The road to Western Canadian competitiveness!

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The Alberta Crop Industry Development Fund (ACIDF) and the Alberta Agricultural Research Institute (AARI) are actively looking at strategies to increase the competitiveness of western Canadian cereal grains. This document reviews some of the issues and the strategies that may be required to set a new path for the long-term sustainability of this industry.

Since value-added processing is expected to encourage increased returns and increased production, this document uses growth in value-added processing for barley, oat, rye, triticale and wheat to measure the success of profitable commercialization programs. To facilitate industry expansion, it appears the industry must harness research resources in cereal genetics in the public and private sector. Plant-breeding initiatives that target specific cereal commercialization initiatives will benefit from seed money already available to organizations like ACIDF. This should attract additional investment in cereal R&D, which the industry may use to leverage additional public and private funding to execute its strategic plan.

At ACIDF and AARI's request, three consultants have studied cereal competitiveness in western Canada over the past six months. Their four reports, the summaries of which are included in this document, provide the basis for discussions about the future of the cereals industry.

While much of the work to date has focused on cereal bio-energy, it is apparent that the feed, bio-industrial and food value chains must also be considered. By framing the discussion around the value-chain, which includes the role of the crop producer, manufacturer and exporter, among others, we hope to develop business scenarios that consider cereal end-uses in terms of the flow of genetic material from the plant breeder, through to the farmer and on to the manufacturer. Business analysts would provide feedback from cereal end-users to plant-breeders to facilitate the selection of genetic traits and the development of cereal cultivars designed to meet ever-evolving market needs.

This report is structured into three sections. The first section, "*Generating momentum"* provides an overview of the issues we face and ACIDF and AARI efforts on the cereal competitiveness initiative to date. Summaries of the four reports generated by the consultants, underline a call to action. The second section, *Today's kernel. Tomorrow's tonne,* presents important information the industry can use to help produce a successful western cereal sector strategy. This section includes information on the current status of cereal crops in western Canada, global trends and their potential affect on western cereal grain markets, cereal crop platforms, trends in customer needs, weaknesses within the system, threats from outside the system and some options for how this cereal industry sector could work together to achieve a common goal.

The third section, *The Future Starts Today,* is a call to action.

We invite you to read this document while reflecting on key developments in the canola and pulse industries, where a deliberate industry-wide focus on premium end-use markets propels:

- **Genetic improvement**
- **Higher farmgate returns**
- **Increased acreage**
- **Increased opportunity for the development of value-added processing.**

Oats, where distinct markets are available for food, feed and industrial uses, are already moving in the same direction.

Generating momentum

We all know the issues. Global geo-politics, increased competition from low-cost producers and the ability of global competitors to deliver improved crop functionality into international markets have eroded traditional advantages for western Canadian cereal crops and reduced producers' access to global markets. Trade distorting policies, trade actions and a Canadian dollar that fluctuates widely in value, dramatically affect the competitiveness of cereal crop producers and of value-added industries that use cereals for feed or feedstock. Industry consultations also suggest there are gaps in the capacity of the cereal production system.

Western Canadian value-added industries have noted that, in addition to requiring predictable supplies of cereal feedstocks, these feedstocks need to be inexpensive to purchase as well as highly functional. Even low-cost feedstocks, however, represent a relatively high-cost component of processed-product sales revenue, making them a major cost to value-added industries. In the absence of competitive feedstocks, these industries must find other competitive advantages to attract investment and prosper.

Traditional value-added industries are concerned that emerging industries could pull large volumes of cereal feedstocks from the system – reducing feedstock availability and increasing costs. This is particularly true of the livestock industry, where the emergence of the bioethanol industry has increased demand for cereal grains. The livestock industry recognizes that feed will be a by-product of the bioethanol production. But Dried Distillers' Grains with Solubles (DDGS), while suitable as cattle feed, has limitations as a feed for other livestock species.

Also, the energy level of DDGS tends to be lower than traditional whole grain rations. What may work in favour of western Canadian livestock feeders is the availability of potentially less expensive DDGS from the US corn bioethanol market.

Another weakness in our system is that the level of investment needed in cereals to sustain the competitiveness of the livestock and the bioethanol industries alone may be insufficient to meet growing domestic demand for cereal feedstocks – let alone the needs of the food sector or our customers in international markets.

These issues must be tackled in the interest of maintaining the competitiveness of the western Canadian cereal sector.

The cereal competitiveness initiative – what has happened so far?

A team of producers and industry executives set priorities for an initial assessment of cereal competitiveness in western Canada. The mandate was to evaluate cereals from the perspective of delivering high volumes of high "energy" cereal feedstocks such as wheat, barley, oats, rye, triticale and corn. This approach recognizes that cereals have been the main source of energy for livestock and bioethanol industries in the past and will continue to be the main source of energy in the future.

In the next phase of the cereal competitiveness initiative, ACIDF and AARI joined forces to evaluate:

- Crop bioenergy needs that contribute to the competitiveness of cereal end-users
- Public and private western Canadian barley, corn, oat, triticale, rye and wheat germplasm and cultivar development programs, with the goal of benchmarking and establishing reliable forecasts of productivity and value enhancement
- The system's ability to deliver genetic traits, with the goal of targeting investments that could help improve crop platform productivity and value
- Strategic energy-based initiatives for each crop platform that could catalyse industry competitiveness

- Short-term investment opportunities to address the livestock industry's need for lower-cost energy in feed

To address these objectives, ACIDF and AARI contracted three consultants to gather facts from senior leaders in the public and private plant breeding community and downstream industry participants. Technology providers, end users, plant breeders and producers identified issues, proposed solutions to these issues, considered barriers to success and outlined a range of genetic opportunities. A synopsis of the four reports generated via this process is included in the next section.

Warning: Falling paradigms

Before we get to the reports, it should be noted that information presented in these reports should be used to challenge the legitimacy of the paradigms we currently use to define the western Canadian cereals industry. To improve cereal competitiveness on a global basis, we must first define the concept of **cereal "improvement."** Crop producers feel that traditional yield productivity targets are too narrow and do not necessarily create better economic returns at the farm gate. *True advances in cereal productivity should be calculated as a product of volume and value, less production and marketing costs.* This definition of productivity reflects cereal production revenue and improvements in producers' financial margins. The aim of cereal producers, as major investors in cereal genetics, is to ensure that returns on their investment flow to their operations in the form of higher gross margins.

The same approach should be used to challenge the concept of **genetic "improvement."** Across the value chain, industry leaders feel that advancements in crop functionality and productivity are cornerstones that will contribute to the growth of domestic value-added processing and improvements in producers' gross margins. This should increase the competitiveness of the commodity and processed products in domestic and international markets. *The gene will be the key to success.* Innovations in genetic research and the commercialization of marketable traits will drive industry competitiveness. Feedback from the market to the plant breeder will create a sustainable, market-driven development loop – contributing to the growth of the western Canadian cereal sector and the retention of this value within the region.

Where we're at: A synopsis of the four reports

Working with ACIDF and AARI, a team of consultants that includes Mr. Carman Read, C&N Partners Inc.; Dr. Keith Briggs, GrainTek; and Mr. Ron Pidskalny, Strategic Vision Consulting Ltd.; produced four comprehensive reports on the status of cereal bio-energy for the bioethanol and feed sectors in western Canada. A synopsis for each report follows. A complete version of each report may download from the ACIDF web site at http://www.acidf.ca. Select *Library* and *Reference Document* tabs at the top of focussed page.

Report 1 – Improving the competitiveness of western Canadian cereal grain crops. An initiative by ACIDF and AARI. Subproject: Review of western Canadian public sector cereal grain crop breeding programs and priorities, with an emphasis on bio-energy market requirements. GrainTek.

As part of the ACIDF/AARI 2007 initiative on cereal competitiveness, GrainTek prepared a summary report describing all ongoing public sector cereal breeding work in western Canada that could serve as a benchmark for future reference, including an emphasis on grain breeding for bio-energy. Information was obtained from all western Canadian public breeding institutions through personal interviews, questionnaires, specially-requested reports, annual reports, web pages, e-mail dialogue, visits to research centers and by attendance at plant breeding and bio-fuels meetings from February to May 2007. Information about fall and spring rye programs was unavailable within the time frame, and there are no public corn breeding programs in western Canada.

Forty-two active, public, cereal crop breeding programs were identified and inventoried in detail, for different classes of spring and winter wheat, spring and winter triticale, barley, oat, and spring and fall rye. Within those programs, more than 120 specific breeding projects were inventoried. The review focussed on identifying cereal breeding programs whose goals have the potential to increase the future competitiveness of western Canadian grown cereals and identifying constraints to achieving those goals. Thirty-nine specific breeding opportunities were identified that could be tackled in these programs.

Items were categorized into 'Blue sky' (= Visionary) opportunities (six), regulatory constraints (four, but of major consequence, including Kernel Visual Distinguishability (KVD) and Plant with Novel Trait (PNT) issues), breeding program infrastructure limitations (17), and specific genetic opportunities within programs (12). Concern about *Fusarium* head blight and related deoxynivalenol (DON) toxin levels as a major threat was very high for all cereal classes, because of potential productivity losses and loss of value in harvested grain. A number of the suggestions focussed on opportunities for new crop types with improved varieties to emerge and/or be adopted on large acreage, or to be created through application of new crop technologies. Examples included:

- Breeding investment in winter wheat and winter triticale improvement to bring western Canadian acreages perhaps up to 30 percent of future cereal acreage
- Improved spring triticale and hulless barley varieties, to take advantage of high yield potentials and improved nutritional quality as feed and for bio-energy
- Breeding support for newly emerging cereal feed crop types, such as the CDC LLH-HOG (= low acid detergent fiber hull, high groat fat, a feed oat)
- Completely new crops, created by application of all the newest breeding technologies, such as a perennial triticale for feed, forage and biomass production

Estimates of likely rates of gain for yield for all cereals in the next five to 10 years were all optimistic, often better than rates of gain thus far. This was especially true for winter cereals, CPS wheat, forage barley and soft white spring wheat, more so if breeding budgets are increased and KVD restrictions eased. The following crops were ranked as a group (albeit with variable opinion) as having the highest potential for playing a significant role in the western Canadian bioenergy sector in the near future, for either feed and/or bio-fuels: Winter wheat, hulled barley, Canada Western General Purpose (CWGP) wheat, winter triticale, CPS wheat and hulless barley. (The absence of spring triticale and SWS wheat from this list was a surprise, but likely reflected lack of widespread production of either of these types in western Canada at this time, and a conservative view of prospects for acreage increases).

