

RECOMMENDATIONS TO BUILD ALBERTA'S BIOECONOMY

2013



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## 1. EXECUTIVE SUMMARY

2013

OVER A FIVE-YEAR PERIOD (2006 – 11), THE GOVERNMENT OF ALBERTA (GOA) INVESTED MORE THAN \$300 MILLION TO SUPPORT BIOINDUSTRIAL INITIATIVES IN BIOENERGY, BIOFUELS, FEEDSTOCK IMPROVEMENT, BIOMASS CONVERSION, BIOMATERIALS, BIOCHEMICALS, AND NEW PRODUCT DEVELOPMENT. AT THE END OF THIS PERIOD, THE TIME WAS CONSIDERED RIGHT TO ENGAGE A RANGE OF THOUGHT LEADERS AND EXPERTS TO ASSESS WHERE ALBERTA IS AND GATHER INPUT ON HOW THE PROVINCE MIGHT MOVE FORWARD IN FURTHER DIVERSIFYING ITS ECONOMY THROUGH BIOINDUSTRIAL OPPORTUNITIES.

THE INITIATIVE WAS INFORMED THROUGH A NUMBER OF MECHANISMS:

- I. CURRENT STATE ASSESSMENT
- II. FOREST PRODUCTS ROADMAP
- III. ECOSYSTEM SERVICES ROADMAP
- IV. ENGAGEMENT AND DIALOGUE WITH GOVERNMENT CORPORATIONS AND MINISTRIES
- V. ALBERTA'S JURISDICTIONAL ADVANTAGE ASSESSMENT
- VI. INDUSTRY/ACADEMIC/MUNICIPAL GROUPS FEEDBACK
- VII. EXPERT ADVICE: INTERNATIONAL THOUGHT LEADERS

# THE SUBSTANTIVE CONSULTATION AND RESEARCH GENERATED A NUMBER OF KEY INSIGHTS:



Alberta is uniquely positioned to drive economic diversification by encouraging biological solutions within the energy sector, the core engine of the economy. Alberta's strong oil and gas sector is the largest driver for the economy, with a well-established industrial ecosystem and value chain. The province's agriculture and forest sectors are also important contributors to the economy, with large biomass resources available. Alberta's investments in bioindustry have provided solid research capacity to support the growth of Alberta's bioindustrial sector.

Building a thriving bioindustry within Alberta by using all these advantages is a thoroughly viable strategy. Opportunities that exist in advanced materials, environmental services, waste management, biochemicals (some longer term than others), and beneficiation, and that are incubated in oil and gas, will spill out into other areas of the economy and global markets. This diversification mitigates risks, enhances economic resilience, ensures balanced and sustained growth, maintains the well-being of communities, and provides diverse employment opportunities to retain the skills and talents of all Albertans.

There is much that needs to be done in order to catalyze this growth in Alberta's bioindustry. A successful bioindustrial innovation model must focus on elements including local, national, and global collaboration, strategic alliances and networks, cross-sector integration, and partnership investment. The GOA must ensure that aligned and cohesive public policy approaches and investment are in place to effectively support development and commercialization of bioindustrial and environmental products and services. The current GOA innovation model is seen by industry as lacking in alignment, efficiency, clear decision making, accountability, and overall governance. Current public policy and policy instruments do not support cohesive or coordinated approaches across sectors or issues.

A new approach must be results based, driven by key performance indicators to ensure a return on investment for both private and public stakeholders. A strong commitment to the mobilization, exchange, and utilization of knowledge will be required. Education and talent development programs and initiatives must be targeted to build skills and capacity in the broad area of innovation,



"A new approach must be results based, driven by key performance indicators to ensure a return on investment..."

- *AI Bio Executive*, 2013

and in biological processes and environmental management. Future efforts and expenditures require effective "shared governance" with industry, government, and non-government stakeholders working in genuine partnership to take advantage of business-driven relationships.

Building and growing Alberta-based bioindustrial businesses requires that effective tools be in place to attract capital, including public and private investment, for the development and commercialization of bioindustrial products and environmental services.

Building a thriving bioindustrial products and environmental services sector would fulfill the implementation objectives of a suite of other strategies and plans related to energy and the environment that the GOA has initiated, including:

- Provincial Energy Strategy
- Land-use Framework
- Water for Life Strategy
- Too Good to Waste Strategy
- Clean Air Strategy

# BASED ON THE RESEARCH AND DISCUSSION, ALBERTA INNOVATES BIO SOLUTIONS DEVELOPED 12 RECOMMENDATIONS TO BUILD ALBERTA'S BIOECONOMY. THE RECOMMENDATIONS RELATE TO PRIORITY AREAS OF INVESTMENT FOR ALBERTA:

1. REVIEW, RENEW, AND IMPLEMENT AN INTEGRATED, ALIGNED POLICY FRAMEWORK.
2. REVIEW AND UPDATE ACCESS TO CAPITAL TO ENSURE AVAILABILITY AND ACCESSIBILITY OF CAPITAL FOR INVESTMENT IN BIOINDUSTRIAL PRODUCTS AND ENVIRONMENTAL SERVICES.
3. ACCESS HUMAN CAPITAL AND SKILL ENHANCEMENT OPPORTUNITIES.
4. IMPROVE FEEDSTOCK LOGISTICS.
5. ENHANCE DATA COLLECTION AND MANAGEMENT.
6. DEVELOP REGIONAL CLUSTERS.
7. CREATE A SCIENCE-BASED VALUE PROPOSITION FOR ENHANCING ECOSYSTEM SERVICES IN ALBERTA.
8. FOCUS ON RESEARCH AND DEVELOPMENT FOR BIOINDUSTRIAL PRODUCTS AND SERVICES.
9. SUPPORT INDUSTRIAL-LEVEL PROTOTYPING AND INDUSTRIAL-SCALE PILOT PROJECTS.
10. ESTABLISH A BUSINESS INNOVATION ADVISORY COUNCIL.
11. STRENGTHEN BUSINESS INNOVATION PROGRAMS (COMMERCIALIZATION ASSOCIATES, EXECUTIVES IN RESIDENCE, MENTORING PROGRAMS, ETC.).
12. STRENGTHEN MARKET INTELLIGENCE.



## 2. CONTEXT FOR THIS INITIATIVE

2013

Alberta, like many jurisdictions, is seeking to identify means to secure sustainable near - and long-term economic prosperity. Economic diversification enhances economic resilience, ensures balanced and sustained growth, maintains the well-being of communities, and provides diverse employment opportunities to retain the skills and talents of all Albertans. A blue-ribbon panel, the Premier's Council for Economic Strategy<sup>1</sup>, recently noted that Alberta must broaden its economic base to set itself up effectively for long-term prosperity.

Alberta's large renewable biomass resources, supporting a resilient sector based on forestry and agricultural commodities, represent a potentially significant opportunity to further diversify its economy. Alberta Innovates Bio Solutions (AI Bio), the biological research and innovation arm of the Government of Alberta (GOA), worked with key stakeholders and performed various analyses to test this assertion and ultimately develop recommendations for advancing Alberta's bioeconomy, in particular the bioindustrial sector<sup>2</sup>. Alberta Research and Innovation Authority, Alberta Innovates Energy and Environment Solutions, Alberta Innovates Technology

Futures, and several GOA ministries all provided significant input throughout the initiative.

Over a five-year period (2006 – 11), the Alberta Government invested more than \$300 million to support bioindustrial initiatives in bioenergy, biofuels, feedstock improvement, biomass conversion, biomaterials, biochemicals, and new product development. At the end of this period, the time was considered right to engage a range of thought leaders and experts to assess where Alberta is and gather input on how the province might move forward in further diversifying its economy through bioindustrial opportunities.

This report is intended to inform development of a strategy as well as stimulate discussions around the drivers, issues, and opportunities for accelerated bioindustrial diversification in Alberta —**the BioE Initiative**. The strategy will need to target and direct future investment and alignment of resources by refocusing, redirecting, and attracting investment to those bioindustrial areas with the most potential return on investment for Albertans.

<sup>1</sup> *Shaping Alberta's Future*. Premier's Council for Economic Strategy. May 2011. <http://alberta.ca/premierscouncileconomicstrategy.cfm>.

<sup>2</sup> See **Appendix A** for an illustration of the Alberta innovation entities relevant to the bioeconomy.

# ALIGNMENT WITH THE GOA'S CORE PRIORITIES

“FOR ALBERTA TO REACH ITS FULL POTENTIAL, WE MUST MOVE FORWARD BOLDLY, WITH CONFIDENCE AND CREATIVITY. AS SUCH, OUR GOVERNMENT IS FOCUSED ON INVESTING IN FAMILIES AND COMMUNITIES, SECURING ALBERTA'S ECONOMIC FUTURE, AND ADVANCING WORLD-LEADING RESOURCE STEWARDSHIP OVER THE NEXT FOUR YEARS.”

