

Building A Common Path  
Toward The Life Science Economy:  
An Action Plan Summary

The Context

Federal, Provincial and Territorial Ministers of Agriculture met in July 2000 to initiate discussions with the aim of devising a long term growth strategy that builds on Canada's strengths in the life sciences. Agriculture and agri-food production, value-added processing, plant and animal science, techniques of biotechnology, medicine and stewardship of resources will be combined to strengthen the nation's capacity for sustainable economic growth.

The Ministers asked a federal-provincial working group to identify opportunities and challenges related to life sciences and to develop an Action Plan for their consideration in June 2001. The plan is based on a goal of positioning Canada as a leader of the Life Science Economy by year 2010.

A Proposed Federal/Provincial Plan of Action

Agriculture continues to grow in an environment that fosters innovation and greater reliance on renewable resources. It will evolve as a key driver of the Life Science Economy because the shared federal-provincial jurisdiction has an innovation system with the potential for collaboration and co-operation between levels of government, academia, and industry - that can, through joint effort, bring significant benefit to all Canadians.

For governments, the integration of functions between departments, such as taxation, environmental regulation, human resource development, and health will provide ways of meeting new challenges in creative ways. As well, the Working Group examined a number of issues related to public confidence, intellectual property and patent protection, as well as public and private investment, and the role of governments in early-stage industry development. As a result, consultation and education have been recognized as critical elements towards building public confidence in life sciences and the Canadian regulatory system.

## The Objectives

This plan proposes a number of federal and provincial initiatives that fall into six specific areas:

- Sharing the Vision;
- Building Public Confidence;
- Infrastructure and Business Environment;
- Investment;
- Research; and
- Human Resources.

## Sharing the Vision

The January 2001 Speech from the throne emphasized a commitment to placing Canada amongst the top five nations in R&D performance by 2010. Agriculture and agri-food will be a core contributor to this undertaking and, thus, a key sector in the Canadian economy of the future. As a sector with expertise present in all regions of the country, and as a shared federal-provincial jurisdiction, there must be engagement between all levels of government, industry, academia and the public.

To achieve a Life Science Economy in which agriculture and agri-food plays a key role, leadership must come from many sources:

- Communities
- Federal and Provincial Departments of Agriculture, Fisheries and Forestry.
- Federal and Provincial Departments of Industry and Economic Development
- Federal and Provincial Departments of Environment
- Industry Associations related to the Life Sciences
- Parliament and Provincial Legislatures
- Primary producers and producer associations
- Other industries (e.g., chemical, pharmaceutical, health etc.)
- Universities and Agricultural colleges

This diversity of this list underscores the importance of consultation as a means of reaching those whose energy and expertise will drive the Life Science Economy. Consultations will not only be a means to identify opportunities and challenges but, also equally important, as a way of receiving views and expectations from producers, industry and other stakeholders about how to best realize the potential for agriculture in this new environment.

Producers have generally been supportive of life sciences development when there are specific benefits that relate to their operations. For example, they have been instrumental in initiatives that create markets for what had previously been waste products, such as the manufacturing of useful products from waste straw. In addition, such ventures also provide jobs in rural communities.

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For producers to become engaged, they must see the benefits for themselves in doing so. In order for such projects to become a reality, outside capital may be required. However, producers who engage in raising capital for enterprises of this sort often fear losing control and therefore sometimes resist the participation of investors with deeper pockets.

The vision of a Canadian Life Science Economy would see our primary producers, enterprises, educational institutions and S&T organizations help Canada achieve a competitive advantage in areas such as:

- Feedstocks, alternative "clean" biofuels, molecular farming;
- Pharmaceuticals, biopharmaceuticals, and diagnostics (biosensors);
- New products from plant materials (e.g., bioplastic and biosteel);
- Germplasm (seeds and animal genetic resources);
- Environmental services (e.g., bioremediation); and,
- New tools and technical advances (e.g., bioinformatics, data mining and biochips.
- Novel chemicals from plants and insects (e.g., bio-pesticides and pheromones); and,
- Diverse and sustainable crop production systems.

The benefits of this economic growth would be felt in areas such as primary production (new production systems and products), research and technology development (Canadian firms as generators of intellectual property and as sought-after collaborators), manufacturing (delivering high value end products to global markets), and services (providing knowledge and expertise).