Without exception, all responses emphasized the importance of long-term continuity of support for the core infrastructures of breeding programs, for breeder positions, career oriented technical staff, phenotyping and genotyping capacity, facilities and equipment. With strong operational infrastructures in place (including shared infrastructure), new breeding traits or goals can be accommodated readily in response to new market demands. By contrast, short-term funding of narrow focus breeding targets may result in inefficiency, impede genetic progress and fail to promote development of long-term western Canadian breeding capacity or competitiveness, even for the designated goals.

Several suggestions from public breeders focussed strongly on the need to develop human resources to staff public breeding programs in the future, especially to replace plant breeders now near retirement, and to replace positions recently closed. In one case a proposal was made to establish a multi-institutional Western Canadian Triticeae Excellence Center supporting cereal breeding, with three Chairs with related support to be placed one each at the Universities of Alberta (Plant Functional Genomics), Saskatchewan (Cereal Stress and Adaptation Physiology) and Manitoba (joint with AAFC, Cereal Pathology). Such an investment, supplementing other excellences found in existing public cereal breeding programs, would re-establish western Canada at the forefront of international competitiveness in cereal research and breeding, for the benefit of Canadian producers.

Report 2 – Cereal crop competitiveness. Private sector report. C&N Partners, Inc.

Western Canadian cereal producers are price-takers in domestic and international markets and pay more to market their products in export markets relative to emerging international competitors. These two factors appear to be the root cause behind the ongoing reduction in cereal acres. **Despite value-added industry demand for higher volumes of low cost feedstocks, this demand cannot be met without first addressing the fundamental issue of providing economically meaningful returns to the producer.**

Three key issues are influencing western Canadian cereal competitiveness:

- Traditional markets are growing slowly and shifts in population demographics are redefining market opportunities and needs
- Production and marketing costs for western Canadian cereal crops are high, and these costs are not being offset by rising cereal prices, leaving our industry vulnerable to competition from nations with lower production costs
- Sector profitability is low and is driving industrial consolidation

A significant challenge to the western Canadian cereal sector is that while competitive or low cost feedstocks are important to the value-added sectors, a reasonable return on investment is critical if grain producers are to remain in business. The biggest issue for cereal producers is that production costs have not kept pace with inflation. Heavy dependence on international export markets also makes western Canadian production extremely sensitive to shifts in international market demands and to production dynamics in countries competing for export volume.

New industrial demand for cereal feedstocks could transform the western Canadian cereal sector. Bioethanol and biodiesel are two of the first major entrants into the world of biological products. The private sector feels that an intense focus on research with an emphasis on bio-refining will lead to the creation of new products with increased functionality and a lower cost of production than current feedstocks. This will produce an opportunity for cereal producers to provide the basic chemical building blocks of an industrial economy within 10 to 20 years.

Bioethanol manufacturers feel the increase in demand for cereals for the production of bioethanol, and the concomitant increase in commodity prices, is good for the production side of the industry. Whether this current demand is sustainable will be determined by demand for bioethanol, the price of bioethanol and the supply-demand balance of cereal crops used as bioethanol feedstocks.

Traditionally, western Canada has had very competitive feed costs. Historically speaking, however, the production of feed grains has been of secondary importance to the need to meet the quality requirements of food grain customers. In western Canada, feed wheat traditionally makes up about 15 percent of the domestic wheat crop. Not surprisingly then, the success of US bioethanol sector is seen as a threat to the western Canadian livestock feeding sector. The concern is that western Canadian bioethanol manufacturers will compete with the livestock feeding sector for lower quality wheat. However, if a larger portion of the wheat crop is converted to bioethanol, there may be more feed available for the livestock industry than there is today in western Canada.

While the market dynamics for DDGS are still in flux, the US Grains Council has focused on two strategies:

- Demonstrating the potential to increase the level of DDGS in cattle and hog rations
- Increasing the amount of DDGS exported outside of the US

Both strategies assume a low cost of DDGS for livestock diets. Whether the low value of DDGS relative to other feedstocks is maintained remains to be seen; however, livestock feeders will likely have a competitive advantage in areas where significant volumes of bioethanol are produced.

Bioethanol industry participants feel that wheat with high starch content and high yield potential would be the best crop platform choice in terms of delivering high net energy. Participants gave five reasons why wheat has an advantage over other cereal platforms:

- The diversity in classes of wheat
- The potential to increase wheat yield
- There is a proven technological process for the conversion of wheat to bioethanol
- Wheat is regionally adapted to western Canadian growing conditions
- An extensive range of research has been conducted on wheat in western Canada

In developing a strategic plan, each market segment will need a critical mass of basic research in order to be sustainable. Specific breeding programs targeted at defined market segments must be evaluated on the basis of the economic return. There will be little benefit in diluting funding resources over a large range of strategic priorities.

In terms of global production of cereals, western Canada is a relatively small player on the production side. Other major cereal producing jurisdictions and private sector companies have considerable capacity to fund the research and development. Western Canada will have to compete against those resources. To achieve critical mass in research, collaboration amongst industry players is essential. Organizations with cereal germplasm cultivar development programs, funding agencies, farm policy organizations and value chain members should all play a role in defining future direction for the western Canadian cereal industry.

It will take time to set up a comprehensive cereal strategy for western Canada. Over the shorter term, however, private industry has identified a number of barriers to innovation that need will to be dealt with immediately.

Regulatory issues include:

- The negative impact of the requirement for KVD in wheat
- The need for Canada to ensure that variety protection regulations are current and in step with the International Union for the Protection of New Varieties of Plants (UPOV)
- The need to develop a more practical and workable alternative to the concept of PNT

Variety development and registration issues include a need to:

- Improve varietal screening capacity
- Improve capacity in the area of plant physiology
- Improve access to genetic traits
- Increase the number of varieties coming through the variety registration system

Commercial and business issues include a need to:

- Increase private sector investment in cereals
- Find a means to increase the use of certified cereal seed

Means of strengthening the levels of industrial innovation and development include:

- Improving market focus and coordination
- Improving the level of research coordination within and between the public and private sector
- Sharing technology

Report 3 – Cereal competitiveness in western Canada. Opportunities and threats facing the grain-based biofuel and feed industries in western Canada. Strategic Vision Consulting Ltd.

This report examines opportunities and threats faced by the cereal-based bioethanol and the livestock feed industries in western Canada. Western Canadian cereal breeders could address these threats and opportunities by genetically manipulating cereal traits. **Cereal traits at issue include those related to grain quantity and quality and those linked to other value-added traits that may increase the utility of cereal grains in these industry sectors. The end goal is to identify traits with the greatest potential to provide a competitive advantage to these industries in western Canada.**

BIOETHANOL MANUFACTURERS

Success in the cereal grain-based bioethanol sector depends on the availability of high yielding, high starch content wheat cultivars. Those profiting primarily from the sale of bioethanol, and the sale DDGS as a by-product, cite these issues exclusively, to the exclusion of all others. There has been little focus on how the industry might evolve and whether or not other specific wheat traits may be of value in 10 years.

The production of bioethanol derived from cereal grains can be broken down into distinct stages – and plant breeders can add value at each stage. While SVC has not determined whether there is an economic justification for funding research on any given issue, the report notes key areas where research is most likely to boost industry competitiveness – and add value.

Value-added products can be extracted from grain before fermentation. There are about 80 different opportunities to extract value-added products in the pre-fermentation stage of the ethanol value chain in areas as diverse as the chemical industry (carbopeptidase), cosmetics (cinnamate), food production (amino acids), human health (vitamin E) and the pharmaceutical industry (lectins). End-users did not identify any of these traits as being important to their businesses; however, these areas may present future value-added opportunities.
Bioethanol producers want the fermentation process to run quickly and efficiently, producing the most ethanol possible from a given quantity of grain. There is a need for feedstock that disassembles quickly into simple sugars, but this may be a difficult trait to select for in breeding programs. Other traits, such as viscosity, to a certain extent, are due primarily to the presence of β-glucans in the grain. β-glucans can be removed in the pre-fermentation process as value-added components of the grain, or the viscosity of these compounds can be lowered using expensive enzymes during fermentation. Bioethanol producers can use up to about 15 percent highly viscous grains in the feedstock, but would prefer to not do so.

Value-added products can be extracted from grain after fermentation. These co-products may be produced during fermentation. For example, acetic, citric and lactic acid are produced during the fermentation operation.

Alternatively, these stable end-products may also be grain constituents left over from the fermentation process. Examples include ash, alkaloids, tannins and residual starch.

SVC differentiated between "stable" and "unstable" end-products. Stable end products will tend not be altered, regardless of changes made to the fermentation process. Ash and tannins, as examples, will always be ash and tannins. "Unstable" end-products, on the other hand, may change as the distiller makes changes to the fermentation process in the bioethanol production facility. DDGS is a prime example of an end-product that is unstable. Assume that plant breeders create a barley cultivar that produces a high oil DDGS with a high-energy value. An increase in the temperature of the fermentation process could destroy the oil. In this case, bioethanol producers may no longer be able to produce a high energy DDGS if there is a fundamental alteration of the production process.

THE LIVESTOCK SECTOR

Addressing issues in several key areas, grain yield, grain supply, costs and the expanding bioethanol industry in the US and Canada, will define success in the livestock sector. Those in the cattle and hog feeding industries cite specific issues in these areas to the exclusion of all others. One interpretation is that these issues may be so fundamental to the success of the sector that a lack of resolution may usher in the demise of the sector in western Canada.

These issues are similar to those identified in the *Strategic research priorities for the feed grain supply and quality initiative* workshop. **The most important items identified were new cultivars with higher yield potential that would lead to more energy harvested per unit area.** Grain supply would need to be consistent and of high quality and the participants expressed a desire for new cultivars to address niche markets.