- Premier Alison Redford, August 1, 2012

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*The BioE Initiative is aligned with the GOA's core priorities of:*

**Securing Alberta's economic future.** *Building on our core economy as a basis for economic development and diversification helps secure Alberta's social and economic future and leverages skills and resources for innovative products and services.*

**Advancing world-leading resource stewardship.** *Through the development of ecosystem services, renewable resource products, and the provision of solutions to the environmental challenges of other sectors, Alberta can green its economy in productive and innovative ways so as to create new opportunities for Alberta firms.*

**Investing in families and communities.** *Through investment in skills, in economic development and diversification, and focused innovation, new employment opportunities can be created that will support families and communities throughout Alberta.*

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### 3. INPUTS TO THIS INITIATIVE

2013

The initiative was informed through a number of different mechanisms:

- |                                 |   |
|---------------------------------|---|
| I. Current state assessment     | IV. Engagement and dialogue with government corporations and ministries |
| II. Forest Products Roadmap     | V. Alberta's Jurisdictional Advantage Assessment                        |
| III. Ecosystem Services Roadmap | VI. Industry/academic/municipal groups feedback                         |
|                                 | VII. Expert advice: international thought leaders                       |

Other international jurisdictions are developing biomaterials, biochemicals, bioenergy, and biofuels as part of their future-focused strategy for economic development and diversification—a cornerstone of a low-carbon economy. The United States is committing significant sums in support of research, development, and deployment of bio-based solutions. US\$877 million is committed in support of the National Bioeconomy Blueprint (2011–14).<sup>\*</sup>The European Union's €87.7-billion proposed R&D plan for the period 2014–20 (Horizon 2020) includes \$4.7 billion dedicated to bioindustrial development and related work on ecosystems services.<sup>†</sup> Within Europe, Denmark will spend \$2.21 billion (€1.8 billion) by 2015 and Norway some \$370 million by 2015, with additional investment now under consideration. Finland spent €217 million (\$267 million) between 2008 and 2011 and intends to spend some €450 million (\$554 million) between 2012 and 2020. Alberta's distinct and unique advantage lies in its energy sector, with its robust value chains and the opportunities that may emerge from solving the challenges associated with that sector.

<sup>\*</sup> The National Bioeconomy Blueprint. Washington, D.C.: The White House.

<sup>†</sup> Innovating for Sustainable Growth – A Bioeconomy for Europe. Commission Staff Brussels: European Commission. Working Document. Brussels: European Commission.

# I. Current State Assessment

Alberta is Canada's second-largest agricultural producer, leading the nation in cattle inventories and producing over a third of Canada's major field crops. With over 200 facilities in operation, Alberta's forest industry manufactures lumber, pulp, newsprint, panel board, and other products, which are shipped globally. The agriculture and forest industries, including food manufacturing and manufactured wood products, contribute \$7.2 billion to the province's economy, or just under 4% of the total gross domestic product (GDP). This figure includes both primary and value-added production in both sectors.

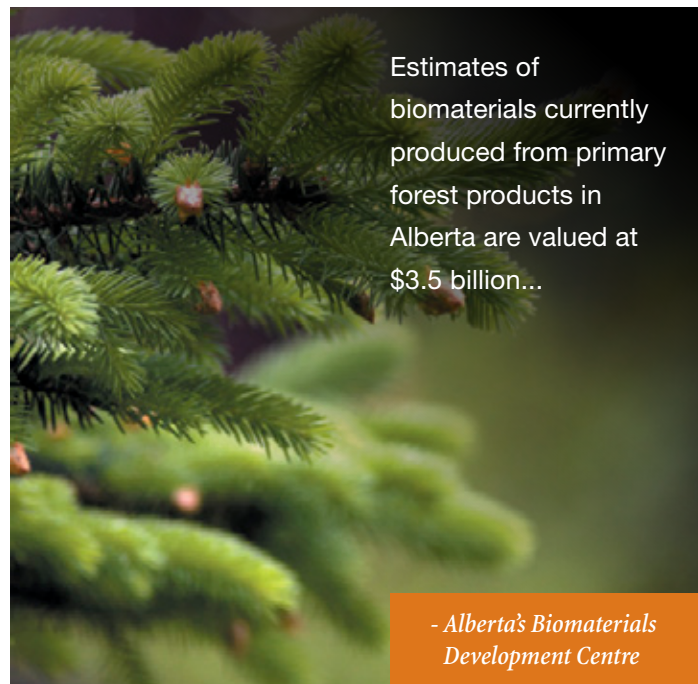
The province's renewable biomass resources include 64 million tonnes from agriculture sources, about 2 million tonnes of underutilized forest biomass and roadside residue, 4 million tonnes from municipal waste, and 78 million tonnes of slowly renewable peat.

A current state assessment was completed in 2011 by staff within the Alberta Innovates system in order to better understand the state of Alberta's bioindustrial sector and achieve a sense of the results of the investments to date. The current state assessment provides detail on Alberta's innovation system, identifying the key agencies, departments, institutions, and individuals involved in supporting bioindustrial investment, research, and commercialization activities in the province. See **Appendix A**.

In contrast to the established agricultural and forest industries, the current contribution of the newly developing areas of biomaterials, biochemicals, and bioenergy to the Alberta economy is relatively small. There are about 50 companies working in biomaterials, 7 in biochemicals, and 14 in bioenergy.

## a. Biomaterials

Alberta sees itself as becoming a dominant player in biomaterials development and commercialization. Areas of expertise include lignocellulosic feedstock development, pulp and paper, biocomposites, green building products, textiles (woven/nonwoven) and environmental protection products. Estimates of biomaterials currently produced from primary forest products in Alberta are valued at \$3.5 billion, secondary wood products at \$1.5 billion, and non-wood products at \$4 billion in total. (Data was drawn from the proposal for Alberta's Biomaterials Development Centre.)



## b. Biochemicals

Alberta's production of biobased chemicals for the refining industry is small. Currently, the industry is valued at approximately \$500,000. In comparison, Alberta's chemical and petrochemical refining industry has revenues of \$21.5 billion. While the biobased chemical industry's size is relatively small, the presence of an already strong conventional chemical refining industry in the province actually provides an excellent opportunity for it to develop further.

## c. Bioenergy (Including Heat, Power, and Fuel)

Biofuels generation in Alberta, while more developed than biomaterials and biochemicals production, is still expanding. Currently, 40 million litres of ethanol and 19 million litres of biodiesel are produced in the province annually, worth an estimated \$23 million and \$15.4 million, respectively. Combustion of forest biomass generates 300 megawatts of combined heat and power annually in the province, worth approximately \$195 million. Alberta also has facilities that produce 17 megawatts from gasification and 60 megawatts from wood-based power boilers.

## II. Forest Products Roadmap

*"The Pembina Institute considers increased bioindustrial innovation in Alberta as an important economic diversification strategy with necessary environmental benefits that supports the recent recommendations of the Premier's Council for Economic Strategy Report." - Ed Whittingham, Executive Director, Pembina Institute, August, 2012*

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In 2010 –11, all sectors of the forest industry and the forest team within Alberta Innovates Bio Solutions (AI Bio) and Alberta Environment and Sustainable Resource Development came together to explore the challenges faced by the sector, the strengths and weaknesses of the sector, and the opportunities ahead. The roadmap teams looked at global markets and developments—wood products, pulp and paper, bioindustrial products, and bioenergy—for opportunities and ideas. After a year of consideration and discussion, the result was a roadmap that provides direction and mileposts for progress. In addition to supporting continued competitiveness, its recommendations were designed to take advantage of new opportunities in non-traditional products and markets and to enable innovation and growth in Alberta's forest sector.

The Forest Products Roadmap recommended developing and implementing an integrated bioindustrial strategy in partnership between industry and government. The following are excerpts from the roadmap:

Alberta has moved to encourage a balanced approach between "green" and fossil fuel production, inclusive of agriculture, forestry and oil and gas sectors. However, the Province has yet to focus on a comprehensive, inclusive development strategy (a Bio-Industrial Strategy for Alberta) that identifies Alberta's jurisdictional advantage, leverages the natural resource base and corporate capacities, and creates economic diversification.

Forest companies recognize that bio-energy production is an incremental first step towards a more sophisticated and potentially higher value bio-refinery operation, based at current sawmill or pulp mill sites. Without a strategy and a systematic approach to innovation and capacity building, any move to develop biorefineries will be piecemeal. . . .

There is also need for a strong focus on high value biobased chemicals ("green" chemistry solutions) and biobased composites that show the potential of a high return on capital.

Alberta's kraft mills also need to partner with intermediary manufacturers further up the product value stream (e.g., oil and gas, electric power, chemical, pharmaceutical and composite

industries) to identify potential win-win product substitutions or import replacements. This is best done on a regional cluster basis, company to company.

The industry needs to capitalize on existing technological capacity within Alberta, utilizing skills of the research community and corporate resources. Market-focused capacity building is needed...

Forest professionals possess high-level capabilities as land stewards to manage the forest to support multiple values and outcomes. Some forests already provide a range of ecological services for communities and other industries. There is potential to grow these services where a clear market can be demonstrated and appropriate regulations and policy are in place. Analysis should be undertaken to better understand needs and opportunities. . .

Alberta needs a single, focused centre dedicated to bio-energy and bio-industrial research, development, demonstration and deployment (referred to . . . as a Centre for Bio-energy and Bio-industrial Deployment) which is: (a) industry driven and government/industry funded; (b) focused on commercial outcomes; and (c) driven by values that reflect the commitment of Alberta to environmental stewardship, sustainability and economic diversification. Critical to this work is further reduction of the fragmentation of the innovation system, which continues despite the significant consolidations of the past five years. Investment in this centre should reflect the scale of commitment to diversification. This centre should be supported at a level to deliver significant outcomes over the medium to long term. One precedent is the Alberta Oil Sands Technology Research Agency, founded in 1974: [research and development] commitments of about \$1 billion each by industry and government over the following decades led to creation of the modern industry, with capital investments totaling about \$150 billion today.

The complete Forest Products Roadmap is available at [www.albertaforestroadmap.ca](http://www.albertaforestroadmap.ca).

### III. Ecosystem Services Roadmap

In 2008, the then Premier of Alberta mandated that the Institute for Agriculture, Forestry and the Environment develop a policy framework for market-based approaches for providing ecosystem services in Alberta. In March of 2010, the institute submitted a framework to the Government of Alberta (GOA) that outlined a phased approach to creating a coordinated, integrated market system for the enhancement of ecosystem services, which would offer many benefits to the GOA, to companies doing business in this province, and to Albertans.

In 2011, AI Bio brought together key stakeholders and experts to set out a strategic framework—the Ecosystem Services Roadmap (ESR)—that was designed to build on the extensive research and knowledge compiled to create the earlier ecosystem services policy framework. The purpose of the ESR is to catalyze innovation and competitiveness in the resource sectors and create opportunities for Alberta to brand itself as a leader in land and environmental management.

