



Accelerate 2050

A Vision for Indiana Agbioscience





Accelerate 2050: A Vision for Indiana Agbioscience

July 2024

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About RTI International

RTI International is an independent nonprofit research institute dedicated to improving the human condition. With a rich history spanning over six decades, RTI has emerged as a global leader in innovative research and evidence-based solutions. Our team of approximately 6,000 experts across more than 75 countries hold degrees in over 250 scientific, technical, and professional disciplines across the social and laboratory sciences, engineering, and international development fields. Combining scientific rigor and technical proficiency, we deliver reliable data, thorough analysis, innovative methods, novel technologies, and sustainable programs that help clients inform public policy and ground practice in evidence. Development of this document was driven by two complementary business units within RTI, RTI Innovation Advisors and RTI Center for Applied Economics and Strategy.

For more information, visit <u>www.rti.org</u>.





Letter from AgriNovus

AgriNovus pioneered the definition and use of the term "agbioscience" shortly after its founding in 2016 to describe the unique assets and scientific disciplines that will shape the future of the food and agriculture economy. Comprised of companies and innovators across value-added food and nutrition, plant science and crop protection, animal health and nutrition, agtech and agricultural production, these agbioscience platforms have proven accurate over the past decade and have all contributed to more than \$69.6 billion of growth to the Indiana economy – an economy that now contributes more than \$22.7 billion to the state's GDP and employs more than 147,000.

The strength of the Indiana agbioscience economy is undeniable, yet companies, innovators, investors, researchers and state leaders must continue to look to the future to identify the trends that will shape this economy and create opportunity for further economic strength, differentiation and growth. This report seeks to do just that.

Fueled by insight from the top minds across the state's agbioscience economy and augmented with quantitative analysis and insights gleaned from immersion exercises to explore future economic interdependencies and impacts, this report provides both a view of potential futures and connects those futures to strengths in the state to identify three key areas of opportunity for economic growth. They include:

- Farmer-Focused Innovation Indiana cultivates a thriving community of early-adopter farmers
 partnering with agbioscience companies, especially start-ups and growth-stage ventures, to create the
 agbioscience solutions of the future.
- Food is Health Indiana drives innovation at the intersection of plant, animal, human, and environmental health, recognizing food as the nexus of these domains, to create both economic growth and improved health outcomes.
- 3. Bioinnovation Indiana serves as the premier destination for bioinnovators and biomanufacturers to research, commercialize, and scale biotechnology processes, platforms, and products.

These opportunities, combined with economic data and analysis, serve as the foundation to guide the next chapter of growth for Indiana's agbioscience economy. Linking futures to current realities and conditions create a framework to guide proactive efforts to attract and retain top agbioscience companies, to accelerate innovation and to advance thought leadership.

Enjoy the report and the journeys to the future it explores. Be inspired by the tremendous economic successes delivered to date and join us in building this next chapter of the agbioscience economy even stronger. Given this is the only economy in the world that touches every person on the planet, your engagement, support and commitment to fueling growth is critical.

Best,

Mitch Frazier President + CEO, AgriNovus Indiana

Executive Summary

The global agbioscience economy is on the precipice of significant change. Multiple forces are converging to accelerate innovation and opportunity at the intersection of agriculture and life sciences. Scientific advances in gene editing, step changes in artificial intelligence (AI) and machine learning capabilities, novel bioinputs, and soil health innovations are driving creative exploration across disciplines and sectors. Shifts in consumer preferences and corporate sustainability commitments are reshaping the agbioscience industry and the agricultural business landscape. Continued fluctuations in global commodity markets, geopolitical and international trade dynamics, extreme weather events, and other uncertainties—although not new to agriculture—put increased pressure on the global agbioscience industry to support sector-wide efforts to produce more food, more sustainably, for a growing population.

Amid a changing agrifood landscape, AgriNovus Indiana (AgriNovus), a nonprofit coalition of agbioscience leaders across industry, academia and government, understands that you cannot predict the future, but you can create it. In 2023, AgriNovus initiated Accelerate 2050 to mobilize ecosystem-wide visioning and strategic planning aimed at proactively seizing emerging agbioscience opportunities. Positioning Indiana's agbioscience economy for long-term differentiated growth amid future uncertainty serves as the ongoing goal for Accelerate 2050.

Supported by its diverse 37-member Board of Directors and parent organization Central Indiana Corporate Partnership (CICP), AgriNovus partnered with RTI International, a nonprofit research institute, to co-design and facilitate Accelerate 2050. Accelerate 2050 leverages the deep expertise of AgriNovus's Board, staff, and broader stakeholder network and data-driven insights provided by RTI. It delivers: (1) a **repeatable methodology for benchmarking** the relative size of Indiana's agbioscience economy against other states, (2) a shared **2050 Vision** for Indiana's agbioscience and (3) three priority **ecosystem opportunities** that, if fully seized, will enable Indiana's agbioscience ecosystem to realize this shared vision.

One of the most significant outcomes of Accelerate 2050 cannot be easily summarized in a report: the **deepened alignment** and **energized commitment of AgriNovus's diverse stakeholders**—leaders of industry, university, farmer cooperatives, state agencies, and other groups—that emerged through the collaborative process of envisioning possible futures and articulating a shared vision for Indiana's agbioscience ecosystem. Indiana's future success in translating shared visioning to shared outcomes depends on how creatively—and quickly—Indiana can mobilize available resources including talent, make strategic investments, take calculated risks, and build a compelling brand aligned with this vision and the prioritized opportunities.

Going forward, Indiana's agbioscience economy is poised to continue leveraging its 53,000 farms; strong university and college system, including the land-grant Purdue University; and many other agbioscience companies and collaborators to stay at the forefront of innovation. AgriNovus, with its robust thought leadership platform, nimble organizational structure, and dedicated Board and CICP organizational support, stands well-positioned to navigate these considerations and enable collective action and progress.

Indiana Agbioscience Ecosystem Key Findings

RTI's benchmarking and global competitiveness analysis highlights several key findings that build the case for three Accelerate 2050 priority opportunities:

- In 2022, the **Indiana agbioscience economy totaled \$69.6 billion**,¹ measured by economic contribution. Indiana agbioscience **employed 147,075 people** and **generated \$22.7 billion** in gross domestic product (GDP, or economic contribution minus the cost of its intermediate inputs).²This is comparable in size of other key industries in the state, such as auto manufacturing and construction, which each generated \$22 billion in GDP.³
- GDP is a metric used to measure the size and performance of the U.S. economy and all 50 states. It enables Indiana to compare the size and performance of its agbioscience economy and five platforms over time and relative to that of other states.
- In addition to measuring the size of Indiana's agbioscience economy, RTI also analyzed the global market size, key trends, and competitiveness of Indiana companies in each of the five agbioscience platforms.
- RTI analyzed the global market leaders in each platform (i.e., the companies that account for 60% or more of sales) and found that Indiana maintains a position of **global leadership in three of the five agbiosciences platforms**: Agricultural Production, Plant Science and Crop Protection, and Animal Health and Nutrition.
- Within the **Agricultural Production** platform (\$10.7B GDP), Indiana is a global leader in corn and soybeans. Going forward, purposeful diversification is key to hedging against the risk of external shocks and demand changes. Indiana should continue to look for and pilot high-value industrial applications for soybean and corn, such as biodiesel for jet fuels and plant-based chemicals and plastics, as replacement to petrochemical products.
- Within the Value-Added Food platform (\$8.4B GDP), a perceived gap—the absence of a global brand in food manufacturing headquartered in the state—may present opportunities to creatively innovate in the value-added food and nutrition space in ways not necessarily possible for other states with vested food-manufacturing interests.
- Within the **Plant Science and Crop Protection** platform (\$1.8B GDP), continued leadership in plant genetics, plant breeding, and data science can help Indiana support the commercialization of new seed and crop protection technologies, while also recruiting companies to Indiana because of its existing talent base.
- Indiana's growth in the **Animal Health and Nutrition** platform (\$0.8B GDP)⁴ can be diversified and strengthened in segments, such as animal diagnostics and nutritional feed additives. Convergent research in plant, animal, and human health and data science is a strength in the state.
- Within the Agriculture Technology and Equipment (AgTech) platform (\$0.9B GDP), a perceived gap—the absence of a major agricultural equipment company headquartered in the state—may be an opportunity to spur new agricultural equipment financing models, as well as complementary AgTech solutions.

The full global market analysis for each platform is presented in the report.



Indiana Agbioscience Ecosystem: 2050 Vision

Through Accelerate 2050, AgriNovus and its Board articulated a shared vision for the Indiana agbioscience ecosystem to drive collective action and progress through 2050:

Indiana is the world-leading destination for developing and scaling agbioscience companies that fuel long-term, differentiated economic growth for the state, the nation, and the global agbioscience ecosystem.

Specific elements of this shared vision include:

- Interdisciplinary, cross-sector collaboration between the agbioscience platforms
- Strong connections between research and commercialization to invent and scale technologies in collaboration with farmers
- · Differentiated and durable growth informed by ambitious strategies and competitive advantages
- Thriving farmers and communities, both rural and urban, that generate value and catalyze impact in the global agbioscience economy
- · Leveraging assets to advance commercialization of new technologies to generate increased productivity

Indiana Agbioscience Growth Opportunities

AgriNovus and its Board identified three high-priority opportunities for achieving durable, differentiated economic growth for Indiana agbioscience:

Farmer-Focused Innovation (pg. 26–27)

Indiana cultivates a thriving community of early-adopter farmers partnering with agbioscience companies, especially start-ups and growth-stage ventures, to create the agbioscience solutions of the future.

Food is Health (pg. 28–29)

Indiana drives innovation at the intersection of plant, animal, human, and environmental health, recognizing food as the nexus of these domains, to create both economic growth and improved health outcomes.

Bioinnovation (pg. 30–31)

Indiana serves as the premier destination for bioinnovators and biomanufacturers to research, commercialize, and scale biotechnology processes, platforms, and products.

Introduction to Accelerate 2050

Organizations represented on AgriNovus's Board:

In 2023, AgriNovus Indiana initiated Accelerate 2050 to mobilize ecosystem-wide visioning and strategic planning aimed at proactively seizing emerging agbioscience opportunities (see **Figure 1**). Accelerate 2050's overarching goal is to position Indiana's agbioscience economy for long-term differentiated growth amid future uncertainty.

Supported by its diverse 37-member Board of Directors and parent organization CICP, AgriNovus partnered with RTI, a nonprofit research institute, to co-design and facilitate this strategic planning effort. RTI's approach coupled the future-oriented, stakeholder-informed discipline of strategic foresight with quantitative economic and market analysis to characterize the current state of Indiana's agbioscience economy. Additionally, RTI worked closely with AgriNovus and CICP to develop a **repeatable methodology for benchmarking the relative size of Indiana's agbioscience economy** against other U.S. states, and a supporting curated data set to inform this analysis, to enable ongoing current-state analysis in future years (see pages 11–19).

Accelerate 2050 culminated with AgriNovus and its stakeholders prioritizing three high-potential growth opportunities aligned with emerging forces of change, grounded in Indiana's unique advantages, and oriented to a shared 2050 Vision for the Indiana agbioscience ecosystem. Additional methodology details can be found in the appendix.

Indiana Farmers Insurance Advanced Agrilytics Indiana Municipal Power Agency Ag Alumni Seed AgReliant Genetics Indiana Pork Indiana Soybean Alliance American Dairy Association of Indiana Beck's Hybrids Indiana State Department of Agriculture **Biomedit** Insighttrac **Biodyne and BW Fusion Keystone Cooperative** Central Indiana Corporate Partnership Lewis + Clark Agrifood Corteva Agriscience Northeast Indiana Regional Partnership Elanco **Purdue University** Farm Credit Mid-America State of Indiana First Farmers Bank and Trust The Pantheon Huntington University Tom Farms Ice Miller LLP United Animal Health Indiana Corn Marketing Council Wabash Heartland Innovation Network Indiana Farm Bureau

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Figure 1: Accelerate 2050 3-Step Methodology



Benchmarking Analyzed Indiana's global competitive positioning across key agbioscience

platforms and industry segmentsIdentified key factors driving or limiting

growth in each platform

• Compared how Indiana ranks against all 50 states in terms of agbioscience gross domestic product and employment

Trend Analysis

- Conducted secondary and primary research to identify ~150 forces of change impacting the future of Indiana agbioscience
- Facilitated sense-making sessions with AgriNovus teams to prioritize ~25 high-impact driving forces and ~10 high-impact stabilizing forces

- Facilitated executive-level roadmapping sessions to clarify AgriNovus's comparative advantage and unique contribution to the prioritized opportunities
- Delineated now, next, and future actions needed by the ecosystem and AgriNovus to seize the prioritized opportunities

Critical Uncertainties and Scenario Immersion

- Considered how high-impact forces may intersect to create critical uncertainties for Indiana agbioscience
- Immersed Board members in three plausible alternative future scenarios through scenario narratives, artifacts from the future, multi-media experiences, and detailed timelines of future events

Collective Visioning and Opportunity Identification

 Facilitated structured discussions and co-creation sessions to generate a shared vision for Indiana agbioscience and three prioritized agbioscience ecosystem opportunities

The Current State of Indiana Agbioscience

Indiana's Five Agbioscience Platforms

The Indiana agbioscience economy is defined by five platforms that drive economic activity and growth across rural and urban parts of the state:

- Agricultural Production spans all types of crop and livestock production and includes primary agricultural processing for animal and human consumption and industrial applications, such as biofuel manufacturing.
- Value-Added Food and Nutrition spans a variety of manufactured foods: dairy products, processed meat, processed fruits and vegetables, bakery products, functional foods, confectionery, edible oil, condiments, sweeteners, and beverages.
- Plant Science and Crop Protection includes seeds and crop protection, such as chemical and biological herbicides, insecticides, and fungicides; biostimulants; and plant nutrient solutions.
- Animal Health and Nutrition includes preventatives and pharmaceuticals, biologics, diagnostics, and medicinal and nutritional feed additives for livestock and companion animals.
- Agricultural Technology and Equipment (AgTech) includes tractors, harvesting machinery, other farm machinery, and agricultural technology aimed at increasing farm efficiency and productivity.

The Size of Each Platform

In 2022, the Indiana agbioscience economy totaled \$69.6 billion,¹ measured by economic contribution, as shown in **Table 1** below. Indiana agbioscience employed 147,075 people and generated \$22.7 billion in GDP, or economic contribution minus the cost of its intermediate inputs.² Indiana agbioscience contributed more to the state GDP than other key Indiana industries, such as auto manufacturing and construction, each of which contributed just under \$22 billion to state GDP.³

Platforms	Employment	GDP (\$BN)	Economic Contribution (\$BN)
Agricultural Production	67,908	\$10.7	\$30.1
Value-Added Food and Nutrition	63,693	\$8.4	\$29.8
Plant Science and Crop Protection	6,594	\$1.8	\$3.9
Animal Health and Nutrition*	3,149	\$0.8	\$3.5
AgTech	5,731	\$0.9	\$2.3
Agbioscience Total	147,075 ⁺	\$22.7 +	\$69.6^

Table 1: Size of Each Indiana Agbioscience Platform by Employment, Output, and GDP, 2022

* Note: Animal Health and Nutrition GDP is likely understated due to data limitations with NAICS codes not distinguishing between veterinary and human health pharmaceuticals. The Animal Health and Nutrition GDP estimate assumes that veterinary pharmaceutical manufacturing accounts for 2% of total pharmaceutical manufacturing GDP based on a 2022 Animal Health Institute study.

