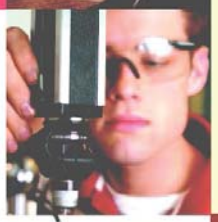
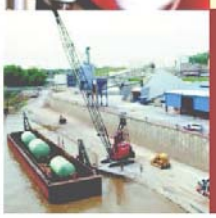
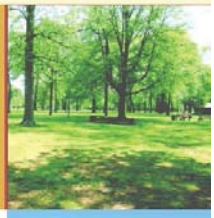
Greater Owensboro
ECONOMIC DEVELOPMENT CORPORATION

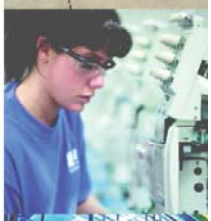
Strategic Plan for the Development of a Life Sciences Initiative in the Greater Owensboro Community

Greater Possibilities









Greater Owensboro
ECONOMIC DEVELOPMENT CORPORATION

Owensboro's economic development agency, Greater Owensboro Economic Development Corporation, is a public/ private partnership formed to attract and to grow primary employers.

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Introduction

In the highly competitive world of economic development, manufacturing companies have been the gold standard for attraction and retention to Kentucky. In recent years there has been a significant outflow of manufacturing jobs to offshore locations and developing markets where labor costs are significantly lower. This shift in market demographics compels a reexamination of economic development strategies, tactics and focus.

Kentucky's highly regarded university system produces thousands of graduates each year. Prior to the recent global economic shift, Kentucky's success in attracting new manufacturing firms allowed many of these graduates to be absorbed into the workforce. As the U.S. economy has shifted away from traditional manufacturing, Kentucky failed to keep pace and now more emphasis must be placed on developing an economy that not only retains these graduates but also harnesses their collective talents to support a continuing upward spiral in economic activity. The term "brain drain" has become very familiar to most community leaders, and it is generally recognized that this issue must be addressed in a substantive fashion.

The best case scenario for Kentucky and for Owensboro is a comprehensive commitment to the development of a statewide strategy that will retain the brightest of Kentucky's residents and provide jobs for the graduates of our higher education system. The Owensboro community has the opportunity to take a major leadership role in the development and implementation of an important component of what could become a statewide strategy.

This report examines the community of Owensboro and what actions the community can take to optimize its opportunity for growing and retaining knowledge based jobs in the area of life sciences.. This report will lay out a strategy for the creation, retention and attraction of key industry that could have a significant impact on the community. It must be emphasized that the authoring of a strategic plan will not have an impact on the community, unless a significant commitment is made to implementation of the plan. There are no quick fixes in today's fast moving world of economic development and any effort must be approached as a long term strategy. But a long term strategy should not be used as an excuse for slow response, or slow implementation. Opportunities arise that require fast and decisive action.

The pursuit of a knowledge based economy should not mean the abandonment of traditional economic development activities. The Owensboro community and its leaders have taken the first step towards a new way of thinking for a well coordinated local economic development initiative. This bold step requires the assumption of risk, but it also holds the promise of tremendous rewards for Owensboro.

Executive Summary

While traditional economic development activities involving the attraction of manufacturing jobs are critical to the success of an overall economic development strategy, the development and execution of a strategy targeting the creation of a knowledge based economy will determine the future of communities like Owensboro. Creation of this new economic development approach requires different priorities and reliance on assets different than those so critical to the industrial attraction approach. Owensboro is fortunate to be blessed with certain assets that not only make a life sciences based strategy viable but also provide the community with a distinct competitive advantage.

The following report looks at potential opportunities for the community of Owensboro to attract and retain knowledge based jobs in a niche where it has some defined competitive advantage or other reason to believe that it can succeed. This report focuses on a knowledge based economy , but should be taken as a key part of an overall economic development strategy. The following are areas in which existing assets are on the ground, and should allow Owensboro a significant competitive advantage:

- Plant Made Pharmaceuticals (PMP)- The production of pharmaceuticals and other proteins in plant sources is an emerging technology that has the potential to revolutionize the pharmaceutical industry. Large Scale Biology Corporation has developed a one of a kind, world class facility for the production of PMPs located in Owensboro. With LSB's recent demise emphasis should be placed on leveraging this facility, without regard to LSB, as an asset for the community of Owensboro to be a world leader in PMP production.