The 2006 Feed Summit further defined quality by focusing on a need for feed grains with high levels of digestible energy, metabolizable energy and net energy, low levels of starch degradability in grains destined for beef and dairy cattle rations and good digestibility of amino acids.

Other needs within the cattle and hog feeding industries that could be addressed by plant breeding improvements to cereals include three energy-related attributes in feed: good feed conversion to protein, good daily weight gain and high levels of feed intake. Five cereal grain traits may contribute to feed conversion, weight gain and feed intake. These include a softer seed coat, low grain viscosity, low pentosan levels, high lysine levels and high threonine levels. Cattle, and especially hog producers, would also like to see low phytate levels and no contamination by Fusarium Head Blight (FHB). An "easier to handle" grain with more uniform kernel size would also be an attribute.

CEREAL PRODUCERS

The challenge for plant breeders will be to increase the starch content of cereal grains for western Canadian bioethanol and livestock producers. It is also clear, however, that grain yield potential will have to increase as well. While plant breeders can increase yield potential in cereal grains, it will still be up to crop producers to realize these gains in the field. Nitrogen fertilizer will be required to maximize yields, as will state of the art production practices. The market will also have to find a way to compensate producers for optimizing grain yields. Once yield potential is realized, producers will then have to protect this yield from pests. Again, they will have to be compensated by the market for doing so.

Report 4 – Cereal competitiveness in western Canada. A survey of cereal producers, livestock feeders and bioethanol manufacturers.

SVC surveyed crop producers and two end-user groups, livestock feeders and bioethanol manufacturers. These three surveys provided a forum for input on various issues that could affect cereal competitiveness in western Canada. **The goal was to identify issues that, if resolved, would help improve gross margins, raise net operating income and improve the competitiveness of western Canadian cereal sector on a global scale.** Cereal producers, livestock producers, livestock specialists and those involved in the commercial production of bioethanol in western Canada completed sixty-four surveys.

CEREAL PRODUCERS

Producer questions fell into six areas: policy and regulatory issues; production economics; livestock health and welfare; the environment; commercial grain traits; and new technologies and the future. Of the cereal producers surveyed from across western Canada, 39 percent farm in Manitoba. Saskatchewan, Alberta and the Peace River region of British Columbia account for 22, 39 and 3 percent of the respondents, respectively. The average farm size is 4,100 acres, with a range of 430 to 31,000 acres.

Top cereal producer priorities included:

- Development of enhanced N use efficiency in all cereal crops. This provides an opportunity to reduce N inputs; however, crops could also be bred to use excess N applied to the soil as hog or cattle manure, reducing the impact of manure applications to the environment. This objective ties into producers' needs to decrease input costs for cereal production and a need for the livestock industry to dispose of manure efficiently.
- Development of cereals with vigorous growth habits and early competitiveness against weeds; semi-dwarf crops or crops with better lodging resistance; resistance to sprouting and bleaching; good harvestability; even dry down; and resistance to new insects and emerging diseases.
- Development of a western Canadian cereal varietal trial system to provide a reliable, unbiased means of evaluating cereal cultivars for producers.

THE LIVESTOCK SECTOR

Livestock sector questions fell into six areas: animal health and welfare; environmental issues; new technologies and the future; amino acids; feed energy; and feed efficiency, feed performance and feed economics. Of the livestock stakeholders surveyed, 33 percent were in Manitoba, with Saskatchewan and Alberta accounting for 8 and 56 percent of the respondents, respectively. Those interviewed included livestock feeders (36 percent), feed manufacturers (21) and animal nutritionists (43). The most common animals under the care of each stakeholder were beef cattle (50), hogs (42) and poultry (8). The second most common animals under the care of each stakeholder were beef cattle (40), hogs (10), poultry (10) and horses (40). The average number of animals under the care of each stakeholder surveyed was 281,450 animals, with a range of 100 to 3,000,000 animals.

Top livestock sector priorities included:

- Creation of feed grains with high levels of feed energy that improve feed intake and are converted efficiently to protein. The livestock sector identifies hulless barley as the most important crop in which these traits would be desirable, though this trait is very important for all feed grains.
- Development of feed grains that contribute positively to the environment by lowering levels of phosphorous compounds excreted from livestock and/or increase the amount of manure that could be used in crop production systems by lowering phosphorous levels in manure.

BIOETHANOL MANUFACTURERS

Questions for bioethanol manufacturers fell into seven areas: feedstock; transportation and infrastructure; cost of production, profitability and competition; manufacturing processes; opportunities for manufacturing clusters; the future of the industry; and by-product utilization and the creation of value from by-products. Of the bioethanol manufacturers or potential manufacturers surveyed from across western Canada, 20 percent were in Manitoba, with Saskatchewan and Alberta accounting for 20 and 60 percent of the respondents, respectively. Those surveyed manage or plan to develop bioethanol facilities that will produce an average of 810,000 litres (L) of bioethanol per year, with a range of 270,000 to 1.35M L per year.

Many of those surveyed are in the process of setting up bioethanol manufacturing facilities. Future bioethanol manufacturers from the province of Alberta may reflect a tendency to favour barley or hulless barley as a feedstock due to the larger acreage of barley in Alberta relative to other prairie provinces. The province of Saskatchewan is under-represented relative to its potential as a bioethanol producing province and many of the larger bioethanol manufacturers in western Canada did not participate in the survey.

Top bioethanol manufacturer priorities included:

- Development of a cereal grain with elevated levels of high total fermentables (HTF) that produces greater amounts of ethanol per unit of feedstock.
- Development of hulless barley with low levels of undesirable, non-fermentable constituents and development of soft white wheat specifically for use as bioethanol feedstock.
- Increased levels of β-glucan in barley, hulless barley, oat and hulless oat and increased levels of avenanthramide in oat and hulless oat (compounds of immediate commercial interest as value-added products).

Enabling technologies that allow the measurement of HTF in cereal grains and a near infra-red spectroscopy (NIRS) assay to identify and quantify traits in whole cereal grains would help provide a direct correlation between the value of the grain delivered and the price paid by the end-user. **This technology would directly influence the industry's long-term competitiveness.**

How can we work together, we're competitors?

This discussion paper outlines the challenging issues faced by the western Canadian cereal sector. It also acknowledges that to create a sustainable cereal industry, everyone along the value or supply chain needs to participate in the industry's development. For the cereal sector value chain, this includes the cereal producer, the buyers and sellers of the raw commodity, processors, packagers, transporters, wholesalers, retailers and the consumer, among others.

The canola and pulse industries have successfully dealt with similar issues regarding competition – and have found mutual benefit. Our goal is to encourage that same kind of cooperation in the Western Canadian cereals industry, without sacrificing the benefits of market competition.

Exciting? Yes. Daunting? Only where we are limited by imagination. In the words of Pogo, "we are confronted by insurmountable opportunities."

Today's kernel. Tomorrow's tonne.

This section presents important pieces of information industry stakeholders can draw on to help produce a successful western Canadian cereal sector strategy. It includes information on the current status of cereal crops in western Canada, global trends and their potential affect on western cereal grain markets, a discussion of cereal crop platforms, an analysis of trends in customer needs and proposals for how the cereal industry sector could work together to achieve a common goal. It concludes with an overview of weaknesses and threats that challenge the current system – and presents opportunities for change.

The underlying message of this second section is clear: Global demand for cereals is on the rise. The western Canadian cereal industry needs products it can take into that market with confidence.

Cereals in western Canada today

Contribution to total crop production

Cereals provide an important contribution to annual crop production in western Canada. These crops are well adapted to western Canada's short growing season, are an important part of crop rotations and play a role in production risk management. Cereals are important contributors to value-added industries such as the Prairie-based livestock feeding industry and the emerging bioethanol industry. In total, cereals represent about 65 percent of the total annual crop base in western Canada. About 45 percent of western Canada's cereal production is exported and about 55 percent is used domestically.

Declining acreage and production

In the 10 years between 1996 and 2006, cereal acreage in western Canada declined 20 percent and production dropped about 16 percent. During this same period, the livestock base has increased substantially, with cattle and hog numbers increasing by 68 and 66 percent, respectively.

The declining acreage and production figures for western Canadian cereals are inconsistent with domestic and international demand trends.

These trends show:

- Higher domestic and international livestock numbers
- Growth in the global population
- A rapidly expanding bioethanol industry.

Western Canadian cereal competitiveness

Declining cereal acreage and lower levels of production suggest western Canadian-grown cereals are becoming less competitive globally. Western Canadian cereal producers' competitiveness may be waning because:

- Cereal production in western Canada is somewhat less than profitable – and what is produced is sold at the price offered by the customer
- International competitors have the ability to provide cereal quality that is comparable to the highest classes of grains produced in western Canada
- Western Canadian producers are at a cost disadvantage compared with emerging cereal exporting nations. That cost disadvantage may be at least partly attributable to the high cost of marketing western Canadian cereals

Even with the creation of new value-added industries that require higher levels of low cost feedstocks, it may prove difficult to increase the production of western Canadian cereals without addressing the fundamental issue of economically realistic returns to the cereal producer.

Global trends will influence the future of the western Canadian cereal sector

Globalization, changing population demographics, technological progress, concern for the environment, economic and industrial trends and changes in the political, legal and regulatory framework shape the future of the western Canadian cereal sector. The interrelationships between these trends, market needs and our ability to meet these needs with western Canadian cereal feedstocks is illustrated in Chart 1 (Global trends and markets – page 30.)

Globalization

The trend to increased globalization, which has been developing for over 20 years, is likely to accelerate in the coming decades. This in turn, will affect global cereal stocks, global demand for cereal grains and global trade patterns.

Global cereal grain supply

Growth in global cereal production will likely continue at historical levels. More and more, the capacity to increase cereal production resides with developing nations. Developing countries have the capacity to adopt existing, proven technology, as opposed to having to create and commercialize new technologies. This puts pressure on developed cereal producing nations to continue to innovate, at great expense, to keep ahead of the developing world.