Source: *RTI analysis of U.S. Bureau of Labor Statistics, U.S. Bureau of Economic Analysis, and Lightcast data. ^Indiana Business Research Center analysis using IMPLAN

Indiana's National Ranking in Each Platform

Indiana is the 19th largest state economy, generating \$470.3 billion in total state GDP in 2022.³ One might expect Indiana's agbioscience economy to be proportional to the size of the state economy and to also rank 19th by agbioscience GDP. In fact, Indiana agbioscience ranks higher: 16th nationally, measured by GDP. In four of the five agbioscience platforms, Indiana ranks among the top 7 to 12 states in the United States by GDP, as shown in Table 2.

Indiana's Global Positioning in Agbioscience

RTI performed a global market analysis to assess the current size, key industry segments, and next-5-years performance outlook for each agbioscience platform. RTI then conducted further market research to assess key factors shaping the near-term growth trajectory of each platform. Finally, RTI analyzed Indiana's strengths, weaknesses, opportunities, and threats to growth in each platform.

Analysis and Lightcast data. RTI found that Indiana agbioscience maintains a position of global leadership in three of the five agbioscience platforms: Agricultural Production, Plant Science and Crop Protection, and Animal Health and Nutrition.

Table 2. Indiana's National Rank by Aqbioscience Platform GDP, 2022

Platform	Ranked by GDP
Agricultural Production	7
Plant Science and Crop Protection	12
Animal Health and Nutrition	12
AgTech	12
Value-Added Food and Nutrition	18

Source: RTI analysis of U.S. Bureau of Economic

- Agricultural Production: Indiana is the eighth largest farming state in the United States by GDP and ranks among the top five U.S. producers of soybeans, corn for grain, hogs, eggs, ducks, and turkeys.⁵
- Plant Science and Crop Protection: Indiana-headquartered Corteva Agriscience ranks second in seeds and fourth in crop protection in global market share, alongside Bayer Crop Science, Syngenta, and BASE⁶ Other significant seed companies based in Indiana are Beck's Hybrids, and AgReliant Genetics, in addition to smaller and more-specialized seed companies. Boston-based Inari operates its Seed Foundry



out of the Purdue Research Park.⁷

• Animal Health and Nutrition: In animal pharmaceuticals and vaccines, Indiana-headquartered Elanco ranks in the top five globally by market share, alongside Zoetis, Merck, Boehringer Ingelheim, and Virbac.⁶ United Animal Health is a major player in medicated feed additives.

The five platforms vary significantly in global market size, from \$67.4 billion in global sales of Animal Health and Nutrition products to \$7.210 trillion in sales of crops and livestock in agricultural production, as shown in Table 3.

Table 3: Global Market Size by Sales of Each Agbioscience Platform, 2017, 2022, and 2028 Projections
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Platforms	2017 Sales (\$BN)	2022 Sales (\$BN)	Projected 2028 Sales (\$BN)	2017–2022 CAGR (%)	Projected 2022–2028 CAGR (%)
Agricultural Production	N/A	\$7,209.6	\$10,841.6	N/A	7.0%
Animal Production	\$1,322.9	\$1,937.6	\$2,358.0	7.9%	3.3%
Crop Production	N/A	\$5,272.0	\$8,483.6	N/A	7.9%
Value-Added Food and Nutrition	\$5,546.3	\$6,747.2	\$9,212.7	4.0%	5.3%
Agricultural Technology and Equipment	\$136.4	\$182.1	\$290.6	5.9%	8.1%
Biofuels	N/A	\$168.6	\$225.9	N/A	5.0%
Plant Science and Crop Protection	\$110.0	\$136.8	\$188.7	4.5%	5.5%
Animal Health and Nutrition	\$52.1	\$67.4	\$95.2	5.3%	5.9%

Source: BCC Research, except for Crop Production, which is from Business Research Company, Crop Production Global Market Report 2023, and Biofuels, which is from Markets and Markets, Biofuels Market 2023

Platform-Specific Insights

Agricultural Production

Definition, Global Market Size, Key Players

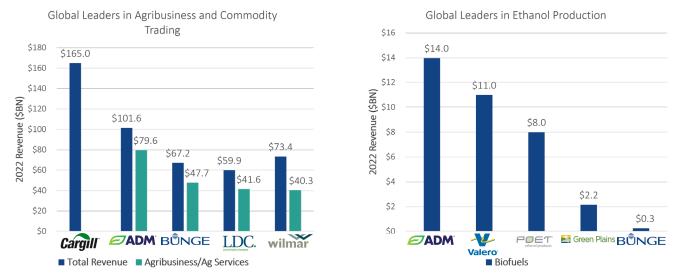
Global agricultural production spans the full range of crop and animal livestock production for human and animal consumption and for crops grown as a feedstock for industrial biofuels and bioproducts. In 2022, the global market size of this platform measured by sales was \$7.210 trillion. The sector is projected to grow at a compound annual growth rate (CAGR) of 7.0% through 2028.⁸

Due to the vast size of this sector, RTI's global market analysis focused on crops and animal products in which Indiana has existing activity and competitive advantages: grains and oilseeds within crops, and meat, dairy, poultry, and eggs within livestock. The major agribusiness companies globally are Cargill, ADM, Bunge, Louis Dreyfus, and Wilmar (see **Figure 2**). For biofuels, the global leaders in one type of biofuel ethanol—are ADM, Valero, and POET. None of the largest agribusiness companies or biofuels companies are headquartered in Indiana, although most have grain and oilseed milling and ethanol production facilities located in the state.



Accelerate 2050 | The Current State of Indiana Agbioscience





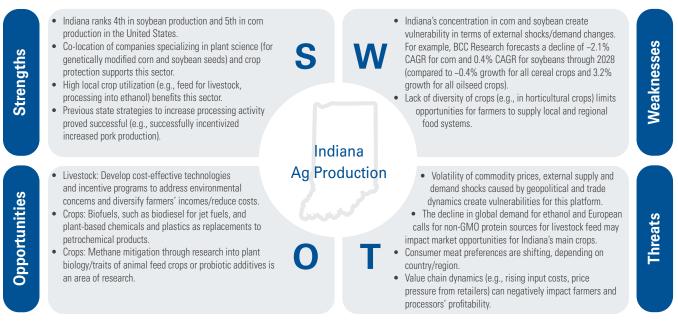
Source: RTI International analysis of ADM, Bunge, LDC, Wilmar, ADM, Valero, POET, and Green Plains SEC 10-K Annual Filings and Cargill Annual Report

In terms of near-term growth outlook, increasing demand for protein as developing countries become middle-income countries and decreasing arable land under cultivation coupled with demand for higher yields are two of the biggest market drivers.⁶ Slower population growth and aging populations in East Asia, Europe, and North America are increasing demand for automation technologies, and environmental concerns are driving precision AgTech solutions that reduce the use of crop protectants and fertilizers.

SWOT Analysis

Key Takeaway: Indiana is a global leader in corn and soybean production, generating higher yields and resilience in these crops. However, purposeful diversification is key to hedging against the risk of external shocks and demand changes. At the same time, Indiana should continue to look for and pilot high-value industrial applications for soybeans and corn, such as biodiesel for jet fuels and plant-based chemicals and plastics, as replacement to petrochemical products (see **Figure 3**).

Figure 3: Strengths, Weaknesses, Opportunities and Threats to Indiana Growth in the Agricultural Production Platform



Value-Added Food and Nutrition

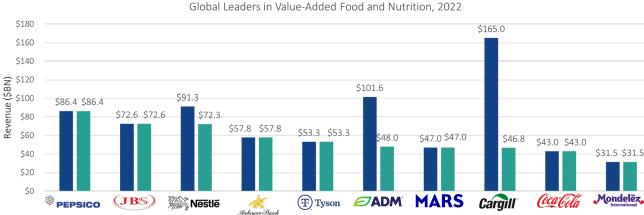
Definition, Global Market Size, Key Players

The Value-Added Food and Nutrition platform totaled \$6.75 trillion in 2022, up from \$5.55 trillion in 2017 (5-year CAGR of 4.0%). The sector is forecasted to grow at a higher CAGR of 5.3% from 2022 to 2028.⁸ It includes two key segments:

- Value-Added Food (\$3.58 trillion) includes dairy products, processed meat, processed fruits and vegetables, processed fish, processed eggs, bakery products, functional food/beverages, confectionery, edible oil, condiments, sweeteners, and breakfast cereals.
- Value-Added Beverages (\$3.16 trillion) include bottled and flavored water, nonalcoholic drinks (e.g., soft drinks, juices), and alcoholic drinks (e.g., beer, wine, spirits).

The global market leaders in value-added food and beverage manufacture a wide variety of food and drink products. They include companies like Nestle, Danone, Mondelez, General Mills, Ajinomoto, and Kraft Heinz, as shown in Figure 4. There are over 100 large global companies with numerous brands; many such as Nestle, Mondelez, ADM, and Cargill have manufacturing facilities in Indiana. None are headquartered in Indiana, however.





Source: Food Engineering (2019). Top 100 Food & Beverage Companies. Updated to 2022 with RTI analysis of SEC 10-K Annual Filings and Annual Reports.

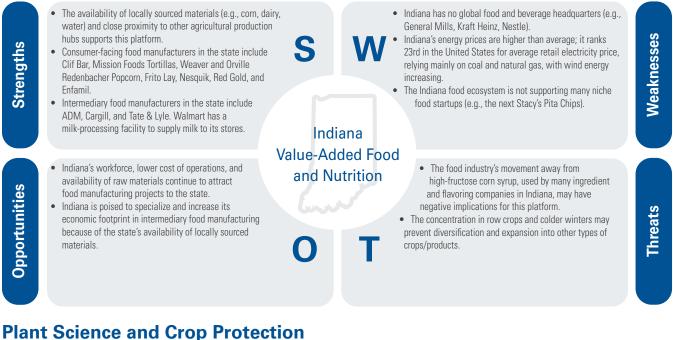
Total Revenue Food & Beverage

SWOT Analysis

Key Takeaway: A perceived gap—the absence of a global brand in food manufacturing—may present opportunities to creatively innovate in the value-added food and nutrition space in ways not necessarily possible for other states with vested food-manufacturing interests (see Figure 5).

Accelerate 2050 | The Current State of Indiana Agbioscience

Figure 5: Strengths, Weaknesses, Opportunities and Threats to Indiana Growth in the Value-Added Food and Nutrition Platform



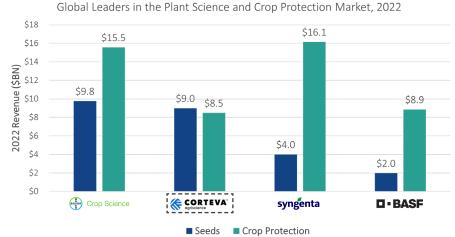
Definition, Global Market Size, Key Players

The Plant Science and Crop Protection platform totaled \$136.8 billion in 2022 and is anticipated to grow at a CAGR of 5.5% through 2028.⁸ It includes two key segments:

- Seeds (\$58.7 billion): The global commercial seed market comprises approximately 7,000 large and small commercial seed companies. The largest companies are seen in the corn, soybean, and cotton markets in the United States and South America and are driven by demand for GMO seeds (developed to be herbicide-tolerant and insect-resistant).
- Crop Protection (\$78.1 billion): The global crop protection market includes chemical and biological herbicides, insecticides, and fungicides. Herbicides account for just over half of this market, with the next-largest segments being insecticides and fungicide.

Seeds and crop protection have become highly integrated due to mergers between companies that produce and sell commercial seeds, seed traits, and crop protectants. A few large, global companies account for most of the row-crop seed and agricultural chemical market share worldwide: Bayer, Corteva, ChemChina/ Syngenta, and BASF (see Figure 6). The global market growth is projected to be strong, with many factors at play, such as the high degree of industry consolidation, input intensity versus environmental concerns, and scientific advances such as gene editing.





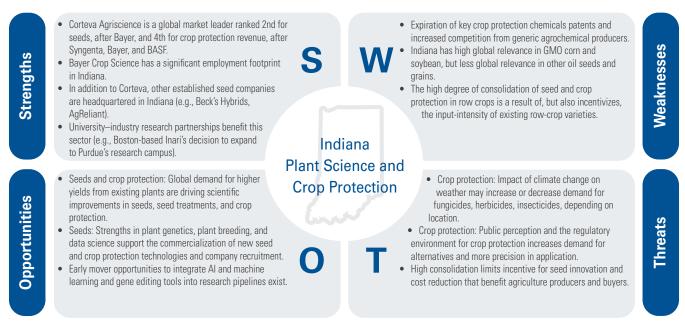
Source: BCC Research and RTI analysis of Bayer Crop Science, Corteva, Syngenta, and BASF SEC 10-K Annual Filings and Annual Reports

HQ in Indiana

SWOT Analysis

Key Takeaway: Continued leadership in plant genetics, plant breeding, and data science can help Indiana support the commercialization of new seed and crop protection technologies while also recruiting companies to Indiana because of its existing talent base (see **Figure 7**).

Figure 7: Strengths, Weaknesses, Opportunities and Threats to Indiana Growth in the Plant Science and Crop Protection Platform



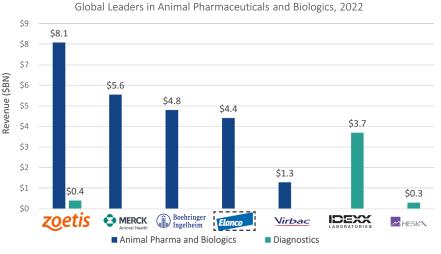
Animal Health and Nutrition

Definition, Global Market Size, Key Players

The Animal Health and Nutrition platform includes pharmaceuticals, biologics, diagnostics, and medicinal and nutritional feed additives for livestock and companion animals. The market for this sector totaled \$67.4 billion in 2022. The sector is forecasted to grow at a CAGR of 5.9% through 2028.⁸

- Pharmaceuticals (\$18.8 billion): Animal pharmaceuticals help animals live longer, healthier lives.
 - They include antibiotics; antiparasitics; and medications to treat inflammation; pain; reproductive, cardiovascular, and metabolic concerns, and other diseases and conditions.
- Biologics (\$9.1 billion): Veterinary biologics are preventatives and therapeutics derived from living organisms and biological processes. They include products such as vaccines, immunomodulators, and diagnostics.
- Diagnostics (\$6.0 billion): Animal diagnostics detect and measure the presence of disease pathogens, monitor disease progression, and assess the response to therapeutics.





