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# **BIOTECHNOLOGY IN HAWAII: A BLUEPRINT FOR GROWTH**

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## **Preface**

Hawaii, as other states across the nation, seeks to diversify and strengthen its economic base through the growth of its high technology industries, including biotechnology. With its natural resources, biodiversity, quality research centers, and strategic position in the Asia-Pacific region, Hawaii has the potential for a dynamic biotechnology industry.

Recognizing this potential, a partnership including the Hawaii Department of Business, Economic Development, and Tourism (DBEDT), the Office of the Governor's Technology Advisor, the University of Hawaii, the Marine BioProducts Engineering Center, the High Technology Development Corporation, and representatives of Hawaii's biotechnology private sector was formed to develop a cohesive plan for growth of the state's industry. It was the consensus of the partnership that such a plan would enable a strategic planning process for long-term industry growth.

As a result, representatives from each industry stakeholder group gathered in September 1999 for a series of meetings to formulate an industry-based biotechnology competitiveness strategy. With consultants from PMP Public Affairs Consulting, Inc. from the Research Triangle Park, North Carolina, and the Biotechnology Industry Organization from Washington, DC, and facilitated by DBEDT, the competitiveness strategy was completed in December 1999.

The overall strategy and recommendations in this document have been distributed to key stakeholders in education, government, industry, and other organizations interested in technology development in Hawaii. The sponsors envision this document as an important mechanism for economic diversification to benefit all citizens of the state.

Funding for the development of the competitiveness strategy and this report was provided by DBEDT, the University of Hawaii, and the High Technology Development Corporation.

# **Biotechnology in Hawaii: A Blueprint for Growth**

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# **Biotechnology in Hawaii: A Blueprint for Growth**

## **Executive Summary**

The growing biotechnology enterprise and its sectors – agriculture, marine sciences, human therapeutics, and the environment – are important sources of quality jobs and long term economic growth in Hawaii. With its cluster of university research institutes, non-profit science centers, federal research funding, ideal climate, and a growing number of biotechnology firms, the growth potential for the local industry is substantial.

The Hawaii-based biotechnology enterprise is a part of a larger worldwide enterprise that is destined to be a dominant technology industry in the next millennium. This growing sector generated an estimated \$23 billion in revenues in 1998 and industry observers predict product development to increase ten-fold to over \$250 billion by 2007.

Because of its strategic location in the Asia-Pacific and critical mass of life science research centers, Hawaii is a logical candidate to excel in the global marketplace of biotechnology research, product development, and services.

More than 45 Hawaii biotechnology-related companies are conducting research and manufacturing and using these products in the state. They employ over 1,700 Hawaii residents and generate over \$320 million in operating budgets. These companies - international food manufacturing and crop companies, aquaculture science, public-private science consortiums, genetics research laboratories, and environmental remediation firms - are all a part of this technology-intensive industry.

And these companies fit well into the state's overall economic development strategy to pursue technology companies and diversify the economy. They are innovative companies that position Hawaii as a leader in the development of new technologies to complement the strong research presence in the state, raise the average income of Hawaii residents, retain a knowledge-based workforce, and produce minimal impact on the overall environment.

While the basic building blocks for continued biotechnology development in Hawaii are in place, the reality is that the biotechnology industry is very competitive and many states and nations have also focused on the industry as a priority. Because of that reality, a coordinated biotechnology retention and expansion plan needs to be implemented as part of the state's broad efforts to move technology industries forward in the next millennium.

Representatives from industry, higher education, and state government gathered together in September 1999 to begin the formulation of an industry-based biotechnology competitiveness strategy aimed at increasing the size and diversity of the industry in the state.

The following questions were posed to a variety of stakeholders in meetings and focus group interviews across the state:

- What products and/or services must Hawaii's biotechnology industry develop to best position itself to be competitive on a regional basis?
- What legislative and regulatory initiatives can the public sector contribute to assure success of the industry?
- How can state and industry marketing resources be utilized to promote those products and /or services and improve market penetration globally?

The focus groups addressed these questions by first identifying perceptions of the strengths and challenges in the areas of Capital and Finance, Education and Training, Technology Transfer, Space Needs, and Public Policy and Business Climate. In addition, the groups offered their perceptions of opportunities and threats facing future development.

### **Findings**

From these interviews and group discussions, the consensus is that Hawaii is uniquely positioned to meet the competitive nature of the industry in key sectors where an already existing critical mass in research, innovative companies and entrepreneurs, and a unique physical environment for research and development are in place. And with recent improvements to the tax treatment of research companies and new emphasis on technology development in the state, there is optimism for the future of the industry.

But there is also general consensus that much more needs to be accomplished. Respondents pointed to the need for a coordinated statewide growth strategy that includes public policy makers, educators, the companies, and other public and private stakeholders to aggressively move technology industries, and biotechnology specifically, forward over the coming years.

### **Action Plan**

From stakeholder interviews and research on best practices by states with a strong biotechnology plan in place, the coordination group has developed a series of competitiveness strategies to propel Hawaii into Asia-Pacific leadership in the development and commercial use of biotechnology. It is a model based on public-private partnerships.

Achieving this public-private partnership will depend on intensive actions by the industry, government and the state's education system to work together on a plan of action that values innovation and technology. Each has a distinct role to play in the process.

The biotechnology industry is responsible for investment in plants and equipment, in hiring and training and retaining its workforce. It also must increase public awareness and support for entrepreneurship, increased deployment of research and development, and public support for quality education.

State government is responsible to serve as a catalyst and facilitator to the industry, providing the infrastructure and support that allows the biotechnology industry to flourish in Hawaii. The federal government, with its ability to fund basic research in a variety of technology sectors, underpins the biotechnology industry's ability to seek new products for development.

The K-12 system, community colleges, and universities are responsible for producing a high quality workforce that can analyze and solve problems, work cooperatively, and contribute to the economic prosperity of the state. They also have the capacity to provide the educational resources to retrain workers as they seek employment in growth industries like biotechnology. In addition, the strong research enterprise at the University of Hawaii in Manoa and Hilo provides the basis for receiving National Science Foundation and National Institutes of Health funds for basic and applied research.

The strategic priorities listed below highlight broad categories of improvements needed to enlarge the size and scope of the industry in the state.

