



# IOWA BIOSCIENCE DEVELOPMENT: CORE COMPETENCY ANALYSIS, PLATFORM IDENTIFICATION AND CROSSCUTTING STRATEGIES

## EXECUTIVE SUMMARY

PERFORMED FOR:  
Iowa Economic Development Authority

PERFORMED BY:  
TEconomy Partners, LLC

# THE IMPORTANCE OF BIOSCIENCES TO IOWA'S ECONOMIC DEVELOPMENT

Iowa benefits greatly from the bioscience sector. By any economic measure—the number of companies, economic output and exports, employment and average wage—Iowa's biosciences industries are important to the state's continued economic growth and development. Biosciences provide high-wage family sustaining jobs, and Iowa has been generally outperforming the nation in terms of bioscience employment growth.

## IOWA BIOSCIENCE BENCHMARKS

COMPILED BY TECONOMY FOR BIOTECHNOLOGY INNOVATION ORGANIZATION

**1,266**  
BUSINESS  
ESTABLISHMENTS

**HIGH CONCENTRATION  
OF EMPLOYMENT**  
IN COMPARISON TO THE  
NATIONAL AVERAGE

**AVERAGE WAGE OF  
\$67,673**  
61% HIGHER THAN  
PRIVATE SECTOR  
AVERAGE

Specialized, growing and paying strong, family sustaining wages – biosciences are critical to Iowa's current economic success and hold much potential for further focused development. As a sector that's driven by advances in scientific knowledge and research and development leading to the commercialization of new technologies, the biosciences sector leverages the Regents universities for science and engineering workforce talent, research collaboration and technology transfer.



# ABOUT THIS REPORT AND ANALYSIS

Because biosciences represent a fast moving and expanding area of scientific and commercial activity, it is imperative that the State of Iowa have an up-to-date understanding of its bioscience assets, core competencies and opportunities for ongoing development. This study builds upon previous work by the Battelle Technology Partnership Practice (TEconomy's forerunner organization) performed for Iowa. The previous work included both a 2004 strategy for Iowa's biosciences sector development, as well as a subsequent 2011 study to assess progress since 2004.

The Iowa Economic Development Authority's (IEDA) Iowa Innovation Council (IIC) Bioscience Workgroup steered the work on this report, providing feedback on the TEconomy analysis and helping narrow the focus to those platforms holding the most promise for Iowa economic development AND most likely to benefit from state programs, industry-university partnerships and other sector stimulating activities. Specific attention was paid to discussion of the strengths and weaknesses of Iowa assets in these platforms, and particularly to line-of-sight to significant commercial product and market opportunities rooted in Iowa competitive advantages.

## ANALYSIS AND REPORT SEEKS TO ANSWER THREE QUESTIONS

- 1 WHAT ARE IOWA'S EXISTING AND EMERGING BIOSCIENCE RESEARCH CORE COMPETENCIES?
- 2 IN WHICH BIOSCIENCE SECTORS IS IOWA SEEING TRANSLATION OF THESE RESEARCH CORE COMPETENCIES INTO COMMERCIAL ACTIVITY AND COMPETITIVE TECHNOLOGY PLATFORMS?
- 3 WHAT STRATEGIES CAN HELP IOWA CAPITALIZE ON THESE OPPORTUNITIES FOR FURTHER BIOSCIENCE-BASED ECONOMIC DEVELOPMENT?

# IOWA'S BIOSCIENCE CORE COMPETENCIES

Iowa enjoys a robust base of bioscience core competencies which vary greatly in the ability to promote economic development in a state. To understand the potential for bioscience development in Iowa, it is necessary to undertake a rigorous analysis of existing and emerging bioscience research core competencies found across the base of R&D performing organizations in the state (universities, national laboratories and industry).

By rooting bioscience development in identified established and emerging core competencies, the IEDA and its partners in statewide economic development can leverage existing clusters of investments in research talent and infrastructure to advance associated discoveries and innovations to build high-growth, technology-based sectors for the Iowa economy.

Iowa's core competencies in the biosciences represent foundational elements upon which the state can build its position and reputation in the global bioscience-based economy.