Source: BCC Research and RTI analysis of Zoetis, Merck, Boehringer-Ingelheim, Elance, Virbac, and Idexx Laboratories SEC 10-K Annual Filings and Annual Reports

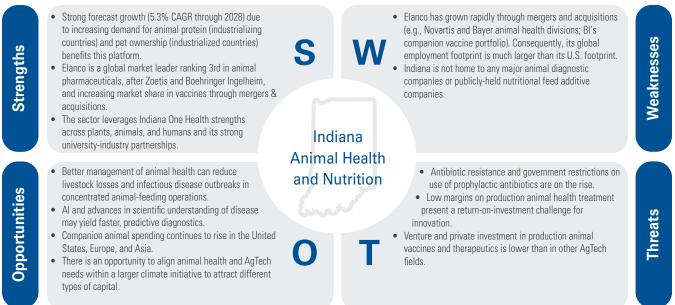
- Medicated Feed Additives (\$6.8 billion) and Others (\$5.5 billion): Medicinal feed additives are fed to animals to prevent, treat, or control bacterial infections, coccidiosis, and worms.
- Nutritional Feed Additives (\$21.1 billion): Feed additives and ingredients include amino acids, vitamins, enzymes, probiotics, and others that improve animal nutrition and performance.

The animal pharmaceuticals and biologics market is highly concentrated and includes market leaders such as Zoetis, Boehringer Ingelheim, and Elanco, as shown in **Figure 8**. Animal diagnostics is also highly consolidated; leading companies include IDEXX Labs, Zoetis, and Antech Diagnostics. Leaders in feed additives include DSM, ADM, BASF, and Evonik. United Animal Health is a major player in medicated feed additives. BiomEdit, a microbiome spinout from Elanco, is headquartered in Indiana.

SWOT Analysis

Key Takeaway: Indiana's growth in this platform can be diversified and strengthened in segments, such as animal diagnostics and nutritional feed additives. Convergent research in plant, animal, and human health and data science is a strength in the state (see **Figure 9**).

Figure 9: Strengths, Weaknesses, Opportunities and Threats to Indiana Growth in the Indiana Animal Health and Nutrition Platform



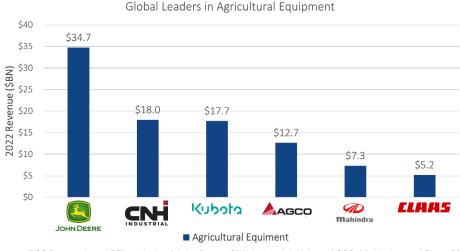
Agricultural Technology and Equipment (AgTech)

Definition, Global Market Size, Key Players

The AgTech platform totaled \$182.1 billion in 2022. The sector is forecasted to grow at a CAGR of 8.1% through 2028.⁸ It includes four key segments:

- **Tractors (\$59.3 billion)**: Tractors come in different sizes and power ranges, with different equipment attachments. They can be broken out by horsepower (> 40 HP, 40–100 HP, 100+ HP), drive type (4WD vs 2WD), and engine type (hydraulic, hybrid, electric).
- Harvesting Machinery (\$31.9 billion): Harvesting machinery includes combine harvesters, forage harvesters, and other machinery used to cut and gather crops, separate the grains (edible parts) from the inedible stalks, and move the unwanted stalks and husks away from the grain.
- Other Farm Machinery (\$70.7 billion): This segment includes machinery for planting and haying and all other agricultural machinery.

Figure 10: Global Leaders in Agricultural Equipment



AgTech (\$20.2 billion): AgTech spans robotics and smart field equipment, farm management software, drone and imagery analytics, and Al applications.

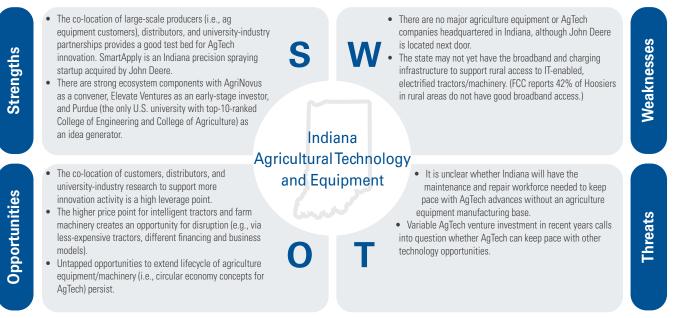
The global market leaders in agriculture equipment manufacture tractors and machinery for applications in agriculture, forestry, and construction. They include companies like John Deere, CNH, AGCO, Kubota, Mahindra & Mahindra, and CLAAS, as shown in **Figure 10**.

Source: BCC Research and RTI analysis of John Deere, CNH Industrial, Kubota AGCO, Mahindra, and Claas SEC 10-K Annual Filings and Annual Reports

SWOT Analysis

Key Takeaway: In a platform ripe for disruption, a perceived gap—the absence of a major agricultural equipment company headquartered in the state—may be an opportunity to spur new agricultural equipment financing models and complementary AgTech solutions (see **Figure 11**).

Figure 11: Strengths, Weaknesses, Opportunities and Threats to Indiana Growth in the AgTech Platform



Exploring Possible Futures for Indiana Agbioscience

Forces of Change Impacting Global Agbioscience

Over the next 25 years, the agbioscience economy will continue to be shaped by global, national, and regional forces of change. Understanding these forces of change is a critical first step in understanding possible agbioscience futures and prioritizing opportunities poised to enable long-term, differentiated growth.

The future is here, it's just not evenly distributed yet. –William Gibson, Futurist

To inform Accelerate 2050, the RTI team conducted divergent secondary and primary research to identify more than 150 forces of change impacting the future of Indiana agbioscience. RTI aggregated and analyzed trends and drivers of change from our own proprietary trends database and data from dozens of organizations such as the Food and Agriculture Organization of the United Nations (FAO), European Commission, the World Economic Forum, and the Global Panel on Agriculture and Food Systems for Nutrition. In addition, RTI conducted 15 expert interviews (e.g., AgriNovus Board members, global food security experts, multinational food and beverages company leaders) and reviewed dozens of interviews conducted for the agbioscience podcast.

AgriNovus and RTI collaboratively analyzed these forces through a series of sense-making workshops and prioritized 24 high-impact driving forces and 12 high-impact stabilizing forces with significant bearing on the future of agbioscience for Indiana, listed in **Table 4**. The forces shaping the agbioscience economy are inherently related and connected. Table 4 presents one way to organize these forces of change, but each force contains dotted lines to nearly every other category. Additional details on each force of change were provided to AgriNovus and are available upon request to RTI.

RTI, together with AgriNovus and its Board, analyzed combinations of forces of change and explored the implications and the uncertainties they create for Indiana's agbioscience industry. The following is a selection of insights from those working sessions and RTI analysis:

Technology and Innovation Insights

- Advances in biotechnology and gene editing will likely drive a surge in biomanufacturing and will revolutionize production processes across various industries.
- Platform innovations (e.g., gene therapy, de novo protein synthesis, microbiome engineering) that work across the plant-animal-human health continuum hold potential but require strategic investment to drive adoption and maximize benefits.
- Biotransformation technologies are poised to transform production processes (e.g., waste valorization, fermentation) and enable new product creation (e.g., food ingredients, bioinputs).
- The combination of biotechnology and Al could significantly enhance farm productivity if potential barriers to adoption (e.g., cost, return on investment) can be overcome.
- The adoption of AI and AgTech in the agbioscience sector, in combination with farm consolidation, has the potential to reshape labor dynamics and the distribution of economic benefits.

Table 4: Forces of Change Impacting the Future of Indiana Agbioscience

		High-Impact Driving Forces		
Driving forces propel change and push a system, organization, or environment toward a new state or direction.	Science and Technology • Computing, Data, and Industrial Automation • Agricultural Biotechnology • The Energy Transition • Precision, Smart, and Data-Driven Agriculture • Health Science Research and Discovery • Artificial Intelligence • Human–Machine Collaborations/Interfaces Economic • Finance, Insurance, and Investments Models • Commodity Production and Prices • Capital Intensity and Consolidation • Entrepreneurship and Corporate Innovation • The Labor Market	Environmental • Water and Other Natural Resources • Climate Political and Regulatory • State and Federal Ag Policy • Geopolitics and Trade • Domestic Food Security • Al Governance and Regulation • Food-Labeling Guidelines	Societal • Social Movements • Public Trust • Population Dynamics • Food Consumption Patterns and Preferences • Integration of Planetary, Plant, Animal, and Human Health Systems	
High-Impact Stabilizing Forces				
Stabilizing forces maintain or restore equilibrium in a system. They resist change and tend to preserve the status quo.	 Fundamental Human Dietary Needs Available Natural Resources Food Is More Than Calories Population Demographics Persistent Efforts and Achievements in Enhancing Productivity 	 Importance of Food Safety Regulatory Pathways Economic Motive and Following Incentives Prevailing Economic Systems (e.g., U.S. Capitalism) 	 Fundamentals of Farming Inputs Link Between Food Security and National Security Existing Food Infrastructure and Systems Inertia 	

Energy and Climate Insights

- Increased weather variability and extreme weather events, coupled with long-term climate shifts and natural resource constraints, may shift traditional growing regions and further amplify the focus on sustainable and resilient agriculture.
- As the impacts of a changing climate unfold, the need for climate-adaptative solutions will likely increase, augmenting the importance of innovation in climate-resilient crops, complementary technologies, and regenerative agricultural practices.
- Changes in climate patterns could lead to significant changes in global migration patterns as people seek stability and economic prosperity in less-climate-vulnerable regions.
- The evolution of infectious diseases and future global pandemics could create new challenges and opportunities for public health, food safety, and food security.
- The ongoing energy transition presents near-term opportunities for biofuels and potential long-term challenges, depending on how technology and the energy landscape evolves.

Consumer Preferences and Nutrition Insights

- The evolution of attitudes toward biotechnology in the U.S. and global markets will influence product development, market access, and regulatory frameworks.
- Global demand for protein is shaping export markets and is linked to several other forces, including geopolitics and trade dynamics, global development and nutrition, and food prices.
- The introduction of gene-edited foods, lab-grown meats, or other biotechnology innovations could cause political or consumer divisions with implications for monitoring, labeling, and regulation.
- The rise of precision and personalized nutrition may drive changes in consumer preferences, product development, and agricultural production practices.
- Increasing consumer focus on health, wellness, and environmental sustainability could dramatically shift consumer preferences for healthier, sustainably sourced, and traceable food.

Rural-Urban Dynamics and Regional Development Insights

- Growing focus on regional or city-specific agbioscience or AgTech hubs (e.g., St. Louis, Research Triangle Park, Boulder) may influence corporate location decisions, investment patterns, and more.
- Uneven availability of digital infrastructure, job opportunities, hybrid work options, and more could widen the rural-urban divide, leading to significant place-based disparities.

Supply Chain and Geopolitics

- Increasing intertwinement of food security and national security with the agbioscience sector is playing a crucial role in ensuring the resilience and stability of both.
- Deepening relationships between farmers and manufacturers, along with increasing verticalization in the agrifood sector, could shift supply chain dynamics, innovation processes, and market structures.
- Geopolitical tensions and global trade dynamics could evolve in multiple ways, potentially leading to reshoring and nearshoring of food supply chains if countries prioritize domestic food security.

Farm Revenue and Risk Management

- Effective risk management strategies become increasingly important to ensure resilient and sustainable agricultural operations amid market uncertainties and environmental challenges.
- Continued market uncertainty pushes farmers to diversify revenue streams and pursue new on- and near-farm opportunities in energy technologies, carbon markets, and vertical integration.

Key Uncertainties

Analyzing forces of change led AgriNovus and its Board to highlight key uncertainties for Indiana agbioscience over the next 25 years:

- How will global instability and natural resource pressures impact domestic agricultural production?
- How will Al catalyze new biological insights and fundamental discoveries, especially at the intersection of human, plant, and animal health?
- How will changes in consumer perception and trust impact food purchasing?
- How will climate volatility impact farming business models?
- How will future mergers, acquisitions, and strategic partnerships shape the agbioscience industry?
- How will Al impact the labor market over the long term? How will future generations view work, including workplace values and desired experiences?
- How will trends in farm consolidation and farmland loss play out, and what will be the implications for the agricultural sector?

Future Scenarios for Indiana Agbioscience

The forces of change analysis highlights the inherent uncertainty in trying to prepare for 2050 and creates challenges for traditional approaches to strategic planning. To help AgriNovus and its Board navigate uncertain futures to clarify opportunities and threats, RTI leveraged strategic foresight methods. These foresight methods enabled AgriNovus and its Board to move from being reactive to trends to proactively designing, shaping, and pursuing preferred futures.

RTI leveraged strategic foresight methods to create three plausible, provocative future scenarios. In March 2024, RTI led the AgriNovus Board through a full-day interactive scenario immersion that included future narratives, tangible artifacts from the future, multi-media experiences, and detailed timelines of future events.

Through Accelerate 2050, AgriNovus Board members used the shared immersive experience to articulate (1) critical **insights**

"Strategic foresight offers a way forward. Its aim is not to predict the future but rather to make it possible to imagine multiple futures in creative ways that heighten our ability to sense, shape, and adapt to what happens in the years ahead."

-Peter Scoblic

about the preferred futures envisioned by Indiana's agbioscience ecosystem, (2) significant future opportunities that the Indiana agbioscience ecosystem was poised to capture, and (3) elements of a shared vision for the economy's growth through 2050.

Additional scenario details are in the appendix (see pg. 48-54).

Figure 12: Indiana Agbioscience: 2050 Future Scenarios



In the bioGENESIS scenario:

- Al fuels a decade of scientific breakthroughs in biotechnology.
- Biotechnology and gene-editing fuel a biomanufacturing boom.
- Regional place-based innovation hubs emerge as anchors for innovation ecosystems, but market dynamics exacerbate the rural-urban divide.
- Gene-edited foods create both **political and consumer divisions** in the United States.
- The energy transition creates near-term opportunities and long-term challenges for biofuels.
- Biotech and AI combine to enhance farm productivity, but technology adoption is expensive, and margins are thin.

In the reclaNATION scenario:

- Geopolitical conflict and biotech innovation drive reshoring and nearshoring of food supply chains.
- Personalized or precision nutrition shapes consumer demand for healthy, sustainably produced, and transparently sourced food.
- Al reshapes the workforce and creates a knowledge-economy recession and a physical-economy renaissance.
- Risk management drives farm revenue diversification and business-minded, entrepreneurial farmers excel as energy technologies, carbon markets, and vertical integration create new opportunities.