**Strategy One: Encourage Entrepreneurship**

Objective: Expand venture capital and marketing efforts targeted for the biotechnology sector and increase the number of Hawaii-based venture capital funding sources, including banks, private placement, retirement funds, and other institutional investors.

**Strategy Two: Public Sector Initiatives**

Objective: Develop and implement a state tax structure that provides incentives for high-technology product development companies, like biotechnology, and create an effective regulatory structure that minimizes impediments.

**Strategy Three: Public-Private Partnership in Technology Transfer**

Objective: Substantially strengthen public-private partnerships to increase the number of commercially viable patents emanating from research laboratories at the University of Hawaii and other research sources located in the state.

**Strategy Four: Develop a Biotechnology-Age Curriculum**

Objective: Establish formal communications mechanisms between the biotechnology industry and the state's education community to plan for and meet the anticipated increases in the industry's employment and training needs.

The members of the biotechnology industry and its support sectors are pleased to present these recommendations for growth of the biotechnology industry to the Governor, the Director of the Department of Business, Economic Development and Tourism, the Hawaii Legislature, and the University of Hawaii.

The successful implementation of these strategies listed above will:

- Assist government to direct its policies and investments to address the needs and opportunities of the state's biotechnology industry.
- Strengthen higher education's ability to build relationships with industry and government that will develop and grow more knowledgeable citizens and workers and thereby contribute to the state's economy.
- Help the biotechnology industry identify market needs and demands that require private-public cooperation and establish an ongoing policy guidance and a review board that assesses progress on the strategy effort.

# **Biotechnology In Hawaii: A Blueprint for Growth**

## **I. Introduction**

For the past three decades, biotechnology been a topic of discussion by medical journals, Wall Street analysts and the popular media, all examining the potential of the industry to save lives, conserve natural resources, generate thousands of new jobs, and propel technologically-oriented states and nations toward long-term prosperity.

That promise has become reality in the late 1990s. The United States is the unquestioned world leader in biotechnology research and development with annual product sales of over \$23 billion in 1998. More than 1,400 U.S. biotechnology companies employ over 120,000 researchers and staff. There are 167 products currently on the market with another 350 biotechnology-derived compounds and processes in various phases of FDA testing. The potential growth in revenues and jobs to produce those products over the next twenty years is significant. (Chart A)

Broadly defined, biotechnology is an industry that uses the new tools of molecular biology and biochemistry to create products and processes useful to mankind. Biotechnology researchers are discovering new medicines and diagnostics, hardier crops, enzymes for industrial use, and more efficient ways to detect and cleanup pollution.

The State of Hawaii - with its quality publicly funded research institutions and centers, cutting-edge public and private biotechnology companies and strategic position in the Asia-Pacific - is a part of this growing industry. The developing local industry offers unique commercialization opportunities that complement the human and physical resources found in the state.

The continued expansion of the state's emerging biotechnology industry, however, is not guaranteed. Other technology centers across the United States and around the world have recognized the growth potential of this industry and are developing innovative private-public partnerships, involving industry, government and education to increase the presence of the industry in their regions.

Hawaii must do likewise if it is to realize the benefits of being a top-tier center for biotechnology research and product manufacturing. A top position in this field translates into high quality jobs, products, business opportunities, and tax revenues throughout the state.

## **II. A Technology Industry Already in Hawaii**

Biotechnology commercialization opportunities in Hawaii have already paid dividends in both quality jobs and revenues for companies in four important sectors - agriculture, marine sciences, environmental remediation, and human therapeutics.



In agriculture, biotechnology on the farm employs the results of several scientific disciplines- agronomy, biochemistry, botany, genetics, soil science and others. The application of biotechnology science has rapidly integrated science with the everyday practicality of growing crops and raising animals for food and fiber.

The University of Hawaii's College of Tropical Agriculture and Human Resources and the Hawaii Agriculture Research Center are leaders in applied research on tropical fruit, forestry, and plant production and preservation. The commercial value of that effort has benefited several companies in Hawaii that are at the leading edge of innovations in disease control and tropical crop production.

In the sea and on the shore, marine biotechnology is another Hawaii strength that is providing significant advancements in biomaterials, health care diagnostics, nutraceuticals, new polymers and biofilms and corrosion science.

The Marine Bioproducts Engineering Center at the University of Hawaii and the Oceanic Institute, for example, are attracting worldwide funding for Hawaii's drug, nutraceuticals, and fish and shrimp research platforms. The Natural Energy Laboratory of Hawaii Authority is an important incubator for commercial marine biotechnology ventures.

Diseases that affect aquatic species cost the \$42 billion international aquaculture and fishing industries more than \$7 billion each year. A subset of marine biotechnology, aquaculture is being used to develop and commercialize vaccines and therapeutics to treat seaborne diseases, thus preserving and managing commercially important fish populations.

Using modern methods developed in Hawaii, researchers have already increased the economic viability and availability of these important food sources. Hawaii possesses industry leaders in marine biotechnology with the presence of companies on several islands including Aquasearch, Inc., CEATECH USA, Inc., and Cyanotech Corporation.

The earth's environmental needs in the next millennium will certainly be one of the industry's great challenges. For the first time, humanity has the capability to both threaten the global environment and manage it beneficially. Biotechnology is already being used to clean up oil and chemical spills, and conserve natural environments through increasing public awareness of the need for biodiversity.

Hawaii's island ecosystem serves the Asia-Pacific region as a model for the use of environmental biotechnology products and practices. Federally funded environmental remediation research, demonstration, and education programs including those administered through the Pacific International Center for High Technology Research, and Hawaii's diversity of climates, plant species, and geology make it a strategic player in the region.

In human drugs and therapies, the state's diverse population offers ideal conditions for epidemiological studies at several facilities, including the University of Hawaii's Cancer Research Center and Pacific Biomedical Research Center, the Hawaii Biotechnology Group, and Queen's Medical Center. A growing contract research industry to larger pharmaceutical companies is in evidence at Queen's and Oahu-based Radiant Research. Queen's successfully generated over \$1 million in contract research in 1998, and has strong prospects for growth in the future.

