

# The Strategic Marketing Institute Working Paper

## State and International Incentives and the Bioeconomy

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## State and International Incentives and the Bioeconomy

### Introduction

This paper attempts to outline the major state and university bioeconomy initiatives throughout the U.S. and in several foreign countries. Every state is involved in developing and encouraging the bioeconomy in some form or another. For example, 44 states have either completed or in the process of constructing bioscience research and development facilities (Battelle, p.38). A primary resource of information for this report is a Battelle Technology Partnership Practice and SSTI study: *Growing the Nation's Business Sector: State Bioscience Initiatives 2006* (Battelle), as well as information gathered at the Biotechnology Industry Organization's annual meeting held in April of 2006 in Chicago.

International initiatives will also be analyzed. This is due to several reasons, some countries such as Canada and Australia have programs similar to the U.S., provincial, state and territorial governments have levels of autonomy similar to states in the U.S. European countries, especially those in the European Union (EU), also resemble U.S. states insofar as they operate in a unified economic zone and in many cases their populations are no greater than many U.S. states.

The information in this paper is not likely to be complete. Individual business development programs, tax abatements and subsidies may not be captured. The units of government themselves have provided this information and are likely to cast their programs in their best light. Also, individual business development or subsidy programs may be tailored specifically to an individual firm interested in locating in a specific location and would not be captured in this analysis.

There are two phrases that are often included in business promotion literature: skilled workforce and world class universities. Unless specific areas of expertise are mentioned by governments, general slogans or assertions will be ignored. It appears that workers and universities around the world suffer from a "Lake Wobegon" effect, they all are above average.

### Background

There are several interrelated industries that represent the bioeconomy. For purposes of this report, these include agricultural feedstocks and chemicals, drugs and pharmaceuticals, medical devices and equipment; and research testing, and medical laboratories (Battelle, p.vii). According to the Battelle study, employment in bioscience industries was 1.2 million in 2004. The largest sector was research testing, and medical laboratories with 413,500 workers or 33 percent of the total; followed by medical devices and equipment with 411,460 workers also representing 33 percent of the workers; drugs and pharmaceuticals accounted for 313,207 workers or 25 percent of the total; followed by agricultural feedstock and chemical firms which accounted for 104,893 workers or 8 percent of the total (Battelle, p.viii).

According to the study indirect and induced employment effects of these bioeconomy industries generated another 5.8 million jobs which means that total employment related to and resulting from these bioeconomy activities is 7.0 million jobs. These jobs are also well paying. The average salary was \$65,775 in 2004 far higher than the average salary for the U.S. economy as a whole (Battelle, p.viii). Given the size of these industries, jobs generated and salaries paid, the impact of these industries on the economy of a particular geographic area could be quite large. The potential for job growth and the salaries earned by workers in these industries help explain government efforts to promote these industries.

## **State Initiatives and Programs**

### **Alabama**

Alabama has committed \$50 million which has been matched by \$80 million in private sector funds to construct a biotechnology facility in Huntsville (Battelle, p.xvii.). The state is also using Tobacco Settlement funds to develop the University of South Alabama (USA) Cancer Research Institute (Battelle, p.5). Funds from the Tobacco Settlement are a result of a lawsuit filed by many state Attorney Generals throughout the country. The USA is also developing a 35 acre research and technology park that is targeting medicine and biotechnology (<http://www.bio.org/local/battelle2006/Alabama.pdf>).

The Office for the Advancement of Developing Industries Technology Center at the University of Alabama, Birmingham (UAB) has a technology incubator with wet-lab facilities for bioscience companies (Battelle, p.61). Also, a \$20 million fund is being established to invest in UAB developed technologies. UAB and the city of Birmingham also have a research park (<http://www.bio.org/local/battelle2006/Alabama.pdf>).

### **Alaska**

Alaska is using Tobacco Settlement funds for a science facility at the University of Alaska-Anchorage (Battelle, p.5).

### **Arizona**

Arizona has approved \$440 million in construction of university research facilities, most of which will be devoted to bioscience facilities (Battelle, p.xvi). The state also offers a tax credit for firms that invest in bioscience enterprises (Battelle, p. xx). The state also provides \$12 million a year in funding to promote translational research projects and assisting in the removal of impediments to interinstitutional biomedical research collaborations (Battelle, p.44).

Voters in Arizona approved Proposition 301 which allocates \$1 billion in bonds for new science and technology activities at the state's universities (Arizona Department of Commerce).

Arizona is also the home of the Critical Path Institute (C-Path) and independent nonprofit organization founded by the University of Arizona, the Food and Drug Administration and SRI. The goal of C-Path is to improve the drug development system (<http://www.bio.org/local/battelle2006/Arizona.pdf>).

Northern Arizona University will start a new bioscience institute focusing on translational research. The Biodesign Institute at Arizona State University was established to improve human health and quality of life through biosystems research (<http://www.bio.org/local/battelle2006/Arizona.pdf>).

The Arizona Biomedical Research Commission allocates \$12 million per year to carry out peer-reviewed scientific projects on health related topics. Arizona Technology Enterprises (AzTE) assesses licenses and launches spin-off companies based on Arizona State University and Northern Arizona University inventions. AzTE also provides investments in the range of \$25,000 to \$50,000 to fund proof of concept activities surrounding industry and university collaborations (<http://www.bio.org/local/battelle2006/Arizona.pdf>).

Downtown Phoenix will house the Phoenix Biomedical Campus, a 15 acre academic and research park (<http://www.bio.org/local/battelle2006/Arizona.pdf>).

## **Arkansas**

Arkansas has two statewide initiatives. The Arkansas Science and Technology Authority integrates several tax credit programs for research and bioscience training. The Authority also administers a \$1 million matching fund designed to help researchers to obtain federal grants which require a match, as well as a technology development program which offer repayable grants to universities, federal laboratories or small businesses that commercialize technologies. The Authority also administers pre-seed capital investment fund (<http://www.bio.org/local/battelle2006/Arkansas.pdf>).

The Fund for Arkansas Future is a \$5.25 million formal angel-investor fund. Investors in the Fund are eligible for a 33 percent tax credit on some investments (<http://www.bio.org/local/battelle2006/Arkansas.pdf>).

The Arkansas Bioscience Institute is a collaborative of five public and private institutions working on agricultural, bioengineering, and biomedical topics. Funding for the Arkansas Bioscience Institute is provided by Tobacco Settlement dollars (<http://www.bio.org/local/battelle2006/Arkansas.pdf>).

Arkansas also offers a wide range of business incentives to firms. The state offers a 10 percent tax credits up to \$10,000 for in house research costs. An income tax credit up to 33 percent for research and development costs for new firms, and a 33 percent research and development tax credit for business doing research and development with an Arkansas university. Firms that build or expand facilities in Arkansas are eligible for

sales and use tax rebates as well as tax credits for jobs created (Arkansas Department of Economic Development).

## **California**

California has a major presence in the bioeconomy. Voters approved a \$3 billion bond proposal to create the California Institute of Regenerative Medicine (Battelle, p.xvi). This funding includes research on embryonic stem cells.

The University of California San Francisco, Berkeley, and Santa Cruz operate the Institute for Quantitative Biomedical Research. The University of California Los Angeles and the University of California Santa Barbara are developing the California NanoSystems Institute (<http://www.bio.org/local/battelle2006/California.pdf>).

The University of California system also administers the UC Discovery Grant Program, which provides grants up to \$250,000 annually for up to 4 years to faculty to conduct research in partnership with a California firm. The firm must match the grant amount (<http://www.bio.org/local/battelle2006/California.pdf>).

The California State University system offer challenge grants of up to \$30,000 for faculty conducting research in partnership with a California company (Battelle, p.47). The University of California San Francisco has started a Bioentrepreneurship Center, which offers mentoring and training for faculty members whose research discoveries might lead to new business development (Battelle, p.51).

Several bioscience research parks are being developed throughout the state. Most of these are allied with universities (<http://www.bio.org/local/battelle2006/California.pdf>).

## **Colorado**

Colorado State University and the University of Colorado both administer programs that provide funding for early commercialization efforts resulting from the work of faculty members. The state has also allocated \$50 million to be invested in venture capital funds (<http://www.bio.org/local/battelle2006/Colorado.pdf>).

The state also provides funding for the Fitzsimons BioBusiness Incubator located at the Medical facility in Fitzsimons. A Bioscience park is also under construction at this location (<http://www.bio.org/local/battelle2006/Colorado.pdf>).

Colorado allows bioscience companies a sales and use tax refund on tangible personal property provided the property is used in Colorado for biotechnology research and development (Bioscience Colorado).

## **Connecticut**

Connecticut has committed \$100 million over a 10 year period to conduct research on adult stem cells (Battelle, p. xix). The state also has a small bioscience seed fund to offer funds to start up biotechnology firms (Battelle, p. xx).