- Natural Products- Natural products covers a broad range, although the traditional definition is a product that is produced, or exists in nature. Owensboro Grain Company is a world class producer of commodity natural products (crude soybean oil, refined soybean oil and soy meal). An opportunity could exist for the production of value added niche products that leverages the infrastructure developed by OGC.

- Cancer Research- The Owensboro Medical Health System is the largest employer in the community. A partnership with the James Graham Brown Cancer Center at University of Louisville could hold tremendous opportunity for Owensboro to attract world class researchers and innovative new health care treatments.

Objectives of the Strategic Plan

1. Create and optimize an environment that is conducive to creating new companies and the attraction and growth of life science companies in Owensboro
2. Develop a proactive plan for attracting life science companies to Owensboro
3. Develop a communications plan for informing the community and community and state leaders of the opportunities and the potential for attracting these industries
4. Identify and obtain the funding and financial support necessary to implement and sustain the effort

Recommendations:

Leverage the Kentucky Bioprocessing facilities to become a world leader in Plant Made Pharmaceuticals- The Owensboro Medical Health System has recently taken the bold step of establishing Kentucky Bioprocessing, LLC to tender an offer to purchase the former Large Scale Biology Corporation facilities. The facilities were designed to extract highly valuable proteins from plant materials. No other facility in the world possesses the capabilities that the Kentucky Bioprocessing facilities have. Coordinated efforts with OMHS and Kentucky Bioprocessing should be made to establish Owensboro as the world leader in Plant Made Pharmaceuticals.

Better coordination of efforts- It is critical that community leaders who are involved with economic development be aware of the respective efforts of their counterparts.

Better define the role of the Owensboro Biotechnology Alliance (OBA)- The OBA has the opportunity to assume a major leadership role in the efforts described in this report. This role should be clearly defined and community and state leaders should be briefed on this role.

Assume a leadership role- There is currently a vacuum of leadership in the state on the front of life sciences.

Establish relationships with key companies- There are a handful of companies that are leading the way on PMP research. A designated community representative should make contact with those companies.

Leverage existing assets- Build upon the existing assets in the community, including the hospital, the LSBC facility, OGC and the post secondary institutions.

Develop a communications plan- Long term efforts require the communication of the benefits of those efforts to the citizenry. This communications plan will be essential to the effort to raise funds sufficient to develop and sustain the effort

Establish a position that has clear responsibility for execution- It is important that a single individual have responsibility for executing the strategy outlined in this report.

Most fundamentally an effort should be made to analyze the entire life cycle of a typical life sciences company. With this analysis the community should align its efforts to create programs or opportunities addressing every possible stage to enhance its potential for growing, attracting and retaining these firms.

Conclusion

Owensboro has an opportunity and is taking decisive steps that could have a significant impact on the local economy. These efforts are not without risk, but they do hold the potential for a significant long term positive impact on the community. The proposed recommendations and implementation plan described in this report provide the general direction for the first steps that are required. This plan will need to be modified and adjusted as progress is made.

SWOT Analysis

It is important to have a realistic understanding of where the community stands. The following is an analysis of the community's Strengths, Weaknesses, Opportunities and Threats (SWOT). By understanding what our strengths are we can build upon those. Conversely, by understanding what our weaknesses are, we can address those appropriately.

I. Strengths
   a. Existing assets
      i. Large Scale Biology Corporation's (LSBC) facilities
      ii. Owensboro Grain Company
      iii. Planet Biotechnology
      iv. Hospital
      v. Community Colleges
      vi. Western Kentucky University
      vii. University of Louisville Collaboration
      viii. Kentucky Wesleyan College
   b. Community willingness to pursue a strategy
   c. Low cost of living
   d. Department of Commercialization and Innovation
   e. Owensboro Biotechnology Alliance
   f. Strong relationship with the Kentucky Tobacco Research and Development Center
   g. Kentucky Natural Products Fund
   h. Kentucky Seed Capital Fund
   i. Experience growing genetically modified tobacco
   j. Political strength of the state
      i. Senator Mitch McConnell- Senate Majority Whip
      ii. Congressman Hal Rogers- Appropriations Committee
      iii. Congressman Ron Lewis
   k. Tradition of innovation and excellence in agriculture

