

LINKING GENOMICS RESEARCH AND INDUSTRY APPLICATION



Annual Report 2017

GENTEC AT A GLANCE

\$60 million – Total Active Funding
59 – Active Projects
12 – Principal Investigators
23 – Graduate Students
13 – Postdoctoral Fellows
7 – Research Associates
>20 – Academic Partners
>80 – Industry Partners
>25 – Government Partners
>550 – Active Gentec Network Partners
>60 – Peer-Reviewed Publications in 2017
390 – Peer-Reviewed Publications since 2010
2 – Laboratories (Research and Service)
3 – Research Ranch Stations

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2017 Highlights

A year of achievements and progress towards our strategic priorities and operational goals.

FINANCIAL AND PROGRAM HIGHLIGHTS

\$0.5M

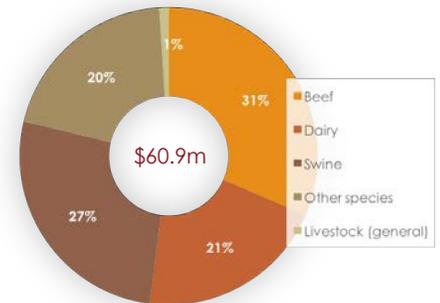
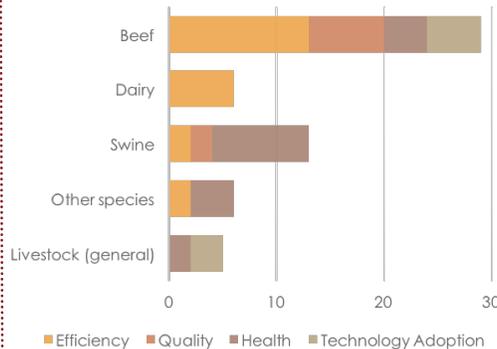
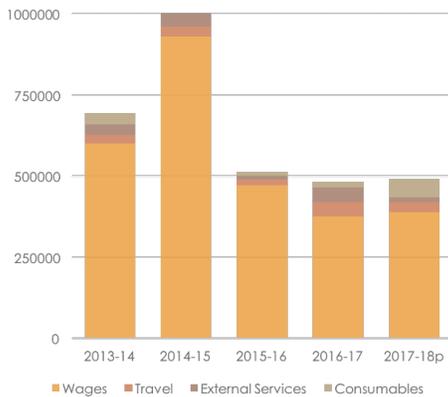
- Gentec operational funding, provided by Alberta Innovates, was allocated to wages, travel, external consultations services, and consumables.

59 PROJECTS

- There were 59 active projects in 2017, split between 6 species and a general 'livestock category', all fitting within our strategic priorities.

\$60.9M

- The 59 active projects represented more than \$60 million in total project funding, with the majority being allocated to beef and swine projects.



OPERATIONAL HIGHLIGHTS

Continued research program success.

- 19 new projects, representing \$7.25m in total funding and 12% of total active projects, were added to the project portfolio in 2017.
- Projects in various major Canadian agricultural industries, including beef, swine, dairy, poultry, sheep, and livestock (general) were successfully funded in 2017.
- More than 50 Highly Qualified Personnel trained in the past 5 years, with more than half in industry positions.

Gentec technology transfer success.

- Approximately one-third of total project funding contributed by industry stakeholders.
- New collaborations Provincial Forage Associations led to record participation at the annual Field Day in Lacombe.
- 'One Health One Genome' theme at LGC2017 widened the scope and allowed for expanded participation in human, pet, and flora fields.
- Commercial beef adoption of genomics accelerating as a result of newly commercialized EnVigour HX™.

Executive Summary

A YEAR OF STRATEGIC PROGRESS

Gentec core funding investment of just over \$5 million over 10 years has been leveraged to more than \$100 million invested in genomic projects, including an estimated \$20 million in industry contributions.

The past 10 years have also seen industry advancements including a 30% increased rate of genetic gain in the Canadian dairy industry. Canada is increasingly a recognized leader in genetic exports with 74%, 44%, and 71% increases in export value for dairy semen, beef semen, and breeding swine, respectively, from 2008 to 2016.

2017 was another good year of strategic progress for Livestock Gentec. An additional 19 projects were added to the portfolio, with 16 being completed. There were 59 active projects in 2017, with total project funding of the active projects valued at approximately \$60 million.

We have added more HQPs, both in training and transitioned to new roles as researchers and industry representatives. Our researchers, staff, and HQP are essential to our program success. We look for individuals who are inspired to make a difference in the livestock industry through applied research. Our group is made up of more than 60 people who have a passion for the agricultural industry.

During 2017, progress in our strategic priorities included:

INCREASING RESEARCH APPLICATIONS

A big theme of 2017 was to extend our current knowledge to multiple applications and species to bring increased benefit to our strategic priorities of efficiency, quality, health, and industry application.

RESULTS FOR INDUSTRY ADVANCEMENT

The first genomics tool developed specifically for the commercial beef industry was introduced and more than 1500 tests have been ordered within a year of the launch.

DIVERSIFYING OUR RESEARCH REACH

In 2017, researchers at Gentec extended their expertise to additional species and applications, including adding flora species.

PRIORITIES FOR 2018

2018 will bring new opportunities to build on our successes in 2017. The aim for 2018 will be to bring new partnerships for enhancing industry adoption of genomics solutions in livestock production.



Progress on the strategic goals include a new product for assessing measures of lifetime productivity in commercial beef, pen-side kit development for pregnancy diagnosis in sheep, and prediction of resilient pigs related to improved time to market. The Hays Converter (the first Canadian beef breed) nucleus herd was moved to Kinsella in Fall 2017, representing a unique opportunity to ensure the preservation of genetic diversity while also exploring synthetic breeds to maximize breed complementarity.

INCREASING OUR HORIZONS

Our Progress

We're continuing to build our position as the leader in livestock genomics research and application. We've made great progress in efficiency research this year and are building on our progress in health initiatives. Our events in 2017 saw increased attendance from a more diverse background and we're becoming more involved in poultry and bison research as we go forward, while continuing to build on our successes in beef, dairy, and swine.

Our People

We are extremely fortunate at Gentec as not only is our group made up of a world-class group of researchers and management advisory representatives, but we also collaborate with world-renowned individuals and organizations to help meet our objectives. Our funding agencies and our industry stakeholders have placed a great deal of trust in our people to deliver on our research goals, and I can say without a doubt that they are worthy of such esteem.

Linking our Strategy and our Performance

2017 saw good progress towards our goals of improving livestock production efficiency, animal health, selection for high quality carcass traits, and increased knowledge transfer on the use of genomics in livestock breeding and production among industry. These initiatives, in parallel, are moving us towards our purpose of improving the competitiveness and sustainability of Canadian agriculture and ultimately helping to feed the world.