Growth in cereal yields should continue at historical levels, but overall production may be more vulnerable to attack by pathogens and may be increasingly sensitive to variability in weather patterns. New technological breakthroughs in cereal production may be required to maintain and/or increase yield stability and manage the major production risks associated with plant disease. The ability of the developing world to increase production through the adoption of existing technology will be tied to political stability and the recognition of intellectual property rights. Lower levels of corruption in developing countries, in conjunction with greater political stability will encourage increases in overall levels of cereal production.

Global demand for cereal grains

Global cereal demand will likely continue to be influenced predominantly by the food and feed sectors of the economy. Increasing demand for cereal grains, particularly corn from the bioethanol industry, will likely be influenced by national policies on a country-by-country basis. These policies will be directly related to the domestic supply of cereals and the ability of each nation to export surplus grain.

For grain importing countries and countries with little excess supply, policies will likely focus on ensuring a stable supply of cereal grain for the food and feed sectors. With the increase in cereal grain use by the bioethanol industry, new processing technologies, over time, may move the processing sector towards whole-crop utilization strategies.

Food and feed demand for cereals will increase along with global population growth. In developing economies, cereal demand will also increase as it is fed to livestock to meet consumer demand for high protein meat products. In developed economies, a higher percentage of cereals will be used to produce functional foods as well as more traditional and ethnic product lines. This trend in developing nations will address the movement towards healthier lifestyles and shifts in population demographics.

The global cereal trade

Global cereal trade is likely to continue in step with recent historical trends. By crop, wheat should continue its slow to flat growth. Higher brewing industry demand for malt barley, particularly in the developing world, should increase global barley trade. Oats are used increasingly as a component of healthier packaged food products, a move that should stimulate demand for food-grade oats and increase global trade in oats. For corn, demand for food and feed and the level of global trade in this crop should be reflected in global population growth. The supply, demand and trade dynamics for corn will continue to fluctuate as the bioethanol industry continues to develop and evolve.

The flow of capital and technology between different regions of the world is likely to increase dramatically. Many countries will want to move to freer trade. Domestic political realities will, however, continue to play a significant role in the speed of movement towards complete trade freedom. A number of countries may get together to consider bi-lateral trade agreements as a mechanism for driving trade. This may ultimately create a framework for a larger world trade deal in agriculture.

We are moving towards a global society in which there will be significant differences in the pace of change between the G8 countries of Canada, France, Germany, Italy, Japan, Russia, the United Kingdom and the United States, which represent about 65 percent of the world economy, and the rest of the world.

Population demographics

Cereal production and utilization will be influenced by social trends that include an ageing population, increasingly diverse populations in G8 nations, global population growth, the consumption of higher levels of protein in diets and the consumption of healthier foods.

Percentage of population above 50 years of age

In the G8, the percentage of the population above 50 years of age is increasing. In the rest of the rest of the world, the percentage of the population above 50 years of age is stable. These trends suggest that the G8 may experience a lower demand for carbohydrates, but more interest in functional foods. In the rest of the world, the growth in the consumption of carbohydrates should be tied to population growth.

Population diversity

Increasing diversity in countries of the G8 could create more demand for a broader range of cereal-based products. In the rest of the world, the level of diversity in the populations of each country is stable, suggesting that demand for traditional cereals and cereal-based products may not change substantially.

Population growth

Population growth is slow in Canada, declining in the remainder of the G8 countries and increasing in the rest of the world. The global population has become increasingly concentrated in countries outside of the G8. Currently, the G8 includes about one-sixth of the world's 6.6 billion people.

High protein diets

The consumption of protein in the diets of G8 consumers is stable, but it is increasing rapidly in the rest of the world. The demand for carbohydrates for human consumption outside of the G8 nations is not keeping up with population growth.

Healthier diets

The percentage of the population with access to healthier diets is increasing in G8 countries and stable in the rest of the world, suggesting that the G8 will demand healthier cereal-based products. Higher fibre content, processed food products with fewer calories, better tasting food and improvements in product consistency will shape processing and brand development.

Technological progress

Cereal production and utilization will be influenced by technological trends such as the development of new core technologies in the public and private sector, the convergence of plant breeding technologies on a global scale, advances in food processing technology and the convergence of food processing technologies on a global scale.

The development of new core technologies

In Canada, the development of new core technologies for cereal production and utilization is stable. In other G8 countries and throughout the rest of the world, it is increasing. Canada will face competition from superior technological improvements and identity preserved (IP) traits in developed economies. The G8, with the exception of Canada, and the rest of the world will continue to build a competitive advantage in core technology development in cereals in the public and private sectors. These developments will enhance capacity in productivity and market functionality and could leave the Canadian cereal industry at a competitive disadvantage.

Global crop breeding technology convergence

Throughout the G8, there is still some level of differentiation between cereal-based crop platform technologies, but the level of differentiation is decreasing. In the rest of the world, access to technology for improving crop germplasm is increasing and many countries are developing locally adapted germplasm that meets the standards of the G8. In the future, competitive advantage in cereal crop quality may be based more on a local crop production practices, climate and genotype-by-environment interactions than on superior crop breeding technology.

Advances in processing technology and global convergence of processing technologies

Advances in processing technology are being noted throughout the world – and the rate of convergence of these technologies is increasing. This suggests that functional differentiation between crop cultivars, and even crop species, could erode as processing compensates for divergent quality and product attributes.

Concern for the environment

In the developed world, cereal production and utilization will be influenced by environmental trends such as demands to address climate change. Water scarcity and the increasing intensity of commercial agricultural operations will be global issues.

Global demands to address climate change

Demands to address climate change have been escalating throughout the G8, but this issue seems to be of minor importance throughout the rest of the world. Demands to address climate change could increase demand for cereal feedstock to produce bioethanol, a product that is perceived to be an environmentally friendly solution to climate change.

Water utilization

Increased competition for clean sources of affordable water throughout the world is slowing the development of irrigation in agricultural regions and reducing increases in crop yields globally.

Reducing the intensity of agricultural practices

In G8 countries, there is a trend to "optimizing" rural landscapes. This implies reducing the overall intensity of agricultural operations. This is not an issue in the rest of the world.

Economic and industrial trends

Cereal production and utilization will be influenced by economic trends such as growth in Gross Domestic Product (GDP), the increasing percentage of disposable income spend on food, the concentration of commodity buyers for the food industry, demand for "just in time" inventory management and the need to process foodstuffs closer to the customer.

GDP growth

GDP is growing slowly in the G8 and faster in the rest of the world. This is increasing the level of disposable income available for food purchases throughout the developing world.

The percentage of disposable income spent on food

The percentage of disposable income spent on food is stable in the G8 and decreasing in the rest of the world. As societies modernize, more disposable income tends to be spent on discretionary consumer products – suggesting that higher protein food products and more functional food products could drive consumption patterns in the future.

The concentration of commodity buyers for the food industry

The concentration of commodity buyers for the food industry is increasing throughout the world. This means demands for high quality, low cost production will likely increase. Differentiation of food products within food categories and company branding will become more important in capturing larger portions of food markets.

The demand for "just in time" inventory management

The demand for "just in time" inventory management is increasing throughout the world. Supply logistics may be increasingly important as a point of differentiation between competing exporters of processed food products. Western Canada will need to put a substantial amount of time, effort and resources into improving its ability to compete effectively with global food exporters.

The political, legal and regulatory framework

Future cereal production and utilization will be influenced by political, legal and regulatory trends. The world will likely see increased levels of protectionism of domestic production, the alignment of legal and regulatory frameworks for crop development along the lines of G8 countries and an increase in political stability that could lead to more comprehensive agricultural policies in developing countries.

Protectionism of domestic agricultural production

Protectionism for agriculture is stable throughout the G8 and increasing in the rest of the world. Despite attempts to liberalize world trade through the World Trade Organization (WTO), domestic political considerations seem to take precedence over the need to make quick progress towards liberalizing global trade in agricultural products.

Regulatory frameworks for crop development

Regulatory frameworks for crop development appear stable in G8 nations and are being developed throughout the non-G8 world, with most countries likely aligning themselves as closely as possible to the G8. Any significant regulatory framework changes in the G8 will likely prove to be slow.

Legal frameworks

Legal frameworks appear to be stable in G8 nations and are being developed more extensively throughout the rest of the world, most likely in the interest of ensuring access to proprietary technology.

Political stability and the creation of more extensive agricultural policies in developing countries

Politically, the G8 is relatively stable and political stability is increasing throughout the rest of the world. In terms of agricultural policy development, the existing frameworks are likely to remain in place in the G8 with modifications designed to align national policies with WTO negotiating positions or to meet the requirements of existing WTO agreements. In the world outside of the G8, there may be movement towards adjusting agricultural support to align with political realities. In non-G8 countries, food production stability and food affordability are very important, so governments will likely be considering the impact of industrial demand for agricultural commodities on food prices.

How will global trends affect western Canadian cereal grain markets?

Globalization, changing population demographics, technological progress, environmental issues, economic and industrial trends, and an evolving political structure will shape the future of the western Canadian cereal sector. (Chart 1 – Global trends and markets – page 30.) Developments at the global level will drive changes in market demand for cereal products and byproducts; transform the ways in which farmers and processors grow, market and sell cereals and cereal-based products; and change our research structure and means of commercializing technology.

Marketplace demand for products and byproducts

Within 10 to 15 years, markets will be looking for a greater supply of:

- Functional foods, specialty food products and a broader range of food products derived from cereals, especially oats for food uses and malt barley for beer
- Cereal grain bio-energy, based on greater global demand for meat-based protein and bioethanol production

Producer and processor issues

Producers and processors, in 10 to 15 years, will be confronted with issues that include:

- Increasing costs of supplying grain to global customers
- Increasing domestic demand for grain that has been traditionally exported
- Public pressure to reduce the intensity of agricultural operations
- Increasing pressure from customers to supply high quality, low cost cereal grains in a timely manner
- A competitive advantage in cereal crop quality that is being eroded due to the global convergence of crop platform and food processing technologies

Research and commercialization issues

In 10 to 15 years, the research and commercialization communities will have to deal with:

- A western Canadian cereal industry left at a competitive disadvantage, in the public and private sectors, as other countries have developed new core technologies and identity preserved (IP) traits for cereal production
- An erosion of western Canada's competitive advantage in cereal crop quality due to improvements in germplasm in countries outside of the G8 nations

The markets

Food, feed and industrial markets of the future will increasingly demand greater functionality and specific attributes from cereal feedstocks. Cereal producers will have to prepare for a future in which cereals are custom-designed for individual market niches (Chart 1 – Global trends and markets – page 30.)