The Connecticut BioScience Facilities Fund provides funding to biotechnology companies for the construction of wet-lab and related space. Since its inception, the fund has invested or committed more than \$33 million to finance more than 300,000 square feet of laboratory and related space for 12 biotechnology firms (Battelle, p.62).

The Connecticut Office of BioScience offers business facilitation and recruitment activities (<http://www.bio.org/local/battelle2006/Connecticut.pdf>).

Connecticut Innovation provides funding for very early stage biotechnology enterprises in Connecticut. Initial investments can be up to \$500,000. This organization also provides funding to biotechnology companies for the construction of wet-lab space (<http://www.bio.org/local/battelle2006/Connecticut.pdf>).

## **Delaware**

The state has provided funding for the Delaware Biotechnology Institute, part of the University of Delaware. The state has also provided funding to link bioscience research at the University of Delaware, Delaware State University and the Delaware Technical and Community College (<http://www.bio.org/local/battelle2006/Delaware.pdf>).

The state is also able to provide start-up and seed funds for life science companies, and grants for clean energy research. The state also offers a wide range of services targeted to technology intensive firms (Delaware Economic Development Office).

## **Florida**

State and local governments in Florida created a \$510 million package to attract the Scripps Institute to locate a facility in that state (Battelle, p. xviii). Funds from the Tobacco Settlement are used to fund the James and Ester King Biomedical Research Program. Grants are made in three categories: New Investigator Research Grants, up to \$150,000 a year for 3 years; Team Science Program Grants intended to prepare Florida institutions for National Institutes of Health (NIH) awards; and Small Business Technology Transfer Grants to explore feasibility of joint commercialization technology (Battelle, p.44).

The state has constructed a \$40 million wet-lab complex totaling 230,000 square feet at the University of South Florida. There are also several other facilities under construction or in the planning stages throughout the state (<http://www.bio.org/local/battelle2006/Florida.pdf>).

The state also has created Centers of Excellence including the Center of Excellence for Regenerative Health Biotechnology at the University of Florida and the Center of Excellence in Biomedical and Marine Biotechnology at Florida Atlantic University-Boca Raton, as well as \$15 million a year to fund research at the Johnnie B. Byrd Sr. Alzheimer's Center and Research Institute at the University of South Florida (<http://www.bio.org/local/battelle2006/Florida.pdf>).

Florida also believes that its tax structure promotes new business development. The state has no personal income tax, and no sales and use tax on goods manufactured in the state for export outside of the state, and no sales tax on purchases of raw materials incorporated in a final product for resale ([eflorida.com](http://eflorida.com))

## **Georgia**

Georgia offers a small bioscience seed fund for start up biotechnology firms (Battelle, p.xx). The state is also using \$4.8 million in Tobacco Settlement funds for the Cancer Coalition's Distinguished Cancer Clinicians and Scientists Program (Battelle, p.5).

The state has also created the Georgia Life Sciences Facilities Fund which provides loans up to \$2.5 million to build research laboratories (Battelle, p.62).

Georgia Institute of Technology is the home of the Center for the Study of Systems Biology. The Center uses IBM computers to conduct research into new drugs. The super computing cluster was funded by \$8.5 million in grants, most of which came from the state. The university will also open a Nanotechnology Research Center in 2008 (<http://www.bio.org/local/battelle2006/Georgia.pdf>).

The University of Georgia will open a 135,000 square foot facility for the biomedical and health sciences this year. The university will also open a \$40 million 75,000 square foot facility designed to address zoonotic diseases, as well as a center for complex carbohydrate research (<http://www.bio.org/local/battelle2006/Georgia.pdf>).

The Medical College of Georgia has expanded its Interdisciplinary Research Building, which includes incubator space for start up companies and a Cancer Research Center. The state also administers the Georgia Cancer Research Fund which is funded through a tax check off program. The Medical College of Georgia also offers entrepreneurial assistance on a statewide basis, with an emphasis on entrepreneurs and companies located in rural areas (<http://www.bio.org/local/battelle2006/Georgia.pdf>).

The state also has a program that provides pre-incubator/commercialization services that help universities identify laboratory discoveries that have commercial potential. There are facilities at Georgia Tech, the University of Georgia, Georgia State University, Emory University, and the Medical College of Georgia (<http://www.bio.org/local/battelle2006/Georgia.pdf>).

The state has also established a bioscience seed fund for early-stage firms. A \$3 investment from the private sector is matched with \$1 of state investment. The Life Sciences Facilities Fund provides loans up to \$2.5 million for firms that want to build laboratories (<http://www.bio.org/local/battelle2006/Georgia.pdf>).

## **Hawaii**

Hawaii is using Tobacco Settlement funds to finance \$150 million in bonds for a new campus at the University of Hawaii Medical School (Battelle, p.5).

The University of Hawaii offers Accelerated Research Commercialization grants to in-state firms that partner with university researchers on research with near-commercial potential including biotechnology (<http://www.bio.org/local/battelle2006/Hawaii.pdf>).

The Natural Energy Laboratory of Hawaii Authority consists of 870 acres that hosts tenants interested in ocean science, aquaculture, marine biotechnology, and other products from deep sea waters (<http://www.bio.org/local/battelle2006/Hawaii.pdf>).

## **Idaho**

The Governor's Science and Technology Advisory Council has identified four areas for the state's science and technology efforts of which agriculture and biosciences are one (<http://www.bio.org/local/battelle2006/Idaho.pdf>).

The University of Idaho has received a 5 year \$16.1 million grant to expand the statewide biomedical research network between the University of Idaho, Idaho State University and Boise State University. Both the University of Idaho and Boise State operate business incubators with wet lab space (<http://www.bio.org/local/battelle2006/Idaho.pdf>).

There are three TechConnect offices located in the state that conduct workshops, provide counseling, and connect entrepreneurs with resources at universities and other agencies as well as the private sector (<http://www.bio.org/local/battelle2006/Idaho.pdf>).

## **Illinois**

The Illinois Institute of Regenerative Medicine has been given \$10 million to further research in the area of stem cells (Battelle, p. xix).

The University of Illinois will be the home of a \$75 million Institute for Genomic Biology. Construction of new biomedical research buildings at the University of Illinois-Chicago is nearing completion. Other new building projects include a cancer institute at Southern Illinois University, and a nanotechnology facility at the University of Illinois (<http://www.bio.org/local/battelle2006/Illinois.pdf>).

The Illinois Board of Higher Education annually provides matching grants to universities to leverage federal funds (<http://www.bio.org/local/battelle2006/Illinois.pdf>).



Bio-Angels is a network of angel investors that invest up to \$1 million in bioscience firms. Also, the Illinois Finance Authority makes investments of \$150,000 and \$300,000 in early stage companies provided angel investors or venture capital funds are also willing to invest (<http://www.bio.org/local/battelle2006/Illinois.pdf>).

The Illinois Emerging Technology Fund and its partner Illinois Venture, owned by the University of Illinois, make investments including investments to bioscience firms (<http://www.bio.org/local/battelle2006/Illinois.pdf>).

## **Indiana**

Indiana University and the Indiana School of Medicine has used a \$105 million grant from the Lilly Endowment to create the Indiana Genomic Initiative (INGEN) (Battelle, p. xix).

Purdue University also has established a Biomedical Entrepreneurship Program which attempts to link scientists with business experts (Battelle, p.67).

The University of Indiana School of Medicine and Purdue University (IUPUI) has a new Biotechnology Research a Training Center; a \$26.9 million, in excess of 40,000 square foot facility. IUPUI also has a new Medical Information Sciences Building. Indiana University also entered into a lease agreement with Norte Dame for space at Notre Dame's Keck Center for Transgene Research located in South Bend (<http://www.bio.org/local/battelle2006/Indiana.pdf>).

Purdue University has constructed several new facilities including the Bindley Bioscience Center a \$15 million facility, the Brick Nanotechnology Center, a \$58 million facility, and the Biomedical Engineering Building a \$25 million facility. Purdue also operates the Chao Center for Industrial Pharmacy and Contract Manufacturing. The university maintains an internally managed venture fund that makes awards for precommercialization research and pre-seed awards (<http://www.bio.org/local/battelle2006/Indiana.pdf>).

The state's 21<sup>st</sup> Century Fund awards grants up to \$2 million. The fund emphasizes proposals that leverage major federal grants or open up new sources of long-term support, encourages university/industry partnerships and the formation of new businesses (<http://www.bio.org/local/battelle2006/Indiana.pdf>).

The Indiana Future Fund is a fund of funds managed by a third party. Fully 60 percent of the money is to be place in Indiana focused or Indiana based venture funds and 70 percent in funds that intend to invest in early or seed stage companies. Furthermore, 60 percent of the funds are to be invested in the life sciences (<http://www.bio.org/local/battelle2006/Indiana.pdf>).

The Indiana Economic Development Corporation offers several financial incentives to firms that invest in the state. Tax credits are available for equipment purchases as well as to providers of venture capital. Grants are also available to firms that train or retrain their employees (Indiana's Life Sciences Report 2006, pp.1-2).