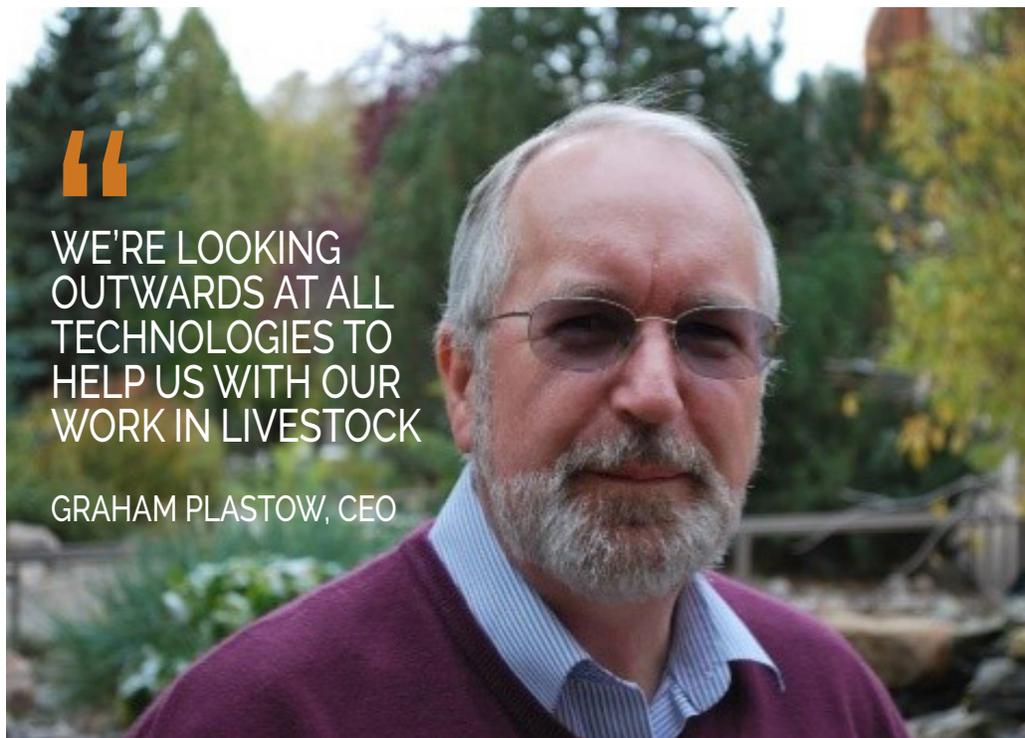
The Outlook

In 2018 we will continue to look outwards and expand our horizons by looking at different approaches to improve livestock. This will mean incorporating new technologies popular in human health and diagnostics techniques. This might include such technologies as wearables in collecting valuable phenotypes on disease and efficiency. Focus areas will include anti-microbial resistance, personalized health and nutrition, and extending our translation reach.



WE'RE LOOKING
OUTWARDS AT ALL
TECHNOLOGIES TO
HELP US WITH OUR
WORK IN LIVESTOCK

GRAHAM PLASTOW, CEO



Mission, Vision, Values

TO BE THE WORLD LEADER IN LIVESTOCK GENOMICS RESEARCH AND APPLICATION

OUR VISION

OUR MISSION

OUR VALUES

TRUST

A vital part of our success is due to the numerous partnerships between the research community and the livestock industry. Trust is an essential component in building these relationships with our stakeholders.

EXCELLENCE

By creating an environment that values excellence we maintain our world-class recognition, including excellence in research and excellence in services provided for the industry.

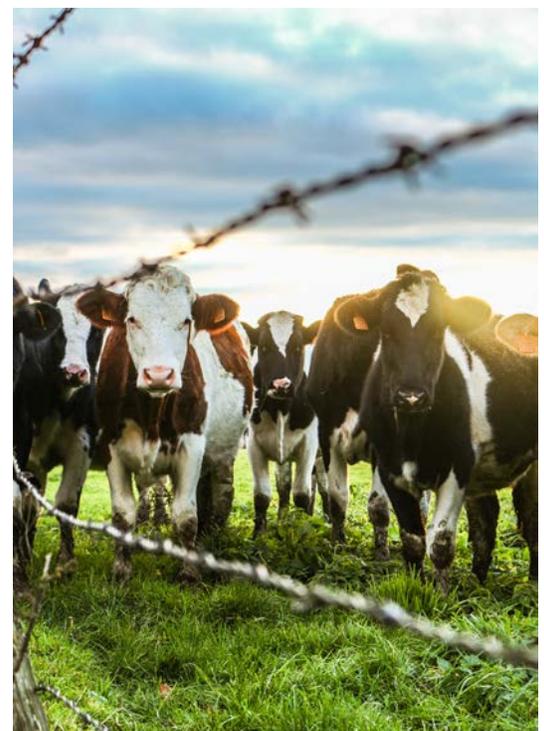
LEARNING

Genomics technologies are rapidly evolving and new solutions are constantly being introduced into the industry. To keep ahead of the trend a culture of continuous learning is promoted throughout our organization.

LEADERSHIP

We value leadership. This means being recognized as a world leader in the livestock industry and developing leaders. Investment in tomorrow's leaders means we maximize our resources today and maintain our successes going forward.

To provide genetic solutions and technologies, through training, leadership, and collaboration, that will improve the sustainability and competitiveness of the Canadian livestock industry.



Strategic Priorities Overview

WHAT WE DO

At Livestock Gentec we are continuously working to ensure that the future genomic needs of the livestock industry are effectively met. To be competitive in today's industry, livestock producers must seek new and innovative methods and technologies to reduce production costs, improve environmental sustainability of production, ensure the health and wellness of their livestock, and provide a product that meets the needs of the consumer.

Research at Livestock Gentec is leading edge in the discovery of genetic and genomic tools that can then be linked into production tools for the economic benefit of livestock producers.

HOW WE DO IT

Our research involves increasing efficiencies at the production level, increasing quality and food safety at the consumption level, enhancing animal health and welfare of Canadian livestock, and ensuring there is a route of application for producers to access and adopt genomics on their livestock operation.

THE FOUR STRATEGIC GOALS OF LIVESTOCK GENTEC INCLUDE EFFICIENCY, QUALITY, ANIMAL HEALTH, AND TECHNOLOGY ADOPTION.



GOAL 1: IMPROVE PRODUCTION EFFICIENCY AND REDUCE EMISSIONS

Target: Develop feed efficiency and emission selection tools with moderate accuracy that are validated in both purebred and commercial populations.

GOAL 3: IMPROVE ANIMAL HEALTH

Target: Develop diagnostic and genomics based tools with low-moderate accuracy to identify livestock with enhanced immune response.

GOAL 2: IMPROVE CARCASS TRAITS AND MEAT QUALITY

Target: Develop carcass quality selection tools with moderate accuracy for tenderness, marbling, yield, and other attributes.

GOAL 4: INCREASED INDUSTRY APPLICATION OF GENOMICS RESEARCH

Target: Genetic selection tools being used directly or indirectly by the majority of producers in the Canadian livestock industry.

Management, Faculty, and Partners

2017 Management Advisory Board Members

Steve Morgan Jones	Amaethon Agricultural Solutions Inc.
Stan Blade	University of Alberta
John Brown	Alberta Economic Development and Trade
Stewart Cressman	Swine Innovation Porc
Jay Cross	University of Calgary
Jamie Curran	Alberta Agriculture and Forestry
Francois Eudes	Agriculture and Agri-Food Canada
Cornelia Kreplin	Alberta Innovates
Fred Lozeman	Industry
Graham Plastow	Livestock Gentec
Brian Van Doormaal	Canadian Dairy Network
David Andrews	Independent (non-voting)
David Bailey	Genome Alberta (non-voting)
Kirk Rockwell	Alberta Innovates (non-voting)

Selected Canadian Partnerships

Agriculture and Agri-Food Canada
 AgSights
 Alberta Agriculture and Forestry
 Alberta Innovates
 Beef Cattle Research Council
 Beefbooster
 Beef InfoXchange System
 Canadian Beef Breeds Council
 Canadian Dairy Network
 Delta Genomics
 Fast Genetics
 Genesus Inc.
 Genome Canada and Alberta
 GrowSafe Systems
 PigGen Canada
 Semex Alliance
 VIDO-InterVac



Gentec Management

Graham Plastow	Chief Executive Officer
John Basarab	Beef Research Advancement
Leluo Guan	Scientific Advancement
Clinton Brons	Business Development
John Crowley	Industry Advancement
Mary De Pauw	Project Manager
Kelly Elkow	Office Manager
Dawn Trautman	Knowledge Translation