Food

Food markets will demand functional ingredients and nutritional functionality in cereal feedstocks. The food industry will need cereal feedstock compounds such as amino acids, energy, enzymes, fibre (bran), flavenoids (phytoestrogens), lipids (fats and oils), phenolic acids, phytoalexins (avenanthramide), pigments (β- carotene), polysaccharides (β-glucans), protein (gluten), starch and vitamins (tocopherol and tocotrienol) (Chart 1).

Feed

Feed markets will look for the efficient conversion of cereal feedstocks to meat, milk and eggs. Cereal feedstocks will provide an array of amino acids as well as energy, protein and starch.

Industrial

In addition to energy, protein and starch, the industrial sector will require a diverse assortment of compounds such as cellulose and hemi-cellulose, enzymes, fibre, pigments, fatty acids, gums, heterosaccharides and polysaccharides, lectins, lipids and phospholipids, organic acids and aldehydes, phenols and polyphenols as well as sugar and sugar alcohols.

Feedstock components in common between markets

The food, feed and industrial markets all have common needs – and cereal feedstocks can provide energy, protein and starch for all of these markets. Unlike industrial markets, however, food and feed markets also require an assortment of amino acids. These amino acids can be provided cost-effectively in cereal feedstocks.

Cereal crop platforms that could meet market needs

The western Canadian cereal sector has access to a number of crop platforms that could be used to meet food, feed and industrial customer needs.

Food cereal crop platforms

The food industry is currently well-served by cereal crops that supply a good combination of functional ingredients and nutritional functionality. Malting barley supplies adequate levels of protein combined with diastatic power. Oats can provide specific levels of β-glucans, fat and fibre; durum wheat, an optimum combination of protein (gluten) and pigment; and milling wheat, high levels of protein.

Feed and industrial cereal crop platforms

The feed and industrial sectors may be well-served with cereal platforms that include: hulled and hulless barley; hulled and hulless oats; spring and winter triticale; a variety of classes of wheat including Canada Prairie Spring (CPS), Canada Western General Purpose (CWGP), Canada Western Red Spring (CWRS), Canada Western Soft White Spring (CWSWS), and winter wheat types.

How can the western Canadian cereal industry take advantage of global trends to meet customers' needs?

The western Canadian cereal industry can harness the strengths of the plant breeding and cereal development infrastructure by targeting genetic research in key crops and by providing leadership for various cereal commercialization programs.

Plant breeding and cereal development infrastructure

The strengths of the plant breeding and cereal development infrastructure will help increase the level of domestic value-added processing by targeting genetic research in key crops and by providing leadership for various cereal commercialization programs. In turn, this should increase the competitiveness of the western Canadian cereal industry by providing end-users with access to competitive feedstocks while raising producers' gross margins and net on-farm returns. Cereal crop acreage should increase in the Prairie Provinces as end-users add commercial value to cereal crops in western Canada.

Strengths of the plant breeding and cereal development infrastructure in western Canada include:

- Plant breeders who communicate directly with cereal end-users and have well developed programs that meet these customers' needs.
- Public breeding programs that dominate cereal breeding in western Canada. These programs have accumulated a wealth of genetic resources for current and future deployment in breeding.
- A cereal cultivar development system that produces very few recommendations for the registration of new cultivars compared to other crops. Market entry requirements are set high and new cultivars that do not represent a significant improvement over existing varieties do not clutter up the seed market.
- A strong team at Agriculture and AgriFood Canada (AAFC) that supports cereal pathology, genetic discovery (including molecular level breeding) and grain quality in major wheat classes.
- A strong international Canadian reputation for the attributes of its registered varieties and for the constancy of quality which it delivers because of high registration standards set by its variety registration process.
- A well respected Canadian reputation for solving cereal disease and pest outbreaks by producing resistant varieties that are of production value to growers.
- The efficient adoption of newly released varieties in western Canada due to well-organized seed industry and extension processes that ensure growers are aware of new market opportunities with new varieties.
- Rates of genetic yield increase in Canadian cereal grain classes that have been competitive with genetic yield gains made in equivalent cereal classes in other parts of the world, despite high registration standards that new cereal varieties have to meet, especially for disease resistance and grain quality type.
- Canadian public cereal grain breeding programs are recognized as amongst the world leaders in their areas of cultivar development.
- A substantial amount of diversity in the germplasm of cereal crops in western Canada that could be used to develop highly functional cultivars for food, feed or industrial markets.
- A capacity for the development of core technologies at institutions like the Plant Biotechnology Institute (PBI) in Saskatoon. These institutions could provide excellent structural and intellectual capital for the development of new traits for the cereal industry.
- Internationally recognized western Canadian research personnel working across most cereal platforms.
- Excellent seed production and marketing capacity in western Canada, with seed growers through to multinational companies working to bring new cultivars to the marketplace.
- A grain-handling infrastructure for western Canadian cereals that is modern and second-to-none in its operational approach to maintaining grain quality.
- An excellent infrastructure for providing cereal production inputs that help optimize the yield potential of the genetic constructs bred into cereal cultivars.

- Modern and highly adaptive farmers and a farming infrastructure that allows the rapid adoption of new crop production technologies.

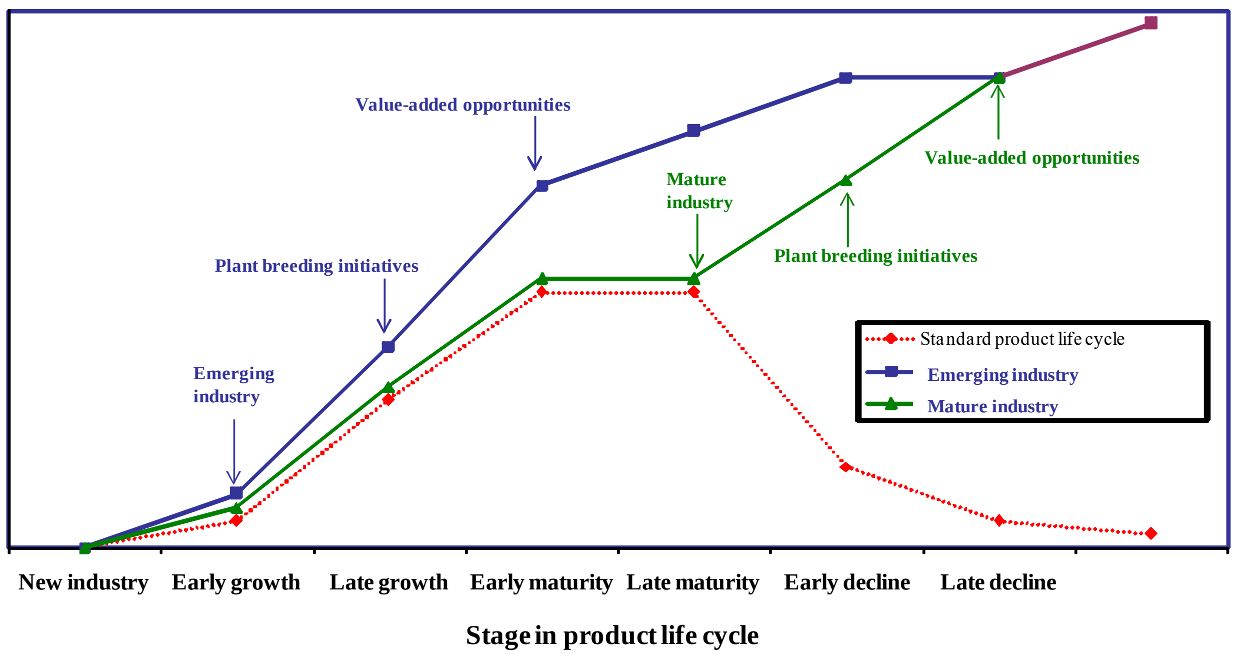
The future is ours

We will not predict the future – we will create the future. We will do this by acknowledging a starting point and then moving towards the steady development of new, and better, value-added markets.

Today

The western Canadian cereal sector is composed of industries that range from those in the early growth stages of the product life cycle to those in the stages of early to late maturity. Ultimately, our goal is to target plant breeding programs to increase the quantity and scope of value-added opportunities. The desired result would be an increase in market potential for emerging industries through the growth and maturity stages of the product life cycle, combined with a delay in the onset of product life cycle decline. This is illustrated in Chart 2 (Product life cycles for emerging and mature industries in the cereal sector in western Canada).

Chart 2. Product life cycles for emerging and mature industries in the cereal sector in western Canada*



* Based on: Porter, M. 1998. *Competitive strategy – techniques for analyzing industries and competitors*. The Free Press. 396 pp.

For mature industries, targeting specific plant breeding programs would be geared to extending the length of the maturity stage of the product life cycle or delaying the onset of industrial decline.

Tomorrow: Emerging sectors

Emerging sectors or new industries experience high initial rates of entry and innovation and the number of companies rises over time. Eventually, the number of companies declines over a long period of consolidation and maturity, despite continued growth. The rate of innovation slowly declines and companies begin to focus on making small, incremental changes in production processes.

How these industries view opportunities and threats reflects their relative positions on the product life cycle. Emerging sectors, for example, have many different product variations, changing production techniques, few companies and a high level of business risk. This is in contrast to mature industries where there is limited product differentiation, markets are segmented, there is some overcapacity in the industry, customers are sophisticated purchasers of the product and competitive costs and cost control are keys to success. Since innovations in plant breeding could take 10 years to reach the point of commercialization, players in emerging industries could access to some of these technologies while their industry is still in its infancy and in a state of technological uncertainty.