In addition to AI Bio, the other key groups involved in the development of the ESR were:

- Other Alberta Innovates corporations—Alberta Innovates Technology Futures (AITF), Alberta Innovates Energy and Environment Solutions
- The Land Use Secretariat and other GOA departments, including:
  - Alberta Environment and Sustainable Resource Development
  - Alberta Agriculture and Rural Development
- The Alberta Biodiversity Monitoring Institute
- The Silvacom Group and Green Analytics
- Ducks Unlimited
- The Pembina Institute
- Miistakis Institute
- The Alberta Livestock and Meat Agency
- Alberta Land Stewardship Centre
- The Intensive Livestock Working Group

The ESR provides the strategic direction for innovation relating to the enhancement of ecosystem services and the application of market-based approaches to strengthening the competitiveness of resource-based sectors through environmental excellence.

It outlines:

- The background and context for market-based approaches to enhancing ecosystem services in Alberta
- An overview of the current state of knowledge regarding ecosystem services, technology, and systems to enhance the application of market-based instruments and the key players engaged in this work (networks)
- Gaps categorized by priority areas of focus
- The key actions needed to fill the gaps in current knowledge on ecosystem service concepts and to turn the goals into outcomes for research and innovation

The ESR identified the following gaps:

- Capacity gaps:
  - A network of engaged experts to move the ecosystem service approach forward with industry, government, environmental, and land management perspectives
  - Training and education on best management practices, assessment, measurement, and monitoring of ecosystem services
  - Governance
- Scientific, biophysical, and socio-economic understanding gaps:
  - The development of a comprehensive ecosystem services assessment approach
  - Protocols for measuring ecosystem service units in a manner that supports market transactions
  - The main drivers of behavioural change in individuals and corporations to support an ecosystem service approach, including development of market-based instruments
  - Causal and quantity relationships between pro-ecosystem service actions and resulting outcomes for ecosystem functions

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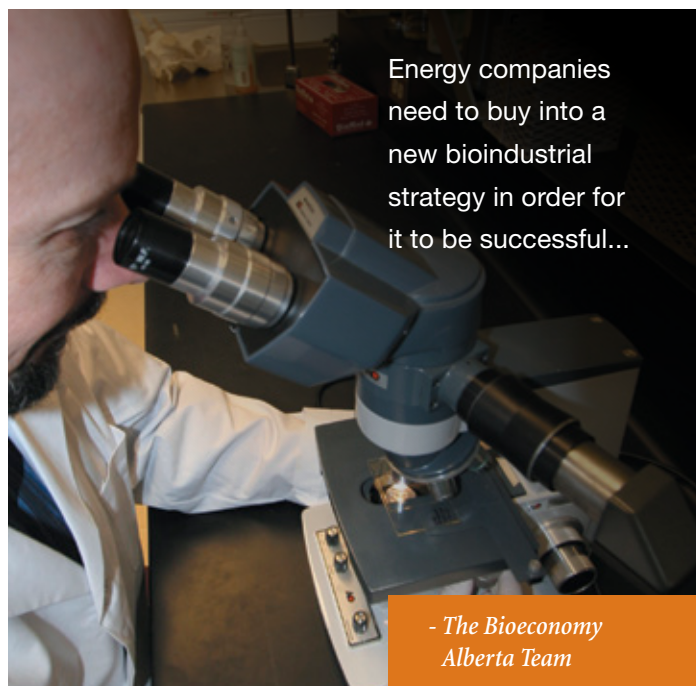
The full *ESR Report* can be found at [www.bio.albertainnovates.ca/media/45788/es\\_roadmap\\_v11\\_may\\_30\\_12.pdf](http://www.bio.albertainnovates.ca/media/45788/es_roadmap_v11_may_30_12.pdf).

## IV. Engagement and Dialogue with Government Corporations and Ministries

- Information to support economic valuation to properly account for the costs and benefits people receive from ecosystems
- Production and process technology to reduce impacts and enhance ecosystem services, linking management to delivery of ecosystem services
- Data and information management gaps:
  - Information management systems to enable spatial and temporal assessment, verification, and validation of changes in ecosystem services being provided
  - A central publicly accessible clearing house for spatial data on ecosystem services, including natural assets, ecosystem functions, and responses to natural and human-driven changes
  - The development of a protocol for recognizing and paying for copyright and patent material in the information management system
- Market opportunity gaps:
  - An integrated system to coordinate and manage market-based instruments and the various initiatives to enable the achievement of environmental targets and desired ecosystem outcomes
  - The size of niche opportunities for eco-labelling and certification of forestry and agricultural products
  - The opportunity for sustainably managed bioresources as supplements to fossil fuel and petrochemical products

A roadmap action plan has been developed to respond to the identified gaps. It will move the state of knowledge and information on ecosystem services and market-based approaches into applied proofs of concept for using conservation offsets as the first type of market-based instrument ready for further development.

One of the principal pieces of work required is the design and implementation of a world-class spatial data system for bioresource information: the Bio Resource Inventory Management System (BRIMS). Such data is necessary to support key government and industry decisions related to land use and integrated resource management. AI Bio, Alberta Environment and Sustainable Resource Development, and Alberta Enterprise and Advanced Education have made the first investments in BRIMS. The focus of Phase 1 was to assemble data to support a biomass inventory for the province, which laid the foundation for assembling other important data sets in the province.



The following government corporations and ministries were involved in the BioE Initiative:

- AI Bio
- AI EES
- AITF
- Alberta Enterprise and Advanced Education
- Alberta Environment and Sustainable Resource Development
- Alberta Agriculture and Rural Development
- Alberta Treasury Board
- Alberta Energy
- University of Alberta

The Bioeconomy Alberta Team, which included the above government groups, met several times to discuss the concept of a 10-year strategy for advancing Alberta's bioeconomy. Draft materials were presented and feedback elicited. This diverse group of contributors presented the following key points:

- Good policy will be important to incent innovation and diversification in Alberta's bioeconomy.
- Energy companies need to buy into a new bioindustrial strategy in order for it to be successful.

## V. Alberta's Jurisdictional Advantage Assessment

- The biosector in Alberta is in its infancy. Companies are not convinced that replacing current products with biobased products will actually work. There will be a need for demonstrations and pilots of how it can work. Suppliers of chemical companies and materials manufacturing companies need to be factored into the discussion as they are already servicing the oil industry.
- A new bioeconomy strategy should have a rural development perspective. It will be important to link economic development and engagement through municipalities.
- The jurisdictional advantage work explains the province's natural resource strengths and the energy opportunity. More work needs to be completed to define the role of a more developed bioindustrial economy in a global context. A more sufficient analysis (based on the jurisdictional analysis work) is required to explain how the bioindustry can transition from an initial base in the energy sector to other sectors and markets.
- There is a need for a "one-stop shop" within government, for companies, to make it simple in terms of accessing dollars and sourcing help.
- Alberta needs to do more to encourage investors, and to do so we need more than four-year windows for strategy from the GOA.
- The bioeconomy transcends all sectors, and the most fruitful growth areas may be at the intersection of the different sectors.
- This initiative should be seen as a way to lower the risk in future endeavours.
- Saskatchewan, Manitoba, British Columbia, and the Government of Canada all have strategies developed or developing around the bioeconomy, so momentum is building and we do not want to be left behind.
- Getting conventional/heritage industry and the emerging bioindustry to work collaboratively in Alberta will be key.
- Alberta is well resourced in terms of natural capital, resource capacity, and technology capacity. However, Alberta lacks integration of services.
- There is a lack of a bioindustrial culture in Alberta, as compared to what has evolved in Europe.

The Jurisdictional Advantage Assessment is a conservative approach to investment options analysis. It is an evidence-based process that identifies the unique strengths, weaknesses, and opportunities that define the province's sustainable advantages. An assessment for Alberta was completed externally for AI Bio by the company Sift Every Thing in late 2011.

The principal idea behind the analysis was to find core engines in the Alberta economy (those areas that drive growth and sustain the province over the long term) that can incubate diversification opportunities. By focusing on these core areas, strategies can minimize risk, stack odds of success, and emphasize strengths.

Analysis included three steps:

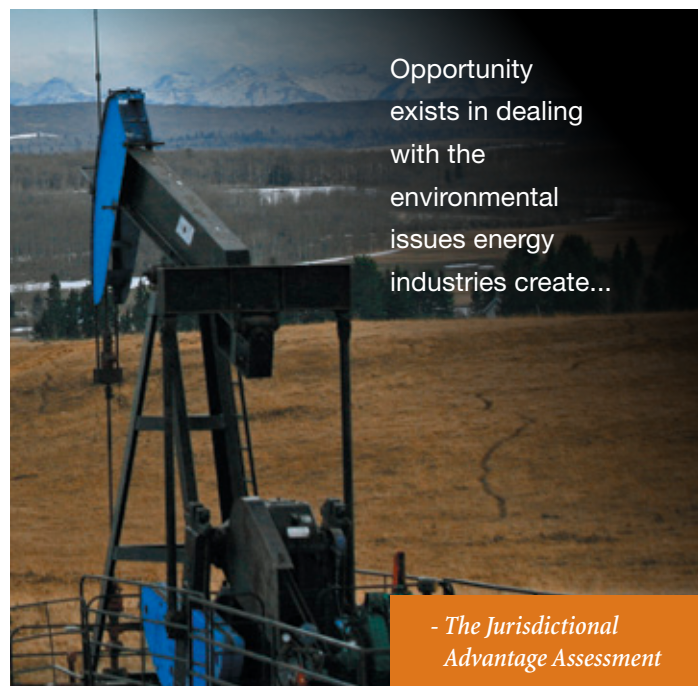
- 1. One-on-one interviews with 121 companies, at the executive management level, which guided and focused the economic analysis**
- 2. Economic analysis of 25 indicators around each major industry in Alberta in the following areas:**
  - A general economic overview
  - The natural resources supporting each industry
  - Each industry's unique technologies, skills, and abilities
  - The supporting institutions around each industry
  - The investment and policy environment for each industry
  - The innovation ecosystem around each industry
- 3. A global scan of similar jurisdictions and successful bioindustrial companies, providing examples and case studies**

The assessment showed that the economic engine of Alberta is oil and gas. Nineteen per cent of provincial GDP was generated by the sector (including oil and gas services) in 2011. Only finance, insurance, and real estate (17 per cent) came close to matching its strength. The next-highest contributors were construction and manufacturing (each at 8 per cent). While agriculture and forestry are important sectors, they are not core engines of the economy. Combined, agriculture, forestry, food manufacturing, and wood products manufacturing totalled 4 per cent (\$7.2 billion) of GDP. The assessment recommended that to reduce risk, reduce costs, and greatly increase the odds of success, the province should diversify within and through its core engines instead of outside its strengths.