Core Faculty & Principal Investigators

John Basarab	Alberta Agriculture and Forestry
Heather Bruce	University of Alberta
Michael Dyck	University of Alberta
Carolyn Fitzsimmons	Agriculture and Agri-Food Canada
Ellen Goddard	University of Alberta
Leluo Guan	University of Alberta
Changxi Li	Agriculture and Agri-Food Canada
Graham Plastow	University of Alberta
Paul Stothard	University of Alberta
Zhiquan Wang	University of Alberta
Ben Willing	University of Alberta
Rong-Cai Yang	University of Alberta

Selected International Partnerships

AbacusBio NZ
 DSM
 Hypor
 Igenity
 Iowa State University
 Neogen Inc.
 AgResearch NZ
 PIC International
 Roslin Institute
 Scotland's Rural College (SRUC)
 Teagasc (Irish Ag & Food Dev. Authority)
 Topigs
 USDA
 University of Queensland

MARKET OVERVIEW



On-farm trends

Farms are increasingly consolidating in Canada and globally. There are fewer farms, with a larger average number of animals. In terms of sustainable production, larger farms are often more efficient and be early adopters of new technologies. This is resulting in more 'high tech herds' and elite breeding programs in developed countries, particularly in dairy and swine production. As there are fewer sources of genetics there is a greater need for research at academic institutions to manage potential bottlenecks in livestock genetics.

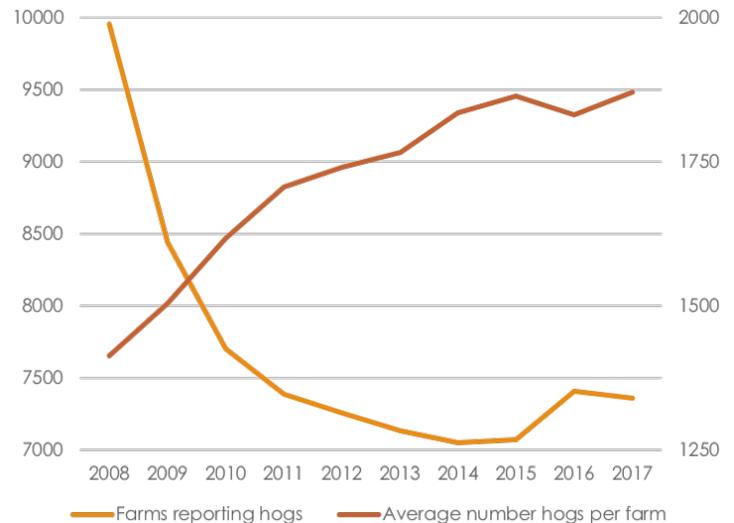
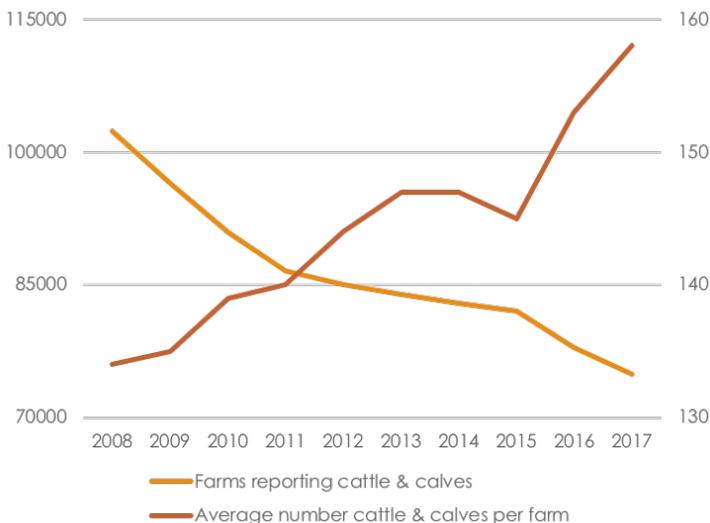
With a growing global population there are greater constraints on resources for livestock production, including water, land, and energy. While livestock in developed countries are more efficiently finished, it is achieved through a high energy diet, requiring feed grains. Impacts from climate change indicate the potential for reduced arable land for crop production.

The increasing competition for resources is driving the need for sustainable livestock production. Technologies, including genomics, gene editing, and sexing will contribute to the already increasingly efficient livestock production practices in developed countries.



New technologies to monitor animal health and behaviour are expected to become more mainstream, even in extensive production systems, as the cost of the technology decreases and the potential for individualized animal feeding and health assessment becomes possible and economically feasible.

There is a big data opportunity to capitalize on in genomics and monitoring technologies in agriculture; this includes fitting all the components together for a more efficient livestock industry with a lower environmental footprint.



Consumer trends

Increased consumer awareness is driving demand for both different shopping experiences and different types of products. Growing consumer awareness is driving demand for high quality products, produced with sustainable practices, and with human and animal health at the top of mind for many consumers (e.g., fewer drugs administered with more regulatory oversight). Climate initiatives to reduce meat consumption are more and more prevalent in both developed and developing countries.

The global population is growing and becoming more urban. As more people move to cities, they also move into the middle class and demand for animal based proteins increases. By 2050 it is expected that meat production will need to double to meet the growing demand in developing countries. For instance, China consumes 20% of global meat produced, however only about 2% of Canada's beef is exported to China.

There have been increasing household income shifts, and as households earn more, their spending tends to shift to more luxury spending. A result of this trend in terms of consumption of livestock products may be continued overall sector growth, but more growth in specialty and luxury food items.

Cultural and generational influences are creating fragmentation of tastes - an opportunity for market diversification, but with challenges for the traditional value animal protein market.

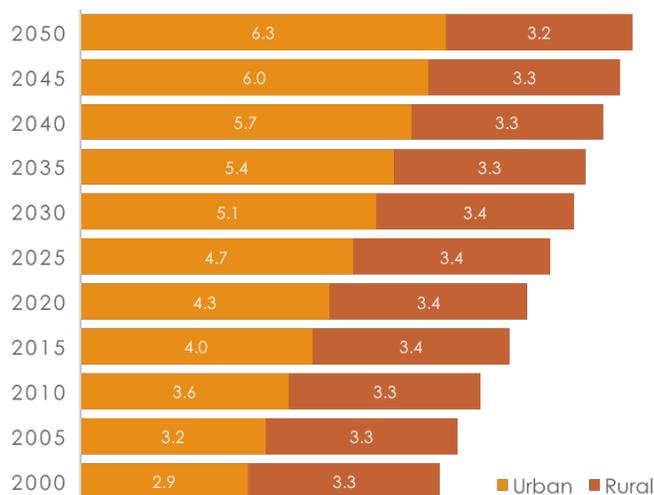
In developed markets growth drivers include health, nutrition, and sustainability. As incomes rise, 'better for you foods' are replacing traditional 'feel-good' junk foods. Related to this transition is a shift to more plant based foods, including plant based meat, marketed as 'clean meat'.

There is increased online retail growth with contactless shopping (e.g., Amazon Go) and direct to consumer retail. This emphasis on the consumer is expected to increase as the millennial consumer values experiences and social shopping, and well as increased demand for value and choice of products.

Emerging markets continue to look more like the traditional agri-food market where population and general demand for food are growth drivers. Meat consumption is growing 3% per annum in these markets, and emerging economies will see the greatest shift to the middle class over the next decades.