### Building Public Confidence

Building public confidence in Canada and abroad in the potential and the benefits of the life science economy is essential. Society is broadly supportive of the benefits of the Life Science Economy (e.g., products, services, economic prosperity) but concerned about the means required to achieve them (e.g., genetically-modified foods). Support is highest when the public good is evident, or where there is direct and significant personal benefit. (e.g., improved environment, health). Industry should be encouraged to include research for products that result in benefits to the consumer as well as those that benefit producers and processors.

An effective regulatory system is a key element in securing the endorsement of citizens. Producers and consumers are concerned that they have no control over the approval and release of transgenic varieties of crops. In the case of both pulses and wheat, producers have expressed concerns that private entities will register and release varieties prior to the market being ready to accept these products. Their concern is related not to these varieties themselves, but to the damage it may do to the conventionally bred crops. Life science efforts in nutraceuticals and bio-health products might involve production of beneficial bioactives from crops and livestock, some of which might involve genetically modified organisms. For producers to embrace such crops and livestock they must be assured that product safety and public concerns have been adequately addressed.

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This introduces an important social science component. The life science economy cannot be developed solely by technocrats. The public confidence strategy involves ongoing polling and surveys to identify needs and concerns, the maintenance of a credible regulatory system to evaluate foods and other products created by means of biotechnology, and a patent and intellectual-property regime that reflects both business needs and social concerns. In addition to receiving the views of the public, mechanisms need to exist to communicate information to the public about the life sciences and life-science products. Specific concerns that need to be addressed include the spread of antibiotic-resistant pathogens, the ability to segregate GMO and non-GMO crops, and to identify a product as containing (or not containing) GMO components, and the preservation of food taste, colour and nutritive value by the application of LSE techniques.

The following actions are proposed for the public confidence strategy:

- Consultation with citizens on the development of the life science economy as a first step in implementing the Action Plan.
- Undertake periodic consumer research and use public consultation to identify and monitor needs and concerns.
- Maintain and promote Canada's credible, transparent and science-based regulatory system.
- Develop delivery mechanisms for information about life science and life science products.
- Develop an Inventory of Canadian Agri-Food Research (ICAR) sub-system for all publicly-funded LSE research projects.
- Research methods to prevent movement of genetically-engineered crops (e.g. cross-pollination in fields.)
- Develop identity-preservation systems for genetically modified and non-genetically-modified food products.

### Infrastructure and Business Environment Strategy

Producers have expressed the concern that market access for some of the life science products is limited, specifically in the case of nutraceutical, medicinal herbs, and products produced by molecular farming. Many of these goods have been brought to market by an individual producer, or a small group of producers, and there is fear of market collapse from overproduction or lack of quality control if the producer base is significantly expanded. Furthermore, research and development efforts must generate technologies that can easily be adopted by producers engaged in processing, and not just for larger processors. Producer input in future regulatory measures is also vital in assuring that undue burden and costs are not placed on their operations.

Canada's comparative advantages should be maintained or enhanced in terms of our infrastructure, business environment and policy regulation, testing and evaluation systems. For example:

- Study the incentives that other countries are using to increase their patenting rate and enhance their pool of IP.

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- Further harmonize IP rules and product registration rules between Canada and its principal trading partners.
- Encourage the allocation of more resources by public and private research organizations to IP protection and IP enhancement.
- Provide incentives to encourage more patenting by researchers in small and medium enterprises (SMEs) and public institutions (i.e., government and university laboratories).
- Canada has a useful mix of LSE sub-sectors: agriculture, health, environment. Expanding each sector will require a focus on specific infrastructure support in each area.
- Lower corporate taxes significantly below that of our major competitor country, the United States.
- Promote and foster a work culture which highlights the importance IP within research institutions and educate researchers in the value of patent protection.

### Investment Attraction

Canada will need to develop a national approach to attract and retain investment in the Canadian life sciences economy. Research and investment needs should be prioritized to reflect the best potential for growth.