In the consoliDATA scenario:

- Farm consolidation accelerates, driven by technology, capital intensity, labor shortages, and an aging farmer demographic.
- Mega-farms propel automation and expand real time data collection.
- Data are centralized and controlled by large agribusiness, transforming the role of the farmer.
- Pork and other protein exports grow in response to rising global middle-class demand.
- Alternative fuels become key complements to electrification.
- Widespread adoption of small modular reactors alleviate decarbonization concerns and food security and robot rights become dominant social issues.

Indiana Agbioscience Vision and Opportunities

Indiana Agbioscience: 2050 Vision

AgriNovus and its Board articulated a shared vision for the Indiana agbioscience ecosystem to drive collective action and progress through 2050 (see **Figure 13**):

Indiana is the world-leading destination for developing and scaling agbioscience companies that fuel long-term, differentiated economic growth for the state, the nation, and the global agbioscience ecosystem.

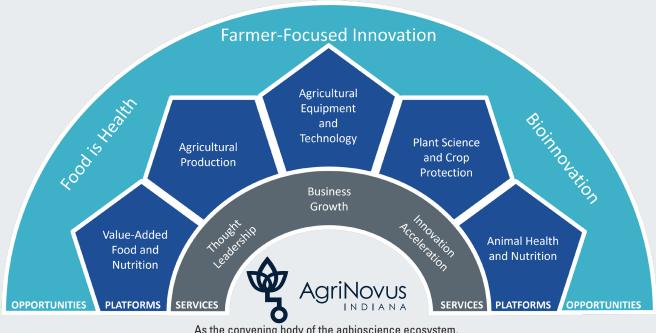
Specific elements of this shared vision include the following:

- Interdisciplinary, cross-sector collaboration between the agbioscience platforms.
- Strong connections between research and commercialization to invent and scale technologies in collaboration with farmers.
- **Differentiated and durable growth** informed by ambitious strategies and competitive advantages.
- Thriving farmers and communities, both rural and urban, that generate value and catalyze impact in the global agbioscience economy.
- Leveraging assets to advance commercialization of new technologies to generate increased productivity.

Figure 13: Bringing together agbioscience services, platforms, and ecosystem-wide opportunities in pursuit of a shared 2050 vision

Vision

Indiana is the world-leading destination for developing and scaling agbioscience companies that fuel long-term, differentiated economic growth for the state, the nation, and the global agbioscience ecosystem.



As the convening body of the agbioscience ecosystem, AgriNovus's mission is to fuel growth in the Indiana agbioscience economy.

Indiana Agbioscience: 2050 Opportunities

Farmer-Focused Innovation

Indiana cultivates a thriving community of early-adopter farmers partnering with agbioscience companies, especially start-ups and growth-stage ventures, to create the agbioscience solutions of the future.

Food is Health

Indiana drives innovation at the intersection of plant, animal, human, and environmental health, recognizing food as the nexus of these domains, to create both economic growth and improved health outcomes.

Bioinnovation

Indiana serves as the premier destination for bioinnovators and biomanufacturers to research, commercialize, and scale biotechnology processes, platforms, and products.

Through Accelerate 2050, Indiana agbioscience leaders identified three high-potential opportunities for durable, differentiated growth for the Indiana agbioscience economy. The opportunities offer complementary innovation pathways by addressing a known need (Farmer-Focused Innovation), demonstrating expertise in an enduring technology domain (Bioinnovation) and setting clear expectations for desired future industry leadership (Food is Health). The following pages include additional information about each opportunity.

Table 5: The Criteria Used to Identify These Opportunities

Characteristic	Questions to Ask
Essential to the vision	Will achieving this opportunity progress the agbioscience economy toward the vision in a meaningful way?
Stands the test of time	Is the opportunity rooted in problems that are likely to persist or grow in importance over time? Is it aligned with long-term trends or drivers of change?
Balances future ambition with current realities	Does this opportunity push the boundaries of the status quo while capitalizing on Indiana's current assets, strengths, and competitive advantages?
Requires collective, system-level action	Does the opportunity require action from many AgriNovus stakeholders? Does it involve multiple agbioscience platforms/sectors?
Builds on Indiana strengths	What is Indiana uniquely positioned to impact? Which opportunities build on Indiana strengths?

Farmer-Focused Innovation

Farmer-Focused Innovation centers Indiana farmers as advisors, co-creators, and early adopters working collaboratively with early- and growth-stage agbioscience companies in the development of new agbioscience solutions. This opportunity formalizes collaboration between early-adopter farmers and agbioscience early- and growth-stages companies to inform and trial new products, services, and business model innovations that benefit Indiana and beyond.

Opportunity in Context

A thriving Indiana agbioscience economy requires

Indiana has the opportunity to cultivate a thriving community of early-adopter farmers partnering with agbioscience companies, especially start-ups and growth-stage ventures, to create the agbioscience solutions of the future.

thriving farmers. However, farmers face compounding risks—increased weather variability, commodity market dynamics, changing regulatory environments and consumer preferences—that add uncertainty to an already challenging business. This is especially true in a place like Indiana, where a high concentration of corn and soybean production creates vulnerability to external shocks and demand changes. Agbioscience innovations hold potential to improve the efficiency and sustainability of farming operations and could offer ways to diversify farm-based revenue (e.g., via tech-enabled value addition or waste valorization). However, a lack of direct farmer input into agbioscience research and development (R&D) efforts means that the products and services available to farmers often fail to deliver clear return on investment or personalized results.⁹ The Farmer-Focused Innovation opportunity brings farmers directly into the agbioscience innovation process so that their interests and opportunities feature centrally in the development of emerging products and services.

This opportunity holds potential to set off a virtuous cycle of value creation for Indiana: early-adopter farmers partner with agbioscience innovators to co-create and shape future offerings; direct access to early adopters attracts new companies to Indiana; those companies create more-informed and demand-driven innovations. Farmer needs are better met and uptake improves, leading to improved farm outcomes. The demonstrated benefits of this approach draw additional capital and companies to Indiana and additional farmers to engage in the process. Indiana strengthens its position as a conducive, enabling environment for innovators and innovative agbioscience companies to thrive.

Critical Components to Capture the Opportunity

- **Mutually beneficial, two-way engagement** between early-adopter farmers and agbioscience companies early in the innovation process
- A neutral broker that facilitates farmer-company interactions, including enabling a shared language and equitable risk-reward arrangements
- Low transaction costs for both farmers and companies (e.g., streamlined access to early-adopter farmers for companies; pre-vetted innovation opportunities for farmers)
- **Financial incentives** (e.g., equity stakes in agbioscience companies, government grants, profitsharing agreements) and other risk mitigation resources to pull farmers into the innovation process, especially for small and mid-sized farms that may be less able to take on increased risk (e.g., see the Manufacturing Readiness Grants in Indiana for an adjacent industry example)
- Risk capital to support the innovation pursuits of early and growth-stage companies
- **Networking and knowledge-sharing opportunities** for early-adopter farmers to build relationships and deepen the community's innovation and entrepreneurial expertise
- Mechanisms to identify on-farm innovations with commercial potential and create pathways for farmers to profit from their inventions

Indiana Strengths to Build Upon

In addition to the strengths identified in the Current State section (pages 11–19), the following are opportunity-specific strengths from which Indiana is well-positioned to build:

• An existing model for farmer-engaged innovation. AgriNovus convenes Indiana farmers, companies, entrepreneurs, and students in a Producer-Led Innovation Challenge competition with a \$25,000 commercialization prize. Since its launch in 2020, every company that has won the challenge has received follow-on funding or has been acquired. This challenge—founded by farmers—continues to be farmer-funded, with challenge winners selected by farmers.

Co-location of large-scale agricultural production alongside

"Being close and being able to get in a pickup truck and talk to your customers—that's a big deal for us."

> -Chuck Margo¹⁰ CEO of Corteva About deciding to move Corteva HQ to Indianapolis

agbioscience leaders, new entrants, and enabling organizations. The co-location of producers, distributors, large corporates, research universities, early- and growth-stage companies, and enabling entities such as Elevate Ventures provides a good test bed for agbioscience innovation.

- Strong farmer cooperatives and commodity groups. Organizations like the Indiana Soybean Alliance and Indiana Farm Bureau (both AgriNovus Board members) provide working knowledge of and access to large farming communities. These organizations can provide starting points for gauging farmer interest and identifying early-adopter farmers.
- **Sizable population of new and beginning farmers**. New and beginning farmers (those with less than 10 years of experience) account for nearly 30% of Indiana's farmer population. With an average age of 43.2 years old, this new generation of farmers stand out as digital natives with potential to integrate new ways of working into their farming operations.
- Indiana's strategic focus on entrepreneurship. Indiana Economic Development Corporation's (IEDC's) economic development strategy¹¹ highlights entrepreneurship as one of its core components. Conferences like the annual Rally Innovation Conference¹² and the 2025 Global Entrepreneurship Congress hosted in Indianapolis¹³ create strong momentum for the Farmer-Focused Innovation opportunity.

What might success look like?



AgriTech Indiana initiative leads to mutually beneficial partnerships and economic prosperity.

In 2050, through the AgriTech Indiana initiative, Eli, a fourth-generation Indiana corn farmer, and Maya, an innovative tech entrepreneur, forged a partnership. Together, they introduced a fleet of Al-enabled micro-drones that can perform high-precision agriculture—from real-time crop analysis to microdosing of nutrients and organic pest control. Their alliance was facilitated by the program's grants and collaborative network, which nurtured their venture from a concept to a sustainable, high-yield farming model. This, and hundreds of other similar examples, became the cornerstone of Indiana's agricultural transformation, highlighting how harmonizing farming expertise with groundbreaking technology can lead to economic prosperity and environmental stewardship.

This is a hypothetical, fictional company.

Food is Health

The Food is Health opportunity encompasses three complementary aspects aligned to the ecosystem's desire to nurture an agrifood system that creates healthier lives, communities, and environment: (1) accelerating food-focused research and commercialization at the intersection of plant, animal, human, and environment health; (2) enabling farmers to diversify production into horticulture crops and supply regional food economies; and (3) growing the value-added food-manufacturing base to address emerging consumer food interests (e.g., personalized nutrition, nutrient density, macronutrient profiles, functional foods) and improve human Indiana has the opportunity to drive innovation at the intersection of plant, animal, human, and environmental health, recognizing food as the nexus of these domains, to create both economic growth and improved health outcomes.

health outcomes. Together, the components of this opportunity unlock the power of food at the molecular, raw-product, and processed-goods levels.

Opportunity in Context

Food is emerging as a central focus in the Indiana agbioscience ecosystem, with consumers increasingly recognizing the impact of their food choices on personal, community, and environmental health. At the same time, scientific advances and emerging technology platforms (e.g., microbiome engineering) create a high potential for intersectional innovation that capitalizes on the similarities in underlying biology and sector challenges.

Also, Indiana agbioscience GDP is poised for further growth if the state can more concertedly translate the outputs of its sizable agricultural production platform into inputs for an expanded value-added food and nutrition platform. Many food companies are shifting toward natural ingredients and exploring new product-development approaches. Others are deepening relationships with farmers and investing in their transition to regenerative agricultural practices to reduce supply chain risks and meet sustainability commitments. Indiana is well-positioned to emerge as a Food is Health leader, with efforts spanning upstream intersectional research to strengthened regional food economies bolstered by diversified agricultural production and an expanded based of value-added food companies.

Critical Components to Capture the Opportunity

- **Dedicated leadership** to prioritize cross-sector collaboration and to mobilize their respective organizations to maintain support for shared ecosystem goals
- Common discovery platforms with corresponding data-sharing agreements that pool resources and enable discoveries relevant to plant, animal, human, and environmental health
- Shared spaces and convening organizations (e.g., networks, shared projects, QUADRANT events) that create collision opportunities by bringing people together on broad and focused cross-sector topics
- **Multidisciplinary research teams** that can identify opportunities and discover novel solutions at the intersection of traditionally siloed scientific domains and industries
- Enabling incentives and structures that promote collaboration across the food value chain and with adjacent industries such as pharmaceuticals; nutraceuticals; health care; and medical technology, which may include joint initiatives or co-funded activities
- Focused efforts to build homegrown or recruit value-added food companies that align with the Food is Health opportunity
- Deepened understanding of local food demand and regional agrifood systems, including ways to shorten food supply chains by better connecting local agricultural production and value addition with communities' food needs
- High-level support and incentives for crop diversification among state agencies, commodity groups, and other key agricultural sector leaders who can influence policies, resourcing, and other support for regional and local food systems

Indiana Strengths to Build Upon

In addition to the strengths identified in the Current State section (pages 11–19), the following are opportunity-specific strengths from which Indiana is well-positioned to build:

- Presence of industry leaders in plant, animal, and human health. Indiana is home to major companies across the full spectrum of plant, animal, and human health (e.g., Eli Lilly and Company, Elanco, Corteva, Elevance Health).
- Indiana's new One Health Innovation District. The recently announced One Health Innovation District aims to be a "globally recognized research innovation district dedicated to optimizing the health of people, animals, plants and the planet."¹⁴
- Strong research universities. Indiana is home to three R1 research universities: Purdue University, Indiana University Bloomington (IU), and University of Notre Dame. Purdue University ranks 11th nationally for animal science majors and IU School of Medicine ranks 13th among all U.S. public medical schools in funding from the National Institutes of Health.^{15,16}

The Indianapolis One Health Innovation District will serve as a place where "innovators will find a vast ecosystem of support—including one of the world's leading universities, funding, lab space, collaboration with many other innovators and companies—and most significantly, shared technical development and pilot plant facilities to manufacture and scale innovations."

-Jeff Simmons, CEO Elanco

- **Growing food science and food-manufacturing base**. Leveraging the availability of local source materials and its proximity to other regional agricultural producers, Indiana continues to support the recruitment and expansion of a variety of food manufacturers such as Clif Bar, Kraft Heinz, and Mission Foods.
- Foundations for growth in food innovation. Purdue's Food Science Technology program ranks fourth
 nationally, and the Food Science Extension program aids Indiana food entrepreneurs and food and
 beverage companies with everything from food safety to preservation and packaging.¹⁷
- Financial support for specialty crop expansion and food systems infrastructure. Indiana state government offers block grants for specialty crop expansion that could be expanded and embedded in a broader crop diversification strategy.¹⁸ It also offers grants to improve food supply resilience in the middle of the food chain.¹⁹

What might success look like?



Ecobiome spins out of Indiana's plant-animal-human health joint venture in 2038.

Ecobiome's multidisciplinary R&D team used AI advances to map genetic pathways in soil, plant, livestock, and humans when they discovered commonalities across digestion, immunity, hormonal signaling, and more. These cellular- and molecular-level insights gave way to their flagship platform, SymbioSync, which optimizes soil microbial solutions for health outcomes across the entire food value chain. SymbioSync's proprietary platform mapped vitamin absorption pathways in the human body and subsequently designed soil strains that upregulate the expression of plant's endogenous genes to create more nutrient-dense fruits and vegetables with enhanced absorption.