II. Weaknesses
   a. Location- Considered remote by many people
   b. Lack of critical mass of industry
   c. Lack of leadership within the state
   d. Lack of significant capital resources
   e. Internal perception within the state that Kentucky can't compete in areas where technology is involved

III. Opportunities
   a. LSBC facility being utilized by other companies
   b. Plant made pharmaceutical companies are familiar with Owensboro
   c. The Kentucky Natural Product Fund- opportunity to get additional funding
   d. Kentucky Seed Fund- Opportunity to get funding in Owensboro
   e. Owensboro could become the world leader in plant made pharmaceuticals which could become a multi-billion dollar industry
   f. Possibility of creating a locally controlled investment fund as a means for investors to support local economic development AND achieve a direct financial benefit

IV. Threats

a. LSBC facility could become unavailable- the company has recently gone out of business and has filed e for bankruptcy or sell the facility to a company without an interest in community involvement
b. Community could lose interest in a long term strategy
c. All efforts to attract new companies could fail
d. State leaders could take a hostile position on the attraction of companies to Owensboro and life science companies in general

Existing Resources

Kentucky Bioprocessing, LLC

As of the date of this report, Kentucky Bioprocessing was moving forward with its attempt to acquire the facilities and assets necessary to operate the former Large Scale Biology facility as a contract bio-manufacturer of plant made pharmaceuticals (PMPs). This would be the worlds only full scale PMP bio-manufacturing facility and would place Owensboro in a strong position to become home to many of the companies and operations attempting to develop and grow within the PMP industry. The Kentucky Bioprocessing facility is very unique and provides the Owensboro community with a significant advantage within the PMP community.

Owensboro Grain Company

OGC has made significant investments in the community building manufacturing facilities. Although OGC currently produces commodity products from soybeans, the existing infrastructure could be utilized to produce value added niche natural products. The expertise in extracting low value materials from high volumes of soybeans could be used to extract other materials from plants. OGC currently produces crude soybean oil, refined soybean oil and soybean meal. Plans are under way for OGC to build a new facility that would produce biodiesel. Additional opportunities could be available for OGC as they seek to expand their business beyond their current core business.

The Owensboro Medical Health System

The Owensboro Medical Health System is the largest employer in the area with over 2,600 employees. Other communities have leveraged the investments that have been made in their hospital systems to anchor their life sciences business attraction efforts. OMHS has physical assets that could be leveraged, but also has tremendous influence and economic capabilities that should play a major role in the development of a life sciences strategy for Owensboro. OMHS recent commitments to its Cardiovascular and Cancer programs are examples of the economic impact of this facility. These efforts and their related research components should be communicated to the community at large and embraced as a key component of the strategy. As of the date of this report, OMHS has taken the bold step to tender an offer to purchase the existing facilities of Large Scale Biology Corporation. This leadership should be rewarded by continued community support and the development of efforts and programs that will help to insure the success of OMHS' efforts in regards to these facilities.

Planet Biotechnology

Planet Biotechnology is a small biotechnology company based out of Haywood, CA that has produced product in the LSBC facility and has a local presence in Owensboro. Although it is an early stage

company and does not have tremendous financial resources that it can bring to bear, it does represent an asset on the ground in the community. Planet Biotechnology has partnered with LSBC in 2004 and 2005 for the isolation of their proprietary product from tobacco. This partnership is an example of the importance of the LSBC facility and how it can be leveraged in the future to attract additional PMP companies. Planet Biotechnology has expressed an interest in expanding their operations in Kentucky and could be a valuable partner in the future.

The Kentucky Tobacco Research and Development Center

Although they are located in Lexington, the Kentucky Tobacco Research and Development Center (KTRDC) is a very valuable asset to the Owensboro Community. The strong relationship with LSBC, Planet Biotechnology and other PMP companies has been fostered from the innovative research and collaborations that have been orchestrated by KTRDC. KTRDC is a strong advocate for PMP technology and continues to foster important relationships that could be very valuable to the Owensboro community down the road. Dr. Maelor Davies, the Executive Director for KTRDC is a member of the Owensboro Biotechnology Alliance and is a tremendous asset to Owensboro and the Commonwealth of Kentucky. His leadership and advocacy of plant made pharmaceuticals has put Owensboro in a position to be a world leader of PMP products.