We acknowledge there is some risk in directing long-term plant breeding goals towards emerging industries. Because emerging industries are under intense pressure to produce products and develop a customer base, managers tend to deal with problems in an expedient manner and may not thoroughly analyze future needs. In addition, because the industry is growing quickly, companies tend to focus on resolving short-term issues rather than on creating long-term strategies. Another risk in funding specific research projects is that some of the companies that could benefit from the research may no longer be in business as the industry consolidates. On the positive side, emerging industries embrace technology and are willing to accept technological and product risk.

Given risk of business failure in emerging industries, it may be prudent to invest in a comprehensive array of value-added opportunities in a range of business within the cereal sector, rather than in a single opportunity. To avoid the pitfalls of consolidation as an emerging industry matures, it may be worthwhile considering how companies could add value streams as the industry matures. The development of these value streams, however, requires intense market opportunity analysis. Some suggest these opportunities, especially in highly regulated industries, are often only open to those working in conjunction with large multinational corporations.

Mature sectors

Companies operating in mature industry sectors tend to have sophisticated customers in segmented markets in which product differentiation may be lacking. Competitive costs and cost control are keys to success and to profitability when margins are declining. The companies in this industry appear to have given considerable thought to technical issues that could drive business opportunities. In many cases, companies in mature industries have considered a range of opportunities and threats and have worked through a number of commercialization scenarios. Potential issues, however, can be extremely technical in nature and it may be a challenge to appreciate all of the subtle nuances of a company's needs in mature industries. Plant breeders, in these cases, may need to consult with a business development specialist with the expertise to link complex technical needs to the technology that is available in the scientific community.

Specific opportunities for the bioethanol and feed grain sectors

Bioethanol sector projects

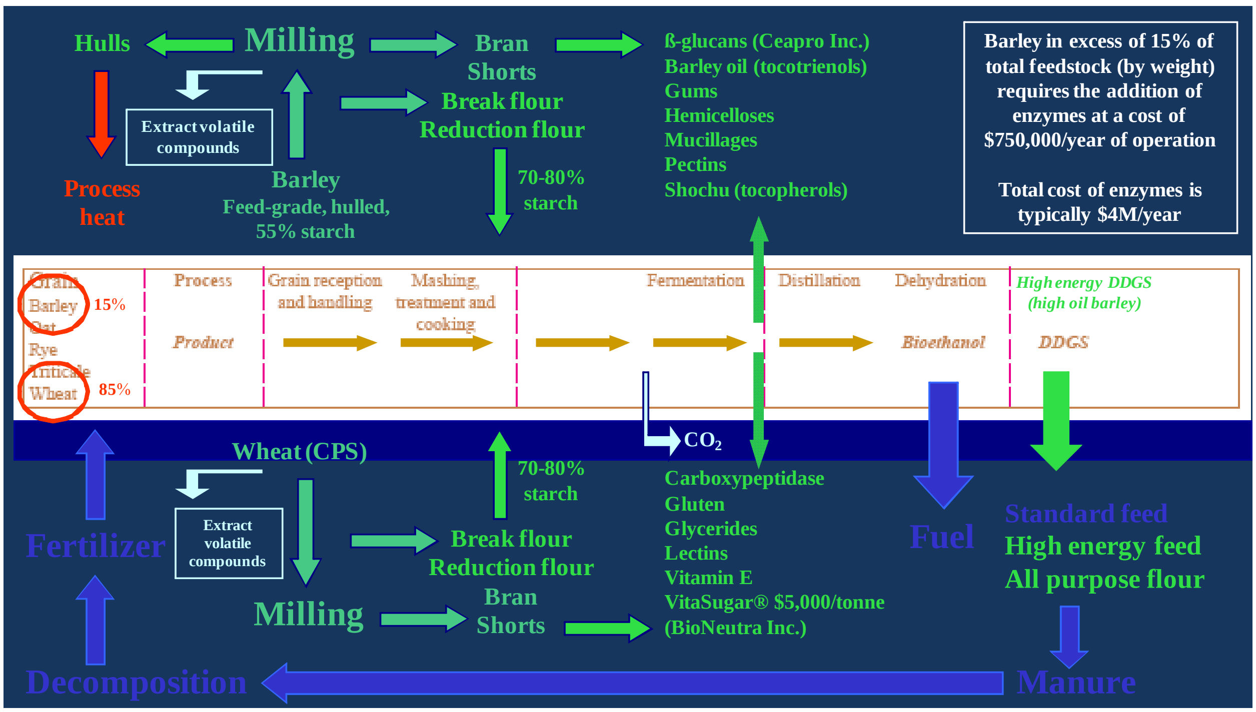
Three specific opportunities are presented for the bioethanol sector to illustrate the type of projects that could be initiated as part of a cereal strategy for western Canada. These are only examples of what our coalition could develop as part of this process.

- Develop a cereal grain to optimize bioethanol production. This grain would have elevated levels of High Total Fermentables (HTF) and produce greater amounts of ethanol per unit of feedstock.

- There may be an opportunity for plant breeders to work with bioethanol producers to develop value added coproducts that can be extracted during the bioethanol distillation process. Projects that fall into this category include, but are not limited to, organic acid by-products such as acetic acid, citric acid and lactic acid, the separation of milled bran prior to fermentation or the secondary processing of DDGS.
- Develop a system to measure total fermentables in cereal grains. When HTF seed is delivered to the bioethanol facility, the producer is paid based on HTF content in the grain. With this technology, there is a direct correlation between the value of the grain delivered and the price paid by the end-user.

Building on these ideas, it may be possible to create a biorefinery approach to the value chain in which value-added products are extracted by a number of commercial partners. One model of the future is presented in Chart 3 (A distiller's view of the value chain – one model of the future).

Chart 3. A distiller's view of the value chain – one model of the future.



Feed grain sector projects

Six specific opportunities are presented for the feed grain sector. Again, these are only examples of what our coalition could initiate as part of a cereal strategy for western Canada.

- Develop a cereal grain to optimize livestock production. These cultivars would have high energy levels, an average minimum protein level of about nine percent, would convert efficiently to protein and would provide for better feed intake. Livestock producers rate net energy (NE) as the most important measure of energy, followed by metabolizable energy (ME) and then digestible energy (DE).
- Invest in genetic research and methodology development for determining the phenotype for digestible energy in feed – building on recent innovations with NIRS technology at FCDC and AAF Lacombe.

- Create a feed grain that contributes positively to animal health – specifically, a feed grain that improves intestinal health, lowers the risk of acidosis in livestock in the beef or dairy industries, or improves intestinal health in hogs.
- Develop feed grains that contribute positively to the environment or provide a social benefit by limiting noxious or greenhouse gas producing emissions, reducing odour levels emitted from livestock facilities, lowered levels of phosphorous compounds excreted from livestock or increase the amount of manure that could be used in crop production systems by lowering phosphorous levels in manure.
- Develop a NIRS assay to identify and quantify traits in whole cereal grains. NIR can be used to determine the value of grain as livestock feed. The feed energy of grain, as an example, could be determined on delivery, providing a direct correlation between the value of the grain delivered and the price paid by the end-user.
- Develop a feed silage cereal cultivar specifically for the beef and dairy industries.

Weaknesses and threats

> *"Some people seem to think there's no trouble just because it hasn't happened yet. If you jump out the window at the 42nd floor and you're still doing fine as you pass the 27th floor, that doesn't mean you don't have a serious problem. I would want to address the problem right now."*
>
> – Charles Munger

Weaknesses

Some of the deficiencies in the plant breeding and cereal development infrastructure that could impede the achievement of a successful and sustainable cereal sector strategy for western Canada include:

- The focus with wheat and barley development primarily on the food sector. This focus is concentrated on the development of export markets for high protein wheat and malt barley – reducing emphasis on the development of cultivars for existing and emerging domestic markets.
- Requirements for KVD that prevent the registration of cultivars with merit in domestic feed and bioethanol markets, among others. The requirement for KVD in CWRS and Canada Western Amber Durum (CWAD) wheat places the full burden for the development of wheat for new markets into other classes of wheat. This creates a drag on the development and introduction of cultivars with a range of agronomic improvements for specific end-use domestic and international markets.
- The definition of "genetically modified" (GM). Where the EU (European Union) defines GM based on the technique used to produce a seed, the Canadian Food Inspection Agency (CFIA) bases its definition on the characteristic of the seed – and disregards the manner in which the seed is produced. The CFIA uses the term "Plant with Novel Trait" (PNT) and defines a PNT as a seed and/or plant characteristic that: "Has been intentionally selected, created or introduced into a distinct, stable population of cultivated seed of the same species through a specific genetic change," and "Based on valid scientific rationale, is not substantially equivalent, in terms of its specific use and safety both for the environment and for human health, to any characteristic of a distinct, stable population of cultivated seed of the same species in Canada, having regard to weediness potential, gene flow, plant pest potential, impact on non-target organisms and impact on biodiversity."
- This definition creates a situation that constrains Canadian development of new crop traits for existing and emerging domestic and global markets, generating an unnecessary competitive disadvantage for the Canadian cereal sector.

- Yield productivity gains have been steady but modest in western Canadian cereals, constrained at least in part by the short length of the growing season compared many international competitors. Estimated gains are from one-half up to two percent per year, whereas inflation, or the cost of production, rises by about two to three percent per year. In comparison, hybrid corn yield in the United States has typically increased about two to three percent per year. High yields from hybrid vigor are not available in the cereal grain crops available to western Canadian producers because no suitable genetic delivery system has been discovered.
- Insufficient screening capacity to evaluate material from the myriad of plant breeding programs in western Canada. In particular, capacity to screen for plant disease resistance in summer disease nurseries as well as the capacity for quality trait evaluation at the Grain Research Laboratory (GRL) of the Canadian Grain Commission (CGC) and in other cereal research centres is insufficient. These limitations negatively influence the number of advanced lines that can be screened pre-Coop. They also limit the number of lines that can be advanced to obligatory Coop trials.
- A cultivar development system with limited ability to respond quickly to emerging market opportunities. The major cereal grades and/or classes and their requirements dominate this system. There is limited opportunity, except through the cumbersome Contract Registration system, to make room for unusual and new cereal types that could be a threat to the integrity of the major types.
- A cumbersome cultivar review system. About 75 individuals, many of whom are competitors, control the process of voting for cultivars brought forward for recommendation. This process hampers the development and advancement of new genetic traits.