The assessment emphasized that by investing in its strong core energy industry while incubating opportunities that spill out into the rest of the economy, the province can create sustainable diversity. Opportunity exists in dealing with the environmental issues those industries create, the inefficiencies within current processes, the abandoned well sites and unproduced resources that remain in the ground, the operations of the manufacturers that feed the industry and the chemical producers that buy from and sell to the sector, the waste that “big energy” in Alberta produces, and the energy that the sector demands.

Currently, a number of successful companies in Alberta within the bioindustrial sector take advantage of these opportunities. They provide reclamation services, clean up wastewater, design biopolymers to fix tailings ponds, and gasify polluted waste streams.

A sophisticated industrial ecosystem<sup>3</sup> has both firm-level and system-level components. The assessment revealed that Alberta has bioindustrial firms in development, production, and (to a limited extent) marketing. At the system level are researchers, an insufficient and small group of input suppliers, and a thin layer of service



providers. Of the bioindustrial firms in the province, few have a deep pool of end-users. Most have no real network to manage supply risk or waste management, and they operate in isolation in the broader business environment.

The industrial ecosystem that supports the bioeconomy in Alberta is patchy. The value chains (the full range of activities and services

<sup>3</sup> *Industrial ecosystems* are defined as a complex mix of resource providers, competitors, complementary organizations, administrative structures, political dynamics, markets, and culture. These systems are important because they attract customers, supply chain capabilities, and strong management, and enable a broad environment of innovation.

*Value chains* include the basic chain of development, production, and marketing, as well as the researchers, input suppliers, support markets (which provide technical, business and financial services for the industry), and business environment in which the industry operates.

*Alberta has a strong energy-focused economy, which generated 19% of the GDP of Alberta in 2011. Oil and gas contributed the single largest sum for any sector in our economy (\$33.8 billion of GDP when oil and gas services are included). Success in many other sectors began by solving problems for oil, gas, and energy and then using the expertise developed to offer products and services beyond the energy sector around the world. In this way, the Information and Communications Technology (ICT) sector has grown (GDP of \$10 billion in 2011), industrial machinery has developed (GDP of \$13.7 billion in 2011), and the energy services sector expanded into other fields. The chemicals sector, which serves the energy sector and other industries, is also a vibrant part of Alberta's economy (GDP of \$25.2 billion in 2011) and, through this work, has developed a strong “can-do” relationship with the energy, oil, and gas sector. Similar developments for forestry, agriculture, and other bio-based industries have potential for similar impact.\**

\* All statistics from Bioindustrial Options for Alberta. Sift Every Thing Corporation. May 2012.

required to bring a product or service from its conception to end use, including input suppliers, producers, processors, buyers, and support services) are strong in a few places and weak in many others. There is nothing in bioindustrials that mirrors, even vaguely, the thriving industrial ecosystem in oil and gas. A bioindustrial ecosystem does not exist. What is in place is a scattered collage of technology developers, prototype and pilot-scale manufacturers, disconnected supporting institutions, and fragmented end-markets.

Bioindustrials as they stand are deemed to exist as a mass of niches. In contrast, oil and gas and associated manufacturing offer rich industrial ecosystems, strong market opportunities, and broad global applications. Ignoring this market seems to be the consequence of a too narrowly defined notion of diversification.

Special themes in analysis, interviews, and the synthesis included the following:

- Mid-size companies and engineering, procurement, and construction companies must lead new bioindustrial options. Focusing on start-ups and new technology development is not enough. Mainly mid-size companies have the credibility, mobility, and stability needed to bring bioindustrials into oil and gas, power, chemicals, and other subsectors of manufacturing.
- Bioindustrials in Alberta should solve problems rather than produce alternatives. Drop-in substitutes sound nice but only matter if there is a problem with whatever they replace. The challenge when substituting bioindustrials for petrochemicals is that petrochemicals are cheap, abundant, and ubiquitous, and they work well. It is better to start with jobs that petrochemicals cannot do well than go head-to-head, especially at \$3/gigajoule natural gas prices.
- Market intelligence is the responsibility of the supplier, not the buyer.
- The wall around process options is very high. All companies and all sectors are open to environmental wins and waste management options.

- Standards, quality, and stability are prerequisites for engagement. All of the fastest-growing small companies built their certification, health and safety, and quality assurance programs early. All of the most aggressively interested large companies complained that the best biobased options they see are wasted because they do not meet prerequisites. Upgrading bioindustrial companies to meet prerequisites is a vital step in maturing Alberta's capacity in this space.
- Every big bioindustrial play will eventually require performance guarantees. Price matters, but not as much as implementation.

More specifically, the Jurisdictional Advantage Assessment concluded that top options for Alberta to diversify bioindustrials in the short to medium term lie in:

- Reducing biological feedstock risk and logistics challenges
- Improving carbon dioxide and greenhouse gas reduction, sequestration, and offsets
- Encouraging clean coal with biomass (coal beneficiation, pyrolysis, torrefaction, co-firing)
- Developing biopolymers for bioplastics and non-toxic biodegradable green fluids
- Building land remediation and abandonment services (tracking biodiversity, bioremediation and bioreplenishment, spill recovery, replanting of native species)

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The report *Bioindustrial Options in Alberta* can be found at <http://bio.albertainnovates.ca/library/activities/reports/>.

## VI. Industry/Academic/Municipal Groups Feedback

An industry round table was organized by AI Bio on November 1–2, 2011. It was a facilitated session designed to learn about industry efforts and views, to assess Alberta's current situation, and to help identify ways to accelerate industry, government, and community efforts and to more rapidly develop a bioindustrial sector. In addition, comprehensive individual interviews and discussions were conducted with over 90 industry, government, and community leaders and academic stakeholders, where observations, verifications, and additional findings were gleaned. Feedback was expansive. When collated, comments related primarily to the areas of innovation, policy, and environment.

### a. Innovation

There is a need to create a more simplified, focused, and streamlined innovation model for Alberta. It must support and drive a strong, innovative business environment that can rapidly deploy technologies, products, and services; builds solutions-based relationships between and among industries; supports and enables technology demonstration; and promotes commercialization through public-private partnerships.

The following were other key observations:

- The Alberta innovation system carries certain redundancies, at times operates in a disconnected fashion, lacks clear accountability and authority, and is not organized around any particular vision.
- Alberta has research-oriented universities and technical colleges with well-established research and innovation capacity, which could collectively be developed into a centre of excellence for integrated environmental solutions.
- The existing research capacity created through bioindustrial investments in Alberta is significant. This capacity can be adapted and deployed to address priorities that have been or will be identified. The government should be more focused on helping innovative firms to grow and on serving the needs of small and medium-sized enterprises.
- Innovation support was seen as too narrowly focused on pure research and development. More support is needed for other activities along the continuum from ideas to commercialization. Ability to pilot, demonstrate, and commercialize is perceived as a fundamental barrier.



- Technologies and processes stand a better chance of successfully reaching the marketplace if intellectual property (IP) is used strategically. Gauging the importance of IP in innovation by merely focusing on patents as the input to and/or output of innovation does not do justice to the significant role that can be played by the other tools of IP. A broader approach to the contribution of IP in innovation is needed.
- Industry has recommended that a single innovation organization be developed, led by industry and communities across the value chain, with a core focus on the rapid commercialization of priority bioindustrial opportunities in Alberta. The organization would concentrate on facilitating connections and relationships between industrial players, developing a business innovation talent strategy, and commercializing delivery. A provincial “concierge” service and associated website to help firms find and access the support tools they need would be a valuable component of the organization. These measures would help to strategically integrate Alberta’s well-established research and innovation capacity with industry. There is also a need for new models that focus on clearly understanding markets and demand.

- Government should have a Business Innovation Advisory Council with a cross-ministry focus that would serve as a permanent mechanism to promote the refinement, coordination, and improvement of the government's business innovation programs going forward.

### b. Policy

Currently, government policies appear to be developed in isolation from each other and generally on a per-sector or per-issue basis. For example, bioenergy alone covers at least six ministries and a dozen research and development providers, influenced by four different industry sectors. Coordination and communication across departments seem limited, with policies appearing at times to be in conflict or, worse, perverse, leading to unintended consequences. This lack of cohesiveness in policy runs counter to a desired outcome of maximizing economic and environmental outcomes across all sectors. Feedback clearly indicated that the GOA must ensure that supporting public policies are aligned, integrated, and cohesive—across all sectors and issues.

The role of market- and fiscal-based policy instruments in supporting the growth of Alberta's bioindustrial opportunities was unanimously recognized as a critical component to incent investment and support more rapid commercialization of products and technologies. Indeed, one Alberta-based biotechnology proponent indicated that his company is looking at other jurisdictions outside Alberta that have policies designed to support bioconversion technologies. It was pointed out that existing policy instruments and tools associated with other sectors in Alberta (e.g., the oil and gas sector) could be applied to the bioindustrial sector, providing improved access to capital by putting related investments on a "more level playing field" with other investment opportunities in the province.