**GLOBAL POPULATION GROWTH 2000-2050P
(BILLIONS)**



Source: United Nations, Economic and Social Affairs (2014)

FEATURED PROJECT AND PROGRAMME OUTCOMES

2015 MARKED THE START OF THREE LARGE SCALE GENOMICS PROJECTS AT LIVESTOCK GENTEC. THE NEXT THREE PAGES WILL EXAMINE PROGRESS TO DATE, FOLLOWED BY AN ILLUSTRATION OF KEY INITIATIVES IN LEADERSHIP TRAINING, EDUCATION, AND COLLABORATION.

SUSTAINABLE BEEF

Provide genomic tools that perform in commercial beef for economically important efficiency and carcass traits.

HEALTHY PIGS

Using genomics to improve disease resilience and sustainability in pork production.

EFFICIENT DAIRY

Provide cost-effective, genomic-based methods to select for improved feed efficiency and lower methane emissions in the dairy industry.

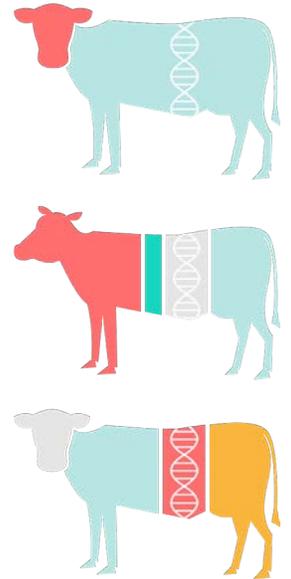
LEADERSHIP TRAINING, EDUCATION, AND COLLABORATION

Facilitate improved adoption of genomics technologies, through training the next generation of leaders in academia, government, and industry.

Sustainable Beef

Funded by Genome Alberta in 2015, the project, *Genomically Enhanced EPDs for Commercial Beef* seeks to bring the benefits of genomics to the commercial cattle industry. This Alberta-led project has in-kind funding from international (Teagasc: Agriculture and Food Development Authority, Ireland) and national sources, includes researchers from Alberta and Ontario, and industry members from across Canada.

Genomics provides opportunity to impact livestock production performance at every step in the beef value chain, and this project was created to help the commercial beef industry respond to new challenges, be more sustainable, and help feed a growing population.



WHY NOW?



Fewer producers



Sustainability concerns of beef



Globally, increased protein demand



Proven benefits of genomics in livestock breeding



Less systematic cross-breeding



Challenges in translating benefits to crossbred herds

RESULTS TO DATE

EnVigourHX™:

- The first genomics tool for crossbred beef cattle in the World.
- The service combines parentage verification, genomic breed composition, and a Vigour Score (assessment of hybrid vigour) to develop an optimized crossbreeding strategy for producers.
- Commercialized by project partner, Delta Genomics.

Preliminary results suggest that the benefits of measuring breed composition and managing hybrid vigour include:

- Improved mating and culling decisions.
- Refined branding programs.
- Improved accuracy in genetic selection.
- LCA of GHG emissions from low vs. high vigour: estimated difference 639 kg CO₂e/animal slaughtered approximately = \$19 at \$30/tonne.
- Nationally: 375,732t CO₂e/year ~ = \$11 million per year.



Healthy Pigs

Funded by Genome Canada in 2015, the *Application of Genomics to Improve Disease Resilience and Sustainability in Pork Production* is a large international research project. This project is led by Dr. Michael Dyck (University of Alberta), Dr. John Harding (University of Saskatchewan), and Dr. Bob Kemp (PigGen Canada) and has industry support from 7 major swine genetics companies and academic support from 6 major research institutions.

The overall objective of the project is to develop genomics tools that Canadian pig breeders and producers can use to: a) select for pigs that are more genetically resilient to disease; and b) manage the nutritional content of pig feed to optimize the gut microbiome. Such pigs stay healthier, grow more and have more successful litters.

One facet of the research developed a natural disease challenge model to investigate how and why some pigs continue to perform well under substantial pathogen exposure, while other succumb to disease. The challenge model provides the opportunity to delve deeper into exploiting the genetics of disease resilience with the ultimate goal of providing alternative strategies to control disease on commercial pig operations, and reduce the reliance on antibiotics.



Our idea is that if we can select more for general resilience, it will have greater advantages for the industry by reducing disease treatment costs and lowering the incidence of reduced performance.

Bob Kemp
Project Co-Lead



Veterinarians always wonder why 'pig A' got sick while 'pig B' is healthy. If, instead of wondering, we can screen for an underlying genetic predisposition and do something about it, we can really focus on prevention instead of just treatment, and that's powerful.

Dr. John Harding
Project Co-Lead



UNIVERSITY OF
SASKATCHEWAN



If a blood sample tells a producer that certain pigs won't fare well against diseases, they may be able to arrange vaccinations or other treatment to prevent those animals from getting sick. Giving individual preventive treatment based on test outcomes is a prime example of precision farming at work.

Dr. Jack Dekkers
Project Co-Investigator

IOWA STATE
UNIVERSITY



With the growing concern worldwide about antibiotic resistance, we must reduce our reliance on antibiotics. If we can do that through breeding strategies and best management practices that include biosecurity, vaccination and enhanced resilience, the public gets the product they demand and producers, processors and retailers all benefit by meeting that demand.

Stewart Cressman
Board Chair



Swine Innovation Porc



Efficient Dairy

Funded by Genome Canada in 2015, the *Efficient Dairy Genome Project* (EDGP) is a large international research project. This Canadian-led project has in-kind funding from international and national sources and includes 30 outstanding researchers from Canada, Australia, Denmark, France, Switzerland, the United States and the United Kingdom.



The overall objectives are to improve feed efficiency and reduce methane emissions in dairy cattle using genomics.



Preliminary estimates from the project show that breeding animals with increased feed efficiency and reduced methane emissions can reduce feed costs by \$108 per cow per year and decrease methane emissions by an estimated 11-26%.

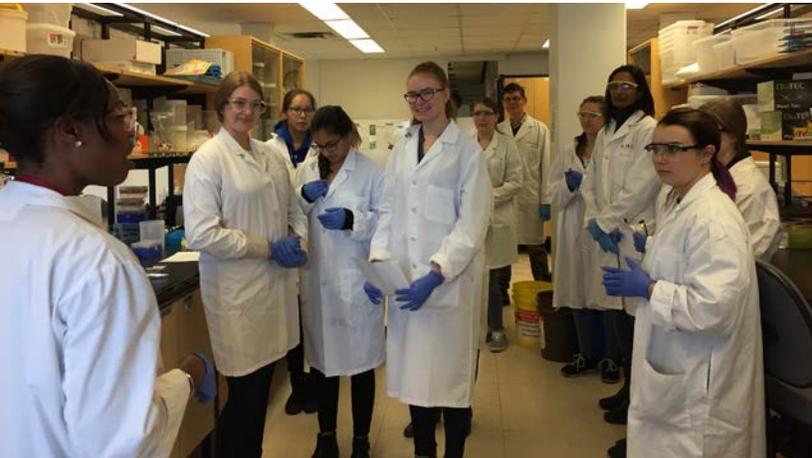
The benefit of selecting for these two traits for the Canadian dairy industry is estimated to be \$108 million each year!