James Graham Brown Cancer Center

The James Graham Brown Cancer Center has made tremendous strides in the care and treatment of cancer patients. Dr. Don Miller, the Director of the center is a visionary who has commercialized cancer treatments and is leading the way for the cancer center to become the states only Comprehensive Cancer Center. Collaborations with James Graham Brown Cancer Center has the potential to impact the quality of health care in the Owensboro community, and has the potential for significant economic development opportunities. The Brown Cancer Center's proposed collaboration with OMHS is one of the most promising components of the life sciences strategy. This collaboration holds the promise of not only improving cancer care in the Owensboro area but is also fully aligned with the PMP component of the strategy.

Pedia Research, LLC

Pedia Research, LLC is a contract research organization based in Owensboro. They conduct clinical research in the pediatric population. The company provides investigators, study coordinators and other resources for the clinical study of infants, children, adolescents and adults. The company carries out clinical studies to establish the efficacy of pharmaceuticals and other health care products.

The Kentucky Natural Products Fund

In 2003 the General Assembly appropriated $5 million to be used for venture capital investment in natural products companies. To date $1.5 million has been invested and the fund recently fell under new management. The remaining $3.5 million could play an important role in the attraction of early stage natural products companies to Kentucky.

Owensboro Community Technical College

Working with Large Scale Biology, Owensboro Community and Technical College developed the first Biotechnology Associate Degree in the state in 2001. The Biotechnology program at OCTC is

housed in a well equipped laboratory on the main campus and will have an additional laboratory in the new Advanced Technology Center (ATC) presently under construction. Additionally, incubator space in the ATC is planned to accommodate potential biotechnology start up companies. A few feet from the ATC is a greenhouse, acquired through the support of a grant obtained in partnership with the Owensboro Biotechnology Alliance. The college has been a partner with the Alliance since its formation. Dr. Scott Williams, a senior faculty member at OCTC is the representative to the Alliance and heads up the biotechnology program.

Kentucky Wesleyan College

Kentucky Wesleyan College offers a tradition of teaching excellence in science. The program is led by an experienced and highly credentialed faculty including three professors with Ph.D's in chemistry, three professors with Ph.D's in biology, and one professor with a Ph.D in nuclear physics.

The Yu Hak Hahn Center for the Sciences opened in fall 2005, offering state-of-the-art classrooms, seminar rooms, labs and faculty offices for biology, chemistry, environmental science and physics. Area business and industry will benefit from the laboratory space available for research and development purposes. Wireless internet service also is available throughout the campus located in the heart of Owensboro, Kentucky.

Brescia University

Brescia University is an independently supported, Catholic, coeducational institution with a campus in downtown Owensboro. Brescia offers undergraduate and graduate course work for career preparation firmly rooted in the liberal arts with degrees in various arts and sciences disciplines. Specific to the sciences Brescia offers bachelor of science degrees in biology, chemistry, and physical science. Additionally, the William H. Thompson School of Business at Brescia has a highly regarded business and management program with bachelor of science degrees in accounting, health care administration, finance and economics, management, and human resource development. The school offers a master of science in management and utilizes a weekend college format for non-traditional students.

Recommendations and Implementation

Support Kentucky Bioprocessing, LLC and its efforts to establish Owensboro as the epicenter of the Plant Made Pharmaceutical industry- The Owensboro Medical Health System has taken a bold leadership role in establishing Kentucky Bioprocessing, LLC (KBLLC) to pursue the purchase of necessary assets from Large Scale Biology Corporation for the operation of the Owensboro facility as a contract and research bio-manufacturing facility. The community should coordinate to assist OMHS and KBLLC in their efforts to establish Owensboro as the PMP capital of the world.

Implementation Plan

The Owensboro community should work to improve the operating environment by establishing a statewide leadership position in the development and creation of policies, programs and legislation. The EDC could dedicate a specific portion of its marketing budget, time and rescources to develop relationships and knowledge within the PMP industry. Part of this could be to undertake an analysis of small PMP firm needs and attempt to create local programs that would meet those needs. A strong asset for these companies would be the establishment of a locally controlled early stage investment fund to take equity positions in start up and young PMP firms.

The EDC and other economic development agencies should work with KBLLC in establishing a formal community marketing and outreach program to introduce Owensboro to the PMP industry. The objective would be to help KBLLC attract customers and for Owensboro to attract those customers to establish local facilities of their own.