Threats

Conditions external to the plant breeding and cereal development infrastructure that could impede the achievement of the objective include:

- The low level of investment in cereal research and development by the private sector challenge the industry's ability to move or respond to new opportunities. Private industry investment may be low because there is no way to capture value from this market.
- A gap between private sector investment in cereal crops and crops such as corn, canola and soybean that continues to widen.
- The level of public funding needed to make progress in cereal breeding programs. With the cost of running a single plant-breeding program at over $1M per year over 10 to 12 years, all cereal checkoff dollars in Alberta would not be sufficient to fund much of an effort.
- The need to separate GM-cereals from "conventional" cereals where the end-product is destined for some export food markets. This is not likely to be the case for exports to the US or most of the developed world. It may be desirable to target North American markets and not segregate cereals at all; then the cereal industry will not be burdened with unnecessary costs.
- Country of origin labeling (COOL) legislation being enacted and applied in the US. This could keep Canadian products derived from Canadian cereals out of the US because of the cost required to keep US and Canadian COOL ingredients and products separated in the US. This could cause the loss of existing markets, including, but not limited to, livestock and livestock products. US enterprises that want access to less expensive Canadian products are not in favor of this legislation.
- Zero tolerance for GM based products in some world markets. This could prevent Canada from taking advantage of a number of technological approaches to plant breeding, especially in cereals.
- Feed grains that contribute positively to animal health or to the environment may not qualify for Canadian registration under current Canadian Food Inspection Agency (CFIA) guidelines.
- The need for livestock that have consumed GM feed ingredients to be excluded from human consumption in some global markets.

- The need to develop value-added opportunities for which there is no existing market or for markets that may develop slowly over a long period.
- Value-added opportunities that may be profitable only if the technology fits into high-value markets.
- Value-added opportunities that may only be developed if a commercial partner is willing to invest in the project and oversee the commercialization of the technology.
- Value-added opportunities that may require strategic public funding directed at building an industry.

Weaknesses and threats specific to feedstock supplies

The US produces almost all of its bioethanol from corn. The 18.2B L (4.8B US gallons) of bioethanol produced annually uses about 16 percent of the US corn crop – and accounts for only three percent of US annual gasoline consumption. If the US used all its annual corn production (10.7B bushels) to make bioethanol, this would only displace about 20 percent of all gasoline consumed.

In 2003, as part of a climate change strategy, the government of Canada initiated the Ethanol Expansion Program (EEP), made a commitment to a renewable content requirement in Canadian transportation fuel and created a federal excise tax exemption for renewable fuels. With these incentives in place, the government of Canada expects bioethanol production will increase to about 2.740M L (2.74 GL) by the end of 2010. Using the Husky Energy Inc. figures for 2006, this equates to 2.73 Mt (million tonnes) of DDGS produced annually in Canada from 7.38 Mt of feedstock. Government of Canada statistics suggest that 2.1 Mt of DDGS will be produced annually from 6.9 Mt of feedstock (4.6 Mt of corn and 2.3 Mt of wheat). Given that Canada produces about 38.8 Mt of wheat, barley, oats and rye annually, (Table 1) bioethanol production in Canada could consume about six percent of these crops by 2010.

Table 1. Tonnes of cereal grain produced annually in Canada*

Crop	Tonnes produced in Canada
Wheat	23,932,000
Barley	11,098,000
Oats	3,464,000
Rye	308,000
Total	**38,802,000**

*Five year average (2002-2006)

Some provinces have instituted road tax exemptions for bioethanol-blended fuels and the provinces of Manitoba, Saskatchewan, and Ontario have mandatory blending rates to encourage increased bioethanol production. With these types of initiatives in place, there is concern that there may be insufficient wheat or cereal feedstocks to meet demand.

To put the quantity of feedstock required into perspective, Alberta's 10-year average for the production of all cereal grains is about 13 Mt (Table 2.) This suggests that the Husky Lloydminster (HL) bioethanol plant alone could consume almost three percent of Alberta's grain production. Five plants in Alberta on scale of the HL facility could consume over 13 percent of the province's grain production per year. With Saskatchewan's 25-year average for the production of all cereal grains at about 18.5 Mt, five HL plants would consume over nine percent of the province's grain production each year. Manitoba's 10-year average production of cereal grains is about 6.2 Mt, so five plants on the scale of the HL plant would consume over 28 percent of the province's grain production each year. Clearly, bioethanol production facilities will require large volumes of suitable grain feedstock – and the province of Saskatchewan is in the best position to supply grain to this industry.

Table 2. Tonnes of grain produced annually in Alberta,* Saskatchewan# and Manitoba^

Crop	Tonnes produced in Alberta	Tonnes produced in Saskatchewan	Tonnes produced in Manitoba
Winter wheat	71,700	129,000	3,366,900
Spring wheat	5,661,700	8,435,500	88,700
Durum wheat	823,700	3,759,200	204,600
All wheat	***6,557,100***	***12,323,700***	***3,660,100***
Oats	814,700	1,427,300	908,200
Barley	5,491,000	4,523,000	1,474,200
Rye	63,500	119,800	64,400
Mixed grains	68,300	20,200	89,298
Triticale	32,900	25,900	-
Total	**13,027,500**	**18,439,900**	6,196,198

* Alberta 10 year average (1995-2004)
# Saskatchewan 25 year average (1982-2006)
^ Manitoba 10 year average (1995-2004)
~ Data not available

The future starts today

"If you always do what you've always done, you'll always get what you've always got."
– Neuro Linguistic Programming adage

This discussion paper was meant to help you start thinking about ways the western Canadian cereals industry must change to meet the challenges and opportunities ahead. Obviously, visionary leadership and committed resources are required to develop and introduce technology in cereals for the development of existing and new markets. One option for the process of technology commercialization is open for consideration in Chart 4 (The process of technology commercialization – page 31). Other options worth exploring, many of them connected and complementary, are noted below. We encourage you to read this section as a call to action.

Commercialization of genetic technology

High-capacity cultivar development and screening

It may be desirable to invest in the creation of a high-capacity cultivar development and screening processes that focus on evolving needs in food, feed and industrial markets. This system could provide rapid plant breeding progress for these market segments. The initiative would be supported by initiatives in the area of market research, market support, regulatory support and research support.

Market research

Market research specialists could work in conjunction with quality analysts to: identify new cereal quality traits; identify new market uses for cereals and determine the suitability of cereals for new markets; and to identify markets for nutraceuticals and other active cereal compounds.

Market development

Market support could include commercial research centers that specialize in bio-fermentation, bio-processing and bio-product development specialty for food product development. This initiative would also include regional pilot scale testing facilities and market tool development, which could include the development of NIRS methodology for the cereal trade.

Regulatory support

Regulatory support for the high-capacity cultivar development and screening program could create a competitive advantage for the western Canadian cereal industry. This proposed new approach to the commercialization of genetic technology would facilitate the acceptance of genetic traits that will give the western Canadian cereal industry a competitive advantage. Regulatory support could include a new approach to cultivar review to allow for rapid and efficient assessment, and registration of new crop cultivars that benefit the western Canadian cereal sector.

Research support

Plant breeders could be supported in three areas of biotechnology: genomics, proteomics and bioinformatics.

The development of successful and sustainable systems

Newly commercialized genetic technologies need continued and sustained support. Successfully supporting new technologies will encourage the introduction of even more innovative means of meeting market needs. The western Canadian cereal sector could develop a competitive advantage over other cereal producing regions by addressing key research and commercialization issues, producer and processor issues combined with the ability to supply high volumes of high quality feedstocks, in a timely manner, to proximate markets. Issues to be addressed include system drivers, production traits, environmental sustainability and technical support for production. A system schematic for consideration is presented in Chart 5 (The development of successful and sustainable systems – page 32).

A sustainable cereal strategy for western Canada would meet consumer needs, address economic realities and consider climate issues.

Essential to our efforts to create a sustainable strategy:

- Cereal feedstock consumers are demanding high quality, low cost feedstock with guaranteed and timely delivery.
- Cereal feedstock producers face ever-increasing costs of production, increasing transportation costs and increased costs associated with supplying cereals to a global market.
- Global warming could limit crop production in the future by increasing the level of risk for producers. A short growing season in western Canada is currently the greatest constraint on increasing crop yields. Even with global warming, however, our growing season remains comparatively short.
- To meet production needs, farmers will need high yield potential in cereal grains. High yield potential may be afforded through the inclusion of traits such as winter hardiness, cold soil performance, nitrogen use efficiency and water use efficiency in western Canada.
- Cereal yields will need to be protected through resistance to diseases, insects and competitiveness with weeds.
- Cereal cultivars with strong straw and those that are easy to harvest and handle will help optimize western Canadian cereal volumes.
- Western Canada may not have the research and development capacity to deliver these traits to cereal producers.
- Low phytate cereals that minimize the amount of P excreted by livestock could allow more manure applied to crop systems.
- Regional cereal varietal trials used to evaluate cultivars could ensure producer access to reliable, unbiased data.

What does a ‘successful’ cereals strategy look like?

In summary, a successful and sustainable strategy for western Canadian cereal sector would address political realities, encourage private sector investment and support, engage and develop consensus among value chain members, create good governance and leadership for the target cereal platforms and put regulatory frameworks in place to achieve the desired outcomes.

The road ahead is long. But it is worth walking.

The drive for change

Key industry players in the livestock, bioethanol and industrial manufacturers sectors have led important discussions about the cereal industry's competitiveness over the last two years. ACIDF and AARI believe these discussions support momentum for increased cereal competitiveness. With that in mind, highlights of some of that work are noted here.

The livestock industry

Various initiatives have probed livestock industry issues. In 2005, the Institute for Food and Agricultural Sciences Alberta (IFASA) developed a feed grain quality and supply program. This was followed by two ACIDF feed summits, the Strategic research priorities for the feed grain supply and quality initiative[1] in June 2005 and the Feed summit[2] in April 2006. These workshops pulled together stakeholders from livestock, crop and feed manufacturing industries and several producer commissions. Alberta Beef has also conducted a study on Competitiveness of the Alberta cattle industry[3] with the support of other livestock sectors. These efforts produced broad support within the livestock, crop and feed manufacturing industries for a comprehensive strategy to improve cereal energy competitiveness.