***Translating these R & D core competencies into broader Technology-Based Economic Development Platforms (TBED Platforms) is where the real utility for economic development is found.***

Identifying TBED Platforms requires the consideration of several criteria:

- Opportunities drawing upon multiple core competencies and organizations. A technology platform should address market opportunities that directly link to, or leverage, core competencies, and ideally, have relevance to commercialization by in-state organizations. The goal is to develop platforms that leverage a fertile base of R&D programs in the state and are multidisciplinary, cross-cutting, and present opportunities for collaborations, rather than just being a stand-alone, single-discipline research strength.
- Presence of existing or emerging industry connections. A TBED Platform should align academic and other institutional research strengths with either established or emerging local industries – creating new linkages and strengthening existing connections.
- Opportunity for external funding. A TBED Platform should relate to pressing issues, needs or opportunities and have a line-of-sight to a sizeable and growing market for likely products and/or services.
- Limited competition from other states or regions. Ideally, a TBED platform will benefit from identified competitive advantages such as geography, market base, expertise and tacit knowledge base, exclusive resources, signature infrastructure or favorable policies.

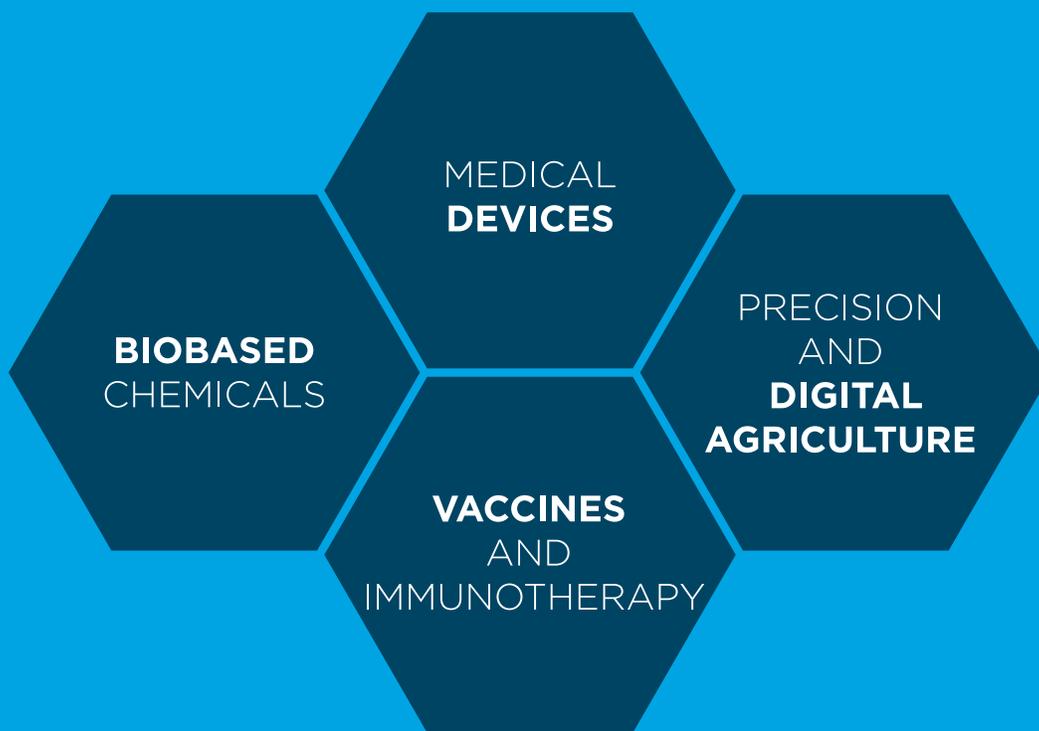
Together, these assets should collectively form a competitive advantage for a group of core competencies to rise to the stature of a TBED Platform.



# RECOMMENDED BIOSCIENCE PLATFORMS FOR IOWA

Based on the core competencies and stated parameters for bioscience platform identification, the IIC Bioscience Workgroup identified those platforms holding the most promise for Iowa economic development and most likely to benefit from state programs, industry-university partnerships and other sector stimulating activity that a strategy could positively influence.

Specific attention was paid to discussion of the strengths and weaknesses of Iowa assets in these platforms, and particularly to line-of-sight to significant commercial product and market opportunities rooted in Iowa competitive advantages.



These platforms represent the focused areas where Iowa is considered to have the greatest likelihood of achieving a differentiated leadership position based on research strengths, established or emerging industry activity, market potential and other competitive advantage factors.