## **Iowa**

Iowa has several university based initiatives. The University of Iowa was given \$3 million by the state for the construction of a facility that ferments and purifies materials suitable for clinical trials. The university also has a Center for Advanced Drug Development that provides a wide range of assays for drug products. Iowa State University receives \$5 million a year for its Plant Sciences Institute that encourages academic and industrial interaction (Battelle, p.49). The state has also provided \$5 million to the state's public universities to expand infrastructure in the areas of technology, commercialization and entrepreneurship and business development (Battelle, p.50-51).

Iowa also has a Value Added Agricultural seed investment fund for agricultural purposes (Battelle, p.57).

The Grow Iowa Values Fund is will provide \$500 million over a 10 year period to support technology based economic activity. The fund will make investments in the state's research and development base and foster an infrastructure that encourages commercialization of university research. This includes the biosciences (<http://www.bio.org/local/battelle2006/Iowa.pdf>).

The Human Nutrition Wellness Center at Iowa State University will allow existing Iowa companies, commodity groups, and university researchers the opportunity to collaborate on projects to evaluate foods and nutritional supplements on human health. Another collaborative project is the High-Throughput Animal Model Facility at the University of Iowa which will allow researchers at the University of Iowa and Iowa State University to create and characterize animal models of human diseases (<http://www.bio.org/local/battelle2006/Iowa.pdf>).

Iowa State also has Plant Sciences Institute which has an annual appropriation of \$5 million per year for plant based research. This program is similar to Project GREEN at Michigan State University. The Center for Crops Utilization Research at Iowa State makes pilot plants available to industry to test new products and processes. The Iowa Biologics Facility also at Iowa State is a dedicated manufacturing facility for non-animal source proteins suitable for clinical trials or industrial applications. Some of these facilities also have incubators attached to them (<http://www.bio.org/local/battelle2006/Iowa.pdf>).

Iowa State also has a grant program to provide funding for proof of concept activities. Projects require a 1 to 1 match. Iowa State also assists with the testing marketing and development of commercially viable products. The University of Iowa will use \$1.4

million of its funding to support competitively selected commercialization projects based on the university's intellectual property (<http://www.bio.org/local/battelle2006/Iowa.pdf>).

The Ag-Based Industrial Lubricants Research Program at the University of Northern Iowa works with Industrial clients throughout the state providing testing services for developers and users of biobased lubricants such as those derived from soy oil (<http://www.bio.org/local/battelle2006/Iowa.pdf>).

To promote technology transfer of university intellectual property, Iowa gives tax credits to firms that use intellectual property development by university employees. If approved, the business as well as the university employee responsible for the development of the technology is eligible for a tax credit (<http://www.bio.org/local/battelle2006/Iowa.pdf>).

Entrepreneurship Centers that offer training and business assistance services have been established at Drake University, Iowa State, Northern Iowa Community College, and the University of Northern Iowa. The University of Iowa also has a business incubator (<http://www.bio.org/local/battelle2006/Iowa.pdf>).

The state is also working with a private sector firm to conduct a feasibility study of a corn based biorefinery. It also has a fund of funds designed to invest in areas of interest to Iowa such as alternative energy and agbiotechnology (<http://www.bio.org/local/battelle2006/Iowa.pdf>).

## **Kansas**

The University of Kansas Medical Center in Kansas City has a new \$55 million Biomedical Research Building and there is a new \$54 million Bio-Security Research Facility at Kansas State University. The University of Kansas recently obtained approval for a \$20 million Structural Biology Center (<http://www.bio.org/local/battelle2006/Kansas.pdf>).

The Kansas Economic Growth Act has several incentives as part of its Bioscience Initiative. The act also captures the growth from bioscience industry tax revenues and deposits them into the Kansas Bioscience Authority. One of these incentives is the potential to create a Bioscience Development District, which can allow the district to use future property tax revenue to repay the costs incurred for the development of the district. The state also has a Bioscience Tax Investment Incentive Act which allows the Authority to make direct payment to bioscience companies in the amount of 50 percent of its net operating loss in Kansas. This amount is capped at \$1 million. The Bioscience Research and Development Voucher Program Act gives vouchers to firms that undertake research and development activities with Kansas universities and research institutions. The Authority can also provide matching funds to match federal and other research funding that requires a match (Jerkovich, p.8).

There are several business incubators located throughout the state including the Biotechnology Development Center of Greater Kansas City, and the Bioprocessing and

Industrial Value Added Programs facility located at Kansas State University (<http://www.bio.org/local/battelle2006/Kansas.pdf>).

## **Kentucky**

The state has provided \$5 million for the Cardiovascular Innovation Institute, a partnership between the University of Louisville and Jewish Hospital. The state has also provided \$1.5 million for the Center for Pharmaceutical Science and Technology located at the University of Kentucky (<http://www.bio.org/local/battelle2006/Kentucky.pdf>).

The state has also provided \$1 million to support the construction of a Nutrigenomics Laboratory that will support research and development work that will focus on genomics and nutrigenomics in animal production systems (<http://www.bio.org/local/battelle2006/Kentucky.pdf>).

The state has a research and development voucher program which is a \$3 million investment fund that is designed to help small and medium sized firms undertake research and development with Kentucky university researchers. A 1 to 1 match is required by the private sector firm. The Kentucky Commercialization Fund invests in university based technology commercialization projects (<http://www.bio.org/local/battelle2006/Kentucky.pdf>).

The state also sponsors Regional Innovation and Commercialization Centers and local Innovation Centers that are designed to help entrepreneurs and scientists in commercializing technologies that demonstrate significant market potential (<http://www.bio.org/local/battelle2006/Kentucky.pdf>).

MetaCyte is a venture development subsidiary of the Louisville Medical Center Development Corporation and is focused on helping scientists, researchers, entrepreneurs and others who are interested in starting life science and health care related businesses (<http://www.bio.org/local/battelle2006/Kentucky.pdf>).

The state also administers a seed capital fund dedicated to encourage economic development in the natural products sector, including nutraceuticals, functional foods, and agbiotech businesses (<http://www.bio.org/local/battelle2006/Kentucky.pdf>).

The state also has several incubators in the state including locations at the University of Kentucky and the University of Louisville Medical Center (<http://www.bio.org/local/battelle2006/Kentucky.pdf>).

The state offers a tax credit for the construction of research and development facilities. The credit is 5 percent of the costs incurred (<http://www.bio.org/local/battelle2006/Kentucky.pdf>).

## **Louisiana**

The Louisiana Cancer Research Consortium is a joint venture of the Louisiana State University and Tulane University Health Science Centers and is funded by cigarette taxes (Battelle, p.44).

The greater New Orleans Biosciences Economic Development District has been established which is designed to create a geographic concentration of academic and private bioscience and private sector research and commercialization. Partners include the Louisiana State University Health Center, the Tulane Health Sciences Center, the Louisiana Cancer Research Consortium, and other organizations (<http://www.bio.org/local/battelle2006/Louisiana.pdf>).

The state revised the state's corporate income tax was replaced with a sales tax. This was done to make Louisiana attractive for life science biomanufacturing facility construction (<http://www.bio.org/local/battelle2006/Louisiana.pdf>).

A total of \$5.5 million has been appropriated by the state to support the Neurobiotechnology Program of Louisiana, a joint venture between Louisiana State University and Tulane University health centers. The state has also committed \$45 million for the Louisiana Gene Therapy Research Consortium (<http://www.bio.org/local/battelle2006/Louisiana.pdf>).

The Louisiana Board of Regents Support Fund supports the biosciences by providing funding to scientists and projects that promote collaboration between the private sector and universities (<http://www.bio.org/local/battelle2006/Louisiana.pdf>).

The state has a Technology Commercialization Tax Credit which allows companies that partner with Louisiana Universities to claim an annual 15 percent credit against the cost of investment in machinery, equipment, and licensing expenses (<http://www.bio.org/local/battelle2006/Louisiana.pdf>).

The state has an angel investing network that provides early stage investment capital. The state also invested \$5 million toward the creation of Louisiana Venture LP for seed and early stage investments. Louisiana Fund I has been created to provide capital to companies developing technologies with an emphasis on developing products resulting from research discoveries at Louisiana universities (<http://www.bio.org/local/battelle2006/Louisiana.pdf>).

The state has several bioscience based business incubators and research parks in operation or under development (<http://www.bio.org/local/battelle2006/Louisiana.pdf>).

## **Maine**

Maine voters passed a bond issue that will allocate \$8 million for the Maine Biomedical Research Fund and \$4 million for the Marine Infrastructure and Technology Fund. These

funds are designed to improve the infrastructure in these sectors. An addition \$5 million is earmarked for the University of Maine system for various programs, and \$1 million is allocated to provide funding for the Small Enterprise Growth Fund to make equity investments in small Maine companies with a potential for growth (<http://www.bio.org/local/battelle2006/Maine.pdf>).

The Maine Technology Institute promotes and supports research and development that leads to commercialization of new products and services including those in the bioeconomy sectors (<http://www.bio.org/local/battelle2006/Maine.pdf>).