While many participants were quick to point out tax credits and royalty structures as key policy levers, all recognized that a suite of policy instruments must be considered and recommended. Participants identified the following as high-level examples of policy instruments and tools that might be applicable to the bioindustrial sector:

- An expanded Scientific Research and Experimental Development tax incentive program that focuses commercialization on bioindustrial opportunities

- A venture capital funding mechanism whereby individual taxpayers can invest \$5,000 per year into a fund, the assets of which must be invested in the province where the money is raised (Alberta is the only province without this type of mechanism)
- A flow-through share tax policy where tax-loss benefit from early-stage projects could flow back to investors
- Improved use of the substantial purchasing power of the GOA to create opportunity and demand for leading-edge goods, services, and technologies from Alberta suppliers—for example, by mandating or strongly encouraging GOA departments to purchase Alberta-made products wherever possible, especially from companies with innovative products and services

The following key observations also reflected the need for new policy approaches and associated instruments:

- Alberta lacks a shared and specific vision for diversifying the economy, much less diversifying the economy through bioindustrial and bioeconomic initiatives.
- Political priorities are changing (with increased emphasis on energy, environment, and innovation), and there is a renewed focus on Alberta being a sustainability leader.
- The GOA's \$300-million investment over the last five years to support bioindustrial initiatives was intended to enhance competitiveness and build a strong foundation for sustainable industries that advance economic diversification and generate environmental benefits. These investments and capacities are ripe for leveraging.
- Building a thriving bioindustrial sector within Alberta would fulfill the implementation objectives of a suite of other energy- and environment-related strategies and plans that the GOA has initiated to improve the quality of life and secure long-term prosperity—in particular, Alberta's:
  - Provincial Energy Strategy<sup>4</sup>
  - Responsible Actions: A Plan for Alberta's Oil Sands<sup>5</sup>
  - Water for Life Strategy<sup>6</sup>
  - Land-use Framework<sup>7</sup>
  - Clean Air Strategy<sup>8</sup>
  - Too Good to Waste Strategy<sup>9</sup>

<sup>4</sup> [www.energy.gov.ab.ca/Initiatives/3082.asp](http://www.energy.gov.ab.ca/Initiatives/3082.asp).

<sup>5</sup> <http://treasuryboard.alberta.ca/ResponsibleActions.cfm>.

<sup>6</sup> [www.waterforlife.alberta.ca/](http://www.waterforlife.alberta.ca/).

<sup>7</sup> <https://landuse.alberta.ca/Pages/default.aspx>.

<sup>8</sup> [www.casahome.org/](http://www.casahome.org/).

<sup>9</sup> [www.environment.alberta.ca/01759.html](http://www.environment.alberta.ca/01759.html)

### c. Environment

Environmental responsibility and a demonstrable commitment to ecological stewardship are now requirements for a successful resource-based economy. Global and local environmental drivers are in turn generating potentially significant economic opportunities in the form of biobased products and services, whether fuels, chemicals, materials or energy, as well as environmental services. Importantly, such products and services must demonstrate that they deliver genuine net-life-cycle environmental benefits. To be branded or labelled as “biobased,” they will most certainly need to meet extensive validation and verification requirements.

A number of other key observations were made around environmental drivers and opportunities:

- Opportunity exists for this sector to connect with the values of Albertans and assist Alberta in re-establishing its reputation for leadership in environmental policy and management.
- Creating zero-waste communities, with supporting technology and public policy to achieve them, is a clear opportunity. If backed by the appropriate policies or regulations, in time it would require municipalities to find alternative uses or outlets for materials and bioresiduals that would normally go to landfill and to provide an incentive to do it in the most economical way possible.
- Access to both private and public capital was identified as a core challenge in supporting new bioindustrial ventures, with typically low tolerance for risk. One idea for addressing this challenge was to identify sources of new investment capital from the “social capital” sector, lesser known in Canada, that deploys higher-risk and more patient capital for more environmental and social projects.
- While some regions and communities are clearly interested in taking a leadership role or taking advantage of new biobased

opportunities, with select communities already developing regional biopathway strategies, community involvement has not been broad based, even though it is key to successful diversification. A rural development and regional delivery model may provide opportunity for broader stakeholder engagement.

- Public awareness on the opportunity related to a robust bioindustry is lacking.
- An opportunity exists around new sets of services. The opportunity includes the commoditization of ecosystem services, whereby industry and government increasingly recognize the financial value of natural services that provide societal benefits, such as clean air, clean water, biodiversity, and carbon sequestration.
- Alberta’s strong business culture provides an excellent basis for environmental entrepreneurship in the province.
- Alberta should partner with suppliers, consumers, and non-government organizations to establish processes and standards to enable environmentally sound “green certification.”

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*“Albertans have a desire to feel proud of the oil sands. Improving real environmental performance through such things as reclaiming tailings and better land reclamation is a way to create that pride. Bioindustries are emerging as a significant contributor to environmental social-licence-to-operate goals. We have only just begun the development of the enormous oil sands resource. Imagination and creativity will surpass engineering as the key element in achieving responsible sustainable oil sands development going forward.”*

*- Ken Chapman, Executive Director, Oil Sands Developers Group, 2012*

## VII. Expert Advice: International Thought Leaders

The Alberta Research and Innovation Authority (ARIA), an international advisory council, provided feedback on how the province might best diversify its economy through bioindustrial opportunities. ARIA emphasized the following:

- The concept of growing the bioindustrial economy in Alberta to meet the goals of environmental stewardship and economic diversification is sound. Using the energy sector as a starting point for growth of the bioindustrial economy makes sense.
- The participation of the post-secondary institutions, GOA ministries, and the private sector will be required if the long-term objectives are to be achieved.
- Using the Alberta Innovates corporations to support the implementation makes sense.
- The global scans detailed in the Jurisdictional Advantage Assessment are important to the development of the strategy.
- Procurement policy for the GOA, as a driver for demand, is essential.
- Collaboration versus cooperation is key.

The Innovation Thought Leaders Forum, held February 7–10, 2012, in Calgary, was designed to obtain additional advice on approaches to diversifying Alberta's economy through bioindustrial innovation. It was arranged through AI Bio. Twenty-seven participants from Alberta, across Canada, the United States, and Europe were asked to provide their insights, opinions, direction, and guidance in developing a strategy for advancing Alberta's bioeconomy. They tested the merits of the draft strategic approaches that were developed based on the information gathered through mechanisms I through VI above. Participants were chosen on the basis of their participation in the bioindustrial sector or their familiarity with the current economic drivers for the Alberta economy.

The ideas that emerged from the forum are outlined below.

### a. Innovation

The next phase for development of the innovation model in Alberta should not be led solely by the GOA. It will require efforts and investment from many players, including large industry, small and medium-sized enterprises (SMEs), post-secondary institutions, the financial sector, and governments at other levels and in other jurisdictions. In the energy sector, the Oil Sands Leadership Initiative (OSLI) is an indicator of industry taking a leadership role. The OSLI collaborative model is the future of innovation.

A clear, unified, and focused vision is required, with a definition of success and SMART (specific, measurable, achievable, realistic, and time-bound) goals. An impact and achievability grid is required to identify the areas where Alberta can have the greatest impact and where that impact is most achievable. Examples of indicators for measuring the success of an innovation system were presented from Tekes, the Finnish Government's innovation system.

Lessons from Tekes indicate that a successful Alberta innovation system should:

- Take into account global seismic shifts.
- Demonstrate long-term leadership. Champions and leaders must be identified within government and outside government to drive implementation of this strategy to success.
- Build trust and have meaningful cross-system collaboration.
- Integrate social innovation.
- Create sufficient risk capital to increase deal flow. Increasing deal flow is about creating more new ideas and technologies for people to invest in—more opportunity means more interest.
- Contain the right regulatory environment.
- Encourage development of the right people to ensure no shortage in the labour market, as it currently exists.
- Create innovation hubs. Clusters should be sector oriented, not technology oriented.
- Develop and support strong businesses throughout their life cycle by mentoring the most promising of them and ensuring increased private leverage as they develop.
- Build companies to scale through significant co-investments with industry in top-priority areas.
- Be careful not to take dollars from one sector within the province to allocate to another sector.
- Highlight the importance of cross-jurisdictional and international partnerships.
- Consider regional context.

An endowment fund, such as the GOA created for carbon capture and sequestration, would create a long-term funding model to create certainty. Within the strategy, there may be a need to stage actions so that other opportunities do not get left behind, but will be addressed in later stages. The Michigan Biotech Institute was also deemed a great model for innovation.

## b. Policy

The following key points were made during the discussion on policy:

- A bioindustrial strategy must clearly align with the identified priorities of government; otherwise, it will be difficult to get government support. The strategy should be developed collaboratively.
- Public policy barriers have not been fully assessed in Alberta. There is a need to look at policy drivers and barriers in more detail.
- For the bioindustrial sector to grow, related policy must become an overall government priority, with efforts and impacts being addressed across multiple departments rather than being handled as “silo” projects.
- It is important to ensure that policy is consistent through more than one administration.

Government policy action can create incentive for investment in new biobased technologies, and this action is required to help not-yet-optimized technology. Federal and provincial tax-based systems (e.g., exploration tax exemption) create stability because tax programs, unlike program funding, are not as likely to fluctuate with annual budgets. This type of incentive is better than program grants that have “winners” and “losers,” as it supports all innovation and technology development. Some policy examples cited were:

- The Canadian Innovation Commercialization Program
- The Green Procurement Program
- The Small Business Innovation Program in the U.S., which has been a very effective tool for innovation and new solutions

## c. Environment

The bioindustrial sector in Alberta may assist with solidifying and re-establishing the oil sands industry’s social licence to operate. In addition, the oil and gas sector has regulatory responsibility for some things that it has limited expertise in and for which it contracts or outsources. The biobased sector could provide the expertise that is needed in these areas.