In 1998, over \$69 million in federal support was granted to the University of Hawaii and other research centers for important life sciences research. More than 100 faculty and researchers at the University of Hawaii campuses at Manoa and Hilo are working on basic and applied biological research for treatment of diseases like Alzheimer's, cancer, AIDS, and asthma, to name a few. That type of research effort has led to 17 approved U.S. patents in just the past three years for the university.

### **III. Biotechnology Fits the State's Agenda**

From the perspective of the industry and public officials in Hawaii, commercial development of biotechnology in the state fits several objectives recently highlighted by both the Legislature and the Governor.

First, biotechnology in Hawaii takes advantage of the technical infrastructure already in place through its public and private research facilities. As illustrated in Chart B, the state's university is a national leader in research funding, a tribute to the faculty and research investigators who are conducting cutting-edge science.

Second, biotechnology's presence in the state provides an important addition to the state's traditional economic base. Marine and agricultural commercialization opportunities in biotechnology are parallel with the tourism industry as they, too, promote the islands' unique physical environment.

Third, because biotechnology companies require large amounts of capital to begin operations, they generally commit to a location for a longer period of time than other industries. If successful, these companies may emerge as headquarters and/or research centers. While there is a temptation to utilize significant resources to attract one large company from outside the state, the most successful technology clusters primarily focus on retention, expansion, and attraction for their long-term growth. The Hawaii Biotechnology Group, for example, demonstrates the retention and expansion model and provides innovation, jobs, and tax revenues to government agencies.

Finally, successful models include public and business investment in the knowledge infrastructure. Providing a readily available labor pool is probably the best support mechanism the state and local governments in Hawaii can provide to the industry.

Recent innovations in workforce training for displaced workers from agriculture illustrate the value of ongoing and close interaction between various islands' companies and state community colleges.

#### **IV. Why Biotechnology is Important to Hawaii**

There are already more than 45 Hawaii-based biotechnology companies that employ over 1,700 Hawaii residents today and generate over \$320 million in operating budgets. These companies - international food manufacturing and crop companies, aquaculture science, public-private science consortiums, genetics research laboratories, and environmental remediation firms - are all part of this technology-intensive industry.

All of these sectors provide a substantial number of jobs and income for Hawaii residents, whether it is a biotechnology researcher working in a laboratory at the University of Hawaii, a quality control technician at a private research facility, or a field tester for a biotechnology seed company.

Because of the considerable costs related to moving various products out of the laboratory and into the market, some sectors of the Hawaii industry will commercialize their products or services sooner.

- Agriculture and marine biotechnology will lead the product development in the nearer term because of the already existing critical mass of companies in the state.
- Environmental biotechnology is already using biotechnology products and services in bioremediation and current research and demonstration will expand application in the near future.
- Drugs and diagnostics product development will develop later because the costs of moving a product through the FDA safety and efficacy process, from the laboratory into the marketplace, can reach \$300-\$500 million over 8-10 years.

#### **V. Role of Industry, Government, and Education**

As has been already noted in this strategy, achieving success in biotechnology commercialization in Hawaii will depend on intensive actions by the industry, government, and the state's education system to work together on a plan of action that values innovation and technology. Each has a distinct role to play in the process.

(Chart C)

The *biotechnology industry* is the main player in this plan. It clearly is responsible for investment in plants and equipment, in hiring and training, and retaining its workforce to stay competitive. It also must increase public awareness and support for entrepreneurship, increased deployment of research and development, and the need for public support for quality education.

*State Government* is responsible to serve as catalyst and facilitator to the industry, providing the vital infrastructure that allows the biotechnology industry to flourish in Hawaii. The State of Hawaii is responsible for providing information and assistance when needed; establishing policies, rules and regulations that affect how firms can operate, including their ability to be innovative; and creating a climate that enhances industries' competitiveness.

*Federal Government* is an essential source of R&D funding for industry, universities, and non-profit institutions in Hawaii. While industry provides the largest share of the total R&D budget, the centrality of the federal government to the effort cannot be over-emphasized. In Hawaii, strong federal support of university R&D, military and environmental programs, dual-use technologies, and marine and agriculture research centers undergird the state's science and technology enterprise.

The *K-12 system, community colleges and universities* are responsible for producing high quality graduates who can analyze and solve problems, work cooperatively and contribute to the economic prosperity of the state. Institutions of higher education should also generate and communicate new technology with applications for industry.

## **VI. Creating a Biotechnology Development Strategy**

With these significant physical and human resources already in place in biotechnology development in Hawaii, the task becomes one of learning how to capitalize on that research and development momentum and increase the size and diversity of the industry in Hawaii.

To that end, representatives from industry, higher education, and state government gathered together in September 1999 to begin the formulation of a coordinated strategy developed in concert with the industry to learn how Hawaii can mobilize its resources to move biotechnology development forward.

The group charged consultants from the Washington DC-based Biotechnology Industry Organization with the responsibility of investigating the human and research assets of the industry in Hawaii and providing recommendations on ways to bolster the human and capital resources necessary for long term industry growth.

The following questions were posed to a variety of stakeholders in meetings and focus group interviews across the state:

- What products, and/or services must Hawaii's biotechnology industry develop to best position itself to be competitive on a regional basis?
- What legislative and regulatory initiatives can the public sector contribute to assure success of the industry?
- How can state and industry marketing resources be utilized to promote those products and /or services and improve market penetration globally?

The focus groups addressed these questions by first identifying perceptions of the strengths and challenges in the areas of Capital and Finance, Education and Training, Technology Transfer, Space Needs, and Public Policy and Business Climate. In addition, the groups offered their perceptions of opportunities and threats facing future development.

## **VII. Findings**

From these interviews and group discussions, the consensus is that Hawaii is in a unique position to meet the competitive demands of the biotechnology industry in the identified sectors because there is a critical mass of experienced researchers and companies willing to pursue long-term development.

Recent improvements to the tax treatment of research companies in the state, partial improvement in regulations on the importation of various species of plants, seeds, and organisms, and in other business climate issues bode well for the state. Stakeholders praised these actions as a sign of movement toward innovative legislative and regulatory measures to support industry.

But there is general consensus that much more coordination needs to be in place statewide if the industry is to flourish. The following overview of industry perspectives of current enablers and obstacles were most apparent during these sessions, and provide the basis for recommended action steps that appear later in this document.