This is a hypothetical, fictional company.

Bioinnovation

Bioinnovation creates the enabling infrastructure, financing, and partnerships needed to advance all scales of biotechnology product, platform and process development—from early-stage R&D to pilot-scale trials to commercial-scale operations. Importantly for Indiana, this opportunity leverages the agricultural sector as primary market for biotechnology products (i.e., bioinputs) and a supplier of the raw materials needed for the industrial biomanufacturing industry. Indiana has the opportunity to become the premier destination for bioinnovators and biomanufacturers to research, commercialize, and scale biotechnology processes, platforms, and products.

Opportunity in Context

Biotechnology and Al are powerful platform technologies that hold wide possibilities for the agbioscience economy, especially in terms of accelerating the discovery and development of novel microorganisms, biological transformations, and biomolecules. This potential boon in early-stage innovations is converging with an unprecedented demand for bio-based products in the United States and globally. Governments increasingly look to alternative fuel options such as biofuel to enable transportation and energy sector transitions. Growing consumer demand for more sustainable and bio-based products ranges from packaging to cosmetics. In the agriculture sector, expanding use of regenerative agriculture practices opens opportunity for complementary bioinputs (e.g., biopesticides and biofertilizers) to reduce synthetic input use.

This convergence of accelerated scientific discovery and growing demand for bio-based products presents a sizable opportunity to more readily advance early-stage discoveries into commercial pipelines, but only if the requisite infrastructure, capital, and partnerships are in place to support this translation to commercially viable bioproducts. Current U.S. shortages of mid-scale bioreactors have forced some biomanufacturing companies to look internationally to scale their operations.^{20,21}

Critical Components to Capture the Opportunity

- **Biological technology platforms** leveraging tools like AI, advanced omics, high-throughput screening, and gene editing
- Optimized bioconversion processes (e.g., feedstocks, microorganism strains, bioreactors) that can serve commercial interests at different scales and for different products
- **Strong linkages** between academic institutions and early-stage start-ups at the forefront of Bioinnovation and the industrial biomanufacturing sector to bring the innovations to commercial scale
- Different scales of retrofitted or new biomanufacturing infrastructure and modular, flexible equipment
- Shared infrastructure and collaborative mechanisms to translate foundational assets (e.g., data sets, computation tools) across the agbioscience ecosystem
- Available capital to support mid-stage companies operating at demonstration and first commercial scale
- Formalized co-locations or circular systems that valorize agricultural waste streams into high-value (e.g., specialty ingredients) or commodity outputs (e.g., chemical feedstocks)

Indiana Strengths to Build Upon

In addition to the strengths identified in the Current State section (pages 11–19), the following are opportunity-specific strengths from which Indiana is well-positioned to build:

- Abundant feedstock. Indiana is the fourth largest producer of soybeans and fifth largest producer of corn in the United States.²² Corn and soybeans are important biomanufacturing feedstocks, providing companies a strong pull to the state.
- Existing bioprocessing industry. Major agriculture processors, such as Cargill, ADM, Bunge, and Primient, have invested in wet and dry mills and soybean processin

"The opportunities ahead are bigger now than Indiana has seen in many many years."

-AgriNovus Board Member

have invested in wet and dry mills and soybean processing facilities across the state. Available feedstocks and bioprocessing infrastructure can be leveraged for higher value-added products, such as biofuels, and bio-based replacements for other petroleum petroleum products.

- Mix of established leaders and new entrants. Indiana's agbioscience economy boasts global industry leaders like Corteva Agriscience, which develops bio-based crop protection products among other products, and new ventures like AgroRenew, a start-up that aims to repurpose watermelon, cantaloupe, and pumpkin waste into bioplastics.
- Established and growing green energy production. Indiana is home to ethanol companies, such as POET, Central Indiana Ethanol, and Verbio/South Bend Ethanol, which have corn-based ethanol plants across the state. Louis Dreyfus Company manufactures biodiesel in Claypool, Indiana.
- Regional Technology and Innovation Tech Hub designation focused on U.S.-based bioproduction. In 2023, the U.S. Economic Development Administration recognized Indiana as a region poised to ensure U.S. global competitiveness in domestic bioproduction. Led by Heartland BioWorks, the effort brings together partners such as Purdue University, IU, and BioCrossroads (a complementary CICP initiative) to grow Indiana's biotechnology manufacturing ecosystem.^{23,7}
- New investment in precision fermentation infrastructure. Biomanufacturing start-up Liberation Labs broke ground on a precision fermentation facility in Richmond, Indiana, in 2023. The facility aims to "fill a pressing need among food companies for animal-alternative ingredients."²⁴

What might success look like?



NanoSynth Solutions, established from the acquisition of a pharmaceutical company's R&D facility in Indianapolis in 2025, revolutionizes biomanufacturing with its rapid microbial evolution platform. The platform speeds up the microbial engineering process from months to minutes. NanoSynth can screen billions of genetic variations in the matter of minutes, unleashing the potential for near-instantaneous development of custom solutions for an unlimited number of possible food and agriculture applications. NanoSynth chose Indiana due to its rich agricultural resources that feed its fermentation platform and for Indiana's unapparelled biomanufacturing workforce that brings the complimentary skillsets needed to operate and maintain its platform, from strain optimization and engineering to fermentation process design and scale-up to downstream processing.

This is a hypothetical, fictional company.

Ecosystem Enablers

Setting up success for all opportunities

To move Indiana's agbioscience ecosystem forward across all three of the prioritized opportunities, leaders will need to cultivate a shared mindset and invest in cross-cutting enablers. These enablers form the building blocks of a strong and durable agbioscience ecosystem poised to capture the prioritized opportunities.

- Inclusive innovation approach. Technology's continued permeation into the agbioscience platforms creates risks in terms of further dividing the haves and have-nots of technology access, especially for farmers and other downstream consumers of agbioscience outputs. Effort must be made to ensure that scientific and technological advances do not perpetuate inequity (rural-urban divides, among different farmer segments) in the broader Indiana state context. Indiana can look at insights from Atlanta, Durham (North Carolina), and Detroit²⁵ efforts to design inclusive ecosystems.
- 2. Access to business support, finance, and customers. Each prioritized opportunity requires a stable source of entrepreneurial business support and finance to realize the ambitions put forward. Too often, entrepreneurs, including farmers, have access to one but not all.
- 3. Business-friendly incentives and policies. Comprehensive and attractive packages of incentives (e.g., tax credit, capital grants), alongside Indiana's conducive policy enabling environment, can position Indiana as an attractive location for new or existing companies looking to expand or relocate. The government also plays an important role in enabling effective collaboration that is essential for innovation, including creating a trusted environment in which to share data and other resources.
- 4. Hyperconnected information exchange mechanisms. Ongoing communication and structures that foster regular collaboration will provide ecosystem stakeholders with the time and space needed to reflect on progress and continuously adapt their efforts as the opportunities take shape.



Recommendations and Next Steps

Recommendations for the Ecosystem

The ecosystem's 2050 Vision is underpinned by a 5-year roadmap that sets the course for actions to pursue the prioritized opportunities in the near-term, as outlined in next section. The 5-year roadmap should be viewed as resource for building alignment among diverse stakeholders and enabling shared accountability to reach key milestones. The 5-year roadmap should not be considered as fixed; rather, it is an adaptive tool to enable ecosystem stakeholders to reflect on progress and lessons learned and adjust their approach as needed.

Importantly, the three prioritized opportunity areas—although exciting and promising represent domains in which many U.S. and global regions are pursuing leadership. Indiana's pursuit of these opportunities is not zero sum; differentiation will come in how creatively—and quickly—Indiana can marshal the full scope of its available resources, make strategic investments, take calculated risks, and build a compelling brand aligned with these opportunities. AgriNovus, with its robust thought leadership platform, nimble organizational structure, and dedicated Board and CICP organizational support, stands well-positioned to navigate these considerations and enable collective action and progress.

Recommended Actions for All Indiana Agbioscience Opportunities

- Amplify the opportunities: Creating a compelling narrative around the prioritized opportunities can enhance branding, bring in additional stakeholders, foster a shared sense of purpose and encourage active participation in the refinement process. This involves communicating the potential benefits and impacts of pursuing these opportunities to a wide range of stakeholders, including industry leaders, researchers, policymakers, and the public.
- Deepen understanding of each opportunity and refine core components: Accelerate 2050 made significant strides in identifying three compelling opportunities. However, each opportunity is still high-level and contains many potential components and different pathways by which the opportunity might be seized. Through deeper research and planning, Indiana's agbioscience ecosystem actors can create a clear picture of the opportunity landscape and the most-promising paths forward.
- Prioritize and align key stakeholders: As opportunities are further refined, smaller groups
 of ecosystem actors should align with specific components that best match their interests
 and capabilities. Subgroups can then prioritize and advance more-focused efforts,
 ensuring they receive the attention and resources needed to drive tangible progress and
 impact.
- Drive to action: Translate the prioritized opportunities into initiatives in a coordinated manner. Include tangible actions with clear accountabilities that drive growth. Identify tactics to execute on high-level priorities like strategies like building a pipeline of companies interested in growing in Indiana, developing place-based innovation hubs, and formalizing collaborations among key stakeholders.
- Measure progress and adapt: Establish clear metrics and key progress indicators to help ecosystem stakeholders understand what is on track and what needs additional support. Embed a culture of continuous learning and adaptation by building in time during existing meetings or gatherings to share updates on these metrics and to discuss implications. These metrics will vary by opportunity but should strive to include both leading and lagging indicators of economic growth, alongside a culture of continuous learning and adaptation. Page 44–45 provides more on ideas for measuring progress.

Recommended Ecosystem Actions for Farmer-Focused Innovation

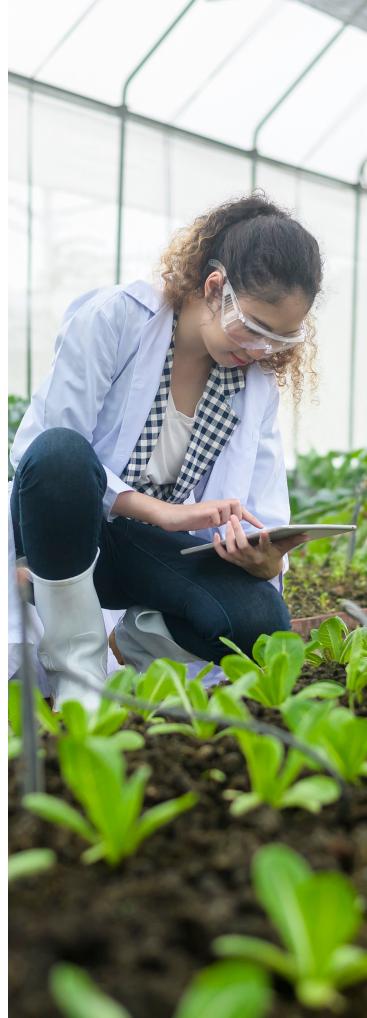
Farmer-focused innovation opportunity involves developing a user-centered innovation program that recognizes farmers' central role in the agbioscience economy. RTI recommends the following next steps for the ecosystem as it advances this opportunity.

Differentiate Indiana through a thriving community of early-adopter farmers. A thriving community of farmers with the right incentives to become early adopters and innovation partners could differentiate Indiana to early- and growth-stage agbioscience companies. To build this community, conduct research to understand Indiana farmer, advisor, and start-up segmentation, as farms and start-ups vary drastically in their innovation ambitions, needs, and challenges. Collaborate with farmer cooperatives, intermediaries, and other stakeholders to conduct listening tours that pinpoint shared innovation ambitions, opportunities to strengthen farmer entrepreneurship, and incentives for collaboration.

Design user-centered innovation program. Engage potential farmers and agbioscience companies that may participate in the program through listening sessions and user-centered design research methods. Design the innovation program and its offerings tailored to Indiana farmers and entrepreneurs' needs.

Support farmers in navigating key innovation and adoption challenges. Provide targeted services and incentives to help early-adopter farmers manage risks associated with adopting new technologies and practices and diversifying their revenue stream. Recognize that farmers are constantly approached with new solutions that promise efficiency and financial returns. Ensure farmers' time is well spent while still preserving the opportunity for farmers to shape agbioscience innovation in its earliest stages of development.

Develop creative mechanisms that reward farmer contributions to innnovation. Pilot innovative investment mechanisms or profit-sharing arrangements that enable farmers to share in the financial success of the innovations they help develop as early-adopter partners. Examples to learn from include AgLaunch and Fulcrum Capital.^{26,27}



Nurture and showcase the Farmer-Focused Innovation program. Convene and nurture connections between early-adopter farmers and agbioscience companies. When possible, showcase innovative Indiana farmers, their inventions, and the innovation program through channels like the Agbioscience podcast. Ensure parallel initiatives and programmatic elements are well-connected to this innovation program to avoid presenting a fractured landscape of entrepreneurial support to farmers.

Measure and adapt for economic, social, and environmental impact. Implement effective learning systems to understand the impact of the Farmer-Focused Innovation program on the Indiana economy and the broader agbioscience economy. Over time, evaluate the net positive social and environmental impacts of technology adoption, alongside economic indicators of growth, to ensure the program contributes to a more sustainable and equitable future for Indiana agriculture. Develop mechanisms to adapt the program and its services based on lessons learned and delivered benefits to continuously improve its impact and effectiveness.



Now (0-1 year)		Next (2-3 years)			Future (4-5 years)	
Differentiate Inc	Differentiate Indiana through a thriving community of early-adopter farmers.					
	gn a user-centered ration program.					
Support farmers in navigating key innovation and adoption challenges.						
	Develop creative mechanisi farmer contributions to innn					
		Nurtur	e and showcase the fa	mer-focuse	ed innovation program.	
				asure and a ironmental	adapt for economic, social, and impact.	

Recommended Ecosystem Actions for Food is Health

Indiana is uniquely positioned to become a global leader in innovation at the intersection of plant, animal, human, and planetary health. Successfully advancing the Food is Health opportunity will depend on the combined efforts of multiple partners, as the scope of this opportunity extends beyond what any single organization can accomplish independently. For Indiana agbioscience to advance this opportunity area and drive economic growth through Food is Health, RTI recommends the following next steps for the ecosystem:

Define and prioritize more-specific focus areas within Food is Health. Differentiating Indiana within the broader Food is Health opportunity will require clarifying and establishing traction in specific focus areas. Finding and prioritizing these focus areas should involve diverse ecosystem stakeholders and involves four steps:

Explore potential focus areas within Food is Health. Food is Health touches many industry sectors and cross-cutting research and commercialization areas. Mapping the landscape of intersection between food and the agbioscience innovation platforms will clarify potential focus areas within Food is Health. Monitor other ecosystems pursuing intersectional Food is Health type strategies to ensure differentiation.