# PLATFORM 1: MEDICAL DEVICES

Healthcare currently represents 17.8 percent of the United States GDP and is a central driver for bioscience R&D and commercial activity. Within the broad healthcare segment of U.S. biosciences, medical devices represent an attractive, significant and growing market with lower barriers to entry and faster timelines to market than pharmaceuticals.

Medical devices and diagnostics encompass all software, instruments and devices used in the diagnosis, prevention, treatment and monitoring of patients. Medical devices can include products that go inside the body or are used externally, or never touch the body at all.

***In Iowa, technology development and startup activity is occurring around the convergence of University of Iowa biomedical research specialties and University Hospitals' clinical practice.***

The University of Iowa's nationally recognized strengths in audiology, ophthalmology, biomedical imaging, dentistry and orthopedics, provide opportunities to leverage research and clinical excellence for the design, testing and development of novel and improved devices.

The University of Iowa and the Iowa City region have invested in three business incubator operations suited to the development of biomedical business ventures.

- Protostudios is a biomedical and electronics prototyping hub established to support startups and small businesses design and test biocompatible medical device prototypes. IEDA provided a \$1.6 million grant to the University of Iowa through the Strategic Infrastructure Program to purchase 3D modeling software, hardware and electronics equipment.
- The Translational Research Incubator is an incubator and accelerator specifically targeted toward development of innovation-based biomedical or life-science startup companies.
- The BioVentures Center is located at the University of Iowa Research Park and facilitates the incubation of early stage life science ventures with wet lab, dry lab and shared user facilities.

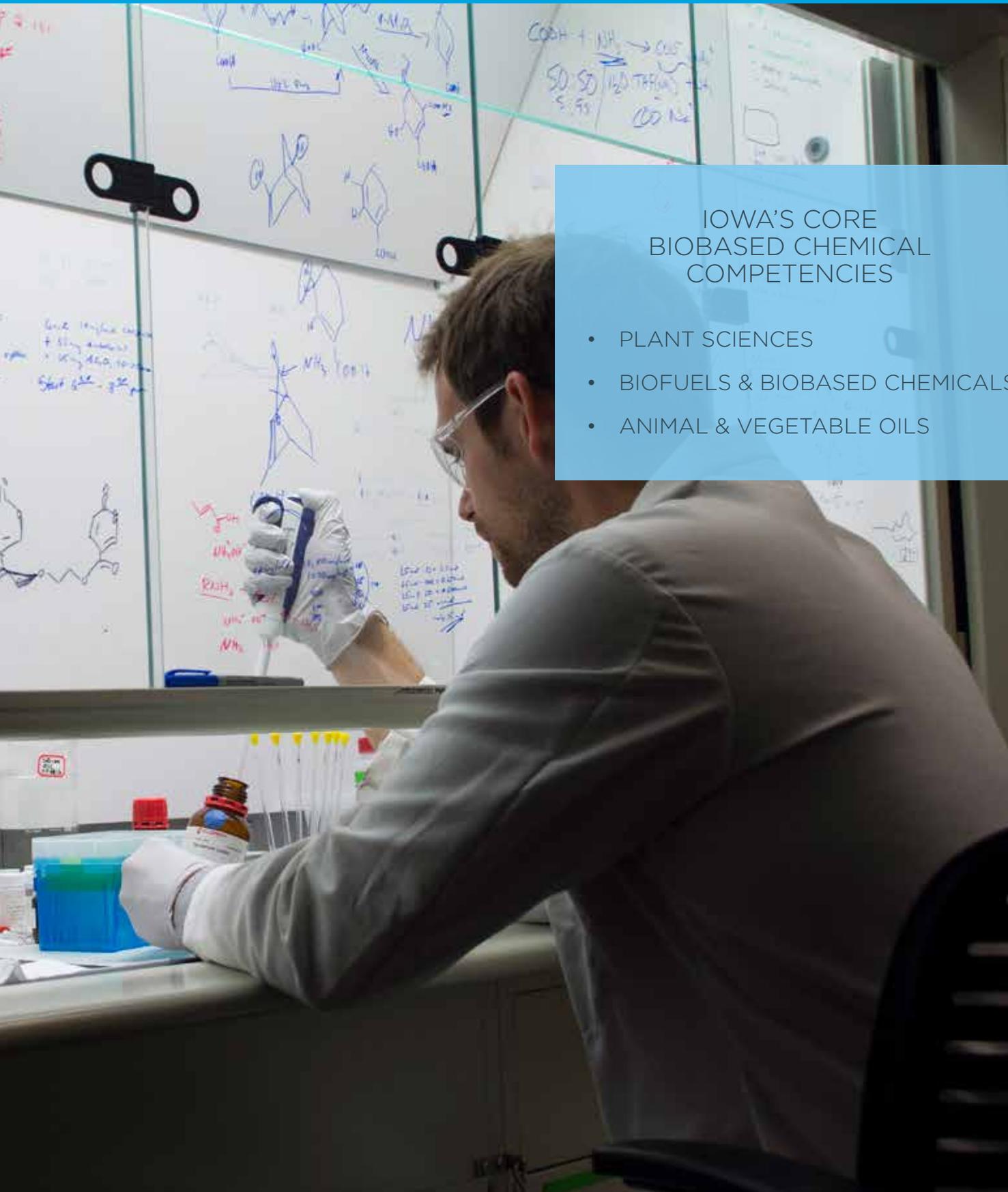
Together, the above represent a good base of facilities for development of startup medical device and med-tech companies.