### **ENABLERS:**

- The state possesses a quality and diversified human resource pool for technology jobs.
- Recent legislation passed dealing with technology research and development and the creation of a position for a technology advisor to the Governor provided the industry evidence that policymakers understand and support efforts to grow the industry in Hawaii.
- Hawaii's biodiversity, including its diverse population, presents natural advantages for contract research.
- Hawaii possesses a unique physical environment that provides a diversity of climatic and oceanic conditions for research and product development.
- The state possesses a renowned cluster of quality universities and research centers, including the University of Hawaii, the Oceanic Institute, the Queen's Medical Center, the Natural Energy Laboratory of Hawaii Authority, the Hawaii Agriculture Research Center, and the Marine Bioproducts Engineering Center.
- The presence of more than twenty federal research sites for advanced basic research provides Hawaii international recognition as a location for cutting-edge resources to solve problems on land and in the water.

- Several world-class corporations including Novartis, Monsanto, Pioneer Hi-Bred, and Dekalb Genetics have made human and capital investments to conduct Hawaii-based research and develop products for the global marketplace. Hawaii's seed crop industry, for example, reached a record \$25 million in sales in 1997, a 24% gain over the previous year.
- The industry is distributed over five Hawaiian Islands, thus spreading the economic impact of the industry to various parts of the state. On the Big Island of Hawaii, the commercialization of transgenic virus-resistant papaya can lead to the restoration of an industry with a farm gate value of \$17 million in 1998.

### **OBSTACLES**

Despite these enablers, interviewees expressed a variety of concerns about technology growth and biotechnology development in Hawaii in particular:

- The lack of a coordinated overall economic plan for the state minimizes partnerships in economic development programs by governmental and university organizations at the state, county, and federal levels, thereby slowing coordinated, multi-island efforts to increase company formation and entrepreneurship.
- The crippling economic downturn in the state's economy over the past several years has put a severe budget strain on the University of Hawaii, thus decreasing its ability to retain and attract key faculty, researchers, and students for this Carnegie One research university.
- A scarcity of affordable wet laboratory space for early stage biotechnology companies raises the costs for available space for current occupants and hinders would-be companies' ability to move into facilities.
- Low investment in state biotechnology companies by both mainland and Hawaii-based venture capital managers. Less than \$5 million or 1/40<sup>th</sup> of a percent of all U.S.-generated venture capital went to Hawaii companies.
- Cumbersome procedures and minimal interaction between the state's research institutions and entrepreneurs inhibit commercialization of relevant research discoveries. While recent changes have occurred in the technology transfer office of the University of Hawaii, it ranked 63rd in technology development in 1998 among the largest U.S. university research campuses. (Chart D)
- The lack of a biotechnology state trade association to present a unified voice for the local industry as stakeholders in government and education discuss programs and resources to assist industries like biotechnology.

## **OPPORTUNITIES**

Interviewees had a variety of perspectives on the growth potential of the industry in Hawaii. They believe the state can succeed in becoming a high performance biotechnology research and development center if industry, education, and government leaders take advantage of the opportunities evolving in the industry.

- Significant federal technology funding awards to the state's university and federal research facilities can leverage the state's position as a center for technology innovation.
- Strengthened science and mathematics curriculums of K-12 schools, community colleges, and the University of Hawaii would produce more high quality workers for state biotechnology company employment, thus lower the need to import high-skilled employees.
- With industry involvement, job availability in the biotechnology industry will broaden across the state in both the numbers of jobs and higher wages.
- With collaboration between the major stakeholders in moving technology forward, the state's biotechnology industry can be a top five applied research center in agriculture, marine sciences, environmental, and human therapeutics in the U.S. by 2010.

## **THREATS**

While there are encouraging signs of optimism from stakeholders, the state still lags well behind most other states in the number of companies, products in development, venture capital and business climate perceptions.

- Many states and nations have created biotechnology-specific development initiatives, including wet labs, tax incentives and technology transfer mechanisms to lure companies to their area. Unless Hawaii further addresses these items, it could easily find itself at a real long-term disadvantage to retain and expand company presence.
- Insufficient venture capital could continue to impede the rate of small company creation in Hawaii. The state received less than \$5 million in venture funding for two Hawaii-based companies in 1998 according to Venture One, Inc. of San Francisco.
- Without that vital resource, Hawaii will not be able to successfully compete for emerging companies when compared to states like California and Washington that together captured over \$1.4 billion in venture capital that year.
- Rising costs in space and labor in the state could force biotechnology companies to consider alternative sites for their business location.

## **VIII. Action Steps for Biotechnology Commercialization**

The following strategic priorities take into account broad partnership responsibilities and bring the pieces - industry, higher education and government - together in an well-integrated and productive whole. It is now the responsibility of the industry to move the communication process forward by placing its agenda in the public spotlight.

There have been a number of studies in the recent past that have reviewed various aspects of biotechnology in Hawaii with its strengths and challenges. Each of these supplementary reports has offered broad suggestions on behalf of the industry through sponsoring groups in education and government. This report and these strategies reflect what the industry itself believes is in the best interest of the industry today and into the next millennium.

### **Strategy One – Encourage Entrepreneurship**

Overview: Entrepreneurship is the hallmark of technology development, whether it is information technology, telecommunications, software development or biotechnology. Hawaii has long worried about its competitiveness in attracting businesses to locate here. Studies done by the U.S. Small Business Administration and the Hawaii Department of Business, Economic Development, and Tourism show that the majority of new jobs come from small business creation or expansion.

At the core of this strength are entrepreneurs – both from industry and university researchers - who are frequently the source of new ideas and fresh approaches to solving business problems or applying technology. Their willingness to take risks and convert innovation to commercial application will help Hawaii stay in the forefront of technology.

High on the agenda for Hawaii biotechnology entrepreneurs is the need to find sources of early-stage capital to hire staff, occupy space, purchase expensive laboratory equipment and begin the long process of product development. For small biotechnology companies in the state, early stage capital formation funds are essential.