A life cycle analysis of the many processes associated with bioindustrial opportunities has not been completed and needs to be completed.



Hard consideration must be given to the sustainability of new technologies and ideas. Understanding cumulative impacts is an emerging driver that needs to be linked within the bioindustrial strategy.

There is a need for “green technology” to satisfy the growing preference for “sustainable” products.

The four “pillars” of the Alberta economy (energy, agriculture, forestry, and tourism) all have growth mandates, and this growth is all expected to occur on the same land base. Alberta often allocates resources independently for each pillar. Each pillar has rights to access its respective resources on the surface, and exercising these rights can create business-to-business conflicts.

Waste management is an area where Alberta is leading, so making that a focus in Alberta and expanding the capacity in the province makes sense.

Additionally, the experts commented that the creation of public acceptance and support will be a critical component of the development and implementation of the strategy.

#### d. Jurisdictional Advantage

With respect to the Jurisdictional Advantage Assessment, the thought leaders considered working through the core engine of Alberta's economy, the energy sector, to be a necessary strategy.

By working through energy, Alberta can build the infrastructure and value chains that will then be deployed to provide bioindustrial products and services to other markets outside of the local energy market—to Europe, the U.S., etc.

On the subject of biomass, the thought leaders agreed that Alberta has abundant biomass but that it is dispersed over large areas and away from where potential demand is located. Economically viable access to feedstock is a problem, and infrastructure is required. There is a need for a facilitated dialogue between sources of biomass feedstock supply, potential users of biomass, and other segments of the value chain. There is also a need to understand where Alberta sits, globally, in terms of biomass production, accessibility, and technology relative to other jurisdictions.

Alberta must redefine our thinking on evaluating the value of biomass and better understanding trade-offs between different uses. Value comes from multiple sources—bioindustry, timber, functioning ecosystems, water storage, etc. Decisions will be needed on the allocation of biomass to these different uses.

Supporting SMEs will be a critical enabler of the strategy, including finding ways to facilitate collaboration rather than competition between them.

The thought leaders agreed that established value chains for bioindustrial opportunities from Alberta do not exist yet. This is a critical gap preventing private capital flow into these opportunities.

Representatives of companies from different parts of the value chain should be brought together to speak to each other.

In the area of biofuels, next-generation technologies should be considered because biofuels have become commoditized and highly competitive. By working in concert with the energy sector, the biofuels sector could create a good starting point for other bioindustrial innovations, which may provide other opportunities and applications.

Medium-sized biochemical companies provide a chance to develop a sector that is further up the value chain.

In terms of bioindustrial innovation, Alberta currently has some cornerstone infrastructure and systems, but it has yet to best position or leverage these to effectively diversify Alberta's economy through value-added renewable biomass products, technologies, and services. The evidence clearly suggests that as the province looks forward, its strategy should be to diversify through Alberta's core engine: its energy sector (and in particular, oil and gas). The thought leaders agreed that specific opportunities to target within the energy sector, in the short to medium term, include:

- Advanced materials
- Environmental services
- Waste management
- Biochemicals

Maintaining the competitiveness of the forestry and agricultural sector will require deliberate, intentional analysis to understand how to promote a healthy industrial ecosystem and the associated value chains.

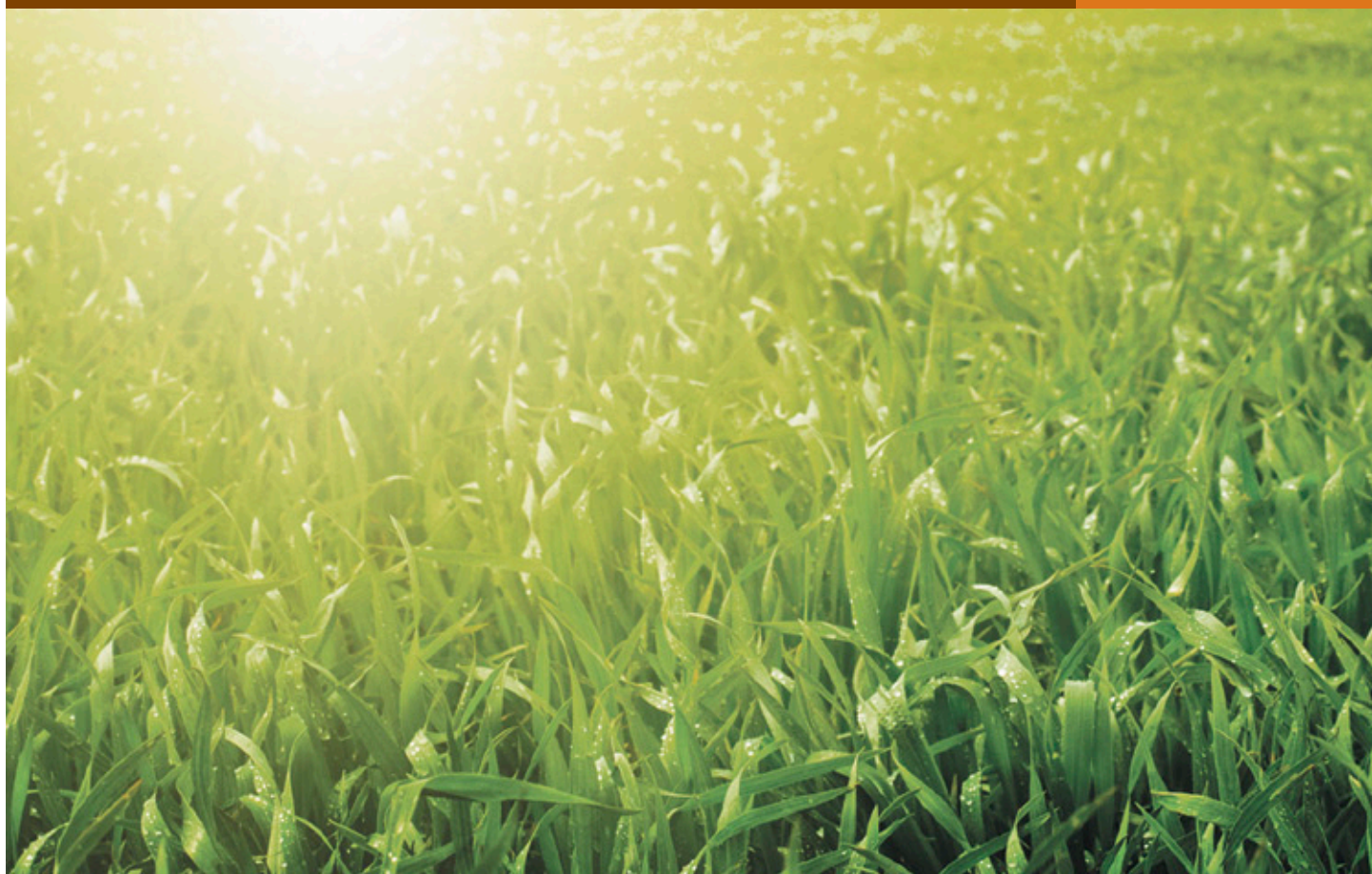
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*"The world is in the midst of a great transformation in energy systems, one that will take a very long time. At every stage in this process, we can contribute with a variety of energy sources, the innovation and technology to supply them sustainably, and best practices on how to use them efficiently. We must ensure that our energy policy is developed in an integrated way with our climate change strategy and our regional management policies." - Premier Alison Redford, November 2011*

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## 4. ALBERTA INNOVATES BIO SOLUTIONS RECOMMENDATIONS

2013



# Critical Elements



The BioE Initiative process found that to successfully diversify Alberta's bioeconomy, an integrated and comprehensive set of critical elements must be put in place to address the province's challenges and build on its assets:

**1. Government, industry, and non-government organizations must work together to create and enable a long-term vision and commitment.** The long-term vision must be clear, with goals that are actively supported by government and industry and informed by global expertise.

**2. The Alberta Innovates corporations must work to establish a cross-sector, industry-led innovation model.** A successful innovation model must enable elements including local, national, and global collaboration; strategic alliances; and networks. Cross-sector integration and partnership investment is necessary.

**3. All partners must work to ensure a market and value chain orientation.** Achieving innovation objectives in an effective and efficient system requires a focus on markets, customer demand, and business capacity and requirements. Understanding, strengthening, and where appropriate, developing value chains is an important strategic focus.

**4. The Government of Alberta (GOA) must create integrated, aligned policy architecture.** Government must ensure that aligned and cohesive public policy approaches, including the proper policy instruments, are in place to support development and commercialization of bioindustrial and environmental products and services and facilitate cross-sector collaboration.

**5. The GOA must ensure access to human capital.** Education and talent development programs and initiatives must be targeted to build skills and capacity in the broad area of innovation and in biological processes and environmental management.

**6. A mechanism that facilitates public and private sector investment must be established.** Building and growing Alberta-based businesses requires that effective tools be in place to attract capital, including public and private investment, for the development and commercialization of bioindustrial products

and environmental services, and to ensure appropriate and timely infrastructure. This investment mechanism includes emphasis on public-private partnerships.

**7. Programs and initiatives should be focused on results-based metrics within a broad performance management system.** The public and business expect governments to provide evidence of the impact and results of public spending and investment. Any strategy should be executed in phases, with "go / no go" decision points based on delivery of expected results.

**8. Objectives must support the development of ecosystem services that accelerate and expand our ability to remediate the environmental impacts associated with industrial development.** These services include greenhouse gas management and capture, land disturbance mitigation, biodiversity and wetlands management, forest management, and the use of markets to support ecosystem services.

**9. The opportunity in the short to medium term is in finding market-based, innovative solutions to problems facing energy and natural resource companies.**

Examples include cleaning tailing ponds, securing rapid response to significant oil spills, completing land disturbance remediation, reducing the carbon footprint, enhancing water quality while reducing water use, and creating cost-effective biochemicals. Such growth will help ensure the responsible stewardship of the province's natural resources and support the social licence to operate for all firms based on natural resources, as well as creating new growth opportunities for Alberta businesses.