The University of Iowa also identified the need for a legislative change to remove several barriers that effect the university's ability to perform commercialization work and engage in startup ventures. In the 2018 legislative session, the university introduced a regulatory relief bill to address these barriers.

## IOWA'S CORE MEDICAL DEVICES COMPETENCIES

- AUDIOLOGY
- OPHTHALMOLOGY
- MEDICAL IMAGING
- ORTHOPEDICS
- DENTISTRY
- CANCER
- CARDIOLOGY
- AGING
- DIABETES
- NEUROSCIENCE
- PERINATOLOGY & NEONATOLOGY
- NEPHROLOGY
- PULMONOLOGY
- OBESITY





IOWA'S CORE  
BIOBASED CHEMICAL  
COMPETENCIES

- PLANT SCIENCES
- BIOFUELS & BIOBASED CHEMICALS
- ANIMAL & VEGETABLE OILS

## PLATFORM 2: BIOBASED CHEMICALS

Over the last 100 years, molecules derived from oil and gas have generated much of the innovation in the chemicals industry, but the ability to derive novel new chemicals from these traditional feedstocks is limited. Petrochemicals have been so well studied, and their inherent chemistry so well exploited, that there is little new to discover of commercial value.

The same is not the case with biobased feedstocks and chemistry. The future of innovation in the chemicals industry is likely to come from the discovery and exploitation of new molecules generated from biomass and in the advanced process technologies needed to generate them.

### ***Iowa already has developed a significant base of assets for biobased chemical platform advancement.***

First, Iowa has many companies engaged in manufacturing intermediate biobased chemical products: ethanol and biodiesel. There is also a base of Iowa companies engaged in R&D related to the use of different feedstocks as biofuels and process-related technologies for conversion of these feedstocks.

Second is Iowa's core strength in academic R&D in biobased chemicals and associated research. The Center for Biorenewable Chemicals (CBiRC) at Iowa State University (ISU) is a National Science Foundation (NSF) funded Engineering Research

Center focused on Biobased chemicals. CBiRC represents a 10-year, \$33 million investment in biorenewable chemicals research in Iowa. Licensing to startup companies that have spun out of CBiRC.

A third core strength, in 2016, Iowa passed a Renewable Chemicals Production Tax Credit which incentivizes production of 30 high-value chemicals derived from biomass feedstocks. It is the first tax credit of its kind in the U.S., demonstrating a commitment by Iowa to be a leader in developing the biobased chemicals economy.

The biomass conversion and processing technology, and its application to the conversion of Iowa-produced biomass, is the clearest path forward for the state. The potential pathways to biobased chemical industries development present opportunities to build upon existing assets and momentum in Iowa.

### IOWA'S BIOBASED CHEMICALS R&D CENTER ASSETS

- Center for Biorenewable Chemicals (ISU)
- Center for Metabolic Biology (ISU)
- Biocentury Research Farm (ISU)
- Center for Crop Utilization Research (ISU)
- Center for Bioprocessing and Biocatalysis (UI)
- BioEconomy Institute (ISU)
- Biobased Industry Center (ISU)
- Center for Bioplastics and Biocomposites (ISU)
- Plant Sciences Institute (ISU)
- Ames National Laboratory

# PLATFORM 3: PRECISION AND DIGITAL AGRICULTURE TECHNOLOGY

Agriculture faces a huge challenge in meeting the food demand generated by the world's expanding population. Much of the focus on increasing yield in agriculture has been via improvement to the varieties and cultivars of crops grown. There is a second important area of technology that is increasingly being linked with the joint goals of enhancing yield and more efficiently using scarce inputs to agricultural production – precision agriculture technology.