The Maine Biomedical Research Fund provides stated funding for various bioscience facilities including genomics, the Maine Medical Center, and the Foundation for Blood Research (<http://www.bio.org/local/battelle2006/Maine.pdf>).

The University of Southern Maine has established a Biosciences Research Institute which has focused its efforts on environmental toxicology among other topics (<http://www.bio.org/local/battelle2006/Maine.pdf>).

The Institute for Molecular Biophysics was created to develop an interdisciplinary center for biomedical imaging (<http://www.bio.org/local/battelle2006/Maine.pdf>).

The state has several seed grants and other programs designed to assist developing firms. This includes programs designed to assist in the commercialization and development of research and development intensive industries, and a venture capital fund (<http://www.bio.org/local/battelle2006/Maine.pdf>).

The Finance Authority of Maine administers the Maine Seed Capital Tax Credit Program which is designed to encourage equity investment in new business ventures. Maine also has one dedicated bioscience business incubator (<http://www.bio.org/local/battelle2006/Maine.pdf>).

## **Maryland**

Maryland offers a Biotechnology Investment Incentive Tax Credit to investors in biotechnology (Battelle, p.xx). The state also has an income tax credit for firms and individuals that invest in qualified biotechnology firms (Battelle, p.4).

The state MdBio program makes Project Accelerator Awards to bioscience firms that need funds to accelerate near-term commercialization of a product or service. The typical award is in the range of \$100,000 to \$200,000 (Battelle, p.57).

The University of Maryland-Baltimore is in the process of building a BioPark. The state is also in the process of expanding the University of Maryland's Center for Advanced Research in Biotechnology, a \$50 million project. The university also houses the Center for Biosystems Research, the Center for Marine Biotechnology, the Medical

Biotechnology Center and the Institute of Human Virology (<http://www.bio.org/local/battelle2006/Maryland.pdf>).

The Maryland Industrial Partnerships program provides grants to university based research that assists companies in developing new products. A match from the company is required (<http://www.bio.org/local/battelle2006/Maryland.pdf>).

The Maryland Technology Development Corporation's University Technology Development Fund provides funding for universities precommercial feasibility research. The Maryland Technology Development Corporation also provides seed funding for companies that engage in technology development and transfer collaborations with universities and federal laboratories in Maryland. In addition the state has several other programs that assist in the funding of new firms and technologies (<http://www.bio.org/local/battelle2006/Maryland.pdf>).

The University of Maryland Technology Enterprise Institute provides a link between biotechnology firms and research carried out by the university (<http://www.bio.org/local/battelle2006/Maryland.pdf>).

The state is home to 20 business incubators, several which are devoted to the biosciences. There are also several bioscience research parks either under operation or under construction (<http://www.bio.org/local/battelle2006/Maryland.pdf>).

## **Massachusetts**

Massachusetts along with the John Adams Innovation Institute provides seed grants and low interest loans to the Boston Redevelopment Authority's Life Sciences Initiative (Battelle, p.57). The state's MassDevelopment also has created a \$25 million Emerging Technology Fund that can make loans up to \$2.5 million for biotechnology facilities (Battelle, p.62).

The University of Massachusetts is in the process of building several bioscience facilities including a medical research building in Worcester, a life sciences building in Amherst, and an expansion of its biologic laboratory in Jamaica Plain. There are also several facilities being constructed at the private universities in the Boston area (<http://www.bio.org/local/battelle2006/Massachusetts.pdf>).

The Massachusetts Technology Transfer Center funded at the University of Massachusetts provides commercialization assistance to early stage companies with technology licensed from any research institution and holds an annual one day workshop for life science researchers interested in starting a new company. There are also several regional bioscience organizations in the state with are involved in commercialization efforts (<http://www.bio.org/local/battelle2006/Massachusetts.pdf>).

The Massachusetts Technology Development Corporation offers seed stage investment funds. The state also has two bioscience incubators, and two dedicated bioscience

research parks with several more under construction. MassDevelopment also makes loans available to firms constructing bioscience facilities (<http://www.bio.org/local/battelle2006/Massachusetts.pdf>).

The state also offers a 10 percent Research and Development tax credit on investment in new facilities and equipment and a manufacturing tax credit for biotechnology and medical device firms (State of Massachusetts).

## **Michigan**

Michigan has set aside funding for economic projects which could include bioeconomy industries through its 21<sup>st</sup> Century Job fund, a \$2 billion grant and loan program designed to foster economic development (<http://www.bio.org/local/battelle2006/Michigan.pdf>).

The state also has a several “Smart Zones” located throughout the state. This program allows for tax increment financing to encourage communities within the zones to add business incubators, commercialization services or both. The state also has several Agricultural Renaissance Zones. Firms located within the Agricultural Renaissance zones are exempt from property and other taxes for a period of time. However, these zones are not necessarily earmarked for Biotechnology firms (<http://www.bio.org/local/battelle2006/Michigan.pdf>).

The Michigan Economic Development Corporation administers a Core Technology Initiative which provides the following facilities to the state’s research institutions: a high throughput screening center, an antibody technology core, a biological imaging center, and a center for biological commercialization (<http://www.bio.org/local/battelle2006/Michigan.pdf>).

The University of Michigan completed a \$200 million Interdisciplinary Life Sciences Institute (<http://www.bio.org/local/battelle2006/Michigan.pdf>).

In 2005, the Michigan Economic Development Corporation awarded \$27.3 million to 24 life sciences projects. The corporation also provides the University of Michigan with a grant to provide a commonly managed pool for precommercialization research for all the universities in the state and the Van Andel Institute. Awards of up to \$150,000 are available and are matched by the university’s resources. The University of Michigan’s School of Medicine also has its own Translational Research Initiative which provides up to \$75,000 for 1 year in partnership with Johnson & Johnson. Michigan State University operates IPVentures, which provides funds for start-up firms (<http://www.bio.org/local/battelle2006/Michigan.pdf>).

The Michigan Economic Development Corporation has invested in several bioscience venture funds. Venture Fund Michigan is a contingent tax credit back fund of funds (<http://www.bio.org/local/battelle2006/Michigan.pdf>). The corporation also administers a loan guarantee program, the loans cannot be used for construction or renovation projects (Michigan Economic Development Corporation).



The state has several business incubators of which one is a dedicated bioscience incubator (<http://www.bio.org/local/battelle2006/Michigan.pdf>).

## **Minnesota**

From 2000 to 2005, Minnesota bonded for \$240 million for bioscience related laboratories located throughout the state (Battelle, p.40). More than \$40 million of university, state, federal and private funds have been used to develop Biodale, located at the University of Minnesota, to provide university departments and outside companies with access to sophisticated services and equipment (Battelle, p.49).

The state also provided funding for the Minnesota Partnership for Biotechnology and Medical Genomics which is a collaboration between the University of Minnesota and the Mayo Clinic. The state is also providing \$20 million for the University of Minnesota's Initiative for Renewable Energy and the Environment (<http://www.bio.org/local/battelle2006/Minnesota.pdf>).

There are two university based programs that foster intellectual property transfer. The Minnesota Research Fund supplies money for the commercialization and development of technology produced by Minnesota's educational institutions. The University Innovation Grants program supports translational research at the University of Minnesota (<http://www.bio.org/local/battelle2006/Minnesota.pdf>).

The state has 3 dedicated life science business incubators, and one bioscience research park (<http://www.bio.org/local/battelle2006/Minnesota.pdf>).

## **Mississippi**

Firms that employ 10 or more full time workers of which 10 percent are scientists, engineers, or computer specialists who have an annual wage of 150 percent of the state average and provide health care for their employees are eligible for local property tax exemptions as well as state sales and use tax exemptions in addition to other tax breaks (Battelle, p. 4).

Mississippi State University's Life Sciences and Biotechnology Institute awards competitive seeds grants for research in the life sciences and biotechnology (Battelle, p.44).

The state enacted a wide ranging economic development package in 2005. The package set aside \$7 million for business incubator support, \$7 million for an equipment and public facilities fund to aid infrastructure improvements, \$7 million for a loan fund for businesses to buy long term fixed assets and \$7 million in bonds that would allow the state to take advantage of "extraordinary" opportunities (<http://www.bio.org/local/battelle2006/Mississippi.pdf>).

A new building is being constructed at the University of Mississippi's laboratory research complex. Mississippi State University has a Life Sciences and Biotechnology Institute that provides seed grants for research in the biosciences. Mississippi State's Franklin Furniture Center is designed to create markets for wood fibers to make building products. Mississippi State has also created the Thad Cochran Endowment for Entrepreneurship to encourage commercialization of the university's research discoveries (<http://www.bio.org/local/battelle2006/Mississippi.pdf>).

The state's Strategic Biomass Initiative attempts to foster business firms through university research and development, by providing funding for research. Private sector firms are required to provide a 25 percent match for projects up to \$300,000. With a 60 percent match, a firm can engage in a commercialization project up to \$400,000 (<http://www.bio.org/local/battelle2006/Mississippi.pdf>).