Excellence in Leadership Training, Education, and Collaboration

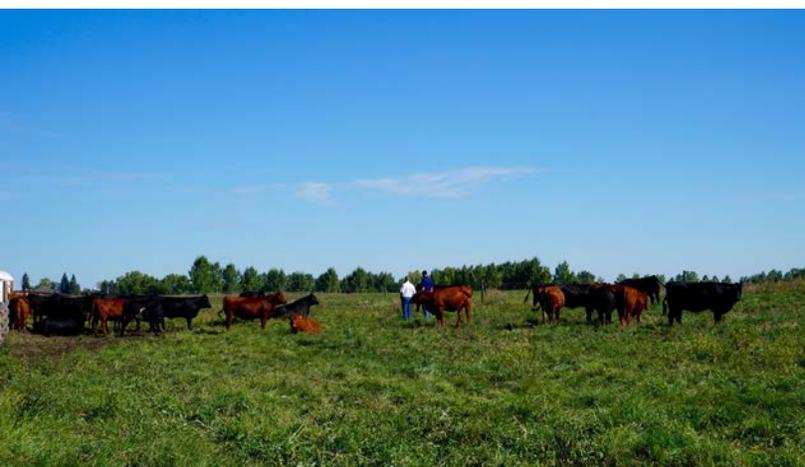
At Livestock Gentec we focus on training the leaders of genomics research and application for tomorrow. We have a strong team of scientists who are dedicated to training masters, doctoral, and even undergraduate students. Our students, research fellows, and staff hail from more than 20 different countries; it is this diversity that contributes to the creativity of our team to develop new approaches to solve production problems for the industry.

Our go-to question for the industry remains, 'what keeps you up at night?' It's this reminder that our results are only useful if they can be quickly and effectively adopted in industry.



Our scientists and staff organize and take part in many outreach, research, and public engagement events, including 4H Canada, Discovery Days in Health Sciences, the Classroom Agriculture Program, and Senior Animal Science Capstone projects. The sustainability and success of the industry is in the hands of these future leaders, and at Gentec we consider it a privilege to share our knowledge to these groups using our platform of expertise, which is made up of our people.

2017 marked the 8th Annual Livestock Gentec Conference, held in Edmonton, AB on October 17th & 18th. The 2017 theme was "One Genome One Health: Our Animals, The Environment and Us". The conference goal to extend knowledge from various fields to agriculture reached more than 150 delegates from industry, academia, and government. The producer session focused on new efficiency technologies available for the commercial sector. The main program considered various applications, from the impacts from the microbiome to the use precision medicine in animal agriculture.



2017 marked our 4th annual summer field day, the "Cow-Forage Gentec Tour", where we co-hosted with Agriculture and Agri-Food Canada and Alberta Agriculture at the Lacombe Research Centre. Attendees ranged from producers, academics, and students, to individuals from government and non-profit organizations as well as agriculture-related exhibitors. With nearly 200 people in attendance, the day was a resounding success in sharing research.



STRATEGIC PRIORITIES AND PERFORMANCE OUTCOMES

At Livestock Gentec we aim to deliver research, development, and technology results that are demanded by the industry. The needs of the livestock industry are diverse, and as such our program targets a range of strategic outcomes.

Livestock Gentec is helping the livestock industry improve its competitiveness and sustainability through the research and application of genomic solutions in efficiency, carcass and meat quality, animal health, and knowledge translation.

We pursue innovative research solutions that contribute to a more efficient production system, including reducing atmospheric emissions from livestock, while also improving feed conversion and efficiency.

The end consumer ultimately drives the demand for the product. We continue to explore research to ensure a positive eating experience for the consumer, combined with carcass traits that benefit the producer.

Healthy animals make healthy people and ensure a healthy planet. Our health research initiatives improve animal welfare, reduce health costs for producers, and reduce risks associated with antimicrobial resistance in livestock production.

Our strategic priorities help guide our mandate of delivering genetic solutions and technologies to improve the sustainability and competitiveness of the Canadian livestock industry.

Priority Goal 1: Improve Production Efficiency in Livestock

What does success look like?

Developing and validating genetic feed efficiency selection tools for purebred and commercial producers.

How do we measure this success?

Tracking the research and adoption of feed efficiency traits and indices.

Our progress:

- Adoption of EnVigour HX™ - first genomics tool for commercial beef populations. More than 1500 non-research tests have been ordered in 2017.
- Patent Application: Single nucleotide polymorphisms and feeding efficiency in cattle. US62/574,925 Oct 20, 2017 (Plastow, Abo-Ismael).

What does success look like?

Identifying breeding strategies for reduced methane yield in livestock production.

How do we measure this success?

Validated changes in methane emissions from baseline herds; incorporation of genes correlated with low-emitting livestock into selection indices.

Our progress:

- Current dairy selection program is reducing the emissions intensity of the Canadian dairy industry by 1% per annum.
- Work at Kinsella is currently supported by work on adding methane emissions to the breeding values and sampling for the international FAANG (Functional Analysis of Animal Genomes).

What does success look like?

Improving lifetime productivity measures for breeding selection purposes in livestock production.

How do we measure this success?

New tools available to the industry for improved lifetime productivity selection.

Our progress:

- Incorporation of genomic hybrid vigour in commercial beef selection indices as an indicator of lifetime productivity.
- Validated improved accuracy in diagnosing pregnancy and predicting litter size at early ewe gestation; metabolomics analyses for pen side kit development underway.



Projects related to achieving this goal:

In 2017, there were 28 active projects with efficiency objectives; 17 in beef, 6 in dairy, 3 in swine, and 2 in sheep research. Of significance are the Genome Canada and Alberta beef and dairy projects, methane emissions from beef cattle bred for low RFI, identifying and validating genomic and fecal microbiome markers for low methane emissions in beef cattle, genetic analyses of feed intake, feed efficiency, female fertility, and cow lifetime productivity in beef cattle, and improved accuracy in diagnosing pregnancy at early ewe gestation using pen side kits.

Priority Goal 2: Improve Carcass Traits and Meat Quality

What does success look like?

Developing and validating genetic carcass quality selection tools for purebred and commercial producers.

What does success look like?

Industry interest in fatty acid composition due to genetic differences.

What does success look like?

Industry and consumer interest in functional health profiles of meat due to genetic differences.

How do we measure this success?

Tracking the research and adoption of carcass traits and indices.

Our progress:

Carcass information from Cargill and additional partners are being incorporated in selection indices, both as an 'all-around' selection and for a terminal beef selection index.

How do we measure this success?

Validation of the correlation of fatty acids, carcass merit, meat tenderness, and gene interaction in beef. Inclusion of the information in breeding objectives and selection indices.

Our progress:

Genetic correlations suggest that contents of some fatty acids in beef tissue and carcass merit and meat tenderness traits are influenced by a subset of the same genes in beef cattle. Due to some antagonistic genetic correlations, multiple-trait economic indexes are recommended when fatty acid composition, carcass merit, and meat tenderness traits are included in the breeding objective.

How do we measure this success?

Validated research results on genetic differences related to diet in carcass quality and fatty acid composition.

Our progress:

Feeding extruded flaxseed as a separate even was more effective at enhancing deposition of beneficial fatty acids (e.g., ALA, VA, RA and CLnA) in beef, as compared to combination feeding of flaxseed with a typical low-medium energy diet (i.e., hay). This shows similar nutritional benefits as grass-fed beef, without sacrificing the efficiency of high-energy diet finishing.

Projects related to achieving this goal:

In 2017, there were 10 active projects with quality objectives; 8 in beef 2 in swine research. Of note are the Kinsella project, the validation of gEPDs that perform in commercial beef, the identification of functional SNPs to enhance prediction accuracy of carcass merit traits, and the relationship among rumen microbial lipid metabolism, meat beneficial fatty acids, and meat quality in beef cattle.



Priority Goal 3: Improve Animal Health

What does success look like?

Develop diagnostic and genomics based tools to identify livestock with enhanced immune response.

How do we measure this success?

Industry interest and adoption of genomic tools to identify livestock with enhanced immune response and immune function.