Precision agriculture is primarily, but not exclusively, an agricultural engineering-based approach to improving yield. In crop agriculture, precision agriculture systems use highly precise global positioning systems in concert with advanced sensors, and data analysis technologies to provide the tools and information farmers need to optimize and customize the timing, amount and placement of seed, fertilizer, pesticides, irrigation and other inputs – all towards the goal of producing maximum yield at the lowest cost.

Precision livestock systems are also a focus of R&D in precision agriculture. The application of technology to precision livestock management presents opportunities across a range of technologies, such as: animal sensors and monitoring systems, precision feeding systems and disease vector monitoring systems.

***Iowa has several strengths it can leverage for precision and digital agriculture platform development and associated economic development.***

First, Iowa has an existing agricultural machinery cluster engaged in research and commercialization activities, in addition to manufacturing.

Second, Iowa has significant agricultural and livestock production occurring across the state, together with ISU research stations, which provide opportunities for the pilot testing of new technologies.

Third, ISU has the top-ranked graduate agricultural engineering program in the country (ranked #1 by U.S. News & World Report in 2017), and there is strong existing university-industry research collaboration and innovation occurring already.

Unlike many other technology sectors, precision agricultural technology is still in the early stages of development with a lot of seed-stage deals. This is a technology sector that is still quite open for new entrants, and in which Iowa's universities and existing industry base can be leveraged to catalyze more innovation and startup activity.



IOWA'S CORE  
PRECISION AND DIGITAL  
AGRICULTURE TECHNOLOGY  
COMPETENCIES

- PLANT SCIENCES
- AGRICULTURAL EQUIPMENT
- LIVESTOCK BREEDING & ANIMAL HUSBANDRY
- ANIMAL & VEGETABLE OILS
- ANIMAL NUTRITION



IOWA'S CORE  
VACCINES AND  
IMMUNOTHERAPEUTICS  
COMPETENCIES

- ANIMAL INFECTIOUS DISEASES
- LIVESTOCK BREEDING & ANIMAL HUSBANDRY
- ANIMAL NUTRITION

# PLATFORM 4: VACCINES AND IMMUNOTHERAPEUTICS

A vaccine is an antigenic biological preparation used to provide immunity against one or several diseases. While incredibly effective public health agents, vaccines have tended to be seen by industry as a low profit business with slow growth. The rationale for the industry perspective is grounded in the fact that a person or animal may only need to receive one dose (or very infrequent doses) of a vaccine over a lifetime and will not represent a repeat customer in the same way that a person needing a therapeutic drug for a chronic condition will be.

Various factors have led to life sciences companies to reconsider its position and now see the vaccine business as a pathway to revenues. Some of these factors include:

- Pressures to significantly reduce the use of antibiotics in livestock and instead use vaccination approaches to livestock health
- Global population growth and rising global incomes enabling the purchase and more widespread use of vaccines
- Spending by governments on vaccine R&D and vaccine stocks for biosecurity purposes (pandemic and bioterror preparedness)

Iowa has established a notable cluster of animal vaccine companies in Ames and its surrounding area. This cluster includes several early-stage companies but also large market leaders with two out of the nine largest global companies in animal health products having locations at the ISU Research Park – Merck and Boehringer Ingelheim.

Outside of Ames, there are other significant operations of leading animal health companies in Iowa. Elanco U.S., Inc. (a subsidiary of Eli Lilly and Company), acquired the Fort Dodge operations and manufacturing of Boehringer Ingelheim Vetmedica, Inc.'s (BVI) U.S. feline, canine and rabies vaccines portfolio. Zoetis, the largest global company in animal health products, also has a major manufacturing facility for vaccines in Iowa.

There are also notable government and academic capabilities that are complementary. Chief among these is a USDA facilities constellation for APHIS-ARS that includes: the National Animal Disease Center (NADC), National Veterinary Services Laboratories (NVSL) and the Center for Veterinary as a number of strengths that contribute to the vaccines cluster – ranging from fundamental microbiological research through to applied veterinary sciences.

ISU is also the leader in the emerging field of nanovaccine R&D. ISU is coordinating the Nanovaccine Institute, a consortium of 70 researchers from universities, medical schools, research hospitals, national laboratories and industry designing nanovaccines targeting diseases such as tuberculosis, malaria and cancer.