The Institute for Technology Development conducts applied research and attempts to convert the research into marketable products and services (<http://www.bio.org/local/battelle2006/Mississippi.pdf>).

The Mississippi Angel Network makes investment into bioscience related firms. The state is also in the process of developing business incubators and a research park (<http://www.bio.org/local/battelle2006/Mississippi.pdf>).

## **Missouri**

The University of Missouri recently opened a new Life Sciences Center. Washington University and its School of Medicine is also in the process of adding several new facilities including genomics, clinical imaging and other research facilities. St. Louis University is constructing a facility that will focus in new vaccines and biologics. The University of Missouri-Kansas City is completing a new Health Sciences building (<http://www.bio.org/local/battelle2006/Missouri.pdf>).

The Research Alliance of Missouri is designed to improve collaboration between the state's research institutions (<http://www.bio.org/local/battelle2006/Missouri.pdf>).

The University of Missouri-Kansas City has created the Institute for Entrepreneurship and Innovation. This includes infrastructure that expedites the transfer and commercialization of new technologies. The university supplies resources to evaluate innovations and works to develop new businesses (<http://www.bio.org/local/battelle2006/Missouri.pdf>).

Washington University and St. Louis University have commercialization funds designed to transfer research into new products and services (<http://www.bio.org/local/battelle2006/Missouri.pdf>).

Several organizations within the state have created BioGenerator whose mission is to accelerate the commercialization of plant and life science technologies in the St. Louis

region by providing funding and management support (<http://www.bio.org/local/battelle2006/Missouri.pdf>).

The state has a venture capital program. Many plant science firms have received financing in the St. Louis area from private sources. There is also a venture capital fund focused on the biosciences in Kansas City (<http://www.bio.org/local/battelle2006/Missouri.pdf>).

There are several bioscience incubators in Missouri as well as research parks that either exist or are under construction (<http://www.bio.org/local/battelle2006/Missouri.pdf>).

## **Montana**

Montana's BioScience Alliance has opened two wet lab facilities and is developing a venture capital initiative (Battelle, p.xvii).

Montana State University has opened a 40,000 square foot Molecular Biosciences Building and is building a 73,000 square foot chemistry and biochemistry research building. The University of Montana is building a 59,000 square foot addition to its College of Health Professions and Biological Sciences facility, and has approval for a \$12 million Bio-Science Building (<http://www.bio.org/local/battelle2006/Montana.pdf>).

The Montana Board of Research and Commercialization Technology offers grants or loans to encourage university/private sector ventures that have commercial potential. A match is necessary (<http://www.bio.org/local/battelle2006/Montana.pdf>).

The state has two bioscience incubators and two bioscience research parks. The state is also in the process of generating funding for venture capital (<http://www.bio.org/local/battelle2006/Montana.pdf>).

## **Nebraska**

Nebraska has created refundable research and development tax credit and other incentives designed to benefit start-up firms (Battelle, p. 4).

The University of Nebraska is building a Biological Process Development facility. The University of Nebraska Medical Center in Omaha received a \$17 million grant from the National Institutes of Health to build biomedical research infrastructure (<http://www.bio.org/local/battelle2006/Nebraska.pdf>).

The Nebraska Research Initiative produces seed funds for university activities in the areas of biosciences and biosecurity. The state also has one incubator and one research park (<http://www.bio.org/local/battelle2006/Nebraska.pdf>).

## **Nevada**

The state has appropriated \$5.4 million for a University of Nevada Biotechnology and Genomics Research Facility. The university also received \$10 million towards a new building that will be occupied by the university and the Nevada Cancer Institute. The University of Nevada Las Vegas received \$15.8 million towards a new Science Engineering and Technology building (<http://www.bio.org/local/battelle2006/Nevada.pdf>).

Additional funds have been made available for cancer and Alzheimer's disease research. There are also two research parks under development (<http://www.bio.org/local/battelle2006/Nevada.pdf>).

## **New Hampshire**

A business incubator is being constructed at Dartmouth College; the state is providing \$1 million in tax credits to the incubator. The college will also provide business development services to companies that locate at the incubator (<http://www.bio.org/local/battelle2006/NewHampshire.pdf>).

## **New Jersey**

The New Jersey Commission on Science and Technology has issued \$5 million in grants to 17 teams to conduct research on embryonic stem cells (Battelle, p. xix). A Life Sciences Building at Rutgers University was recently completed and a Biomedical Research Building in Camden has been proposed (<http://www.bio.org/local/battelle2006/NewJersey.pdf>).

The state also has a series of incentives to firms that locate in New Jersey whether or not they are related to the bioeconomy. Seed funding for proof of concept and commercialization research is also available as are bridge funds. The state also has venture capital available to bioeconomy entrepreneurs. New Jersey also has several state supported business incubators and bioscience research parks (<http://www.bio.org/local/battelle2006/NewJersey.pdf>).

## **New Mexico**

The University of New Mexico has expanded its Clinical and Magnetic Resonance Research Center, and plans to build a \$50 million Cancer Research and Treatment Center. Some funds from the Tobacco Settlement are earmarked for bioscience research programs at the University of New Mexico Health Sciences Center (<http://www.bio.org/local/battelle2006/NewMexico.pdf>).

The state has a dedicated Technology Research Collaborative which is designed to commercialize research discoveries. The University of New Mexico and New Mexico

State each have nonprofit corporations designed to commercialize research at these universities (<http://www.bio.org/local/battelle2006/NewMexico.pdf>).

Seed capital and venture capital organizations are also in place in the state. This includes the New Mexico Venture Capital Investment Program which allows the state to be a limited investor in venture capital funds provided the fund has an office in the state and assists emerging New Mexico companies. The state also provides low cost loans for new business and facility construction. In addition, the state has several research parks (<http://www.bio.org/local/battelle2006/NewMexico.pdf>).

## **New York**

New York allows tax credits up to \$250,000 a year for a wide variety of expenses included research and development (Battelle, p.4). The state has also funded a 150,000 square foot Center of Excellence in Bioinformatics and Life Sciences at the State University of New York – Buffalo and a \$78 million facility at the State University of New York – Albany for the Center for Functional Genomics and other programs (Battelle, p.40). The state is also building a \$24 million Structural Biology Research Center for the Hauptman-Woodward Institute and a \$72 million Center for Genetics and Pharmacology at Roswell Park Memorial Cancer Institute. Several other construction projects throughout the state have also be financed (<http://www.bio.org/local/battelle2006/NewYork.pdf>).

The New York State Office of Science, Technology and Academic Research (NYSTAR) administers a Technology Transfer Incentive Program which makes grants up to \$750,000 over 2 years to support commercialization of university owned technology by a New York based firm provided the firm matches the grant on a 1 to 1 basis (Battelle, p.51). NYSTAR also provides funds to help researchers match federal awards. It also funds 15 Centers for Advanced Technology which are supposed to conduct applied research in conjunction with New York companies; 5 of these centers have a biotechnology focus (<http://www.bio.org/local/battelle2006/NewYork.pdf>).

The state also has a Qualified Emerging Technology Company tax credit program that include refundable tax credits up to \$250,000 per year for a firm involved in a research based business (<http://www.bio.org/local/battelle2006/NewYork.pdf>).

The state also has several local commercialization support programs, several related to the bioeconomy. The state's financing agency operates a Small Business Technology Investment Fund as well as making investments in venture capital funds (<http://www.bio.org/local/battelle2006/NewYork.pdf>).

New York also has several business incubators including eight that focus on the bioeconomy. There are also two bioscience research parks in operation and several more under development (<http://www.bio.org/local/battelle2006/NewYork.pdf>).

## **North Carolina**

North Carolina is using \$60 million of Tobacco Settlement funds for a Biomanufacturing and Pharmaceutical Training Consortium and is also using Tobacco Settlement funds for bioscience venture fund (Battelle, p.5).

The state also offers matching funds of up to \$50,000 for 3 years to match university and private sector contributions to joint research projects (Battelle, p.47).

The University of North Carolina system is building a new bioscience park north of Charlotte. A \$35 million College of Veterinary Medicine Research Building has been built at North Carolina State. Funding has also been provided for a Bioinformatics Research Center at the University of North Carolina – Charlotte and a new research and clinical facility at the University of North Carolina Cancer Center. A Cardiovascular Disease Institute at East Carolina University is also being constructed (<http://www.bio.org/local/battelle2006/NorthCarolina.pdf>).

The state has two types of bioscience grants available to university researchers: one for equipment and another for interdisciplinary research that emphasizes industrial applications. North Carolina State also offers matching grants for university-private sector research projects (<http://www.bio.org/local/battelle2006/NorthCarolina.pdf>).

The North Carolina Board of Science and Technology has a \$3 million fund for match for federal programs for pre-seed and seed capital projects. The Biotechnology Center also makes product development and proof of concept loans. There is also a tax credit program for small firms and licensees of the University of North Carolina system (<http://www.bio.org/local/battelle2006/NorthCarolina.pdf>).