Identify Indiana-specific resources and assets aligned with potential focus areas. Innovating at intersections requires connecting and convening existing assets and building new ones. Build a fresh and data-driven understanding of the breadth of Indiana's food-related assets within each potential focus area.

Align ecosystem stakeholders on Indiana's differentiated research and commercialization priorities within Food is Health. Prioritization will drive intentionality and focus to prevent Food is Health from becoming all-encompassing and difficult to communicate or execute.

Coordinate resources, action plans, and messaging around focus areas. Chosen focus areas may overlap with other Indiana initiatives or ecosystem actors. A critical role of an ecosystem convener like AgriNovus will be to ensure that related initiatives collaborate rather than duplicate efforts in pursuit of the goal.

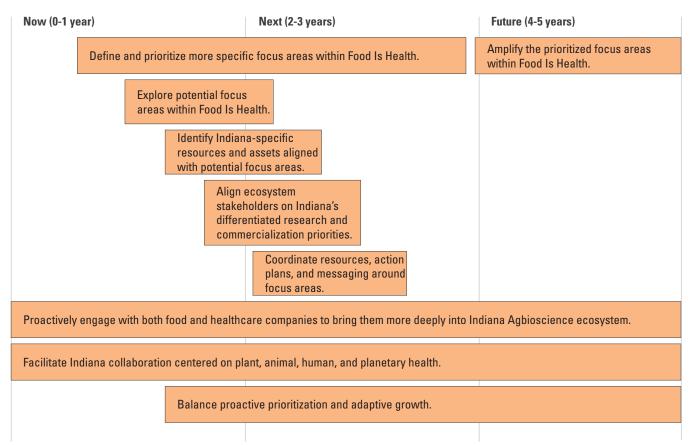
Proactively engage with food and health care companies to bring them more deeply into Indiana agbioscience ecosystem conversations. Monitor the landscape of relevant start-ups and establish relationships with related larger entities. Nurture formal (i.e., joint venture agreements) and informal collaborative relationships within the priority focus areas.



Facilitate Indiana collaboration centered on plant, animal, human, and environmental health. To succeed, the ecosystem must go all-in on collaboration and build both the physical and social infrastructure needed to make collaboration more than just a buzzword. Indiana agbioscience must continue to foster an environment where various industries collide that are working toward similar goals and are striving to solve similar problems. In addition to broad convenings, topically focused convenings can accelerate specific opportunity identification, drive collaboration, and strengthen the brand of the Indiana agbioscience ecosystem.

Balance proactive prioritization and adaptive growth. Food is Health is likely to be a very dynamic opportunity area over the next decade, as advances in Al accelerate scientific discovery, consumer health and wellness trends shape behavior, scientific understanding of precision and personalized nutrition advance, and the health care system evolves. A deeper understanding of differentiated focus areas is necessary, but the agbioscience ecosystem should be adaptive and responsive and should seek to accelerate growth in focus areas that gain early traction. Network effects make attracting the next company within a focus area easier with each successive win.





Recommended Ecosystem Actions for Bioinnovation

From early-stage research and product development to scale-up to commercial operations, biotechnology is ripe with potential for innovation and scaled impact. Pathways to economic growth through the Bioinnovation economy could take several forms. RTI recommends that the next steps for the Bioinnovation opportunity involve identifying focus areas to drive targeted growth activities.

Clarify industry-specific needs and challenges related to the development and scaling of Bioinnovation solutions. Whereas the long-term potential of Bioinnovation is clear, the near-term needs and specific opportunities vary by industry segment (e.g., the needs and near-term opportunities for sustainable aviation fuels are different from precision fermentation for food ingredients). Specific actions include the following:

Segment the Bioinnovation ecosystem into its component biotechnology processes and platforms, from early-stage to commercial, to further describe discrete subopportunities (e.g., traditional fermentation, precision fermentation, microbial strain engineering, bioproduct discovery and characterization).

Identify industry needs across the Bioinnovation segments. Consider the full breadth of bioproduct industries, including pharmaceuticals, enzymes, ingredients, oils, fats, textiles, plastics/polymers, fuel, pigments, and other specialty chemicals to understand the latent or underserved technology or innovation needs that could be addressed.

Identify priority focus areas of Bioinnovation R&D where Indiana can leverage its existing university and corporate R&D assets to become the global leader in accelerating discovery and development. This step will include clarifying Indiana's unique advantage in commercialization and scaling industrial biomanufacturing vis-à-vis other Midwest states. Gather intelligence to compare Indiana's commercialization infrastructure, crops, land or water assets, and other advantages (energy, waste treatment, business incentives) with those of other Midwest states (lowa, Illinois, Nebraska). Research the return on investment for building out biotechnology infrastructure to understand which investments will generate the highest impact.

Explore building additional biomanufacturing

infrastructure. Europe is leading the world in fermentation capacity. The U.S. government is investing in expanding domestic biomanufacturing infrastructure. Conduct additional research to evaluate the economic development potential of building out biomanufacturing infrastructure.



Ensure communication and collaboration with the various initiatives focused on Bioinnovation, including those in Indiana like Heartland BioWorks and BioCrossroads, and other regional or national groups like BioMADE. For example, BioLaunch, a strategic initiative of Heartland BioWorks, is targeting small and medium biotech innovators in the drug substances and drug products space, moving innovations from late-stage clinical development to manufacturing and distribution. Both the BioWorks consortium and the agbioscience biotechnology opportunity aim to accelerate the Bioinnovation lab-to-market pipeline by connecting stakeholders within advanced manufacturing and biotechnology.

Establish an inclusive workforce strategy for Bioinnovation. Today, industrial biomanufacturing lacks a trained workforce—one that blends high-science skills with advanced manufacturing and trade labor. Creating a workforce strategy can signal to prospective companies that Indiana is committed to building the skilled talent pipeline required to grow its footprint. Anchoring the strategy in the principles of inclusive workforce development can ensure that economic growth benefits both rural and urban communities and promotes diversity of talent within the biomanufacturing field.

Develop a coordinated marketing plan for attracting Bioinnovation companies. As place-based Bioinnovation hubs in Indiana like Heartland BioWorks and the LEAP Lebanon Innovation District mature, the ecosystem should create a coordinated plan to monitor the landscape of relevant start-ups, and build the pipeline of prospective companies. Example activities within this plan could include the following:

- Promote the existing industrial biotechnology industry in Indiana as anchor facilities to attract new companies.
- Expand relationships with Indiana bioprocessors who have relationships with emerging companies that are nearing commercial production.
- Monitor domestic commercialization pipeline of de-risked companies to identify and connect with prospects.
- Work with biomanufacturing Initiatives to identify funding sources.
- Assemble consortium partners that act as market uptake actors creating agreements with new companies.

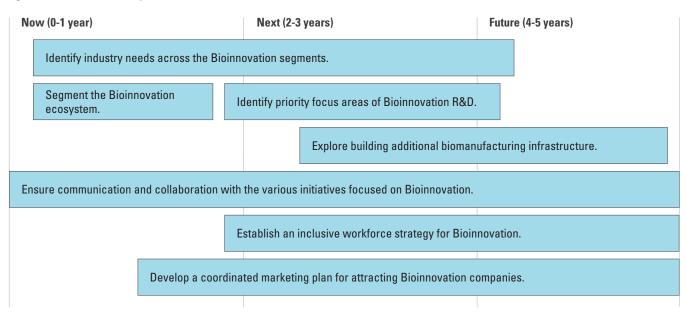


Figure 16: Recommended Ecosystem Actions for Bioinnovation

AgriNovus as the Catalyst to 2050

As the convening body of the agbioscience ecosystem, AgriNovus' mission is to fuel growth in the Indiana agbioscience economy.

Figure 17: AgriNovus's Three Service Areas

Thought Leadership

Conduct primary research, amplify the agbioscience story, inspire talent, and host events that drive collaboration. Serve as a trusted source of content and context for the agbioscience community.

Business Growth

Accelerate economic development by building, attracting, retaining and aiding agbioscience companies.

Innovation Acceleration

Create an ecosystem for innovators and entrepreneurs to connect with industry and capital. Galvanize the agbioscience community for the success of the individual and the ecosystem as a whole.

AgriNovus inspires, energizes, and drives actions that fuel differentiated growth across Indiana's agbioscience economy through three service areas:

Thought Leadership. AgriNovus's podcast, *Agbioscience*, serves as a trusted platform and voice for the agbioscience ecosystem, providing the critical content and context to shape discussions and narratives. Field Atlas is AgriNovus's career exploration platform and inspires students about agbioscience professions and connects Indiana-based companies to talent. AgriNovus commissions research studies to generate data-driven analyses that support decision-making across the ecosystem.

Business Growth. AgriNovus hosts **Innovation Acceleration**, which tasks companies, entrepreneurs, students, and innovators with creating new market-driven technology, business models, or service solutions that address barriers identified in the agbioscience platforms. AgriNovus supports existing businesses as they scale and innovate, and it works with IEDC to generate an active **pipeline of companies and secure commitments** to add new jobs and investment in the Indiana agbioscience economy.

Innovation Acceleration. Through its quarterly event series, **QUADRANT**, AgriNovus offers a platform for diverse members of the agbioscience community to engage in speaking, learning, and networking opportunities. AgriNovus hosts, sponsors, and speaks at **national events** throughout the year to tell the agbioscience story; showcase Indiana's accomplishments; and attract investors, companies, and talent to the region.

AgriNovus's role in thought leadership, business growth, and innovation acceleration is enabled by its highly engaged and diverse Board, its organizational agility, and its relationship with its parent organization, CICP.

AgriNovus serves a large set of actors in the Indiana and global agbioscience ecosystem (see **Figure 18**). The inner ring includes ecosystem actors that are most directly engaged and central to AgriNovus's mission. The second ring includes actors that benefit from AgriNovus's services and are often constituents of the groups in the inner ring. Finally, the outer ring includes the broadest set of actors that AgriNovus reaches today. Figure 18: AgriNovus Serves a Diverse Set of Stakeholders Representing Multiple Perspectives on the Agbioscience Ecosystem



"We are growing the agbiosciences for the economy of Indiana but for an impact that will extend far beyond our borders."

-AgriNovus Board Member

AgriNovus is committed to mobilizing Indiana's ecosystem toward its Accelerate 2050 Vision. Enabled by a highly engaged Board of Directors and dedicated team, AgriNovus has a solid foundation from which to build and support the three ecosystem-level opportunities described.

Recommendations for AgriNovus

AgriNovus plays the critical role in the Indiana agbioscience ecosystem of catalyst, convener, and enabler. As such, RTI recommends that AgriNovus supports the three prioritized opportunities in a similar manner. In the near term, AgriNovus should lean into its thought leadership platform to amplify the three Indiana agbioscience opportunities. Similarly, AgriNovus can embrace its role as ecosystem convener and mobilizer to lead a process of conducting deeper research on potential focus areas and convening ecosystem actors to prioritize focus areas and create shared action plans. Over time and as these focus area–specific action plans are developed, other ecosystem actors may take the lead on implementing the roadmap, depending on the focus areas chosen. However, in a dynamic environment of technological, political, and social change, ecosystem conveners, like AgriNovus, will continue to have an important role to play in catalyzing action, aligning diverse stakeholders, and shaping ecosystem growth.

Thought Leadership

Tell the Agbioscience Story

- Use the podcast to reinforce the three ecosystem opportunities to align the AgriNovus brand with the opportunities, for example, showcase innovative Indiana farmers, unpack Bioinnovation with Indiana thought leaders, and champion crop diversification as an enabler of Food is Health.
- Diversify into other platforms beyond podcasts; resource-intensive, high-production video can be memorable and brand-building. Add short innovation briefs or other lighter-touch outputs alongside the more-detailed research products already available.

Create a Research Agenda

- Create a research agenda that simultaneously delves deeper on ecosystem opportunities and provide the outputs as a public resource to incentivize Indiana investment.
- Benchmarking with NAICS codes is complicated, as codes do not adequately represent the agbioscience sectors. Consider advocating for policy changes that allow clear tracking of the agbioscience platforms, including splitting animal and human health into separate codes and tracking which industries headquarters and R&D operations are tied to.

Foster the Agbioscience Workforce

- Work with Ascend Indiana colleagues to routinely assess the supply of and demand for talent in the agbiosciences.
- Engage with employers, research universities, trade and technical schools, community colleges, and certification or apprenticeship programs to bolster Field Atlas with career resources, degree pathways, and job postings that are tailored to the ecosystem opportunities.

Business Growth

Recruit and Grow Businesses

- Balance the emphasis on external business recruitment with internal business creation. Indiana's location, geopolitical environment, and competition from other established and burgeoning AgTech hubs (e.g., St. Louis, Research Triangle Park, Austin, Denver/Boulder, Champaign-Urbana, Sacramento) are not factors within AgriNovus's control and may challenge a recruitment-centric business growth approach.
- Define a targeted international recruitment plan engaging emerging global leaders from Brazil, India, Europe, and other leading global agricultural innovation hubs, especially as aligned with the three

opportunities prioritized by ecosystem actors. Traditional support packages (e.g., physical space, tax incentives) coupled with intangibles (e.g., talent recruitment support via Ascend Indiana, connections to farmers and large corporates) could tip the scales vis-à-vis other agbioscience hub regions recruiting international companies.

Support Indiana Farmers

- Continue to focus on business creation and innovation within the existing agbioscience industry base (farmers, especially, are looking for ways to diversify farm income and reduce costs)
- Measure success in terms of retaining Indiana's agricultural competitive advantage (e.g., number of farms, income of farms, productivity of farms).
- Include Indiana farmers in the entrepreneurs supported by AgriNovus programming, especially for networking, business development, and incentives programs.

Make the Case for Indiana

- Name and promote the existence and role of AgriNovus as a selling point for Indiana. AgriNovus is a large part of the "why Indiana" equation.
- Work with CICP and other partners to grow attraction not only for working in Indiana but also for living in Indiana.

Innovation Acceleration

Convene the Agbioscience Community

- Embrace the role of convener, especially to harness the power of collaboration along supply chains and across sectors that are traditionally siloed. For example, continuing to bring together farmers, processors, food companies, retailers, and health insurers on a regular cadence to advance the Food is Health opportunity.
- Continue to develop an active and engaged community beyond the current Board by facilitating tailored meetups, forums, and events to draw actors across disciplines to converge on agbioscience.
- Experiment and innovate the ways in which AgriNovus creates value through convening. For example, consider integrating an investor forum or similar mechanism to highlight local companies and invite high-potential out-of-state recruits to see the agbioscience ecosystem on full display.
- Host convening sessions on topics that address the aggregate needs of the ecosystem. For example, navigating the global regulatory landscape is a current barrier for many companies in the biological agriculture inputs space. Use these sessions to inform focused communication campaigns that influence on behalf of the ecosystem.

