropriation. The following funds are appropriated from the General Fund to carry out the purposes of this Act.

	1999-00	2000-01
MAINE TECHNICAL COLLEGE SYSTEM, BOARD OF TRUSTEES OF THE		
Maine Technical College System - Board of Trustees		
All Other	$1,000,000	$1,000,000
Provides funds for the initial capitalization of new or expanded catalog programs to meet the employment needs of growing high-technology companies.		

SUMMARY

This bill implements one of the recommendations of the Joint Select Committee on Research and Development. It appropriates $1,000,000 per year in the next biennium to the Maine Technical College System for the initial capitalization of new or expanded catalog programs at the technical colleges to serve new and emerging high-technology industries.

Title: An Act to Implement a Recommendation of the Joint Select Committee on Research and Development Relating to Math and Science Training for Maine Educators

Be it enacted by the People of the State of Maine as follows:

Sec. 1. Appropriation. The following funds are appropriated from the General Fund to carry out the purposes of this Act.

	1999-00	2000-01
EDUCATION, DEPARTMENT OF		
Learning Systems		
All Other	$100,000	$100,000
Provides funds to expand the Department of Education's partnership with the National Aeronautic and Space Administration to provide intensive, high quality training in math and science for Maine educators		

SUMMARY

This bill implements one of the recommendations of the Joint Select Committee on Research and Development. It appropriates funds to support the expansion of the Department of Education's partnership with the National Aeronautic and Space Administration (NASA). Through the partnership, the Department of Education will use NASA materials and technology for professional development, curriculum development and teacher and student internships.

Title: An Act to Implement a Recommendation of the Joint Select Committee on Research and Development Relating to Professional Development in the Use of Technology

Be it enacted by the People of the State of Maine as follows:

Sec. 1. Appropriation. The following funds are appropriated from the General Fund to carry out the purposes of this Act.

	1999-00	2000-01
UNIVERSITY OF MAINE SYSTEM, BOARD OF TRUSTEES OF THE		
Board of Trustees of the University of Maine System		
All Other	$2,000,000	$2,000,000
Provides funds for the development and implementation of professional development and curricular development programs to train teachers to effectively use technology in the classroom.		

SUMMARY

This bill implements one of the recommendations of the Joint Select Committee on Research and Development. It appropriates funds for the development and implementation of professional development and curricular development programs to train K through 12 teachers to effectively use technology in the classroom. The University of Maine System will collaborate with the Department of Education, the Maine Technical College System and the regional education partnerships to provide these programs.

Title: An Act to Implement a Recommendation of the Joint Select Committee on Research and Development to Provide Adequate Laboratory Equipment in Maine Schools

Be it enacted by the People of the State of Maine as follows:

Sec. 1. Appropriation. The following funds are appropriated from the General Fund to carry out the purposes of this Act.

	1999-00	2000-01
FOUNDATION FOR BLOOD RESEARCH		
ScienceWorks for ME		
All Other	$100,000	$100,000
Provides funds to support the ScienceWorks for ME equipment program to provide adequate laboratory equipment in secondary schools.		

SUMMARY

This bill implements one of the recommendations of the Joint Select Committee on Research and Development. It appropriates funds to the Foundation for Blood Research for the ScienceWorks for ME equipment donation program. This funding will support expansion of the program to reach more schools with more equipment.

Title: An Act to Implement a Recommendation of the Joint Select Committee on Research and Development to Provide Research Internship Opportunities for Teachers and Students

Be it enacted by the People of the State of Maine as follows:

Sec. 1. Appropriation. The following funds are appropriated from the General Fund to carry out the purposes of this Act.

	1999-00	2000-01
MAINE SCIENCE AND TECHNOLOGY FOUNDATION		
Maine Science and Technology Foundation		
All Other	$150,000	$150,000
Provides funds to support the Maine Research Internships for Teachers and Students program to provide internship opportunities in science and mathematics for teachers and students.		

SUMMARY

This bill implements one of the recommendations of the Joint Select Committee on Research and Development. It appropriates funds to the Maine Science and Technology Foundation for the Maine Research Internships for Teachers and Students (MERITS) program. This funding will allow the MERITS program to continue and expand the number of teachers and students able to participate in research internships.

Title: An Act to Implement a Recommendation of the Joint Select Committee on Research and Development Relating to Increased Opportunities for Maine Students in Math, Science and Engineering

Be it enacted by the People of the State of Maine as follows:

Sec. 1. Appropriation. The following funds are appropriated from the General Fund to carry out the purposes of this Act.

	1999-00	2000-01
UNIVERSITY OF MAINE SYSTEM, BOARD OF TRUSTEES OF THE		
Board of Trustees of the University of Maine System		
All Other	$750,000	$750,000
Provides funds to develop, pilot and assess accelerated learning programs for high school students in the areas of math, science and engineering.		

SUMMARY

This bill implements one of the recommendations of the Joint Select Committee on Research and Development. It appropriates funds to the University of Maine System to develop, pilot and assess accelerated learning programs for high school students. These programs may include coursework on campus or delivered through technology, summer academies, and mentoring programs with faculty. The goal of the programs will be to increase opportunities for high school students to learn about and experience success in post-secondary math, science and engineering programs.