Better coordination of efforts- It is critical that community leaders that are involved with economic development be aware of the respective efforts of their counterparts. Efforts associated with the hospital, the cancer center and the Owensboro Biotechnology Alliance should be coordinated.

Implementation Plan

Key individuals need to be appraised and continually updated on the progress of efforts. A board should be established with the key players that meets on at least a quarterly basis. Preliminary recommendations for the composition of this board include: the Mayor; the county Judge Executive; the Chairperson of the Owensboro Biotechnology Alliance; the CEO of the hospital; the CEO of Owensboro Grain; the Director of the Owensboro Economic Development Corporation; ; a representative from the University of Kentucky; a representative from the University of Louisville; a representative from Western Kentucky University; the Presidents of Owensboro Community and Tehnical College, Kentucky Wesleyan College and Brescia University; and a representative from the state (the ICC Director may be the logical choice for this position). This board should be responsible for updating the strategic plan and overseeing the tactical implementation of the plan. Monthly updates via e-mail should be a part of this implementation.

Better define the role of the Owensboro Biotechnology Alliance (OBA)- The OBA has the opportunity to assume a major leadership role in the efforts described in this report. This role should be clearly defined and community and state leaders should be briefed on this role.

Implementation Plan
OBA could become a key player for the implementation of this strategic plan. If it is to be a permanent entity its composition must be changed to reflect the broader mission of the entire life sciences strategy. Key players will need to participate on this board and the overall mission of the OBA will need to be adjusted. One option would be to restructure the OBA to place it as an arm of the EDC and to allow it to provide input into EDC policies and programs.

Assume a leadership role- There is currently a vacuum of leadership in the state on the front of life sciences. Owensboro has the opportunity to play a statewide leading role in the area of life sciences.

Implementation Plan
The Kentucky Life Sciences Organization (KLSO) and the Governor's Consortium on Life Sciences have been inactive for the past year. There is a plan to disband the KLSO and reconstitute a new corporate entity that will be the state BIO affiliate. Owensboro has the opportunity to be at the forefront of this effort. Resources used for the implementation of this plan could be directed to assist in the reconstitution of the KLSO with requirements that the organization be based in Owensboro.

Establish relationships with key companies- There are a handful of companies that are leading the way on PMP research. A designated community representative should establish a relationship with each of these companies to inform the companies of the opportunities in Owensboro.

Implementation Plan
Identify and contact companies that may have an interest in locating to Owensboro. These companies will play an important role in this strategic plan and a visit should be made to their offices.

Leverage existing assets- Build upon the existing assets in the community, including the Hospital, the LSBC facility, OGC and the community college system. KCTCS/Owensboro Community College should be engaged to assure that the programming and curriculum at the new advanced technology center is fully aligned with this economic development strategy. Further, OCTC, KWC, WKU, and Brescia University should be engaged in an effort to leverage the unique capabilities that each institution can bring to the science and business components of this effort.

Develop a communications plan- Long term efforts require the communication of the benefits of those efforts to the citizenry. A communications plan should be developed to inform the public of the efforts being made.

Implementation Plan
A press conference to roll out this report should be the first step in a communications plan. Local press and community leaders should participate in the rollout with the delivery of a power point presentation. Brief reports should routinely be made at the board meetings of the EDC, and other appropriate local government functions on the efforts being made. A quarterly report should be provided to the oversight committee that lays out the progress which has been made and any recommended changes to the plan.

Establish a position that has clear responsibility for execution- It is important that a single individual have responsibility for executing the strategy outlined in this report.

Secondary Recommendations

Coordinate with State officials- State officials should be appraised of the efforts that are being made and regular communications should take place with the Department of Commercialization and Innovation.

Identify and facilitate resources for companies- Kentucky has multiple programs that could be implemented to attract companies to Kentucky. Some of those include the Kentucky Natural Products Fund, the Kentucky Innovation and Research Fund, the Rural Innovation Fund, and the SBIR phase 0 program. An effort should be made to identify and facilitate the utilization of these resources for companies interested in moving to Owensboro.

Work to have the bi-annual Plant Made Pharmaceutical conference held in Kentucky- Every other year a PMP conference is held in Montreal in February. Efforts should be made to have the 2007 conference held in Kentucky.