Our progress:

- Porcine blood counts show the potential to predict resilient pigs with an accuracy of ~65%, which translates to 2 days faster to market ready.
- Compositional changes in microbial populations might be associated with variations in host mucosal innate immune function. Supplementing young livestock with nutritional concentrates could enhance lifetime host health.
- Continued research in 2018 on the effect of environmental enrichment on immune response and measures of disease resilience and welfare in pigs.

What does success look like?

Test new technologies for early disease detection.

How do we measure this success?

Test and control herds for disease detection.

Our progress:

- Validated use of infra-red thermography for early disease detection (e.g., up to 24 hours prior to changes in feeding behaviour) in pigs.
- Novel uses of wearables technologies (e.g., GPS collars and pedometers) for early detection in beef, dairy, swine, to be a focus in 2018.

What does success look like?

Gene expression related to health status as an early indicator.

How do we measure this success?

Comparative transcriptomic analysis of expressed genes related to health status.

Our progress:

- 246 differentially expressed genes were identified to be specific to sick pigs.
- Results suggest a subset of novel marker genes that may be useful candidate genes in the evaluation and prediction of health status in pigs under commercial production conditions.



Projects related to achieving this goal:

In 2017, there were 19 active projects with health objectives; 4 in beef, 9 in swine, 3 in poultry, 1 in cervids, and 2 in general livestock research. Of importance to this goal are the 2015 Genome Canada healthy and resilient pigs project, control approaches to bovine respiratory disease, beef longevity prediction, vaccine response due to genetics, and genetic predispositions to environmental stressors related to animal comfort and welfare (e.g., lesions), and the systems biology and molecular ecology of chronic wasting disease.

Priority Goal 4: Improve Research Reach to Industry

What does success look like?

Genetic selection tools for efficiency, carcass, and production traits adopted by industry.

How do we measure this success?

New products launched and adopted by industry.

Our progress:

- In early 2017 Delta Genomics commercialized the genomic breed composition, hybrid vigour, and parentage tool, EnVigour HX™. Over the year more than 1500 tests were ordered directly from new industry clients. This is a result of training and information sessions that have directly reached an estimated 325 commercial beef producers.

What does success look like?

Increased participation in events hosted.

How do we measure this success?

Measuring changes in delegate attendance at Livestock Gentec events.

Our progress:

- An estimated 200 individuals attended the 2017 field day; this represents about a 50% increase in attendance from 2016.
- An estimated 150 delegates attended the 2017 conference. While this is similar to previous years, our repeat delegate attendance rate is high at about 70%, indicating continued value of information for our stakeholders.

What does success look like?

Increased partnerships with industry groups, nationally and internationally.

How do we measure this success?

Continued long-term collaborations and new partnerships developed.

Our progress:

- Gentec has more than 80 industry and industry group partnerships.
- 2017 saw continued facilitation to establish the Canada-China International Center for Innovative Beef Industry Technology and the Canada-China Beef Industry Alliance between the University of Alberta and the China Agricultural University (CAU).

Projects related to achieving this goal:

In 2017, there were 8 active projects with knowledge translation as the primary objective; 5 in beef and 3 in general livestock research application. Of significant importance is the support and contribution from Alberta Innovates for Gentec operational funding. Traditional research grants are often lacking in this essential priority, despite it being the enabling agent that allows for translational actions that ultimately make a difference in the livestock industry. Also of note are the contributions from the Beef Cattle Research Consortium to support the Kinsella Project and NSERC funding for event support.



Financial Overview



2017 Operational Financial Performance and Projections

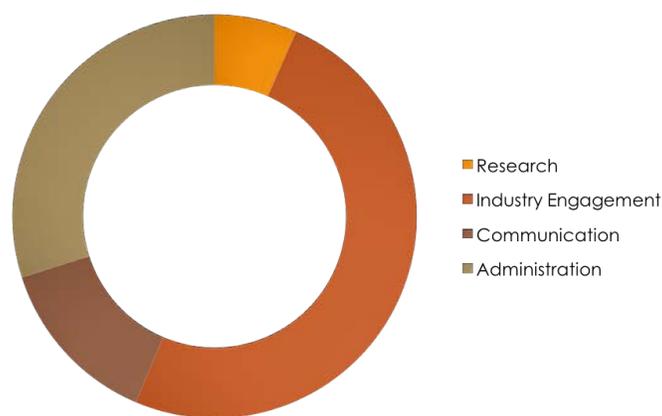
LIVESTOCK GENTEC Financial Performance For the period ending March 31

Y8
(April 1, 2017 - March 31, 2018)

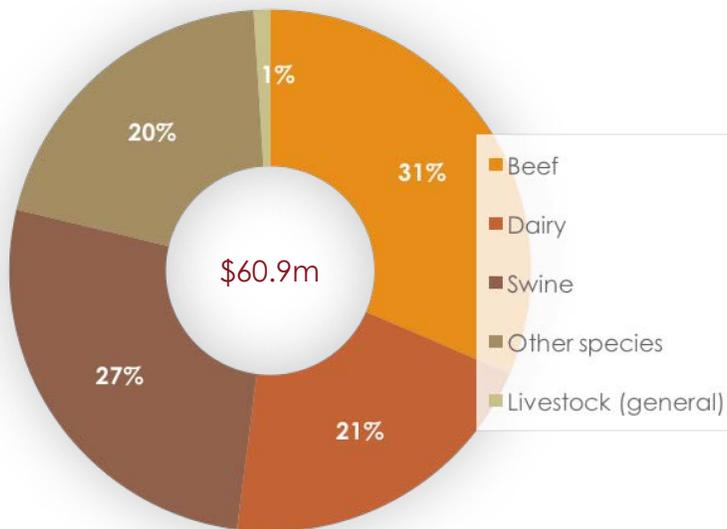
INCOME	Budget	Budget	Actual	Var.	Budget	Actual	Var.	Budget	Actual	Var.	Budget	Forecast	Var.	Actual YTD	% YTD	Forecast YTD	% YTD
		Q1				Q2			Q3			Q4					
AI-BIO	500,000	125,000	125,000	-	125,000	125,000	-	125,000	125,000	-	125,000	125,000	-	500,000	100%	500,000	100%
Carry Forward	61,644	31,020	61,644	30,624	-	-	-	-	-	-	-	-	-	61,644	100%	61,644	100%
Non-Research Project Revenue	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Income	561,644	156,020	186,644	30,624	125,000	125,000	-	125,000	125,000	-	125,000	125,000	-	561,644	100%	-	100%
EXPENSES																	
Research:																	
Wages	20,000	-	-	-	-	-	-	10,000	2,948	7,052	10,000	16,952	(6,952)	19,900	99%	19,900	99%
Consumables	30,000	10,000	1,415	8,585	15,000	4,828	10,172	5,000	1,147	3,854	-	5,148	(5,148)	12,538	42%	12,538	42%
Travel & Training	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Research Expense	50,000	10,000	1,415	8,585	15,000	4,828	10,172	15,000	4,094	10,906	10,000	22,100	(12,100)	32,438	65%	32,437	65%
Industry Engagement:																	
Wages	273,132	82,727	36,669	46,058	54,927	74,450	(19,523)	54,927	44,758	10,169	59,927	58,004	1,923	213,881	78%	213,881	78%
Travel	15,980	4,730	8,404	(3,674)	3,750	9,866	(6,116)	3,750	4,278	(528)	3,750	8,312	(4,562)	30,860	193%	30,860	193%
Training & Courses	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Ind. Eng. Expense	289,112	87,457	45,073	42,384	58,677	84,317	(25,640)	58,677	49,036	9,641	63,677	66,316	(2,639)	244,741	85%	244,742	85%
Communication:																	
Wages	40,400	10,600	13,101	(2,501)	6,600	13,400	(6,800)	6,600	13,435	(6,835)	6,600	13,399	(6,799)	53,334	132%	53,335	132%
Training & Conferences	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
External Services	37,440	10,065	2,390	7,675	9,125	3,211	5,914	9,125	-	9,125	9,125	8,698	427	14,299	38%	14,299	38%
Total Comm. Expense	77,840	20,665	15,491	5,174	15,725	16,610	(885)	15,725	13,435	2,290	15,725	22,097	(6,372)	67,633	87%	67,633	87%
Administration:																	
Wages	114,040	28,510	25,273	3,237	28,510	25,378	3,132	28,510	24,832	3,678	28,510	26,396	2,114	101,879	89%	101,879	89%
Office Costs	16,352	4,838	4,017	821	3,838	3,612	226	3,838	8,789	(4,951)	3,838	7,859	(4,021)	24,277	148%	24,277	148%
Hosting	5,300	1,550	-	1,550	1,250	389	861	1,250	43	1,207	1,250	4,856	(3,606)	5,288	100%	5,288	100%
MAB	9,000	3,000	-	3,000	2,000	1,505	495	2,000	6,612	(4,612)	2,000	7,300	(5,300)	15,417	171%	15,417	171%
Total Admin. Expense	144,692	37,898	29,290	8,608	35,598	30,884	4,714	35,598	40,276	(4,678)	35,598	46,411	(10,813)	146,861	101%	146,861	101%
Total Op. Expenses	561,644	156,020	91,270	64,750	125,000	136,639	(11,639)	125,000	106,840	18,160	125,000	156,924	(31,924)	491,673	88%	491,673	88%
Surplus/(Deficit)			95,374			(11,639)			18,160			(31,924)		69,971		5,288	