The state also has several business incubators and research parks. It is also developing an authority to assist in facility financing (<http://www.bio.org/local/battelle2006/NorthCarolina.pdf>).

## **North Dakota**

North Dakota has created a Center of Excellence in Life Science and Advanced Technologies at the University of North Dakota (Battelle, p.xvii). This includes a 60,000 square foot, secured academic/industrial BSL-3 laboratory at the university (Battelle, p.50). The Centers of Excellence also fund academic-private sector projects provided that a match is provided (<http://www.bio.org/local/battelle2006/NorthDakota.pdf>).

The state has a Seed Capital Tax Credit as well as a venture capital tax credit. The State Bank of North Dakota, the only bank of its kind in the U.S., also maintains a New Venture Capital Fund that may make investments in firms using university intellectual property (<http://www.bio.org/local/battelle2006/NorthDakota.pdf>).

The state has two business incubators and two research parks (<http://www.bio.org/local/battelle2006/NorthDakota.pdf>).

## **Ohio**

Ohio's \$1.6 billion Third Frontier project so far has awarded \$180 million out of \$300 million to bioscience activities (Battelle, p. xvi). The Ohio Biomedical Research and Commercialization Program awards grants to support biomedical and biotechnology research, leading to commercialization and long-term improvements in the health of Ohioans (Battelle, p.43).

The state also provides funding for Omeris, a nonprofit organization designed to build and accelerate the bioscience industry, research and education in the state (Battelle, p.55).

The Wright Centers of Innovation is a grant program designed to support large scale world class research and technology development with the goal of commercialization, bioscience projects are considered. The Biomedical Research and Commercialization Program also provides grants to projects with a potential for commercialization (<http://www.bio.org/local/battelle2006/Ohio.pdf>).

The state provides pre-seed and seed capital funds for commercialization and pilot production activities. It also makes grants to venture capital funds to invest in Ohio firms (<http://www.bio.org/local/battelle2006/Ohio.pdf>).

The state offers a tax credit for firms that invest in research and development technology. Ohio also has several business incubators either in operation or under construction and three research parks in operation or under construction (<http://www.bio.org/local/battelle2006/Ohio.pdf>).

## **Oklahoma**

Oklahoma established a \$5.1 million Life Sciences Fund for seed capital. However, most of these funds have been invested (Battelle, p.57).

Oklahoma has created a Health Research Scientist Recruitment and Retention Program to support the research projects of health research scientists who are new to Oklahoma for a period of 1 to 3 years at a maximum of \$100,000 per year (Battelle, p.47).

The state has passed a bond proposal that will fund several capital projects including a Chemistry and Biochemistry building at the University of Oklahoma, an advanced technology research center at Oklahoma State University – Tulsa, and a health science and technology center at Oklahoma State University - Okmulgee (<http://www.bio.org/local/battelle2006/Oklahoma.pdf>).

There are several other buildings that have been constructed at various campuses in Oklahoma (<http://www.bio.org/local/battelle2006/Oklahoma.pdf>).

The Oklahoma Health Research Program awards seed funds for research projects related to human health. The Oklahoma Applied Research Support Program is a grant program that focuses on projects with commercial potential. A match is required (<http://www.bio.org/local/battelle2006/Oklahoma.pdf>).

The state has a seed capital program for start up technology companies. The Oklahoma Capital Investment Board provides funds to venture capital firms. The state also has a venture capital tax credit (<http://www.bio.org/local/battelle2006/Oklahoma.pdf>).

Oklahoma has one business incubator and one research park (<http://www.bio.org/local/battelle2006/Oklahoma.pdf>).

## **Oregon**

The state has recently constructed a \$113.4 million Biomedical Research Building at the Oregon Health and Science University in Portland. Oregon has also recently established a University Venture Development Fund that will pay for precommercialization research and other programs at Oregon universities. The source of funding is donations from taxpayers who receive a tax credit for their donations (<http://www.bio.org/local/battelle2006/Oregon.pdf>).

Portland State University provides mentoring for start up companies that facilitate the commercialization of Oregon universities' intellectual property (<http://www.bio.org/local/battelle2006/Oregon.pdf>).

The Oregon Growth Account uses lottery funds to invest in venture funds that are geared toward economic activity in the state (<http://www.bio.org/local/battelle2006/Oregon.pdf>).

Oregon has one research park (<http://www.bio.org/local/battelle2006/Oregon.pdf>).

## **Pennsylvania**

Pennsylvania has created several Keystone Innovation Zones (KIZs), similar to Michigan's SmartZones. Firms located in a KIZ can qualify for \$25 million in tax credits if they are early stage firms facing rapid revenue growth (Battelle, p.4). Institutions located in these zones also are eligible to compete for grants of up to \$250,000 to build infrastructure for collaboration and technology transfer (Battelle, p.51).

The Pittsburgh Life Sciences Greenhouse offers a Collaborative Research Fund that provides matching funds for projects with in state companies (Battelle, p.47). Life science greenhouses also exist in Philadelphia and in central Pennsylvania (Battelle, p.57). The University of Pittsburgh also recently opened a \$205 million Biomedical Science Tower (<http://www.bio.org/local/battelle2006/Pennsylvania.pdf>).



Several other health and research related facilities have been approved throughout the state, including facilities that focus on cancer, life sciences, and other types of research (<http://www.bio.org/local/battelle2006/Pennsylvania.pdf>).

The Commonwealth Universal Research Enhancement Fund provides grants to universities, research institutes and hospital statewide. This competitive grant program is funded by Tobacco Settlement dollars. The Ben Franklin Technical Development Authority can make grants for university research programs or consortia as well as capital projects. The Health Venture Account of the Tobacco Settlement Investment Board has invested more than \$50 million in Pennsylvania venture capital funds (<http://www.bio.org/local/battelle2006/Pennsylvania.pdf>). The state also provided \$60 million for the PA Venture Investment Program for venture capital partnerships, and a loan guarantee program (State of Pennsylvania, p.12). In 2004, the state allocated a total of \$175 million in the form of loans, tax credits and grants (State of Pennsylvania, p.23).

The University of Pittsburgh operates a Technology Commercialization Alliance for a gap fund that is available to researchers from the University of Pittsburg and Carnegie Mellon. Innovation Philadelphia uses local and state funds for pre-seed investment (<http://www.bio.org/local/battelle2006/Pennsylvania.pdf>).

The state has several business incubators in the state as well as several research parks (<http://www.bio.org/local/battelle2006/Pennsylvania.pdf>).

## **Puerto Rico**

Puerto Rico offers low tax credits for companies that use technologies that were not in existence before 200 (Battelle, p. 4). Firms in Puerto Rico also do not have to pay U.S. federal income tax and could be eligible for reduced tax rates on Puerto Rico taxes (PRIDCO). The territory has also allocated \$14 million for the Puerto Rico Science, Technology and Research Trust that will be make grants, loans, or other investments, including investments in biosciences (Battelle, p.40).

The Puerto Rico Industrial Development Company and the University of Puerto Rico has established \$40 million endowment to support the construction of research facilities. The University of Puerto Rico will also start construction of a 152,000 square foot Molecular Sciences Complex. This complex is part of the Puerto Rico Knowledge Corridor which is primarily geared to medical research and development (<http://www.bio.org/local/battelle2006/PuertoRico.pdf>).

The Industry/University Research Consortium (INDUNIV) has provided seed funding for a Center of Pharmaceutical Processing Research and a Center for Advanced Packaging Technologies. The packaging center is geared primarily towards to the pharmaceutical and medical device industries (<http://www.bio.org/local/battelle2006/PuertoRico.pdf>).

Puerto Rico will also construct a \$12.5 million Biotechnology Center for Research and Training I Bioprocesses. It is also in the process of adding incubation space at two of its research facilities (<http://www.bio.org/local/battelle2006/PuertoRico.pdf>).

The Puerto Rico Small Business Development Center has a Technology Development Commercialization Center that assists entrepreneurs in commercializing technology based products and services (<http://www.bio.org/local/battelle2006/PuertoRico.pdf>).

### **Rhode Island**

Voters in Rhode Island approved a \$50 million bond proposal for a Center for Biotechnology and Life Sciences at the University of Rhode Island-Kingston. The state has also provided financing to private firms for biomanufacturing facilities (<http://www.bio.org/local/battelle2006/RhodeIsland.pdf>).

The Slater Technology Fund makes investments of up to \$100,000 in start-up companies in the biosciences as well as other fields. The firm also provides space in an incubator. The Cherrystone Angel Group also makes pre-seed investments to firms including those in the biosciences (<http://www.bio.org/local/battelle2006/RhodeIsland.pdf>).

### **South Carolina**

South Carolina bioscience initiative is headed up by the state's Centers of Excellence program which provides funds for faculty recruitment and possesses the ability to bond for new facilities. Much of this funding has been used for facilities related to health care. State funding was also used for a \$27 million Biosystems Research Complex at Clemson University (<http://www.bio.org/local/battelle2006/SouthCarolina.pdf>).