Appendices

Overview of the Life Sciences Industry

Generally when we discuss Life Sciences we are talking about industries encompassed by one of the four following sectors: pharmaceuticals, biotechnology, medical devices and diagnostics. Although these sectors have distinct differentiating aspects, they share much in common. The unifying thread that makes them part of the life sciences is their direct involvement with living organisms. Some other commonalities include: highly regulated; address very multi-billion dollar markets; and are highly technical.

Pharmaceuticals

In 2003 the world wide pharmaceutical market was nearly $460 billion. Pharmaceuticals generally involve small molecules that have a beneficial biological impact. Many pharmaceutical products such as aspirin, were originally isolated from natural sources, but are now made synthetically. The research and development process for the regulatory approval of pharmaceuticals is very expensive and time consuming. It is estimated that the average cost to develop a new drug is over $800 million dollars. It can take up to 12 years from the time a new drug is discovered, for it to make it through the regulatory process and gain market approval. Pharmaceuticals are regulated by the FDA.

Biotechnology

The biotechnology market can be broke into several components. Those include ag-biotech (like Roundup Ready soybeans), healthcare (biotechnology based drugs), nutraceuticals, and biotech diagnostics. Biotechnology is the use and manipulation of microorganisms, such as cells or bacteria, to accomplish tasks. Biotechnology based drugs are generally large molecules, called proteins, that are too complex to produce synthetically. Ag-biotech is generally regulated by the United States Department of Agriculture, biotechnology based drugs, nutraceuticals and diagnostics are regulated by the FDA.

Medical Devices

Pharmaceuticals and biotechnology use drugs to achieve a beneficial biological impact and medical devices use engineered tools. A few examples of medical devices include catheters, cardiac assist devices and dialysis machines. Medical devices are regulated by the FDA.

Diagnostics

The pharmaceutical, biotechnology and medical device sectors all address the treatment of disease. Diagnostics is the sector of life sciences that is involved with identifying the disease. The area of diagnostics includes x-rays, nuclear magnetic resonance imaging, and antibody based diagnostics. Diagnostics are also regulated by the FDA.

GOVERNOR'S LIFE SCIENCES CONSORTIUM: EXECUTIVE SUMMARY OF RECOMMENDATIONS

Kentucky's economy has historically been fueled by our signature tobacco, bourbon and equine industries. As the Commonwealth has become competitive in attracting and growing automobile manufacturers, Kentucky has become known as a world class manufacturing state. This report outlines a strategy for leveraging current assets and developing new opportunities, to enable Kentucky to emerge as a recognized world leader in the area of the life sciences. The implications of embarking on this endeavor go well beyond the primary potential economic impact, as the Commonwealth pursues new businesses and industries that reflect emerging biological and technological research and advancement. Kentucky is uniquely positioned to be recognized as a state that leads the world in areas that heal and bring life to its citizens.

The Life Sciences industry consists of several different sectors that include: pharmaceutical, nutraceutical, biotechnology, medical devices, bio and health informatics and services related to these respective sectors. For example, just in the area of biotechnology, the industry has mushroomed since 1992, with U.S. revenues increasing from $8 billion in 1992 to $39.2 billion in 2003. Similar such growth patterns are emerging in nearly every other area of the Life Sciences as well. According to a recent survey conducted jointly by the Kentucky Science and Technology Corporation and the Kentucky Life Sciences Organization, there are approximately 200 life science related companies in Kentucky. Kentucky has a minimally established base in the industry, but as a number of national studies indicate, Kentucky is not maximizing its resources.

Kentucky is considered to be an emerging novice state in the life sciences area, particularly with respect to the commercialization of research. Although several national reports on this area have placed Kentucky 48th or 49th position in the nation, a recent article in The Chronicle of Higher Education referenced the impressive gains made by the University of Kentucky and the University of Louisville in attracting federal research funding and potentially patentable inventions. The Life Science/Bioscience Consortium Report identifies areas in the life sciences in which Kentucky has both resources and assets that could be leveraged to significantly improve the Commonwealth's prosperity within this sector. With the proper utilization of existing resources, the development of key new programs, strong leadership within state government and coordinated efforts among all programs and stakeholders, Kentucky has the opportunity to become a world leader in specific niches of the life sciences industry and to develop world-class status in others. However, now is the time for Kentucky to act. The Commonwealth is already facing strong competition from Iowa, South Carolina, North Carolina, Indiana and other states in the vigorous quest to commercialize bioscience research.