Forecasted Expenses FY2017-18

Total forecasted operating expenses = \$491,673



2017 Project Financial Overview



GENTEC AT A GLANCE

- \$60 million – Total Active Funding
- 59 – Active Projects
- 12 – Principal Investigators
- 23 – Graduate Students
- 13 – Postdoctoral Fellows
- 7 – Research Associates
- >20 – Academic Partners
- >80 – Industry Partners
- >25 – Government Partners
- >550 – Active Gentec Network Partners
- 390 – Peer-reviewed Publications since 2010
- 2 – Laboratories (Research and Service)
- 3 – Research Ranch Stations

Projects funded and total funding, by Gentec goal.

Active projects, as of February 2018	Number	%	Funding	%
Efficiency	21	47%	22,691,279	40%
Quality	2	4%	1,234,020	2%
Efficiency & Quality	4	9%	5,128,451	9%
Health	14	31%	24,813,550	44%
Knowledge Transfer	4	9%	2,704,856	5%
Total	45	100%	56,572,156	100%

Projects funded and total funding by species.

Active projects, as of February 2018	Number	%	Funding	%
Beef	21	47%	22,691,279	40%
Swine	2	4%	1,234,020	2%
Dairy	4	9%	5,128,451	9%
Other livestock and livestock (general)	14	31%	24,813,550	44%
Total	45	100%	56,572,156	100%

Looking Ahead

In the year ahead of us we will continue to advance our strategic priorities to the benefit of the livestock industry. We will do this by enhancing our current partnerships and collaborations, while also seeking new partnership opportunities to diversify our knowledge base and reach. On the horizon include goals to partner with additional forage associations and breeding companies.

Exploration of a *Canadian Beef Improvement Network* continues to be a priority of Gentec, with some transfer of the leadership to industry to ensure long term success of the initiative.

Our group is in preparation for the expected 2018 calls for Large-Scale Research Projects. Here we will focus on animal health and antimicrobial research in numerous species, as well as the whole-animal nutrition for improving production efficiencies.

The Livestock Gentec Management Advisory Board (MAB) meets three times per year and is representative of a diverse mix from industry, academia, and government. The MAB is critical to our long term success, including helping to secure operational funding. We continue to look to our MAB for advice and to evolve our strategic goals to fit the needs of livestock producers and the Canadian livestock industry.

Appendix



List of Active Projects in 2017

Project title	PI	Organizations	Start	End	Primary Funder	Industry	Goal
Improvement of cow feed efficiency and the production of consistent quality beef using molecular breeding values for RFI and carcass traits (Kinsella Project)	Plastow	UofA; CAA; CChA; Beefbooster; BIXS; ABP; ARD; AAFC	2013	2018	ALMA; BCRC	Beef	Knowledge Translation
Genetics of collagen	Bruce	UofA	2014	2017	BCRC	Beef	Quality
Identifying genomic predictors for Vaccine Response in Swine	Plastow	UofA; VIDO; Fast Genetics	2014	2017	ALMA	Swine	Health
Performance validation of RFI selected cattle under extensive cow/calf production systems. Mattheis Ranch Project	Bork	UofA; ARD; Doerkson Farms; Delta Genomics	2014	2017	ALMA	Beef	Efficiency
The practical application and development of easy to use genomic selection tools for breed improvement in the Canadian beef breed associations	Latimer	CBBC; UofA; CAA	2014	2017	ALMA	Beef	Knowledge Translation
DNA-based biomarkers for feed efficiency in beef cattle- Walsh Fellowship Program	Li	AAFC; UofA	2014	2018	TEAGASC	Beef	Efficiency
Identifying functional SNPs to enhance genomic prediction accuracy for feed efficiency and carcass merit traits in beef cattle	Li	AAFC; UofA	2014	2018	ALMA; AAFC	Beef	Efficiency
Methane emissions from beef cattle bred for low RFI	Basarab	ARD; UofA; AAFC	2014	2018	ALMA; CCEMC	Beef	Efficiency
Collaboration with Canadian Charolais Association	Plastow	UofA; CChA	2015	2017	CChA	Beef	Efficiency, Quality
Genetics of the eating quality of high connective tissue beef	Bruce	UofA; BCRC; ABP	2015	2017	AI Bio; ALMA; BCRC	Beef	Quality
Genomic approaches to the control of Bovine Respiratory Disease Complex	Plastow; Orsel	UofA; UofC (UCVM)	2015	2017	ALGP2 (ALMA and Genome Alberta)	Beef	Health
Incorporating genomic information to improve carcass quality and reproduction traits in beef cattle	Plastow; Stewart-Smith	Beefbooster; UofA	2015	2017	AITF	Beef	Efficiency, Quality
Development of "all-in-one" RFID, DNA collection, and management tags to improve efficiencies and traceability in livestock production	Kathler; Coros	SAIT, Delta, UofA	2015	2018	ALMA	Beef	Knowledge Translation
Genetic improvement of feed efficiency and reducing methane emissions for dairy cows to support "green Alberta milk"	Wang	UofA; Alberta Milk; CDN	2015	2018	ALMA	Dairy	Efficiency