Bioethanol and industrial manufacturers

A similar dialogue with bioethanol manufacturers and the industrial manufacturing industry established that specific cereal sectors actively drive policy, innovation and investment to strengthen and capture new opportunities for the cereal industry. While business development and genetic advances are a reality for some crops, there is a perceived gap in the area of cereal grains development. For the cereal industry to remain competitive, we need to make significant progress to meet the demand for feedstock and be more competitive in food, feed, health and industrial markets.

Similar crop sector initiatives

Programs like the *Pulse Innovation Project*, *Flax Canada 2015*, *Canola . . . growing great 2015*, and the *Potato Innovation Network 2020* also focus on future needs, opportunities and international and domestic competitiveness in their respective crop sectors. Industry leaders share the view that we need to assess the current situation in cereals and identify strategic initiatives to meet the needs of cereal producers and the existing and emerging value-added industries that cereal grains support. The collective strengths of the cereal industry need to be leveraged to meet today's needs and to position this industry for future success.

[1] Alberta Crop Industry Development Fund. 2005. Strategic research priorities for the feed grain supply and quality initiative – focused discussion workshop – summary report. (http://www.acidf.ca/files/focus/fgsqisummary.pdf.)
[2] Alberta Crop Industry Development Fund. 2006. Feed summit 2006. (http://www.acidf.ca/files/focus/feed2006.pdf)
[3] Informa Economics. 2006. Competitiveness of the Alberta cattle industry. (Summary notes prepared by Andrea Brocklebank and Peggy LeSueur.) (www.albertabeef.org/pdf/Competitiveness%20Study%20Shorter%20Summary.pdf)

Chart 1. Global trends and markets

Global trends

Market demand

- Functional foods, specialty food products and a broader range of food products derived from cereals.
- Cereal grain energy – based on greater global demand for meat-based protein and bioethanol production.

Producer and processor issues

- Increasingly costly to supply cereals globally, coupled with greater domestic demand for a commodity that is traditionally exported.
- Increasing pressure to supply high quality, low cost cereals in a timely manner.
- Public pressure to reduce the intensity of agricultural operations.
- W Canada's competitive advantage in cereal quality is being eroded by a convergence of crop platform and food processing technologies.

Research and commercialization issues

- W Canadian cereal industry will be put at a competitive disadvantage as competitors develop new core technologies and identity preserved traits.
- W Canada's competitive advantage in cereal quality is being eroded due to improvements in germplasm in countries outside of the G8.

Market

Market	Food	Feed	Industrial
Need	▪ Functional ingredients ▪ Nutritional functionality	▪ Efficient conversion to meat, milk, eggs	▪ Functional feedstock
Cereal feedstock can provide	▪ Amino acids ▪ Energy ▪ Protein (gluten) ▪ Starch ▪ Enzymes ▪ Fibre (bran) ▪ Pigments ▪ Flavenoids (phytoestrogens) ▪ Lipids (Fats and oils) ▪ Phenolic acids ▪ Phytoalexins (avenanthramide) ▪ Polysaccharides (beta-glucans) ▪ Vitamins (tocopherol, tocotrienol)	▪ Amino acids ▪ Energy ▪ Protein ▪ Starch	▪ Energy ▪ Protein ▪ Starch ▪ Enzymes ▪ Fibre ▪ Pigments ▪ Fatty acids ▪ Gums ▪ Hetero /polysaccharides ▪ (Hemi) cellulose ▪ Lectins ▪ Organic acids/aldehydes ▪ (Phospho) lipids ▪ (Poly) phenols ▪ Sugar/sugar alcohols
Crop platform	***Crop*** — ***Functionality*** ▪ Barley (malt) — Protein, diastatic power ▪ Oat (food) — Beta-glucans, fat, fibre ▪ Wheat (semolina) — Protein/gluten, pigment ▪ Wheat (milling) — High protein	***Crop*** ▪ Barley (hulled, hulless) ▪ Oat (hulled, hulless) ▪ Triticale (spring/winter) ▪ Wheat (CPS, CWGP, CWRS, soft white, spring/winter)	***Crop*** ▪ Barley (hulled and hulless) ▪ Oat (hulled, hulless) ▪ Triticale (spring/winter) ▪ Wheat (CPS, CWGP, CWRS, soft white, spring/winter)

Chart 4. The process of technology commercialization

Meshing market needs with global trends – Cereal feedstocks will provide: functional food ingredients; nutritional functionality; efficient feed conversion to meat, milk and eggs; and functional industrial feedstocks to high-value and proximate markets. Cereal feedstocks will consist of high quality product that will be delivered to the customer in a timely manner.

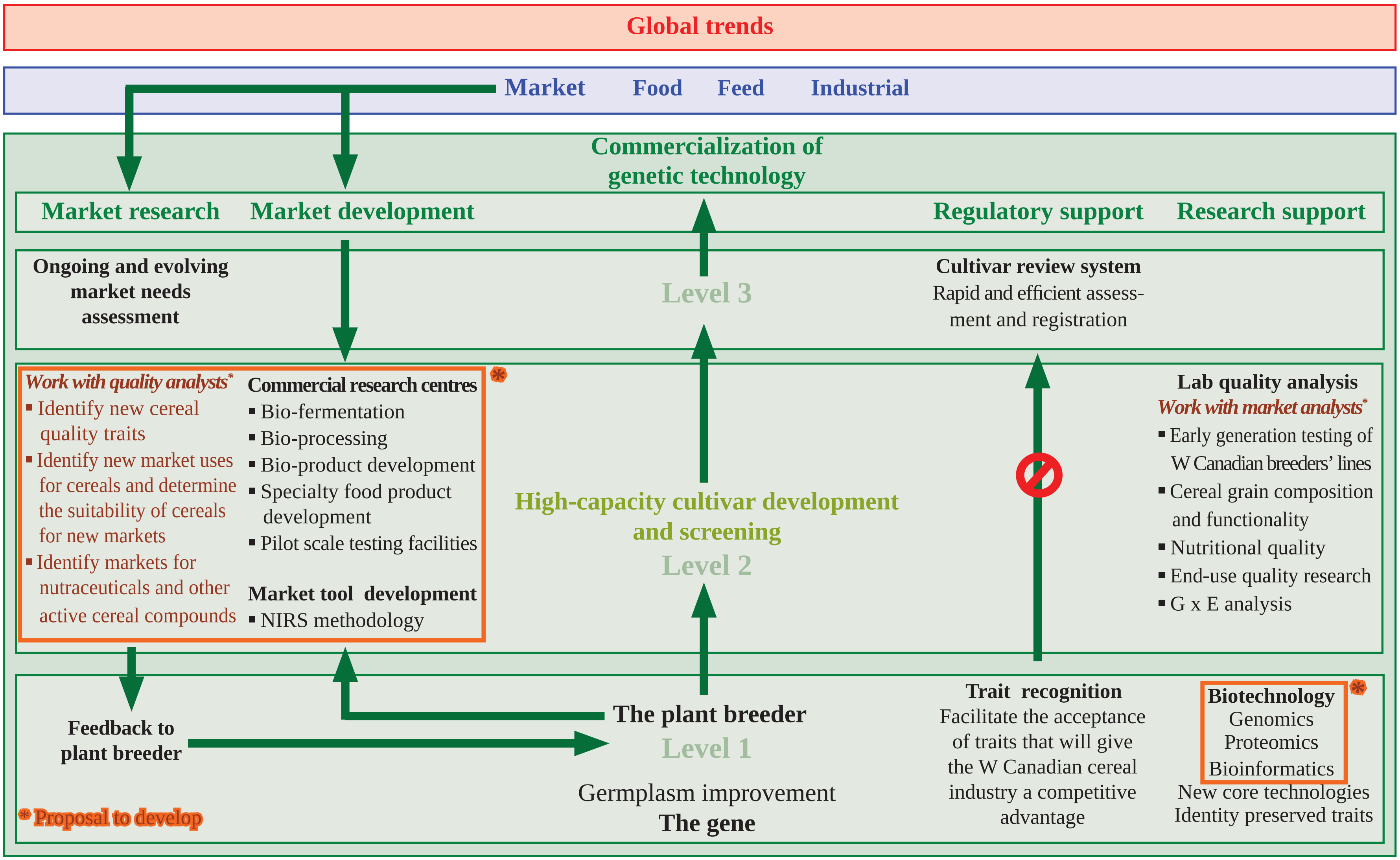


Chart 5. The development of successful and sustainable systems

Supporting success – Newly commercialized genetic technologies need continued and sustained support. Successfully supporting new technologies will encourage the introduction of even more innovative means of meeting market needs. The western Canadian cereal sector will find itself with a competitive advantage over other cereal producing regions by addressing key research and commercialization issues, producer and processor issues combined with the ability to supply high volumes of high quality feedstocks, in a timely manner, to proximate markets.

Global trends

Market **Food** **Feed** **Industrial**

Commercialization of genetic technology

Successful and sustainable systems

System drivers | **Production traits** | **Environmental sustainability** | **Technical support** | **Markets**

System drivers

Consumer needs
High quality feedstock
Low cost feedstock
Timely, assured delivery of feedstock

Economic reality
Increasing cost of production
Increasing cost of transportation
Increasing cost of supplying globally

Climate issues
Global warming
Short growing season

Production traits

High yield potential
N and water-use efficient
Drought and cold soil tolerant
Winter growth habit

Yield protection
Resistance to diseases, insects and weeds

Agronomic traits
Strong straw, ease of harvest and handling

Environmental sustainability

High N use crops
Increase N uptake
Reduce impact of manure applications

Low phytate levels
Less P excreted by livestock
More manure applied to crop systems

The plant breeder
Germplasm improvement
The gene

Technical support

Technical development and support
Regional cereal varietal trials will be used to evaluate cultivars – ensuring producer access to reliable, unbiased information