Title: An Act to Implement a Recommendation of the Joint Select Committee on Research and Development to Fund the Governor's Marine Studies Fellowship Program

Be it enacted by the People of the State of Maine as follows:

Sec. 1. Appropriation. The following funds are appropriated from the General Fund to carry out the purposes of this Act.

	1999-00	2000-01
MARINE RESOURCES, DEPARTMENT OF		
Governor's Fellowship		
All Other	$50,000	$50,000
Provides funds for the Governor's Marine Studies Fellowship Program.		

SUMMARY

This bill implements one of the recommendations of the Joint Select Committee on Research and Development. It appropriates funds to the Governor's Marine Studies Fellowship Program to provide support for undergraduate and graduate students enrolled in state-chartered colleges and universities to work with researchers in academic institutions, marine industries and marine industry associations.

Note: The Committee's recommendation that the 119th Legislature establish a Joint Select Committee on Research and Development was implemented through a Joint Order on December 2, 1998 (House Paper 5).

STATE OF MAINE

In House December 2, 1998

ORDERED, the Senate concurring, that the Joint Select Committee on Research and Development is established as follows.

1. Establishment. The Joint Select Committee on Research and Development, referred to in this order as the "committee," is established.

2. Membership. The committee consists of 3 members from the Senate appointed by the President of the Senate and 10 members from the House of Representatives appointed by the Speaker of the House. The first Senate member named is the Senate chair and the first House member named is the House chair.

3. Responsibilities. The responsibilities of the committee include the following:

A. To review legislation referred to it by the Legislature and, with the approval of the President of the Senate and the Speaker of the House, to report out legislation relating to research and development;

B. To conduct oversight and review of the State's research and development policies and to make recommendations to the Legislature on appropriate actions to promote research and development in the State, including appropriate funding levels; and

C. To perform other tasks assigned to it including conducting studies on assigned topics and issuing reports to the Legislature on policy issues related to research and development.

SPONSORED BY: _____
(Representative ROWE)

TOWN: Portland

APPENDIX E

Charts

R&D Recommendations: 5-Year Investment Strategy
R&D Recommendations: Appropriations by Agency

R&D RECOMMENDATIONS

5-Year Investment Strategy

Recommendation	FY 1999-00	FY 2000-01	FY 2001-02	FY 2002-03	FY 2003-04
UMS Base Funding	$10,000,000	$10,000,000	$15,000,000	$15,000,000	$20,000,000
UMS Capital Construction	$15,000,000	$15,000,000	$15,000,000	$15,000,000	$15,000,000
Research Library	$5,000,000	$4,900,000	$4,800,000	$4,700,000	$4,600,000
Center for Advanced Law and Management	$200,000	$200,000	$200,000	$200,000	$200,000
Investment in Target Technology Areas	$15,000,000	$15,000,000	$15,000,000	$15,000,000	$15,000,000
Maine Technical College System	$1,000,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000
NASA Partnership	$100,000	$100,000	$100,000		
Professional and Curricular Develop.	$2,000,000	$2,000,000	$2,000,000	$2,000,000	$2,000,000
ScienceWorks Equipment Donation	$100,000	$100,000	$100,000	$100,000	$100,000
MERITS Program	$150,000	$150,000	$150,000	$150,000	$150,000
Accelerated Programs for High School Students (UMS)	$750,000	$750,000	$750,000		
Marine Studies Fellowship Program	$50,000	$50,000	$50,000	$50,000	$50,000
TOTAL	**$49,350,000**	**$49,250,000**	**$54,150,000**	**$53,200,000**	**$58,100,000**

Other Potential Recommendations for Funding:

*Tentative: Center for Technology-Based Business Develop.		$500,000	$500,000	$500,000	$500,000
**Tentative: MSTF Initiatives	$455,000	$400,000	$175,000	$175,000	$175,000

*The committee recommends State funding if NSF funding is not available beyond July 2000.

**The committee supports these initiatives in concept, but is not making a final recommendation pending an update from MSTF in January 1999.

R&D RECOMMENDATIONS

Appropriations by Agency

	FY 1999-00	FY 2000-01
University of Maine System:		
UMS Base Funding	$10,000,000	$10,000,000
UMS Capital Construction	$15,000,000	$15,000,000
Research Library	$5,000,000	$4,900,000
Center for Advanced Law and Management	$200,000	$200,000
Professional and Curricular Development	$2,000,000	$2,000,000
Accelerated Programs for High School Students	$750,000	$750,000
UMS Total	$32,950,000	$32,850,000
Maine Technical College System:		
New or Expanded Catalog Programs	$1,000,000	$1,000,000
Department of Education:		
NASA Partnership	$100,000	$100,000
Department of Marine Resources:		
Marine Studies Fellowship Program	$50,000	$50,000
Maine Science and Technology Foundation:		
MERITS Program	$150,000	$150,000
Foundation for Blood Research:		
ScienceWorks Equipment Donation Program	$100,000	$100,000
Not Determined:		
Investment in Target Technology Areas	$15,000,000	$15,000,000
TOTAL	**$49,350,000**	**$49,250,000**