South Carolina has recently passed legislation that will allow the state to borrow \$220 million for university facilities (Battelle, p.xvi). The state has also passed legislation that allows bioscience companies to take advantage of incentives providing the project results in \$100 million in investments or create 200 or more jobs that pay 1.5 times the state's per capita income (<http://www.bio.org/local/battelle2006/SouthCarolina.pdf>).

SC Bio, a collaborative of three of the state's universities and Greenwood Genetics Center operates a commercialization center as well as a business incubator. South Carolina also has a Venture Capital Authority which will manage a \$55 million fund of funds authorized by the state (<http://www.bio.org/local/battelle2006/SouthCarolina.pdf>).

Additional business incubators as well as bioscience research parks are in the planning stage (<http://www.bio.org/local/battelle2006/SouthCarolina.pdf>).

### **South Dakota**

South Dakota has created three new Centers of Excellence focusing on the biosciences (Battelle, p. xvii). This includes the Center for Infectious Disease Research and

Vaccinology at South Dakota State University, the South Dakota Signal Transduction Center at the University of South Dakota Cardiovascular Research Institute, and the Center for the Research and Development of Light-Activated Materials also at the University of South Dakota (<http://www.bio.org/local/battelle2006/SouthDakota.pdf>). The state also has a \$3 million Value Added Agricultural Fund that provides loans for feasibility and marketing studies for value added agricultural projects (Battelle, p.57).

The state has appropriated \$445,000 in Research Seed Grants to help South Dakota university researchers compete for federal grants. A match from the university is also required (<http://www.bio.org/local/battelle2006/SouthDakota.pdf>).

The state operates a Commercialization Office within the Department of Tourism and State Development to promote the commercialization of university research discoveries. It also has two entities, the Enterprise Institute based at South Dakota State and the Genesis of Innovation, that work with entrepreneurs in business development capital acquisition and other services (<http://www.bio.org/local/battelle2006/SouthDakota.pdf>).

South Dakota has a low interest loan program to make funds available to start up companies. The state has two business incubators and a bioscience research park is also under construction next to South Dakota State University (<http://www.bio.org/local/battelle2006/SouthDakota.pdf>).

## **Tennessee**

Cumberland Emerging Technologies is an incubator and a commercialization company that is a joint venture of Cumberland Pharmaceuticals, the Tennessee Technology Development Corporation and Vanderbilt University (Battelle, p.62).

The state also has a Center for Entrepreneurial Growth designed to link entrepreneurs to university research as well as financial services. Tennessee entrepreneurs also have access to seed and venture capital (<http://www.bio.org/local/battelle2006/Tennessee.pdf>).

Tennessee has several business incubators and research parks up and running or under construction (<http://www.bio.org/local/battelle2006/Tennessee.pdf>).

## **Texas**

Texas allocated \$50 million for start up costs for the Texas Institute of Genomic Medicine. Texas A&M was recipient of a new Interdisciplinary Life Sciences Building and a Veterinary Research Building addition as well as other facilities. The University of Texas system is in the middle of a \$3 billion construction program that will fund several bioscience facilities located at University of Texas campuses throughout the state (<http://www.bio.org/local/battelle2006/Texas.pdf>).

The state also has its own competitive research grant program, and provides funds to help researchers meet their match requirements for other grant programs. There is also a

Commercialization Grant Program that encourages university/industry collaboration (<http://www.bio.org/local/battelle2006/Texas.pdf>).

The Texas A&M system has recently created an Intellectual Property Office (<http://www.bio.org/local/battelle2006/Texas.pdf>).

There are several pre-seed and venture capital funds available to entrepreneurs. Some of these are funded by the state or by universities related entities (<http://www.bio.org/local/battelle2006/Texas.pdf>).

There are several business incubators and research parks in the state. Several additional research parks are under development (<http://www.bio.org/local/battelle2006/Texas.pdf>).

## **Utah**

The Utah Centers of Excellence Program received a one time increase of \$3 million to its budgets. This program is designed to identify university research programs with a strong commercialization appeal. The University of Utah offers grants for commercialization research (<http://www.bio.org/local/battelle2006/Utah.pdf>).

Utah has a state authority that will back a Utah Fund of Funds which provides venture capital to firms. The state also has one business incubator and two research parks (<http://www.bio.org/local/battelle2006/Utah.pdf>).

Several large scale bioscience facilities are in the proposed and are in the planning stage (<http://www.bio.org/local/battelle2006/Utah.pdf>).

In early 2006, the legislature passed Senate Bill 75 that established the Utah Science, Technology and Research (USTAR) initiative. Among other things, USTAR allows for \$110 million in capital facility bonds for the construction of laboratories and \$4 million in annual appropriations for USTAR centers throughout the state (Thomson and Webb, p. 15)

## **Vermont**

The University of Vermont has completed an addition to its Life Science Building. A new Plant Science Building is under construction. The university also has an Office of Technology Transfer designed to aid in the commercialization of the university's research results. There is also a business incubator at the university (<http://www.bio.org/local/battelle2006/Vermont.pdf>).

The state has a grant program for emerging businesses as well as a tax deferral program for capital gains provided the gain is used for a capital investment in an eligible business (<http://www.bio.org/local/battelle2006/Vermont.pdf>).

## **Virginia**

The University of Virginia is building a \$70.7 million research building, and Virginia Tech has constructed an Innovation Center for Biotechnology-Based Economic Development. The focus of the Virginia Tech facility is plant and microbe research and development for new biobased products (<http://www.bio.org/local/battelle2006/Virginia.pdf>).

The state also has a \$26 million initiative to leverage federal and private sector research at Virginia universities (<http://www.bio.org/local/battelle2006/Virginia.pdf>).

The Carilion Biomedical Institute is a partnership between the Carilion Health System, Virginia Tech and the University of Virginia. It invests in early stage companies. The state is also Home of the Virginia Biosciences Development Center, which attempts to provide business start-up assistance to life science companies located at the facility (<http://www.bio.org/local/battelle2006/Virginia.pdf>).

The state also has a pre-seed and seed capital program for start-up and emerging technology companies. It also provides an angel investor tax credit of 50 percent to individuals who invest in technology companies. Virginia also allows for a 100 percent sales and use tax exemption for company purchases used exclusively for research and development as well and manufacturers' purchases of production equipment (<http://www.bio.org/local/battelle2006/Virginia.pdf>).

Virginia also has several business incubators and research parks (<http://www.bio.org/local/battelle2006/Virginia.pdf>).

## **Washington**

The state of Washington created a \$350 million Life Sciences Discovery Fund that will allocate \$35 million annually from the Tobacco Settlement to support bioscience research with economic development potential (Battelle, p.xvi). In some respects this program is similar to Michigan's Life Sciences corridor (<http://www.bio.org/local/battelle2006/Washington.pdf>).

The state is also constructing a \$24 million Bioproducts, Sciences and Engineering Laboratory. Of this amount, \$13 million will be state funds. The University of Washington is constructing a \$150 million Bioengineering-Genome Sciences Building. Washington State University is building a \$57.1 million Biotechnology/Life Sciences Building (<http://www.bio.org/local/battelle2006/Washington.pdf>).

The state has recently started a Life Science Discovery Fund to provide public support for strategic life science research and development. A 2:1 match from other sources is required to qualify for funding (<http://www.bio.org/local/battelle2006/Washington.pdf>).

The Washington Technology Center has a series of grant programs across multiple disciplines that link Washington companies with researchers at Washington State and the University of Washington. The Washington Research Foundation, a nonprofit organization that was spun off from the Intellectual Property office at the University of Washington, offers a Gap Fund for precommercialization research. The university also has its own Technology Gap Innovation Fund (<http://www.bio.org/local/battelle2006/Washington.pdf>).

Washington also has pre-seed, seed and venture capital programs for emerging businesses as well as limited business tax exemption programs for emerging life science companies (<http://www.bio.org/local/battelle2006/Washington.pdf>).

The state has some business incubators and bioscience research parks (<http://www.bio.org/local/battelle2006/Washington.pdf>).

### **West Virginia**

There are several university bioscience facilities that are under construction or have recently been completed. These include: a Biotechnology Development Center at Marshall University which is geared toward commercialization of biotech research and development, a medical research facility for the Blancette Rockefeller Neuroscience Institute at West Virginia University, and other health related facilities at West Virginia University (<http://www.bio.org/local/battelle2006/WestVirginia.pdf>).

The Marshall University Forensic Science Center is creating a bacterial source database for tracking sources of bacterial contamination as the first step towards environmental remediation. West Virginia University has a Biometric Knowledge Center (<http://www.bio.org/local/battelle2006/WestVirginia.pdf>).