Unfortunately, the current level of funds available to the industry is low. Venture capital industry figures in 1998 showed that Hawaii-based companies received less than \$5 million that year, less than 1/40<sup>th</sup> of one percent nationwide, with little perceived interest by state pension fund administrators, banks, trusts, and foundations to support their research efforts. Innovative funding sources have been used by other states to provide capital to support the industry, including the recent tobacco settlement.

Objective: Expand the formation of venture capital and marketing targeted for the biotechnology sector, and the number of state-based venture capital funding sources, including banks, private placement, retirement funds, and other institutional investors.



**Near-term Recommendations:**

- Strongly encourage the state to begin investment of a percentage of state trust funds (eg, ERS) in Hawaii-based venture capital firms and invite \$100 million over five years in alternative investments to assist early-stage technology companies, including biotechnology.
- Encourage other potential venture capital funding pools – charitable trusts, foundations, land trusts – to invest in investment pools aimed at Hawaii technology companies including biotechnology.
- Support efforts to authorize \$100 million special purpose revenue bonds dedicated specifically to the capital construction needs of technology companies, including biotechnology.
- Encourage the creation of a companion technology/business marketing campaign to complement the highly successful tourism marketing effort now in place. The effort could be jointly sponsored by the Hawaii Tourism Authority, the Department of Business, Economic Development, and Tourism, and the Hawaii Visitors and Convention Bureau, specifically focusing on technology opportunities in Hawaii, including biotechnology.

**Longer-term Recommendations:**

- With the assistance of the Department of Business, Economic Development, and Tourism, develop an index of entrepreneurial indicators (ENDEX) in Hawaii and provide stakeholders ongoing measurements on improvements in areas such as company formation, venture capital, intellectual property, and federal funds for small business development.

<b>Strategy Two – Public Sector Initiatives</b>
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Overview: Biotechnology firms in the state are facing difficult issues surrounding revenue taxation, permitting, and environmental regulations. Biotechnology companies would like to see Hawaii state and county agencies become more technology friendly, and consistent and clear in their administration of regulations.

Objective: Develop and implement a state tax structure and business climate that provides incentives for high-technology product development industries, like biotechnology, and create an effective regulatory structure that minimizes impediments.

**Near-term Recommendations:**

- Remove the General Excise and Use Tax on machinery and equipment purchased by technology companies. (Note: Hawaii provides a 4% “capital goods excise tax credit” on tangible depreciable personal property used for business.)

- Authorize the sale of Net Operating Losses (NOLs) and R&D credits by technology companies.

**Longer-term Recommendations:**

- Encourage timely review and approval of permits for biotechnology companies. The industry is characterized by innovation and rapid technological advancements. Delayed processing of county and state permits is a severe business impediment for technology companies.
- Encourage the Hawaii Department of Agriculture to set in place policies to ensure timely responses to requests for importation of plants and microorganisms and for updated lists of prohibited samples.

<p><b>Strategy Three – Public/Private Partnerships in Technology Transfer</b></p>
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Overview: Hawaii biotechnology firms and other stakeholders perceive a lack of interest and capability on the part of the University of Hawaii to fully support technology development and the transfer of that technology into commercial opportunities. And because Hawaii’s biotechnology industry’s economic viability rests on the ability to tap into commercially relevant research activities, the only realistic question for Hawaii is not whether to undertake technology transfer, but how to ensure that it is done well in both process and outcomes.

Local academic institutions and commercial organizations play essential and complementary roles in delivering the benefits of science to Hawaii. Without this transfer, many creative ideas are likely to remain dormant, economic activity lessened, and public benefit seriously diminished.

Biotechnology industry leaders strongly believe that the university leadership and the state must make it clear that technology development and transfer is a valued mission of the university. To that end, mechanisms should be put into place to support and recognize the efforts of the faculty interested in commercialization of their research.

Objective: Substantially strengthen public-private partnerships to increase the number of commercially viable patents emanating from research laboratories at the University of Hawaii and other research sources located in the state.

**Near-term Recommendations:**

- Support amending the state tax code to create a credit for companies that invite the University of Hawaii to be a part of their company’s R&D effort and share facilities to foster collaboration and product development.
- Encourage the University Seed Capital Program, an important resource to nurture research on products with strong technology transfer potential, to develop specific performance milestones that encourage commercialization.

- Urge the University of Hawaii to focus its indirect cost recovery funds from federal grants on efforts that encourage technology development research and support adequate state incentive funding for the Small Business Research Innovation Program.
- Create a University of Hawaii “culture” that would look favorably upon technology development via education on the benefits of technology innovation, transfer, and development.
- Improve the technology transfer office’s capacity to serve a top research university through increased staff expertise, examination of staff functions, and relocation to the research campus.

#### **Strategy Four – Develop a Biotechnology-Age Curriculum**

Overview: Those regions and nations that possess a quality labor pool are attractive to the biotechnology industry. In this global economy, nearly every competitor has access to big breakthroughs in technology and to the equipment and capital to create products. Resources and training programs should be retooled to update vocational training for the industry.

And, just as important, businesses must cooperate with the state’s secondary schools, community colleges and universities to develop curricula that meet the expected needs of the biotechnology job market. Industry interaction provides a useful conduit for understanding of how schools can tailor their courses to prepare students in workforce readiness. An added outcome of biotechnology education programs will be an increased understanding and support of the industry by the general community.

Objective: Establish formal communications mechanisms between the biotechnology industry and the state’s education community to plan for and meet the anticipated increases in the industry’s employment and training needs. There currently are not enough experienced workers to fill all positions in the state’s biotechnology industry. Companies expect to train entry-level workers in relevant skills, but are supportive of efforts to link their company’s employment needs to those of education and training programs offered by local universities, community colleges, and the K-12 system.

#### **Near-term Recommendations:**

- Create workforce development programs for biotechnology companies that include classes tailored to company needs and product development schedules. Vocational education in high school and community colleges must be retooled from established trade skills to job skills in the fast-paced biotechnology sector.
- Develop a community college/university/K-12 biotechnology teacher and student internship program with Hawaii biotechnology companies. The opportunity for teachers to participate in the real world of science and development will provide additional insights for the teacher and transmit that knowledge back to the classroom.