The following actions are proposed for the investment attraction strategy:

- Develop an investment attraction plan for the life science industry, under the auspices of the existing Federal-Provincial Steering Committee on Investment. The plan would promote Canada's commitment to, and its national and regional advantages in life sciences; coordinate foreign investment, strategic alliance and technology transfer opportunities; and profile business climate issues that discourage investment in life sciences.
- Consult with small and medium-sized enterprises to develop initiatives that foster entrepreneurship and help small businesses to grow. This would ensure that SMEs have access to capital at all stages of innovation and development. Foster networking with the research community, encourage the development of private sector business incubator services, develop entrepreneurial, managerial and marketing skills and ensure that SMEs have access to product and market development services.

### Research

The dynamic forces in the Life Science Economy of the 21st century are the life sciences themselves. Structural biology, genomics, biotechnology and biomedical imaging - to identify a few - are supplying both knowledge and the technology necessary for economic growth. These fields - and many others - are data-intensive and require collaboration between scientific and technical disciplines (e.g., natural sciences, medicine, and computing) for research and technology development. The best example is the Human Genome Project, which combined leading edge

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biology and medicine with complex, computationally intensive problem solving.

The research strategy for the Life Science Economy can build on Canada's excellent government, academic and private sector research organizations and researchers. This will mean investing in long-term life sciences research and technology development, as well as the system which connects them and moves the knowledge from these laboratories to end users. This research should be balanced among basic sciences, social sciences and applied agricultural research that relates to life sciences - notably in areas in which Canada has a demonstrated record of success, such as agriculture, health, and environment. Not all our research has economic benefits that are evident and measurable in the short term. The value of R&D should not be measured against a narrow commercial yardstick. There are long-term benefits from agriculture and agri-food research in terms of good stewardship of natural resources, the protection of the environment and indeed the general advancement of knowledge. This knowledge itself may lead to more avenues of research that eventually give us new products, or processes that increase productivity, create jobs, or capture a market.

Producer groups that have the capacity to fund research and development, such as commodity associations with check-off revenue, have also been interested in funding research that will lead to additional market opportunities. Examples in the life sciences area where this has led to significant producer funding are in the research of medicinal benefits from specified livestock and crops products, industrial uses of oils, and transgenic crops that produce long-chain fatty acids. Again, the defining criterion is the direct benefit that producers perceive for their operation in the long run, which means that the benefits must accrue also to the users of the technology, not just to the commercializing body that produces it.

The following actions are proposed for the research strategy:

- Increase capacity in both basic and applied research;
- Create new research capacity beyond the laboratory, which could include pilot plants;
- Technology-proving facilities and life science business incubators;
- Establish a private-public sector governance mechanism to set priorities and fund programs within each segment of the research spectrum from basic to sustainable production technology commercialization;
- Support research at government laboratories, universities, private sector research firms and provide incentives to collaborate;
- Enable participation in international life sciences research initiatives;
- Invest in social sciences research including ethical, economic, marketing, environmental and institutional issues;
- Ensure that there are incentives for technology transfer and commercialization; and
- Build a life science culture through educational institutions and other youth-related organizations.

## Human Resources

Success in the new LSE will depend largely on human resource development in several areas: life science teachers, researchers, highly skilled technicians and specialists in a variety of disciplines. This can be achieved through a policy mix that combines workplace strategies, learning opportunities, and immigration, as well as a research infrastructure capable of developing the necessary human capital. Existing initiatives can continue, provincially within the provincial biotech groups, and nationally with the Biotechnology Human Resources Council (BHRC) and the Council of Ministers of Education Canada (CMEC).

The following actions are proposed to address human resource needs:

- Identify human resource and education gaps across the country;
- Take note of the impact of trends in Canadian society (e.g., an aging society, an increasingly educated agricultural and industrial workforce, immigration and emigration of skilled workers and entrepreneurs);
- Encourage Canadian students and attract students from other countries to help us achieve goals;
- Develop professional designation recognition from other countries;
- Maximize the benefits of existing human resource programs and determine the current state of occupational projection information in life sciences occupations;
- Gather and disseminate to the private sector the relevant information on immigration policy and regulations; and
- Identify skill gaps in the life sciences and work with Human Resources Development Canada to target training, skill development and immigration;

## The Timeline, the Challenges and the Opportunities

The Working Document seeks to integrate these issues into a coherent whole: an Action Plan which sets Canada on the path to becoming a leader of the Life Science Economy by the year 2010.