The strategic areas of focus (those areas in which world class status will be sought) identified by Governor Fletcher's Life Sciences/Biosciences consortium are:

Natural Products
Medical Devices
Health Technology Services
Niche Pharmaceuticals and Niche Biotechnology

In addition, these areas of focus have the potential to dramatically impact the therapeutic categories of cardiovascular, oncology and neurosciences.

The following descriptions outline the strategic focus areas identified and recommended by the Consortium.

Natural Products
The natural products industry encompasses a portion of the pharmaceutical industry, the biotechnology industry and the entire nutraceutical area including the functional food and ag-biotech industries. If a compound or product is produced in nature by a plant, animal or microorganism, it is considered a natural product. The Consortium has identified Natural Products as an area of focus because of the assets within the state that provide a foundation for this sector. Those assets include: the Kentucky Tobacco Research and Development Center, which conducts unique commercialization research on plant-made pharmaceuticals and other natural-products opportunities for Kentucky agriculture; Large Scale Biology Corporation which has a state of the art manufacturing facility in Owensboro for plant made pharmaceuticals; Alltech, a Kentucky based company in Nicholasville that utilizes biotechnology to produce world renowned animal feeds; and Martek, a company with manufacturing facilities in Winchester that produces docosahexanoic acid (DHA) from marine algae for use in baby formula.

Medical Devices
Medical Devices are devices that are used to enhance patient health. Often times these devices are used in surgical procedures. Examples of medical devices range from catheters to sophisticated electronic devices that are used to enhance patients' health. The Consortium has identified Medical Devices as a strategic area of focus because of the assets within the state that can build on this sector. Those assets include: MedVenture Technologies, a Louisville based company that engineers, designs and manufactures state of the art medical devices; engineering programs at both the University of Kentucky and the University of Louisville that have the potential to develop new medical devices; the Cardiovascular Innovation Institute partnership between the University of Louisville and Jewish Hospital; and the close proximity to United Parcel Service, which allows for the efficient and rapid delivery of time sensitive medical devices.

Health Technology Services
Health Technology Services is an area of the life sciences that includes bioinformatics, biologistics, diagnostics and other services involving the application of technology to life sciences. The Consortium has identified Health Technology Services as a strategic area of focus because of related assets within the state that can enhance this sector. Those assets include: Advanced Imaging Concepts (AIC), which is a company that digitizes computer records; Humana, a major health care company that has spun out multiple new companies that utilize technology to provide services in the life sciences area; and the close proximity of United Parcel Service which can provide significant opportunities in the area of biologistics.

Niche Pharma and Niche Biotechnology
Niche Pharma and Niche Biotechnology involve areas of the pharma and biotech industry that do not involve big pharma and big bio. These areas include specialty pharma, formulation work, and niche manufacturing. The Consortium has identified Niche Pharma and Niche Biotechnology as a strategic area of focus because of the assets within the state that can build on this sector. Those assets include: The Center for Pharmaceutical Science and Technology at the

University of Kentucky that will be applying advanced manufacturing concepts to meet current good manufacturing practices (cGMP) for production of niche products; a prestigious School of Pharmacy at the University of Kentucky that is ranked 3rd in the nation and has considerable expertise in formulation work; and companies such as Xanodyne and Pediamed that are specialty pharmaceutical companies.

Further explanations of these areas will be discussed in the report. It should be noted that these areas of focus should not be used to exclude programs or opportunities that are later identified to have potential value within the Commonwealth. Rather, these should be considered as areas to target because they represent existing expertise and initiatives that have the potential to help spawn economic growth and development in Kentucky.

There are four key ingredients required to successfully compete and excel in the life sciences industry. These ingredients are:

- Research
- Commercialization Capital
- Business Talent
- Infrastructure

Kentucky has made great improvements over the past several years in increasing the Research and Development dollars that are coming into the University system from state and federal sources. Those efforts are proving successful and should continue to receive support. The infrastructure ingredient is required for both supporting the increased R&D and supporting commercialization.

The final two ingredients are aimed at commercialization, which is, turning research into profitable companies. Kentucky lacks life sciences venture capital and life science business talent. Significant improvements have been made in life sciences infrastructure over the past five years; however, substantial improvements still must be made to ensure that Kentucky can develop appropriate niche markets.