**Longer-term Recommendations:**

- Reach out to corporate biotechnology partners in the state and on the Mainland to create a statewide web site that coordinates information exchange between teachers, students, and biotechnology firms to share insights into the future of science and technology in Hawaii and beyond. A coordinating committee comprised of representatives from industry and education should approach companies that have interactive web sites that provide information and educational materials to school districts and community colleges.

**IX. Conclusion**

Hawaii's biotechnology industry can provide a stable source of high-quality, high-paying jobs. Building on the success of this small but growing industry is a no-lose proposition for the state. Support for the biotechnology industry is consistent with Hawaii's overall strategy of seeking Asia-Pacific prominence as a center of technology and innovation. From aquaculture and pest-resistant fruit and vegetable products created in state laboratories, to environmental remediation and human therapeutics, future growth of the industry can improve the quality of life in Hawaii and beyond.

Other states and nations are aggressively pursuing the industry, and expansion of key sectors of biotechnology in the state is by no means certain. Significant hurdles to industry growth in the areas of capital for growing companies, stronger math and science curricula for the workforce, improved commercialization of university research, expanded wet laboratory space for growing companies, and a more competitive tax structure must be addressed in the next 12-18 months.

It will not be easy. A distressed state budget and competing interests in public funding from various sectors of the economy will most certainly test the resolve of policymakers. But they must trust their instincts that technology, including biotechnology, must be a vital part of the state's future economic development plan.

With strong, unified leadership and a shared vision for the economic future of the state, Hawaii will flourish in its unique and central location in the Asia-Pacific.

**Biotechnology Industry Growth Projections  
1985-2020**

<b>Year</b>	<b>U.S. Revenue (1)</b> (Millions)	<b>U.S. Employees (1)</b>	<b>Hawaii Revenue (2)</b> (Millions)	<b>Hawaii Employees (2)</b>
1985	\$1,100	34,200	\$10	150
1990	\$2,000	55,000	\$12	200
1998	\$23,000	120,000	\$320 (3) (4)	2,000 (3)
2010	\$200,000	700,000	\$3,100	6,700
2020	\$600,000	1,500,000	\$7,300	9,000

Sources:

- (1) Ernst and Young, 1999
- (2) University of Hawaii CTAHR, 1999
- (3) BIO Hawaii Business Survey, October 1999
- (4) Operating Budget

Chart B

Total Higher Education Funding (*) Federal Sources FY 1999			
State	Amount (Millions)	State Ranking by	
		Amount	\$ Per Capita
California	\$220	1	17
Florida	\$117	2	22
Louisiana	\$85	3	6
<b><u>Hawaii</u></b>	<b><u>\$76</u></b>	<b><u>4</u></b>	<b><u>1</u></b>
Pennsylvania	\$75	5	14
W. Virginia	\$72	6	5
Dist. Of Columbia	\$68	7	2
Illinois	\$63	8	19
New York	\$63	9	20
Massachusetts	\$58	10	25