Canada, with its well-educated populace, excellent communications systems and informational infrastructure, and a highly-regarded food and animal-health safety system, is in a strong position to take the lead in the development of a strong national Life Sciences Economy.

The knowledge, expertise and technological potential of the life sciences will be a key driver for a Canadian innovation strategy. Developments in this area will provide wider opportunities for primary producers and secondary processors and value-adding enterprises in areas such as:

- Conventional foods (e.g., enhanced taste, texture, nutrition, product life);
- Novel and functional foods (e.g., basic or processed food with a demonstrated unique

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- physiological benefit or capacity to reduce the risk of disease);
- Nutraceuticals (e.g., a product isolated or purified from foods and generally sold in medicinal forms);
- Bio-energy (e.g., fuel and energy sources from renewable sources - corn, soybean, animal manure);
- Bio-health (e.g., specially developed proteins for human and animal health);
- Biomaterials (e.g., crops and livestock products used to make strawboard, printer's ink, cosmetics, fibres, plastic, etc.);
- Plant and animal genetic resources (e.g., germplasm, biodiversity, rare breeds and varieties); and
- Environmental protection and remedial measures (e.g., natural alternatives to vaccines, antibiotics and pest control chemicals).

The successful development of a life science economy in Canada demands the collaboration of industry, the research community, governments, producers, and consumers -- a process requiring both collective and individual commitments and actions. This will also entail cooperation between the different levels of government, as well as a sharing of responsibilities between the various government departments responsible for such areas as agriculture, health and the environment. Governments will also influence social, economic, political and business linkages between public and private sectors, addressing public concerns with biotechnology as well as the impact on the environment of the life science economy.

In this context, a number of specific points will need to be addressed:

### Intellectual Property and Patent Protection

The rules and regulatory climate relating to intellectual property and patent protection need to be clarified, particularly concepts applying to the ownership and sale of biological materials. Canada's protection of intellectual property must be seen as adequate or better than that of our key competitors in the global economy (e.g., Japan, United States, United Kingdom, Germany, Australia) if companies that specialize in research and development are to remain in or relocate to Canada. However, economic and trade issues must be balanced by social and ethical considerations in the development of intellectual property rights, particularly as they relate to the life sciences.

### Creating an Attractive Business Climate

Canada must be able to attract major investors, both national and international by promoting its business climate. Both federal and provincial trade development initiatives and networks must support life science industries in their efforts. Potential investors must come to feel that the necessary infrastructure is in place to do business in Canada. There must also be adequate access to capital, particularly for small and medium-sized startups. In turn, successful ventures will be able to project a Canadian presence in the world market for LSE goods.



Leadership, Governance and Collaboration

Leadership and motivation are essential components for the development of the Life Science Economy. The respective roles of government and industry should be outlined and agreed upon early. Linkages between agriculture and other economic sectors and scientific disciplines need to be greatly strengthened. Although these connections often form in reaction to objective needs, governments can play a role, for example, in promoting the growth of internationally-recognized clusters of scientific, research and technology development activities.

Public Awareness

Canada has a solid reputation around the world for food safety that is virtually unmatched by any other country. Thus public awareness efforts should stress the safeguards that Canada has in regard to health and food safety and environmental protection. However, that reputation cannot be taken for granted. It must be nurtured and improved upon, to meet the demands of consumers in Canada and abroad. Consumers today are well informed. They are aware of the concerns about biotechnology in regard to food safety and quality, human and animal health and the environment. They wonder about the ethical, social and legal implications of biotechnology research and development. These concerns keep the life sciences in the public consciousness, and no strategy for maintaining Canada's reputation for food and agricultural safety can afford to overlook them.

Communication efforts must address the risks as well as the benefits and the safeguards of products issued from biotechnology, failing to do so, such efforts will be met with skepticism and resistance by the public. While biotechnological advances may offer social, economic and environmental benefits, the risks and costs resulting from using that technology must be adequately examined and regulated through a process which minimizes the risk of human or ecological harm. Such process must be transparent and communicated to the public.

Legislation and Regulations

Canada's food safety system is sound. In fact, it is one of the best in the world and the federal government has underscored the point that it will apply the most stringent expertise in dealing with advanced technologies.