The development of an animal vaccines cluster offers a potential near-term path to technology-based economic growth in Iowa. Iowa's trifecta of existing industry base, USDA regulatory and research activity, and university research, higher education and tech transfer activity help position Iowa extremely well for growth in the animal vaccine area.

# ADVANCING IOWA BIOSCIENCE DEVELOPMENT TO THE NEXT LEVEL

The overall opportunity for Iowa is significant in terms of continuing to build momentum and economic development through focused attention on the biosciences development ecosystem in the state. It is imperative that Iowa be committed to bioscience strategy and action implementation over a long-term time horizon. As shown in the successful bioscience initiatives in other states, there is significant pay-off for economic development accomplished through bioscience sector development pathways, but robust development within the sector takes time (often decades) and a long-term, sustained commitment of resources is required.

Each of the bioscience development platforms for Iowa is distinct enough to require development of a series of focused strategies and actions specific to each platform. There are, however, several cross-cutting strategies that TEconomy's analysis identified for consideration relevant to bioscience development overall in the state.

### **Strategy One: Establish a Public/Private Iowa Bioscience Development Center**

Iowa needs to establish an Iowa Bioscience Development Center (IBDC) as a public/private economic development initiative focused on coordinating existing assets and strategy implementation and actions to advance Iowa bioscience platforms and overall sector growth. Biosciences represent such a significant and specialized suite of sectors in Iowa that future development mandates a well-coordinated, shared approach across stakeholders to provide strategy and action plan implementation over the long term.

### **Strategy Two: Increase Capital Available for Investment in Iowa Bioscience Companies**

For a small state, Iowa is quite competitive in terms of performance of academic bioscience R&D and in terms of innovation. Iowa is far less than competitive in venture capital to finance growth of companies based on Iowa innovations. Increasing Iowa's bioscience employment, especially in high-paying technology ventures is hampered by a comparative lack of risk capital investment – particularly investment required to scale an enterprise post proof-of-concept. Specific actions are needed to increase access to risk capital in Iowa.

## **EXISTING PROGRAMS - IOWA ECONOMIC DEVELOPMENT AUTHORITY**

Refundable Research Activities Credit

Proof of Commercial Relevance (POCR) program

Demonstration Fund

Iowa Innovation Acceleration Fund

SBIR/STTR Outreach program

Angel Investor Tax Credits

Innovation Fund Tax Credits

High Quality Jobs (HQP) program

### **Strategy Three: Ensure continued legislative support for existing innovation ecosystem development programs**

Investors and entrepreneurs are risk takers, but they seek to minimize risks to the extent possible. One of the key risks that a state should have control over is the stability of its government-sponsored programs and incentives. The State of Iowa needs to assure that a long-term commitment is sustained in terms of maintaining the programs and incentives in its current economic development portfolio. Iowa sets itself apart as being one of the few states to offer a Refundable Research Activities Credit, which will be critical in the development of these platforms.

### **Strategy Four: Improve Connectivity and Collaboration Opportunities Between Key Stakeholders in Each of the Focused Bioscience Development Platforms**

Interviews and discussions held throughout the core competency review and platform identification provided a consistent theme of a lack of awareness and connectivity between key companies, university research teams and other key stakeholders in Iowa. This is related to the need for standing up the recommended IBDC as an organization that will coordinate activities and communication across the full bioscience spectrum and coordinate actions within specific platforms.

# IOWA INNOVATION COUNCIL

The Iowa Innovation Council (IIC) is a business-led group that develops strategies and long-term plans to make sure Iowa stays competitive in the global business economy. As an advisory council to the Iowa Economic Development Authority, the IIC develops recommendations on programs, services and policies needed to support existing businesses and increase the chances for success for entrepreneurs. The IIC's Bioscience Workgroup, with representatives from bioscience companies, bioscience startups, the universities and entrepreneurial service providers, steered the work on this report.

## Bioscience Workgroup

### *Co-chairs*

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John Greaves, Vice President Specialty Crops  
Kemin Industries

### *Members*

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Voxello

John LaMarche, Principal  
VentureNet Iowa

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The Iowa Bioscience Development Core Competency Analysis, Platform Identification and Crosscutting Strategies full report can be found at [iowaeconomicdevelopment.com/reports](http://iowaeconomicdevelopment.com/reports).



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