The Institute for the Development of Entrepreneurial Advances at Marshall University focuses on commercializing research results especially those in the area of biotechnology. The institute will assist in linking entrepreneurs with faculty members, build an incubator, and provide additional services for developing businesses. The Mid-Atlantic Technology, Research and Innovation Center is a nonprofit research and development corporation. It is designed to provide research and other services to assist in the development of new businesses and the commercialization of research discoveries (<http://www.bio.org/local/battelle2006/WestVirginia.pdf>).

The state has a venture capital arm that has invested in several venture capital funds. It also provides loans for fixed assets and loan insurance for businesses involved in technology based products and services. The state has several business incubators in operation or under development and one research park (<http://www.bio.org/local/battelle2006/WestVirginia.pdf>).

## Wisconsin

Wisconsin has undertaken several construction projects that will enhance its biotechnology sector. There is a \$100 million Microbial Sciences Building and a \$134 million Interdisciplinary Sciences Building under construction at the University of Wisconsin. A \$132 million research facility on infectious diseases, cardiovascular illness and bioengineering is planned for the Medical College of Wisconsin located in Milwaukee (<http://www.bio.org/local/battelle2006/Wisconsin.pdf>).

The state budget allocated \$2.5 million for Alzheimer's and Life Science Research at the University of Wisconsin Medical School. The university's Office of Corporate Relations through the Wisconsin Department of Commerce offers \$600,000 annually for the Industrial and Economic Development Research Program. This program offers faculty grants for applied research projects of interest to the private sector or likely to offer opportunities for additional support (<http://www.bio.org/local/battelle2006/Wisconsin.pdf>).

The Wisconsin Alumni Research Foundation (WARF) may be unique in the U.S. It is an independent foundation that returns patent license revenues back to the university through an annual grant program. The university also sponsors a First Look Investor Forum that introduces university spin-offs to sources of informal and formal capital (<http://www.bio.org/local/battelle2006/Wisconsin.pdf>).

The state funds the Wisconsin Entrepreneurs Network which provides commercialization services to firms. The state also provides Technology Assistance Grants to help companies hire consultants to assist in obtaining additional funding (<http://www.bio.org/local/battelle2006/Wisconsin.pdf>).

Wisconsin offer loans and grants to help businesses develop or commercialize new technology. Angel investors are eligible for income tax credits for investments in certain new businesses. The state also as organized a Wisconsin Angel Network which allows investors from all parts of the state to provide capital to start-ups located in the Madison or Milwaukee areas. The state has also invested in several venture capital funds (<http://www.bio.org/local/battelle2006/Wisconsin.pdf>).

The state also offers several tax incentives to businesses. Angel investors and seed capital investors can obtain tax credits. There are also tax credits for research and facility expenditures. Wisconsin also provides sales tax credits for manufacturing machinery and equipment, raw materials, and pollution abatement equipment (Forward Wisconsin).

The state has three business incubators and two research parks (<http://www.bio.org/local/battelle2006/Wisconsin.pdf>).

## **Wyoming**

The University of Wyoming has a Research Products Center which acts as an intellectual property office and also offers technical support to entrepreneurs. The state's Business Council offers grants to firms that are in the first stages of development (<http://www.bio.org/local/battelle2006/Wyoming.pdf>).

## **Foreign Nations**

### **Belgium**

The University of Liege has several programs to assist in business development. This includes business services to emerging enterprises, a small seed capital fund, and an Intellectual Property Office. The university also administers an incubator (Unversite de Liege).

### **Canada**

*British Columbia* provides a tax credit on research and development costs for Canadian firms as well as tax credits for income earned as a result of patents (Leading Edge British Columbia).

*Ontario* has five Centres of Excellence including four that possess some applications in the bioeconomy. These centers are able to invest in research and offer other services to potential entrepreneurs (Province of Ontario).

*Quebec* offers several incentives to biotechnology firms. Companies that locate in one of the four Biotechnology Development Centres in the province may be eligible for a tax credit on: 30 percent of the wages paid to an employee, 30 percent of the cost of acquiring or renting eligible goods, and 30 percent of eligible rental fees for specialized facilities (Invest Quebec).

Quebec also offers a range of loans, loan guarantees and other financing options as well as investing in venture capital (Invest Quebec).

*Saskatchewan* purports to have several tax advantages. It has the lowest corporate tax rate in Western Canada for manufacturers and processors. It also provides a 15 percent tax credit for scientific research and development spending, and a 7 percent provincial tax credit for equipment purchases (Saskatchewan Industry and Resources).

### **Finland**

The Finnish Funding Agency for Technology and Innovation (Tekes) provides funding and business support for emerging firms, research and development projects as well as university research. Tekes also aids in linking foreign firms with Finnish firms and



sponsors an exchange program which allows Finnish researchers to work at the University of California – Berkeley. (Tekes).

### **Iceland**

Iceland's corporate income tax rate is 18 percent. There is no local tax, nor is there any taxation of dividends received by corporations. While not a direct government policy, the lack of genetic diversity of the population and good genetic and medical records has made Iceland attractive for conducting clinical trials (Invest in Iceland Agency, p.22,7).

### **Ireland**

From 2000 to 2006 the Irish government has spent \$3 billion in research (Focus on Ireland, p.28). The Irish development agency, Enterprise Ireland operates a Commercialization Fund; funding is provided on a competitive basis for proof of concept, technology development and business development (Focus on Ireland, p.20). Seed capital and venture capital are also provided by the government (Focus on Ireland, p.22).

Enterprise Ireland also supports six business incubators that are focused on the biosciences (Focus on Ireland, p.22).

### **Malaysia**

Malaysia has established a Biotechnology Corporation. The corporation's mandate is to be a one-stop center for biotechnology. The three main areas of emphasis for the corporation are agricultural biotechnology, healthcare biotechnology and industrial biotechnology (Malaysian Biotechnology Corporation, p.9). These areas of emphasis are supported by the establishment of three centers of excellence: the Agri-Biotech Institute, the Pharmaceutical and Nutraceutical Institute and the Genome Institute (Malaysian Biotechnology Corporation, p.9).

Malaysia also has several business incubators, most of which are aligned with universities (Malaysian Biotechnology Corporation, p.12).

Funds have also been set aside for investments in biotechnology firms. These funds are targeted to companies in the early or expansionary stages of research and development and commercialization (Malaysian Biotechnology Corporation).

### **Norway**

Norway is in the process of establishing a Biopolis, a cluster of bioscience related institutions in As near Oslo. Participating institutions include: the Norwegian University of Life Sciences, the Norwegian Institute for Aquaculture, the Norwegian Institute for Agricultural and Biological Research, the Norwegian Food Research Institute, and the Norwegian Forest Research Institute. Biopolis also includes a commercialization arm,

Bioparken AS, which aids in intellectual property issues, negotiates license agreements and operates a business incubator among other services (Biopolis).

## **Sweden**

Sweden has five Biotechnology clusters that are designed to improve effective collaboration between universities, the private sector and government (Eames b, p.8). The Swedish government has also appropriated approximately \$317.5 million to the scientific community over the next four years, and has promised to put 1 percent of GNP into scientific research (Eames a, p.24).

## **Switzerland**

Switzerland's primary focus on the biosciences is through the Innovation Promotion Agency (CTI). The Life Sciences section of the CTI provides funding for public/private research usually at a 50 percent of the total cost of the project. The organization also provides business assistance to start up businesses (Swiss Biotech Report, p.10).

## **Michigan's Competitive Position**

Michigan's offering of business services, subsidies tax breaks, etc. are similar to those of other states. Michigan's investment for capital outlay projects for universities also appears to be similar to other states. However, the state is not perceived to be a leader in the bioeconomy.

While somewhat simplified, Michigan does not rank among the top 16 states and Canadian Provinces in the number of biotechnology companies. California and Massachusetts clearly dominate the biotechnology sector (Hildreth, p.24). It is not surprising that these states also have large university sectors.

There are two areas where Michigan can improve its competitive position. The first is by providing venture capital and business development services to emerging firms. Michigan does not appear to offer the access to credit, and support to new entrepreneurs that other states offer. The second area for improvement is in the realm of commercialization of university research. While the structure of commercialization appears to be in place, the actual level and pace of transfer of university intellectual property appears to be lacking. Formal programs similar to Wisconsin's First Look program may foster the commercialization of research results and lead to enhanced economic growth in the economy.

## **Conclusion**

Industries in the bioeconomy are becoming a major source of employment. Furthermore, jobs in these industries tend to pay high wages. This paper outlined the major bioeconomy initiatives undertaken by each state in the U.S. and by several foreign countries. Every state is involved in some way or another in the bioeconomy. Many

foreign nations, especially those in Europe and East Asia are also involved in developing bioeconomy industries and products. The level of business services, tax credits, and other incentives Michigan offers is typical of many states.

However, in some respects Michigan appears to trail other states and countries. Michigan's support of venture capital is not as great as many states. Also, the state lags behind many in providing business support services to emerging entrepreneurs. Finally, the state's universities are not as effective as universities in other states in commercializing and transferring intellectual property to the private sector. If the state addresses these shortcomings, it has the potential to be a leader in a wide range of bio based industries.

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