**10. Deployment of products and services to align assets and investments in capacity and infrastructure will create a world-class innovation engine in Alberta, focused on regional jurisdictional advantage, that others will seek to emulate.** The early focus on solving problems experienced within the energy sectors should then shift to leveraging the work and know-how gained to other sectors and applications elsewhere in the world.

# AI Bio Recommendations for Priority Areas of Investment (Resources and Funding)

## Policy

**1. Review, renew, and implement an integrated, aligned policy framework.** The GOA should work with stakeholders to ensure that aligned and cohesive public policy approaches, including the proper policy instruments, are in place to support development and commercialization of bioindustrial and environmental products and services, and facilitate cross-sector collaboration. This work would include a review of existing policies and programs that affect innovation, economic diversification, environmental management, and commercialization of technologies and services across the resource-based sectors (forestry, agriculture, and energy) to ensure policy alignment, cohesion, integration, and elimination of inconsistencies while maximizing effectiveness.

Alberta Innovates Bio Solutions (AI Bio) recommends that emphasis be placed on creating enabling policy that incents business innovation, including policy around procurement, tax, fiscal, and market-based instruments. Policy review and renewal also includes integration and coordination with responsible stewardship policies such as the land-use framework to build effective and appropriate regulations that permit the development and use of the market for a range of ecosystem services. Taking this approach is consistent with the recommendations of the Institute for Agriculture, Forestry and the Environment (2010) framework and subsequent technical and science work supported by AI Bio and Alberta Innovates Technology Futures (AITF) (2012).

**2. Review and update access to capital to ensure availability and accessibility of capital for investment in bioindustrial products and environmental services.**

The aim is to ensure local access to capital for firms seeking to develop and grow through serving bioindustrial product or service markets. This review might be undertaken with the guidance of the Business Innovation Advisory Council and build on existing mechanisms within the province.

**3. Access human capital and skill enhancement opportunities.** Working in partnership with industry and Campus Alberta, identify competencies and skills and then invest in appropriate programs (both in-class and online) for the accelerated



development of skills and labour and support the development of an innovative culture in the sector.

## Infrastructure and Capacity

**4. Improve feedstock logistics.** Improving the ability of firms to access reliable, quality feedstocks with affordable systems and transport requires a systematic and innovative approach to harvesting and collecting of feedstocks, preprocessing of feedstocks, storage and queuing, and handling and transportation. At each stage of these logistics, opportunities for innovation exist, enabling competitive access to reliable feedstock and competitive prices.

**5. Enhance data collection and management.**

The GOA should support the creation of an open-source, accessible, transparent, and publicly available data set for the analysis of ecological systems. Monitoring of these systems should be aimed at enabling accountability and transparency and developing markets for land disturbance and remediation, wetlands management, and biodiversity monitoring. Use of these data resources for management decisions, policy development, and regulatory monitoring also

## AI Bio Recommendations for Priority Areas of Investment (Resources and Funding) (Cont'd)

supports a world-class monitoring system for the cumulative effects of oil, gas, energy, and other industrial development on ecosystems.

**6. Develop regional clusters.** Community collaboration, skills clusters, and industrial clusters are all enabling devices for effective economic development. Such collaboration mechanisms can reduce transportation costs for raw materials, enhance cross-sector use of scarce labour, increase the efficiency of feedstock logistics, and be a base for market and educational activities. Clusters are also the basis for developing an innovation culture in firms. Product and service innovation needs support at the local level. The intent is to build on existing expertise, networks, infrastructure, capacity, and regional jurisdictional advantage to create local innovation engines.

**7. Create a science-based value proposition for enhancing ecosystem services in Alberta.** We must develop the systems, tools, and processes required to use market-based instruments to manage ecosystem services. To this end, we must invest in assessment protocols that assess the supply of ecosystem services; use a credible, functioning exchange or trading platform; support the development of proofs of concept; and catalyze science and knowledge exchange relating to ecosystem services.

### Programs

**8. Focus on research and development for bioindustrial products and services.** Invest in the key bioindustrial and environmental sectors identified as core to the focused strategy. The research would be both basic and applied, with emphasis on the latter. It would include a focus on innovative uses of waste streams, biobased solutions to challenges in energy, oil and gas, new applications of nanotechnology, synthetic biology, and improving available Alberta feedstocks, as well as innovative work on ecosystems services and processes.

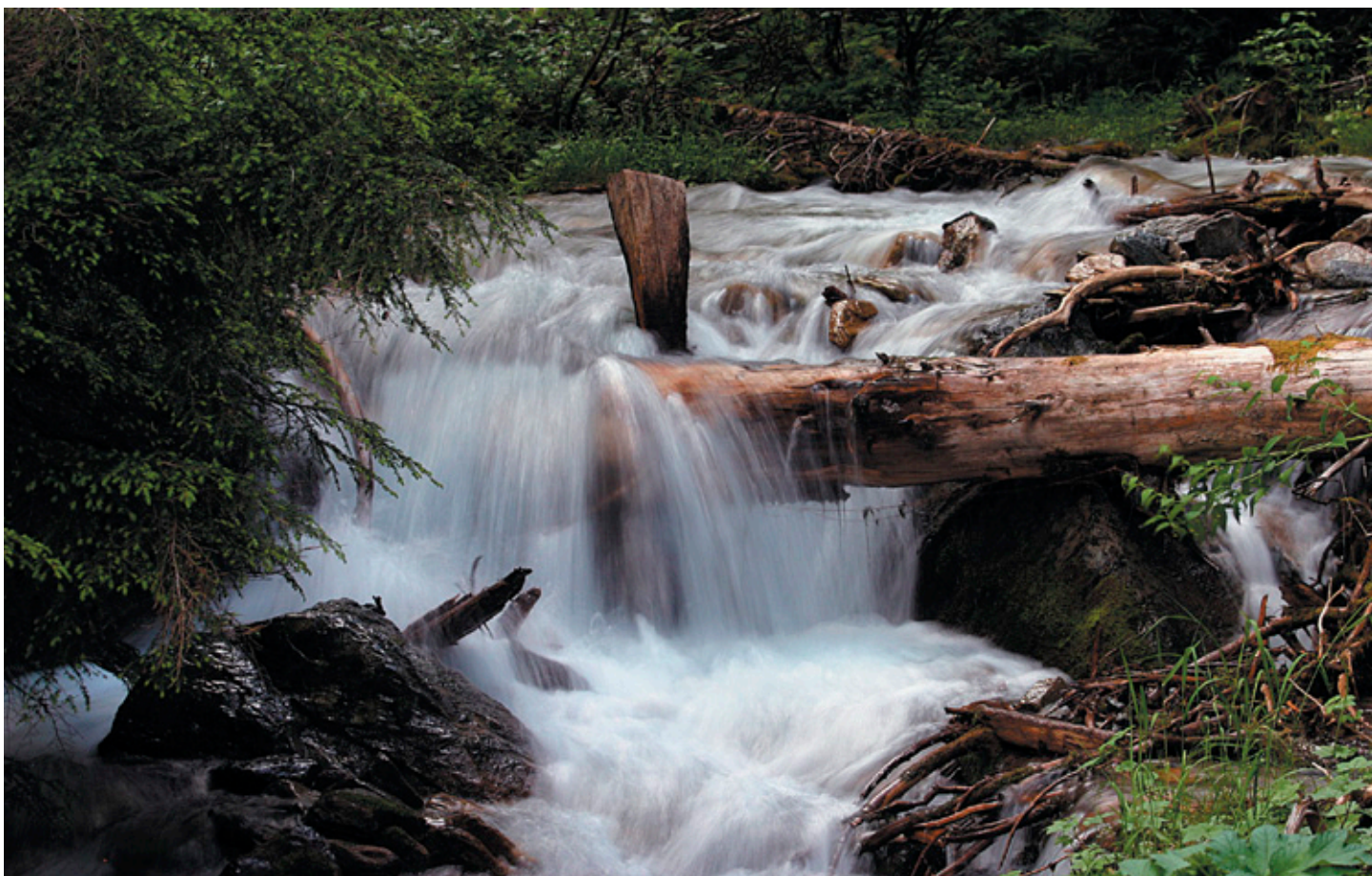
**9. Support industrial-level prototyping and industrial-scale pilot projects.** The purpose of these would be to move from pilot, small-scale test facilities for market-demanded products to large, industrial-scale projects (with dollars from

industry and additional contributions from other provincial and federal government agencies where appropriate).

**10. Establish a Business Innovation Advisory Council.** The Alberta Innovates corporations should establish a process to engage, across sectors, representatives from industry, academia, government, and non-government organizations to work and invest in strategic alliances that build the bioindustrial and environmental services sectors. The council's role would include providing oversight advice to direct and adapt the strategy, ensure the appropriate use of funds, and develop outcome measures. This mechanism would enable cross-sector collaboration, address bottlenecks, and establish systemic competitiveness to support the bioindustrial and environmental services sectors in order to strengthen, diversify, and green the economy. The council may over time evolve into a public-private partnership.

**11. Strengthen business innovation programs (commercialization associates, executives in residence, mentoring programs, etc.).** The intention of these programs would be to increase direct support to innovation and commercialization for firms in the bioindustrial and ecosystem services sector, building on the successful AITF support-for-industry programs.

**12. Strengthen market intelligence.** There is a need to develop and maintain market intelligence that includes intelligence on products demanded, products produced, technology options, management capacity, the dynamics of fast-growing companies, and key global players. The aim would be to produce and develop forward-looking tools and resources to support evidence-based decisions by government and industry. This work would be undertaken jointly by industry and government, working through a collaborative structure.