(\*) Source: Chronicle of Higher Education, August 1999

Chart C

# Hawaii Biotechnology Partnerships

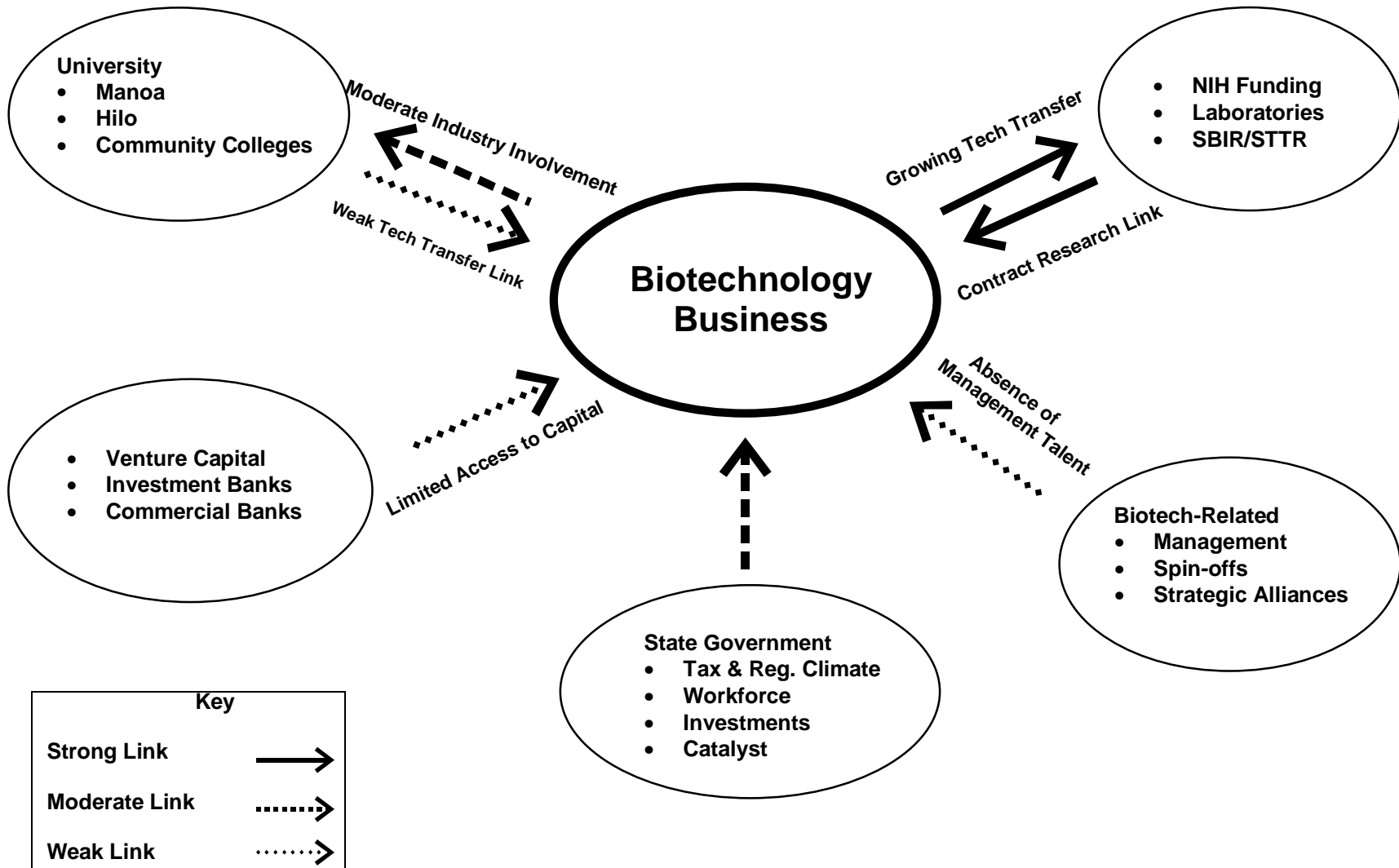


Chart D

University Research Expenditures and Income FY 1998				
Rank	University	Total Sponsored Research (Millions)	Total Patents Issued	Licensing Income (Millions)
1	University of California	\$1,500	206	\$76.20
2	Johns Hopkins	\$942	37	\$4.90
4	University of Washington	\$528	40	\$17.10
17	University of Arizona	\$295	59	\$0.59
22	University of North Carolina	\$263	34	\$1.60
59	Oregon State University	\$131	5	\$0.52
<b>63</b>	<b>University of Hawaii</b>	<b>\$120</b>	<b>5</b>	<b>\$0.95</b>

Source: Association of University Technology Managers, 1999

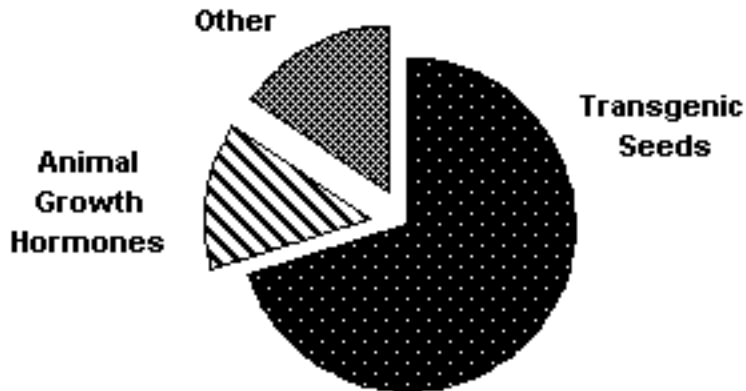


**U.S. AGBIO PRODUCT SALES 1994-2002 (\*)**  
**(Millions)**

	<b>1994</b>	<b>1997</b>	<b>2002</b>
Transgenic Seeds	\$20	\$405	\$2,030
Animal Growth Hormones	\$80	\$225	\$405
Other	\$142	\$245	\$450
<b>Total Sales</b>	<b>\$242</b>	<b>\$875</b>	<b>\$2,885</b>

\*Source: Burrill, and Company, 1999

# Projected AgBio Product Sales, 2002



# **HAWAII BIOTECHNOLOGY ASSESSMENT AND STRATEGY**

- I. Hawaii Biotechnology Commercialization  
Building Blocks**
- II. Public Policy Strategies for Biotechnology  
Development in Selected States**

December 1999

## **Hawaii Biotechnology Assessment And Strategy**

### ***I. Hawaii Biotechnology Commercialization Building Blocks***

If Hawaii is to be successful in attracting and retaining biotechnology companies and related businesses, it needs to review its tax and investment structure and consider inventories -particularly in the area of capital formation - which will assist companies through the early stages of product development. The following is a list of some of the more useful broad capital formation initiatives that will support growth goals.

- ◆ **Capital Access Funds-** Several states have either enacted or have pending legislation to encourage states to invest in or support the creation of venture funds that invest in biotechnology. Investment funds can be created through a variety of different mechanisms that will allow a state to support the industry with little or no expense to the state taxpayer.
- ◆ **Pension Fund Investment-** Targeted investment of a very small portion of state pension funds in the biotechnology industry can provide a pool of much needed capital, yet only a handful of state pension funds actively seek biotech investments. States should encourage pension fund managers to make investments in high-tech industries located in their own state.
- ◆ **Capital Gains Tax Cut-** Reducing the state tax rate for individual investors provides a powerful incentive for investors to support biotechnology companies. Several states exclude the gain from taxable income for investors who hold stock in qualified companies for at least five years.
- ◆ **Net Operating Loss (NOL)-** Various states allow heavily regulated R&D research intensive industries like biotechnology to carryforward 100% of the NOL for 15 years as an offset against taxable future income.
- ◆ **Research and Development Tax Credit-** Several states encourage R&D expenditures by allowing firms R&D credits, modeled on the Federal credit with a rate of 50% of the incremental increase in expenditures as compared to the firm's gross receipts.
- ◆ **Investment Tax Credit-** An investment for the purchase of equipment for research as well as manufacturing, this credit is more helpful than depreciation deductions or the ability to expense the cost of the equipment.

- ◆ **Clinical Trial Loan Program-** Providing a low-interest loan program to help fund “instate” trials in hospitals, third party organizations would provide welcome support to a state’s biotechnology industry as well as create high paying jobs in state medical institutions.

## ***II. Public Policy Strategies for Biotechnology Development in Selected States***

### **California**

**A Look at California:** California has a 6% state sales tax but exempts biotechnology and other qualified companies from certain portions of this tax. California has a sales tax credit for R&D expenditures and exempts new businesses with less than \$50 million in assets or less than \$1 million in annual revenue. California has a 6% investment tax credit on equipment purchases. The state offers a 12% credit on research (increased research) and earnings with no carryback, and unlimited carryforward (24% for university research).

California offers 50% Net Operating Loss (NOL) credit but 100% credit on new businesses with less than \$1 million in receipts with up to an 8-year carryforward. In addition, qualified companies can carryforward investment tax credits for 10 years.

- ◆ **Team California:** Team California is a consortium of business development groups within the California Trade and Commerce Agency working to keep businesses in the state. Along with a host of other ventures, Team California assists in alternate and expansion site location and provides information about local jurisdiction tax incentives and infrastructure programs.
- ◆ **State Interagency Task Force on Biotechnology:** California state agencies with jurisdiction over biotechnology matters participate on a task force chaired by the State’s Secretary of Trade and Commerce. The interagency task force coordinates activities and helps streamline the regulatory process for biotechnology development.
- ◆ **Centers of Excellence/Incubator:** California has eight centers for biotechnology, facilitating research and development, instrumentation resources, faculty development, technology transfer, public policy and communications. The UCSD-sponsored center, CONNECT, seeks to link high-tech companies with the financial, managerial and technical resources to succeed.
- ◆ **Biotechnology Investment:** Investment pools are available in the California Employee Retirement System (CALPERS) and the California State Teachers Retirement System (CALSTERS) to invest in technology companies. Four industries have been identified to benefit from these pools. Those include interactive media, high technology communications, alternative transportation and biotechnology.