Enable Innovation Across the Ecosystem

- Proactively cultivate enablers of and work to remove barriers to innovating across organizations, sectors, and domains. This approach includes upholding an ongoing listening function to understand the innovation-related incentives, risks, opportunities, and barriers faced by the agbioscience ecosystem. Use the AgriNovus Board as a resource for sharing good practices and prioritizing collaborative innovation barriers to be addressed.
- Scout for and introduce the broader ecosystem to innovative business models, novel risk-sharing approaches, creative cross-sector problem-solving approaches, etc., that are used in adjacent sectors or other places (e.g., in the United States and beyond) poised for impact in Indiana.

• Create low-risk ways for the agbioscience community to experiment and create together (e.g., via co-funded collaborative innovation challenges, hackathons, inventor days, or other bounded efforts). These efforts can build trust and familiarity among participants, setting a strong foundation for higher-risk and -reward collaborative innovation efforts later.

Work Across CICP Initiatives

- Continue to work with partners at CICP to clarify cross-initiative relationships and roles, particularly to create alignment on the agbioscience opportunities.
- Determine the unique needs of entrepreneurs in the agbioscience ecosystem and share them with CICP to inform and refine the state-wide entrepreneurial support strategies it implements.

AgriNovus-Wide Recommendations

Engage in Focused Exploration of New Capabilities

AgriNovus is small but mighty. The team has been very successful at delivering data-backed results and impact to their stakeholders. Yet, a common concern elevated by its Board and echoed by RTI is the cautionary warning not to spread the team too thin.

- What does AgriNovus not do? Articulating this list alongside naming its service areas is important.
- What can AgriNovus own? AgriNovus is uniquely positioned to develop this point of view on behalf of the ecosystem. Use leadership platforms to articulate the specifics necessary to focus future initiatives.

There is room to experiment with new ways to deliver value within AgriNovus's three well-defined service areas, without diluting its focus.

- Set AgriNovus up as the zoom-in and zoom-out function of the ecosystem. Regularly pause to reflect how the ecosystem is growing and developing in aggregate. What are the weak spots? Is progress in one area being slowed by progress in another?
- **Keep leaning forward.** Grow AgriNovus's anticipatory capabilities to arm the ecosystem with a scouting function that keeps stakeholders abreast of macro-trends, drivers of change, emerging breakthrough technology, and disruptors. Share the insights with the Board on a semi-regular basis.

Diversify to Ensure Resilience

- Create deeper areas of specialization and technical expertise with the team to broaden organizational and staff profiles.
- Bring other voices alongside the CEO's to further bolster the organization's credibility and role as a trusted advisor.
- Consider revenue diversification only if it does not threaten or compromise AgriNovus's unique position and value-add to the ecosystem.

Measuring Progress

As an ecosystem-enabling organization, AgriNovus has vested interest in assessing progress across multiple levels of the agbioscience ecosystem (e.g., agbioscience economy-wide progress, ecosystem-level progress, AgriNovus-directed efforts). However, it has differentiated control over outcomes in the nested ecosystem in which it operates, which must be accounted for in the organization's measurement approach. AgriNovus will be well-served to focus its progress measurement efforts most prominently on what is in its *sphere of control* (i.e., those activities, outputs, and intermediate outcomes most closely linked to its efforts) or in its direct *sphere of influence* (i.e., those outputs and outcomes to which it either

directly or indirectly contributes). Economy-wide progress in agbioscience falls within AgriNovus's sphere of interest (i.e., the ultimate impact the organization, and many other actors, seeks), which is influenced by many factors outside of its control or influence.

AgriNovus may consider complementing progress measurement, per the previously mentioned potential metrics, with contribution analysis (e.g., ripple effect mapping) to assess the ways in which it has contributed to higher-level ecosystem goals. Such qualitative evaluation approaches could be employed at a mid-point of the strategy.

	AgriNovus's Full Sphere of Interest	Key Questions & Metrics for Assessing Progress (along different ecosystem levels & time horizons)
Sphere of Interest	Indiana as the world-leading destination for developing and scaling agbioscience solutions, fueling long-term differentiated economic growth for the state, the nation, and the global agbioscience economy.	 Economy-Level / Long-Term Change Horizon Key Questions: Are we making meaningful progress toward our shared, systems-level vision? Is the broader economy shifting in desirable ways? Key Outcome Metrics (lagging, measured every 1–2 years): Overall size and rate of growth of Indiana's agbioscience economy Indiana's relative position vis-à-vis global competitiveness analysis (e.g., number of market leaders; market share of those leaders) Change in agbioscience business revenue, employment Non-Indiana or externally produced rankings of U.S. national agtech or agbioscience leaders
	Agbioscience Economy Wide	 Key Output Metrics (leading, measured annually or more often): Number of companies located in Indiana Public, private, and public-private investment in agbioscience facilitators
Sphere of Influence	Food Is Health Bioinnovation Farmer-Focused Innovation Agricultural Production Value-Added Nutrition Agricultural Equipment Technology Plant Science and Crop Protection Animal Health and Nutrition Agbioscience Ecosystem Wide	 Ecosystem-Level / Medium- to Long-Term Change Horizon Key Questions: Are we making meaningful progress toward the strategic opportunities we are pursuing as a collective? Are we achieving the opportunity-specific outcomes we seek? Key Outcome Metrics (lagging, measured every 1–2 years): Opportunity-specific metrics (to be defined as opportunities are further specified) Cross-opportunity shared metrics (to be defined as opportunities are further specified) Platform-specific metrics (e.g., size and rate of growth) Key Output Metrics (leading, measured annually or more often): Cross-opportunity metrics (e.g., numbers of university-private sector collaborations, established companies engaged in projects, start-ups engaged in projects) Ecosystem health metrics (e.g., density of network connections; cost of co-investment among AgriNovus ecosystem members)
		Organizational-Level / Short- to Medium-Term Change Horizon Key Questions: • Are we delivering the outputs and near-term outcomes we expect? • Are we contributing to ecosystem-level outcomes in meaningful ways?
Sphere of Control	Thought leadership Business Growth Innovation Acceleration	 Key Outcome Metrics (lagging, measured every 1–2 years): Number of inbound inquiries from companies or other entities from outside Indiana Cost leveraged for AgriNovus programming among ecosystem actors Board or partner satisfaction (i.e., perception of value-add) Key Output Metrics (leading, measured annually or more often): Number and rate of change in podcast listeners Number of connections made between ecosystem actors and potential entrants
S	AgriNovus Specific	 Number of ecosystem stakeholders engaged in programming (e.g., organizations or individuals served)

AgriNovus's Full Sphere of Interest Key Questions & Metrics for Assessing Progress (along different ecosystem levels

Conclusion

The Indiana agbioscience sector is poised for significant growth and transformation by 2050, driven by a confluence of technological advancements, evolving consumer preferences, and pressing global challenges. The insights generated through the Accelerate 2050 initiative have revealed a range of opportunities for Indiana to leverage its strengths in agriculture, biosciences, and technology to become a global leader in the agbioscience economy. By fostering regional specialization; embracing innovative solutions at the intersection of plant, animal, and human health; and proactively addressing challenges, Indiana can create a resilient and sustainable agbioscience ecosystem that drives economic growth, improves quality of life, and contributes to global food security.

However, realizing this vision will require a concerted effort from all stakeholders within the Indiana agbioscience ecosystem. AgriNovus Indiana, as the state's agbioscience initiative, is well-positioned to serve as the catalyst for this transformation. By convening industry leaders, researchers, policymakers, and entrepreneurs, AgriNovus can facilitate collaboration, investment, and innovation across the agbioscience value chain. The 5-year roadmap outlined in this report provides a strategic framework for AgriNovus to prioritize initiatives, engage stakeholders, and measure progress toward the 2050 vision. By embracing the opportunities and challenges identified in this report and by working together toward a shared vision of success, the Indiana agbioscience ecosystem is poised to create a brighter, more sustainable future for all.

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Appendix

Detailed Methodology – Accelerate 2050

AgriNovus and RTI designed the 2050 Accelerate planning process to include both trends and findings from a current-state analysis and next-25-years prospective strategic visioning and opportunity identification through a future-state analysis. These complementary approaches helped ensure the 2050 Accelerate vision is aspirational yet rooted in a firm grasp of Indiana's current assets and comparative advantage.

1. Explore the current state through competitive market analysis.

The current-state analysis analyzed Indiana's global competitive positioning across different agbioscience platforms and industry segments. RTI performed market research drawing on BCC Research, 10-K SEC filings, and annual reports to estimate the current global market size and the past and future 5-year growth rates for each platform and their key segments and to identify the global market leaders. RTI performed additional market research and interviews to identify key factors driving or limiting growth in each platform. Finally, we used a SWOT framework to assess Indiana's competitive positioning for growth within each platform.

RTI also performed a regional benchmarking analysis to compare how Indiana ranks against all 50 states in terms of agbioscience GDP and employment. The goal was to produce a replicable methodology with readily available data that can be used to track Indiana's performance over time.

The current-state analysis is not exhaustive of all factors that impact competitiveness, such as workforce dynamics, entrepreneurial ecosystem, and policy landscape.

2. Understand emerging opportunities by analyzing forces of change and future scenarios.

Strategic Foresight is a disciplined approach to exploring alternate futures. It is an approach best suited to time horizons with high levels of uncertainty. The has a unique, proprietary methodology for strategic foresight that combines foresight best practices with lessons learned over many years of innovation strategy consulting. Our foresight process takes participants through a series of experiences that immerse them in plausible, provocative future scenarios that are rooted in signals and drivers of change. The purpose of strategic foresight is not to predict the future, but to help leaders understand the range of *possible* futures; identify threats, opportunities, and preferred futures; and align stakeholders around futures-informed visions and action plans.

RTI Foresight Principle:

Organizational conviction and stakeholder alignment from a foresight project requires more than reading a report. Much of the value gained in a foresight project is from directly participating in the trends synthesis and future scenario immersion. Foresight is a bit like riding a roller coaster. Reading about the future is not the same as experiencing it. RTI IA-led foresight projects all involve some type of participant immersion to maximize impact and align key stakeholders.

3. Co-create a brigde to the future and enable action through strategic roadmapping.

For Accelerate 2050, the RTI team used the outputs of all previous tasks to inform the creation of an agbioscience strategic roadmap that is aligned with AgriNovus's 2050 Vision and future emerging opportunity areas, anchored in Indiana's comparative advantage, and establishes meaningful priorities, goals, and metrics to accelerate growth of the agbioscience economy.

In March 2024, RTI conducted an executive roadmapping workshop to engage AgriNovus and its executive committee and to collaboratively create the Accelerate 2050 roadmap. Using various inputs from both the current-state analysis and futures immersion and visioning, workshop participants prioritized opportunity areas and mapped potential next steps to pursue each opportunity area. Workshop outputs were synthesized by RTI and integrated into the broader analysis to inform the creation of the Accelerate 2050 roadmap in this report.

Indiana Agbioscience: 2050 Future Scenario Details

bioGENESIS

The year is 2050...

It would not have been much of a surprise for people in 2025 to hear that the next 25 years would be dominated by **AI** and **Biotech**, but these two technologies have reshaped agbioscience in both intended and unintended ways.

The Roaring 2020s saw an **unprecedented rate of scientific breakthroughs**, fueled by advancements in AI applied to gene-editing, omics, and other biotechnologies. Powerful AI systems mined massive biological datasets, uncovering revelations about genetics, microbiomes, and more. The **pace of discovery far exceeded the pace of commercialization**. Just as the release of ChatGPT and other large language models set off a decade of AI-enabled product innovation, the biotech discoveries enabled by AI between 2025 and 2030 triggered entrepreneurial and economic opportunities that lasted for decades. Looking back, **data ownership decided AI winners and losers** as AI systems proliferated, **including in agbioscience**.

Deep collaboration between medical schools, pharmaceutical researchers, data scientists, and agricultural biotechnologists that emerged in the late 2020s created the vital bridge to translate breakthroughs into products. Multidisciplinary teams used AI advances to map genetic pathways in humans, livestock, and plants, unraveling commonalities across digestion, immunity, hormonal signaling, and more. These cellular- and molecular-level insights **enabled innovations to cross over rapidly between spheres**. For example, medical insights into the microbiome's role in gastrointestinal health led to the creation of foods tuned to better support consumer gut ecology. Understanding vitamin absorption pathways in the human body helped tune the expression of nutrient-dense pigments and antioxidants in vegetables and fruits. The **integration of health and agriculture sciences continuously spun off new startups**, finding molecular mechanisms to drive the next pocket of disruption.

Yet 2025–2035, the Decade of Discovery, had downsides too. AI systems consumed massive amounts of energy and deepened societal concerns about sustainability. And despite AI's pivotal role in scientific discovery, several high-profile, **viral AI system failures, deepfakes, and privacy breaches eroded public trust in AI** and led to strict AI regulation. People remained skeptical of AI agents, preferring human interaction and decision-making in their daily lives. A dichotomy emerged in the technological landscape—AI thrived out of consumer's view in behind-the-scenes applications like R&D, while consumer-facing interfaces avoided putting AI-agents front and center.

During the Decade of Discovery, successful regions created **place-based knowledge hubs that specialized in different platforms**, such as gene editing, drug discovery, sustainable materials, or energy technology and leveraged cross-disciplinary collaboration. **States and regions became synonymous with specific scientific platforms**, redefining their global identity and appeal. Although states and regions differed in their growth strategies, one thing was constant: **regional specialization created ecosystem effects**. Some regions specialized in scientific advances and leading-edge discovery, anchored by both universities and corporate R&D. Other regions specialized in commercialization by investing in infrastructure incentivizing/derisking early adopters.

These regional hubs, together with Al-enabled advances in biotechnology, fueled a **biomanufacturing boom**, as innovators applied these cutting-edge discoveries and scaled up the production of **new innovative products and processes**, including animal and human therapeutics, biofuels, food ingredients, synthetic materials, and more. A pivotal enabler of the commercialization of biomanufacturing technologies was the growing use of **modular production systems**. As one startup failed, the modules could be quickly reconfigured to produce different biologic products. This flexibility helped modular biomanufacturing companies like BioBuilder capitalize on the explosion of high-potential biotech innovations worldwide.

The Midwest saw Iowa, Illinois, and Nebraska leverage these modular production systems to transform the corn belt into a powerhouse for industrial biotechnology through the 2030s. Cover crops once grown for soil health were now

Accelerate 2050 | Appendix

optimized for biofuels, bioplastics, and other precision fermentation products. Although still dwarfed by scale of fields and commodity grain trade, biomanufacturing output became a cornerstone of regional economies and **attracting and retaining talent became the rate-limiter to regional economic development**. In the intense talent wars of the 2030s, companies grew footprints in urban and suburban tech hubs rather than in rural communities. This differential growth, combined with talent and skills gaps, contributed to **talent drain** from rural areas and **exacerbated the rural–urban divide**.