## 5. ACKNOWLEDGEMENTS

2013

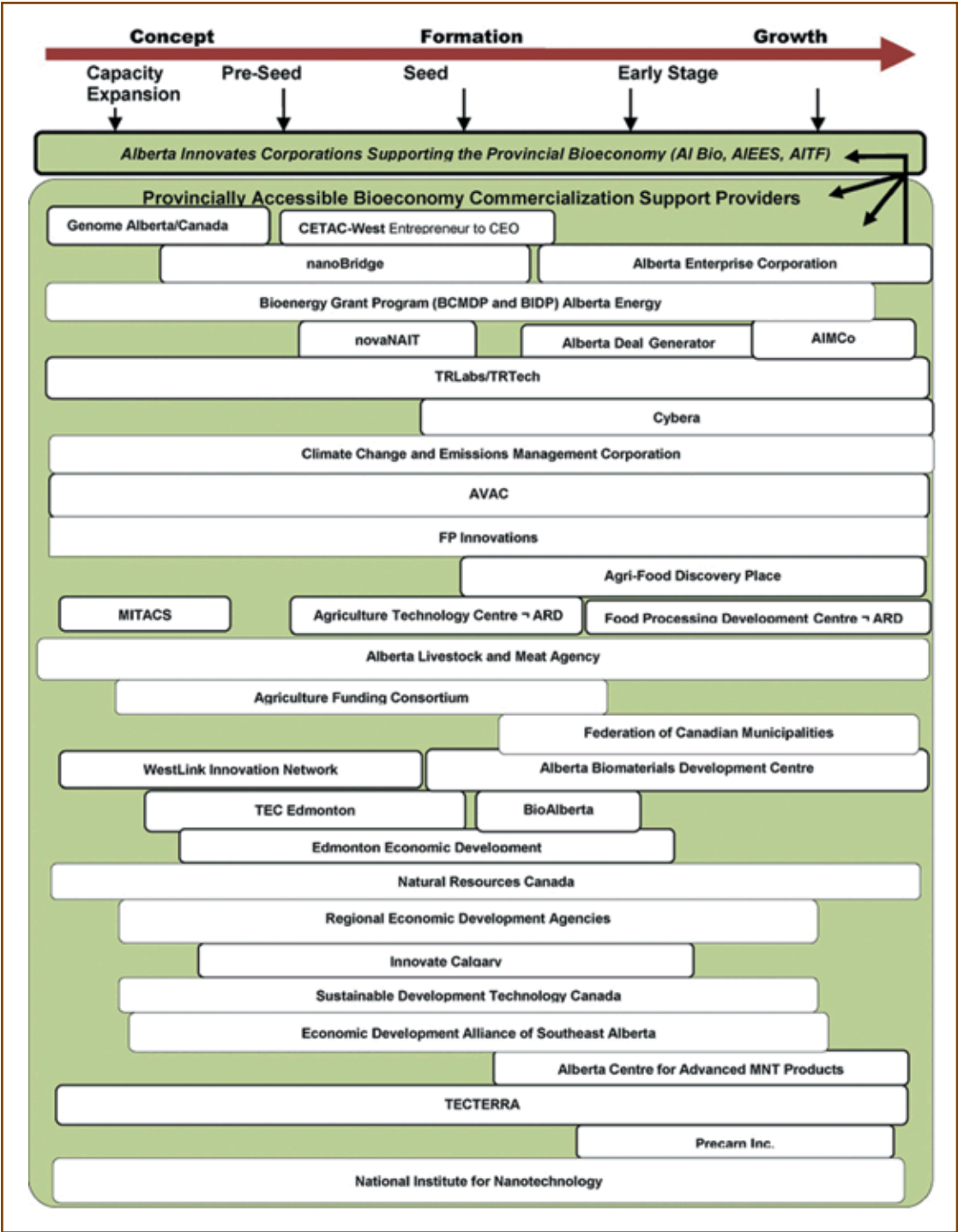
AI BIO THANKS EVERYONE WHO PARTICIPATED IN THE BIOE INITIATIVE FOR THE QUALITY OF THE DISCUSSIONS AND FOR THE CONTRIBUTIONS MADE TO THE FUTURE OF BIOINDUSTRIAL GROWTH IN ALBERTA. ORGANIZATIONS AND INDIVIDUALS WHO PARTICIPATED IN VARIOUS COMPONENTS OF THE BIOE INITIATIVE ARE LISTED IN APPENDIX B. THE AI BIO WORKING GROUP INCLUDED CAROL BETTAC, PEGGY LESUEUR, MARIE CUSACK, STEVE PRICE AND CHRISTINE MURRAY.

**Bill Hunter**, Chairman, BioE Initiative

**Dr. Stan Blade**, Chief Executive Officer, AI Bio

# Appendix A: Alberta's Current Bioindustrial Innovation System

The following figure summarizes the current Alberta bioindustrial innovation system, including organizations and programs within an investment and commercialization continuum. These institutions and programs support the advancement of the provincial bioeconomy and bioindustrial sector.



## Appendix B: Participant List

### Individual Interviews

AdFarm  
Agrium Inc.  
Agriculture Financial Services Corporation  
Alberta Biomaterials Development Centre  
Alberta Chamber of Resources  
Alberta Economic Development Authority  
Alberta Forest Products Association  
Alberta Innovates Energy and Environment Solutions  
Alberta Innovates Technology Futures  
Alberta Newsprint Company  
Alberta Pacific Forest Industries Inc.  
Arctos & Bird  
Ashland Specialty Chemicals  
Bayer CropScience Inc.  
BioAlberta  
Biohome Developments  
Biorefining Conversions Network  
C3 Unlimited Inc.  
Canadian Energy Research Institute  
Canadian Natural Resources  
Canadian Oil Sands Innovation Alliance  
Cambridge Strategies Inc.  
CBC Consulting  
Cenovus  
Chemtrade Logistics Inc.  
Climate Change and Emissions Management Corporation  
Cluster Industrielle Biotechnologie  
CORE BioFuel Inc.

County of Stettler  
County of Strathcona  
Daishowa-Marubeni International Ltd.  
Dow AgroSciences Canada Inc.  
Dow Chemicals  
ECO Consulting Inc.  
Edmonton Waste Management Centre of Excellence  
Fame Biorefinery Corp.  
FPInnovations  
Growing Power Hairy Hill LP  
Hilgartner Grain Farm  
Ian Murray & Company Ltd.  
Iogen Corporation  
Infinite Mat Solutions Inc.  
La Crete Sawmills Ltd.  
Ledcor  
Leo Meyer Grain Production Ltd.  
Lignol  
Lochend Luing Ranch  
Manning Diversified Forest Products Ltd.  
Mascoma Corporation  
Mercurius Biofuels  
Millar Western Forest Products Ltd.  
Momentive Specialty Chemicals  
Murgatroyd Inc.  
Naturally Advanced Technologies Inc.  
North West Upgrading Inc. (NWU)  
NOVA Chemicals Canada  
Novozymes

## Appendix B: Participant List (Cont'd)

Octoco Inc. (Redengine Inc.)	Tolko Industries Ltd.
Oil Sands Leadership Initiative	Town of Drayton Valley
Pembina Institute	Town of High Level
Penn West Exploration	TTS
Permolex International, LP	University of Alberta
Porozni Farms Ltd.	University of British Columbia
Rentech, Inc.	University of Calgary
Shell Chemicals Canada Ltd.	University of Lethbridge
Sift Every Thing Corp.	VisionGain Consulting Inc.
Suncor Energy Inc.	Viterra Inc.
Synerchem International Inc.	VRM Management Solutions
Syngenta Canada Inc.	Waterfall Group West Fraser Timber Co. Ltd.
Tekes	Western Hydrogen Ltd.
Tembec Inc.	Weyerhaeuser Company Ltd.
The Silvacom Group	Woodbridge Foam Corporation
Titanium Corporation Inc.	

## Industry Roundtable Participants

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Bard, John	Ashland Inc.
Bykowski, Len	VRM Management Solutions
Chapman, Ken	Oil Sands Leadership Initiative
Ernst, Peter	Town of High Level
Garbowski, Tom	The Silvacom Group
Goetsch, Joerg	Daishowa-Marubeni International Ltd.
Heigh, Jeremy	Sift Every Thing Corp.
Hilgartner, D'Arcy	Hilgartner Grain Farm
Jones, Keith	Fame Biorefinery Corp.
Kaufield, Jennifer	Titanium Corporation Inc.
Khailil, Hamdi	Woodbridge Foam Corporation
Kotelko, Bern	Growing Power Hairy Hill LP
Meyer, Leo	Leo Meyer Grain Production Ltd.
Murgatroyd, Steve	Murgatroyd Inc.
Putzke, Mike	Alberta Newsprint Company
Reis, Ronald J.	Millar Western Forest Products Ltd.
Rippon, Peter A.	West Fraser Timber Co. Ltd.
Schubert, Jim	Edmonton Waste Management Centre of Excellence
Shelast, Curtis	Momentive Specialty Chemicals
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Towers, Michael	Tolko Industries Ltd.
Unger, John	La Crete Sawmills Ltd.
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Young, Terry	

# Thought Leaders Forum Participants

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Andries, Kirk	Climate Change and Emissions Management Corporation
Beltz, Linda	Weyerhaeuser Company Ltd.
Brawn, Robert	Alberta Economic Development Authority
Chapman, Ken	Oil Sands Leadership Initiative
Chepyha, James	Chrysalix Energy Venture Capital
Clark, Paul	VisionGain Consulting Inc.
Clendennen, Stephanie K.	Eastman Chemical Company
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Heintzman, Andrew	Investco Capital and Green Economy Advocate
Hesje, Brian	Alberta Innovates Bio Solutions
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Hooper, Doug	Waterfall Group
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Luoma, Greg	Luoma Tech Inc.
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Morton, Bob	The Silvacom Group
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Hutton, Drew	International and Intergovernmental Relations
John, Gabriel	Energy
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Kloeck, Trevor	Agriculture and Rural Development
Li, Rona	Enterprise and Advanced Education
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