- ◆ **Manufacturing and Research Equipment Credit:** This credit reduces the California corporate franchise tax, and in some instances can be used to reduce the sales tax on the acquisition of qualified property. Corporations are entitled to 6% of the amount paid for equipment placed in service in the state.

### Florida

**A Look at Florida:** Florida has a sales tax of 6%, a corporate tax rate of 5.5% and has no personal income tax. Florida offers a limited use tax exemption on self-constructed assets used for R&D manufacturing and an exemption for new/expanding business and allows NOL carryforwards for 15 years, but does not have an investment tax credit.

- ◆ **Business Development:** Enterprise Florida is a not for profit government-based partnership established to guide the development of Florida's economy with a mission to maintain a business-friendly climate conducive to job creation and retention. The Enterprise Development Corporation facilitates the attraction of new companies to locate in the state, with special attention focused on high technology industries.
- ◆ **Grants and Other Assistance:** Florida is one of twenty-eight states with a Sea Grant Program. Florida Sea Grant is the state university system's program for marine research, education and extension. Using federal and state dollars, the program funds marine biotechnology research at the universities as well as cooperating private research institutions.
- ◆ **Pending Legislation:** Initiated by several high technology trade associations, legislation was introduced this year aimed at bringing more high-paying technology jobs to the state. The Health Technologies Act would help provide adequate access to growth capital; improve the structure of Florida's universities' technology transfer and licensing; and increase the share of federal and private research and development funds.

### Maryland

**A Look at Maryland:** Maryland has a 5% state sales tax with exemption for certain R&D and for manufacturing. This includes a sales tax exemption for tangible personal property used in the development, production and assembly activities in the biotechnology industry. The state allows the federal 15-years NOL provisions with no carryback.

- ◆ **Commercial Biotechnology Strategy:** In 1991, Maryland became the first state to develop a comprehensive strategy for development of the biotechnology industry. Many of the 26 near-term initiatives identified in the strategy have been partially or fully implemented.

- ◆ **Maryland Venture Capital Trust:** This fund provides funds to help finance young firms. Maryland recently invested \$250,000 in a company this July that agreed to locate in Baltimore.
- ◆ **Industrial Partnerships:** Maryland encourages university research with commercial potential by awarding matching funds up to \$70,000 annual for University of Maryland faculty members to perform research or development work for a company.
- ◆ **Favorable Utility Pricing:** Maryland life science firms are eligible to receive a 5% discount on their gas and electric bills.

### Ohio

**A Look at Ohio:** Ohio has an 8.9% corporate and 7.5 individual tax rate. The maximum state and local sales tax rate is 7% and has a sales tax credit for R&D manufacturing expenditures. The state allows a 15-year carryforward for losses.

- ◆ **Tax Credits:** The Technology Investment Tax Credit is a new program to promote private investment in small research and development companies. Investors can reduce state income taxes by a credit of up to \$37,500 per investment.
- ◆ **Technical Assistance:** The Ohio Department of Development is an active partner in the federal SBIR network. Since 1991, there have been 564 Ohio-based companies that have received SBIR awards in excess of \$97 million.
- ◆ **Centers of Excellence:** Ohio has three centers that have a focus on biotechnology. The collective budget is \$9 million annually. These centers are tied into 15 academic programs across Ohio that focus on basic research, technology transfer, education, training and seed funding.

### Oregon

**A Look at Oregon:** Oregon does not have a sales tax by has a 7% income tax.

- ◆ **R&D Tax Credits:** Oregon allows a 5% tax credit for qualified research and basic research expenditures over the previous three-year period. The maximum credit is \$500,000 or one-third of the tax liability. No carryforward is allowed.
- ◆ **Incubator:** The Oregon Biotechnology Innovation Center is a new 13,000 square foot facility located in an Oregon Health Sciences University Building. The center was developed with funding from the state lottery earnings and loans from the Portland Development Commission.

- ◆ **Capital/Loan Availability:** The Oregon Economic Development Department has developed several programs that work with Oregon banks and other financial institutions to make funds available to Oregon businesses. Funds from the department complement those from the commercial banks, allowing banks to make high risk yet still prudent loans than they normally would by providing additional security.
- ◆ **Workforce Training:** Oregon's work force training program helps fund biotechnology intern programs in Oregon high schools for placement into biotechnology and other related facilities.

### Washington

**A Look at Washington:** There are several state tax initiatives for high technology businesses. The manufacturer's sales tax exemption saves up to 8% on the cost and installation of machinery and equipment. Sales tax is further excused on machinery and equipment used for research and development of potential new products. There is also a Business and Occupation Tax Credit for high technology businesses like biotechnology.

There is no corporate, unitary or personal income tax in Washington. Washington businesses are subject to three taxes and two employee-related insurance expenses:

- Business and Occupation Tax- based on gross receipts
- Sales and Use Tax, Property Tax
- Unemployment insurance, Industrial Insurance

- ◆ **The Pacific Rim Enterprise Center:** A not for profit organization with offices in Seattle and the Tri-Cities region of eastern Washington State, Pacific Rim has received seed money from the Department of Energy to aid in the transfer and commercialization of technologies that are federally and other-source funded. The Center's objective is to stimulate the creation of science and technology networks that can solve environmental problems globally.
- ◆ **Washington Research Foundation:** This private, non-profit's mission is to maximize the economic and community benefits of technologies resulting from research at state institutions, especially by starting companies and investing earnings in further research, education, and local enterprise.
- ◆ **Washington Technology Center:** This is the state-funded enterprise that supports commercially promising research and technology development that is of direct benefit to the economic vitality of the state. The state provides grants to professors to encourage them to team-up with entrepreneurs. Grant money is available for up to two years and \$100,000.