Canada needs to ensure that the legal and regulatory framework is in place to attract investment in the life science economy. This will require both a degree of consistency across jurisdictions and departments, and a balance between public concerns about some life science economy processes or products on the one hand, and desire for business to have a regulatory framework which is conducive to innovation and product development. Canada's response in that regard will also be to take note of the regulatory climate in other states that promote the LSE.

Research

Research and technology development should move further towards an approach where users and providers of research and science and technology will identify common interests and recognize shared national needs.

Science, research and technology development needs to be framed by a consensus on what kind of society Canada should be in ten to fifteen years and to harness Canada's innovative potential for the benefits of all Canadians. In order to be seen as being an investment worth making, research and technology development needs to be responsive to public concerns and consumer needs. In addition to the science, research and technology development aspects of the LSE, social science research must also be undertaken to examine the effects of innovation, the management of technological change, and the socio-economic dimension of new technologies.

Information Sharing

Advances in computer and communication technologies have expanded the possibilities for the life sciences, but researchers are more dependent than ever on access to shared data and analytical tools. National and international networks need to be created and sustained in order to reduce unnecessary duplication of effort. Information gathering and sharing is critical if Canada is to be on the leading edge of life science commercial activity. National and international networks need to be created to identify opportunities and to avoid duplication of effort in the sharing of non-proprietary information and research. At the same time, the commercial potential of research will give the data produced a monetary value, which in turn could reduce information flows.

Value Chains and the Life Science Economy

Value chain models should be used to present the new opportunities for enhanced revenue through the response of consumer demand for life science products. The use of renewable resources for new food and non-food products requires relationships between sectors of the economy that have traditionally had little contact. For example, cooperation between primary producers and energy companies are required for bio-fuels. Similar cooperation between primary producers and pharmaceutical companies are required for nutraceuticals. Producers of both conventional and GMO food products can benefit from participation in value chains.

Industrial and research clustering is another form of network relationship. A cluster refers to a concentration of companies, often in the same or related industries, that are close to one another geographically. These companies are often linked to a strong science and technology development base. Industrial clusters are important because they create opportunities for technology transfer, facilitate the attraction of investment capital, contribute to a better understanding of markets, and help commercially exploit innovative ideas. There are also economic opportunities for firms which can support and service the clustered industries.

### Performance Measurement

Producers, industry, institutions and governments need to come together to share information, to form strategic partnerships and to jointly determine the most effective ways to develop and share resources. Public consultation is the key component to long-term planning. Governments need to hear directly from industry, producers, citizens and groups and associations on a variety of economic and health and social issues connected to the development of a life science economy, as well as communicating with the public at large. At the same time, various government departments, at both the federal and provincial levels, will need to strengthen their internal collaboration, as so much of the life science economy cuts across the respective government departments of agriculture and agri-food, health, environment, industry and economic development.

To have any meaning for Canadians, the goal must be defined in measurable terms. It is evident that measures which relate to volume of goods or total value of products, especially compared to giant economies such as the USA, are not the most meaningful measures in the Canadian context. In a uniquely Canadian sense we must define what being a world leader really means. In order to align this development with the principles of sustainability and societal outcomes for the public good, Canada can frame its development of the life science economy so as to be the leader in areas such as public confidence in the life science economy, having environmentally responsible production and manufacturing systems, and developing and implementing a regulatory system which address societal and environmental concerns.

### The Need for Commitment

The vision of a Life Science Economy can only be achieved if all those with the potential to shape its development (e.g., governments, R&D organizations, universities, producers and processors) are ready to commit themselves to this Action Plan and to the reassessment of priorities which it will imply. The first step, already underway, is consultation. Through consultation we want to:

- Identify how advanced we are in the Life Sciences (areas of strength, comparative advantage, etc.);
- Set priorities for Canada, provinces, the agri-food sector and specific industries;
- Develop ways and means to provide adequate funding and to remove obstacles to achieve goals; and
- Draw the attention of citizens to the emerging possibilities of the Life Science Economy and its technologies to help to ensure a truly inclusive and durable economic prosperity.

The LSE is not about quick fixes or a uniform approach to change. A diversity of approaches reflects the diversity evident within Canadian agriculture. Strategies for change are driven by people and people are driven by values. Achieving and maintaining a vibrant life sciences economy will mean a long-term commitment to investing in change and supporting it.