Yet, amid this biotechnology revolution, **U.S. consumer views on bioengineered and gene-edited foods diverged and factions emerged**. On one side, food security and sustainability-conscious U.S. consumers gradually accepted gene-edited and bioengineered foods for their climate-smart advantages like drought, heat, and pest tolerance. Simultaneously, many U.S. consumers swayed by pseudo-scientific sources and influential media voices questioned the long-term health effects and potential unintended consequences of consuming these "unnatural" foods. The U.S. market fractured into mainstream, low-cost, **gene-edited and GMO foods** and premium **biotech-free foods** in an evolution that paralleled the organic movement of the 2000s.

The other major force that shaped American diets was the proliferation and widespread adoption of the many variations of GLP-1 drugs. Colloquially called Spawns of Ozempic, the popularity of these drugs slowly **reduced the caloric volume of the average the American diet**. These medications, initially developed for diabetes management, have become widely used and beneficial for weight management, substance use disorders, gambling addictions, and more. These new drugs had many substantive health benefits, but traditional eating patterns persisted, albeit in slightly smaller portions.

Internationally, **divisions deepened between export markets**. Export-oriented breadbaskets like Brazil and Argentina were slow to adopt biotech innovations as their target EU markets restricted gene-edited varietals. Others, like Australia, doubled down on biotechnology for climate adaptation. Segmentation emerged around supply chains verified as either traditional breed or climate-smart. As global economies matured, a rising middle class in developing nations spurred an increased demand for high-quality protein. The **increasing demand for protein**, **biotechnology innovations, and the dynamic regulatory environment around gene-editing** creates a complex web of interdependencies, reshaping the global export market.

On farms, farmers continued to integrate the advances made during the Decade of Discovery, including biotech innovations, Al-driven crop management systems, and autonomous harvesting machines. Despite farmer enthusiasm for these innovations, they were expensive to adopt. Farmers benefited from **increased efficiencies and yields**, but they also experienced **rising costs of technology acquisition/integration**. This reality drove margin compression and accelerated farm consolidation. Although farms that adopted new technologies experienced tangible benefits, the bulk of the economic windfall from creating and scaling agbioscience innovations was captured off-farm. Input providers, data aggregators, and value-adding food and biomanufacturing companies became the primary beneficiaries, reaping substantial profits.

In the 2020s and 2030s, **biofuels production grew steadily** as a result of supportive low-carbon fuel policies in Europe and North America. The highly successful collaboration between Corteva Agriscience, Bunge, and Chevron showed how cover crops used for biofuels could add a revenue stream for farmers and could increase biodiversity in the soil without disrupting the food supply. Next-generation corn ethanol and soy biodiesel production expanded steadily for years, buoyed by demand for renewable diesel blends and gasoline additives. However, **over time, the energy transition eroded demand for traditional biofuels**; 25 years of continuous battery density improvements, infrastructure build-out, and slow but steady consumer and business adoption of electric vehicles, new battery storage solutions, and the expansion of solar and wind diversified the U.S. energy mix. Biofuels challenges were further compounded by the **stagnation in the development of biofuels for aviation**, which never quite took off as anticipated due to challenges with cost competitiveness, a lack of regulatory mandates or incentives, and an unwillingness of mainstream consumers to pay a premium to fly on sustainable airlines.

Accelerate 2050 | Appendix

reclaNATION

The year is 2050...

Few concepts feel as abstract as national security—until the effects of **geopolitical conflict** show up in grocery stores and on dinner tables. The global political clashes of the last 25 years have reshaped how most American families think about food security. A watershed moment came in 2033, when China invaded Taiwan, triggering geopolitical fractures, proxy wars, and open hostilities. The resulting massive **global supply chain disruptions and food price shocks** created an **America-first approach** to global trade and food security. Dozens of politicians like Senator Amy Smith successfully centered their 2036 campaigns on the message that food security is national security.

The passage of the **Nutrition Security Act of 2035** marked the largest federal government investment in a single sector since the CHIPS Act of 2022. This massive investment accelerated the scaling of various biotechnology and agriculture innovations and enabled **localized production of diverse crop varieties** once limited to tropical regions overseas. Over the next 15 years, the American heartland transitioned into a technology-enabled everything-basket, growing everything from canola to oranges to cocoa.

Whereas geopolitical instability, biotechnology, and government incentives catalyzed change, **evolving consumer demands** enabled this new food production paradigm to fully take root and thrive. Patriotic shoppers preferentially purchased food with Grown in America labels and sustainability-minded consumers shopped for locally sourced foods with lower carbon footprints.

In parallel with a move toward locally sourced foods, **a wider wellness movement also shaped consumer behavior**. Breakthroughs in nutrigenomics and the proliferation of wearables created Al-enabled **precision and personalized nutrition products**. Grocery store shelves ballooned with new functional food categories, marketing ingredients smart-matched to genetic profiles. **Personal Al Agents** with access to personalized health information, DNA, blood biomarkers, gut microbiome data, and more recommended everything from snacks to vitamins to meal kits for personalized nutrition. **U.S. consumers trusted these Al recommendations** and shifted buying patterns toward **healthy, sustainable, transparently-sourced food**. Once skeptical of GMOs, Americans increasingly embraced **gene editing** as an enabler of enhanced nutrition, food security, and sustainability. **Educational campaigns** explained how innovations like CRISPR not only secured the domestic food supply, but also optimized nutritional content and sustainability.

The same technology optimizing human diets soon extended across the entire plant-to-animal continuum. Breedoptimized foods for both pets and livestock became common. Plant genetics were modified to minimize pathogenic disease in animals and methane production from animals. Precision nutrition for both humans and animals, combined with reshoring production of more food types, exponentially **increased demand for diverse, specialized crop types, and genetic varietals**.

Alongside scientific advances, AI has also created **exponential workforce productivity gains** within the knowledge economy. Within leading corporations, economic output per employee has increased 100-fold. Now, in 2050, specialized AI agents make more strategic decisions and perform more tasks than humans for nearly all Fortune 500 companies. For individuals, AI agents have become integral parts of the way we live and work. These experts in your pocket become trusted news sources, shape public opinion, and **surpass human-level expertise** across nearly all domains.

Faced with diminishing prospects in a workforce increasingly managed by AI, and resentful of inherited crises, younger generations grew disillusioned. Gen Alpha college grads sought purpose and community in the physical economy. Skilled trades flourished, including mechanics, farmers, nurses, and more. In parallel, entrepreneurial opportunity, government incentives, and nationalism drove **a flood of young, idealistic entrepreneurs to food and agriculture**, enabled in part by the specialized AI agents that serve as ag experts in their pockets.

Although the agricultural renaissance offered new opportunities, risks also multiplied from ongoing global resource strains. **Extreme weather** patterns, commodity **price volatility**, and **input shortages** ensured farming remained an inherently risky endeavor, even as new technologies created stability in other arenas. In response, successful **farms diversified revenue streams** across everything from energy generation to carbon credit programs. Cover crops are routinely harvested for biofuels or fed into on-site bioreactors. Consumer demand for certified carbon neutral fueled **blockchain-enabled transparency** and **thriving carbon markets**. Energy generation from solar, wind, and green hydrogen are increasingly integrated into diversified farming business models. Solar grazing 2.0 optimized land use for agricultural and solar farming, maximizing profits for both income streams.

The relationship between multi-national food companies and producers has evolved. As commodity markets became more volatile and specialized ingredients become harder to obtain, companies like Mars Wrigley and Danone dramatically expanded their use of long-term sourcing commitments and direct farmland acquisition to **decrease their supply chain risk**. In 2038, Nestle's decision to invest more than \$20 billion in acquiring and operating farmland created an industry domino effect that further deepened verticalization. Enabled by these deep partnerships, farmers became innovation enablers by scaling customized ingredient varieties desired by food companies. Other companies like General Mills, which had made ambitious sustainability commitments in the early 2020s, created profitable new revenue streams for farmers through **carbon insetting partnerships** and **transparent end-to-end supply chains**.

The phrase "no two farms look the same" is just as true in 2050 as it was in 2023. However, now **innovative business models of producers have proliferated**. "There are 1001 ways to make money by becoming a farmer." Out of necessity, managing risk through integrated diversification became the new agricultural business imperative. **Capital markets accelerated this agricultural transformation**, eager to fund diversified tech-enabled agricultural enterprises that promised stable returns amid global volatility and positive sustainability impacts.

Although most of the agricultural transformation unfolded organically from changing consumer priorities and generational reshuffling, state governments helped seal the deal by incentivizing **integrated local food economies**. Regulatory reforms encouraged regional business collaborations spanning input suppliers, farmers, processors, distributors, and even retailers. Tax breaks attracted massive investments in food processing, and cold storage logistics combined with autonomous vehicle transportation logistics to create **new value-added market channels**. Farm goods no longer left counties or even states after harvest; instead, they move straight to regional canning, freezing, and packaging facilities for direct distribution to local markets. States launched campaigns like Ohio Proud branding to educate consumers while keeping dollars circulating close to home. The corresponding local economic multiplier effects reinforced the transformation of the agrifood system.

Recognizing the value of baseline data in **creating shovel-ready sustainability investments**, California took bold action to capture corporate sustainability dollars. In 2028, the state legislature approved a landmark \$500 million Ag Transformation Grant program. This program provided farms with capital to invest in baseline data collection and digitalization. The data further solidified California farms as the preferred suppliers to food companies that required data-backed verification of farm practices. In return for the grants, the state got access to the anonymized farm data, which it used to attract innovative agbioscience companies to locate to California by demonstrating its prime conditions for R&D. The grants accelerated technology adoption that made farms more productive, profitable, and climate resilient.

consoliDATA

The year is 2050...

In the dawn of 2050, the American farm has been transformed into a landscape of technological marvels. **Technology**, once a mere tool, had burgeoned into the very essence of modern agriculture. Farms had become a sophisticated network of **connectivity**, with every inch of soil and every aspect of animal husbandry intricately monitored and managed by an array of Internet of Things (IoT) **sensors**. These devices, dispersed across fields and within the very fabric of barns, collected **data** on a scale previously unimaginable. Autonomous **drones**, like mechanical pollinators, buzzed through the skies, their cameras capturing hyperspectral images that unveiled the invisible stresses of crops, while satellites in orbit cast a watchful eye, ensuring a macroscopic oversight that tied the vast operation together.

As the farm evolved, so did the profile of the American farmer. The **aging population of traditional farmers**, with the average age cresting 55 by 2025, found it increasingly difficult to compete. The **capital requirements** to adopt these new technologies were steep, and as the older generation retired, fewer of their heirs chose to follow in their footsteps. Those who did were often crushed under the weight of financial pressures, leading to a wave of **consolidation** that saw over 60% of farms owned by larger corporations, real estate investment trusts (REITs), or investment funds by 2050. **Foreign investment**, particularly from nations like China and Saudi Arabia, played a subtle yet significant role in this shift, as they acquired American farmland under the guise of diversification and food security.

Consolidation spurred investment in **precise, automated, and connected farm machinery**. As farmers signed on the dotted lines, they signed their rights to their **data** and eventually their jobs away. No longer the custodian of the land, the **farmer became a data manager**, their title evolving to Chief Farm Data Officer. These skilled individuals, with their deep understanding of agronomy and data analytics, worked in concert with specialized AI entities known as Gen AI Agents. Together, they parsed through the deluge of data, their insights fueling decisions that shaped every facet of farm management.

Providing operational recommendations to farmers through AI and advanced analytics has become a huge business. Successful companies like AgriData created the best data feeds and the most sophisticated predictive modeling capabilities. By **consolidating data rights and AI talent**, agribusiness giants were able to offer superior customized AI Agents to farmers, for a price. Their bundling of proprietary data, digital agronomy tools, and traditional physical inputs created additional value for producers but also resulted in customer lock-in and increased operating costs.

Yet, as technology ushered in an era of abundance and efficiency, it also sowed the seeds of disparity. The **data** that flowed like lifeblood through the veins of these operations became a commodity more precious than the crops themselves. Corporate entities, which had steadily risen to prominence within the agricultural sector, now held dominion over these data. This intellectual property held by multinational corporations provided the seeds, the technology, and the analytical tools necessary to thrive in this new age.

The geopolitical landscape provided both a mirror and a catalyst for these changes. The dance of power between the United States, China, and India reshaped global markets and trade alliances. Yet, Xi Jinping's death in 2034 led to a new era of cooperation between the United States and China. Trade alliances and exports grew, and bilateral relations flourished, fostering an environment where agricultural products, particularly protein sources, became valuable commodities in international trade. **New cooperation**, coupled with the **burgeoning middle classes** of Asia, redefined the purpose of American farmland. The United States responded by pivoting its output to meet this demand, transforming the Corn Belt into a **Protein Belt**, with Indiana at its heart, becoming the epicenter of pork production.

Abundant manure, once problematic, became a valued waste steam supplying carbon for **alternative fuel** products. Alternative fuels, such as renewable diesel, renewable natural gas, and sustainable aviation fuels, had come to the fore, their adoption accelerated by compatibility with existing infrastructure and lower conversion costs. Further, in 2040, **small modular reactors** (SMRs) became the cornerstone of the global shift toward clean, efficient, and reliable energy production, driven by advancements in nuclear technology and significant changes in regulatory and public acceptance landscapes. Governments worldwide streamlined nuclear energy regulations, promoting faster deployment of SMRs and attracting substantial private investment.

As the 2050s dawns, the revolution in alternative fuels and the widespread adoption of SMRs have **diminished the urgency of decarbonization**, allowing society to turn our attention to other pressing issues. Food security is a paramount concern, as the centralization of agricultural data by large agribusinesses poses new challenges for equitable access to nutrition. The global discourse is shifting toward ensuring that technological advancements in food production translates to widespread benefits rather than corporate profiteering.

Over the last 25 years, consumer **perception of big agribusiness grew increasingly complex and polarized**. On one hand, big ag was commended for using advanced technologies to bolster food security and contribute to alternative energy sources. On the other hand, many consumers viewed these corporate giants with skepticism; they were concerned about monopolistic tendencies, the undermining of farmer autonomy through data control, and a perceived deprioritization of sustainability. This dichotomy led to a consumer base that was divided between those valuing efficiency and output, and those advocating for transparency; environmental responsibility; and the preservation of traditional, localized farming practices.

Concurrently, the rise of advanced automation and AI led to an ethical and legal renaissance concerning the rights of robots and AI entities. The reliance on AI extended from the consumer—who now looked to it for everything from shopping decisions to personal health—to Chief Data Officers, whose every move was informed by predictive analytics. The **blurring lines between human and machine cognition** sparked debates and the establishment of regulatory frameworks to navigate the integration of AI into society responsibly. These frameworks aimed to protect both the displaced human workforce and the autonomous beings contributing to societal advancement, with concepts like universal basic income gaining traction to support those affected by the rapid technological evolution. This era was marked by a redefinition of labor, ethics, and the very fabric of societal structures, as humanity grappled with the implications of its own creations.

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