Project title	PI	Organizations	Start	End	Primary Funder	Industry	Goal
Production and testing of PUFA-BHP in beef II: optimizing diets, NIRS predictions, rumen bacterial profiles, and human health implications	Guan (Co investigator)	UofA;	2015	2018	ALMA	Beef	Health
Systematic study on the relationship among rumen microbial lipid metabolism, meat beneficial fatty acids, and meat quality in beef cattle	Guan	UofA;	2015	2018	ALMA	Beef	Quality
Using predicted and residual ruminal volatile fatty acid concentrations to predict feed efficiency, carcass yield, and carcass composition in beef cattle	Guan	UofA; Virginia Tech	2015	2018	ALMA	Beef	Efficiency, Quality
Application of Genomics to Improve Disease Resilience and Sustainability in Swine Production	Dyck; Stothard; Plastow	SIP; SMAF; ISU; PigGen Canada; FNIAR; Alltech; USNPB; UKBBSRC; FAANG	2015	2019	Genome Canada	Swine	Health
Canadian Agriculture Adaptation Program (CAAP2)	Latimer	Angus, Simmental, Limousin and Hereford	2015	2019	AAFC	Beef	Knowledge Translation
Development and deployment of MBVs/gEPDs for feed efficiency and carcass traits that perform in commercial cattle	Basarab	CBBC; Breed Associations; Beefbooster; BIO; Teagasc; CCHMS; ICBF	2015	2019	Genome Alberta; ALMA	Beef	Efficiency, Quality
Increasing feed efficiency and reducing methane emissions through genomics: a new promising goal for the Canadian dairy industry	Stothard; Miglior	UofA; UofG; CDN; GrowSafe	2015	2019	Genome Canada	Dairy	Efficiency
Improving the annotation of genetic variation associated with feed efficiency and methane yield in beef cattle	Plastow	University of Guelph, Roslin Institute, INRA, AF, AAFC and UC Davis	2016	2017	ALMA	Beef	Efficiency
Knowledge transfer	Crowley / Latimer	CBBC	2016	2017	ALMA	Livestock	Knowledge Translation
New tools to enable effective genomic selection for disease resilience	Plastow	Swine Innovation Porc	2016	2017	Swine Innovation Porc	Swine	Health
Reducing frequency of early embryonic mortality in Duroc swine	Dyck	Genesis	2016	2017	ALMA	Swine	Health
Using pooling allele frequency to cost-effectively test if there is a genetic predisposition to footpad lesions in commercial poultry	Bench		2016	2017	ALMA	Poultry	Health
Breeding strategies for improving feed efficiency and reducing methane emissions in dairy cattle	Baes	UofG; UofA; CDN; AB Milk	2016	2018	Alberta-Ontario Innovation Program	Dairy	Efficiency

Project title	PI	Organizations	Start	End	Primary Funder	Industry	Goal
Enhancing bioavailability of human inedible crop byproducts and lowering carbon footprint for sustainable dairy production	Guan	UofA	2016	2018	China Opportunity Fund	Dairy	Efficiency
Genetic variations associated with feed efficiency and methane yield in beef cattle	Plastow	N/A	2016	2018	ALMA	Beef	Efficiency
Genomic and metabolomic approaches to improving new economically important traits in pigs	Plastow	Topigs Norsvin	2016	2018	Mitacs	Swine	Health
Genomic and metabolomic approaches to improving new economically important traits in pigs; p.2	Plastow	Topigs Norsvin	2016	2018	ALMA	Swine	Efficiency, Quality
Improving chicken responses to glycoconjugate vaccination against Campylobacter jejuni.	Plastow	VaxAlta; Delta Genomics	2016	2018	ALMA	Poultry	Health
Development and application of functional genomic prediction for feed efficiency and carcass traits in beef cattle	Li	AAFC (A-Base)	2016	2019	A-Base	Beef	Efficiency, Quality
Development of an integrated model to predict longevity of beef cows	Li	UofA; AAFC; AAF	2016	2019	ALMA	Beef	Health
gGreenBeefcow: Identifying and validating genomic and fecal microbiome markers for low methane emissions in beef cattle	Fitzsimmons	AAFC; UofA	2016	2019	ALMA	Beef	Efficiency
Identifying functional gene variants and non-additive effects to enhance the power of genomic selection of purebred pigs for crossbred performance	Plastow	Hypor	2016	2019	NSERC CRD	Swine	Quality
An integrative genomics approach to uncover genetic mechanisms underlying susceptibility to important infectious diseases in pigs	Stothard	UofA	2016	2020	NSERC	Swine	Health
An integrative genomics approach to uncover genetic mechanisms underlying susceptibility to important infectious diseases in pigs	Stothard	UofA	2016	2022	NSERC Discovery	Swine	Health
Genomics and metabolomics analyses of sheep residual feed intake and carcass quality: a follow up study	Wang	Alberta Sheep Producers	2016		ALMA	Sheep	Efficiency
Systems Biology and Molecular Ecology of Chronic Wasting Disease	Stothard (collaborator) (McKenzie and Wishart)	UofA; UBC	2016		Genome Canada	Cervids	Health
Benefits of yeast derived mannan-oligosaccharide supplementation on piglet gut microbial profiles and health	Willing	UofA	2017	2017	Mitacs; Alltech	Swine	Health
Development a collaborative research project on application of yeast byproducts	Guan	UofA	2017	2017	NSERC Engage; Biolargo	Livestock	Health

Project title	PI	Organizations	Start	End	Primary Funder	Industry	Goal
Field Day and Conference support	Plastow	UofA	2017	2017	NSERC	Livestock	Knowledge Translation
Assessment of rumen microbiota in beef cattle with different feed efficiency on grazing rangeland	Guan	UofA	2017	2018	RRI	Beef	Efficiency
Effects of iodine in water on intestinal microbial communities of chickens and other livestock animals	Willing	UofA	2017	2018	NSERC Engage; Biolargo	Poultry	Health
Evaluating the biological basis of feed efficiency to create tools that can assist selection for feed efficient lactating cows.	Wang; Plastow	UofA	2017	2018	AFC	Dairy	Efficiency
Improved accuracy in diagnosing pregnancy and predicting litter size at early ewe gestation; metabolomics analyses for pen side kit development.	Markus	AAF, UofA; UofG; Laval U; Olds College; Lakeland College; Alberta Beef Health Solutions	2017	2018	AAF; Ontario Sheep; Canadian Sheep Breeders Association; Alberta Lamb Producers	Sheep	Efficiency
Livestock Gentec as an Alberta Innovates Centre (1-year grant renewal)	Plastow	UofA	2017	2018	Alberta Innovates	Livestock	Knowledge Translation
Microbial modifying properties of iodinated water in animal production	Willing	UofA	2017	2018	Mitacs	Livestock	Health
Testing for signatures of selection in Canadian BSE cases	Plastow; Czub	UofA; APRI	2017	2018	APRI	Beef	Health
The application of genomics into the commercial cow/calf sector of the beef industry. 2017. NSERC Connect. (Stothard, Brons, Miller).	Stothard	UofA; Delta	2017	2018	NSERC	Beef	Knowledge Translation
Assessment of rumen microbiota in beef cattle with different feed efficiency on grazing rangeland	Guan	UofA	2017	2019	RRI	Beef	Efficiency
Evaluating a new tool (GGP-F250) for improving accuracies of gEPDs for production efficiency in commercial beef cattle	Basarab (Plastow)	UofA; AAF	2017	2019	AAF	Beef	Efficiency
Genetic evaluation of sow efficiency traits using single step genomic evaluation methods	Plastow	UofA; Genesis	2017	2019	Mitacs; Genesis	Swine	Efficiency
Optimize heterozygosity in composite and crossbred beef populations using genetic and genomic tools	Basarab (Plastow)	UofA; AAF	2017	2019	AAF	Beef	Efficiency
Phenomics for genetic and genome-enabled improvement of resilience in pigs	Plastow	UofA	2017	2019	NIFA	Swine	Health

Project title	PI	Organizations	Start	End	Primary Funder	Industry	Goal
Development of genomic crossbred estimated breeding values (gcEBV) to maximize profitability for Canadian pork producers	Plastow; Kemp	UofA; ISU; Genesis	2017	2020	Genome Canada	Swine	Efficiency
Genetic analyses of feed intake, feed efficiency, female fertility, and cow lifetime productivity in beef cattle raised under two environments.	Basarab; Li	UofA; AAF; BCRC	2017	2023	AAF; BCRC	Beef	Efficiency
Elucidating the biological basis of feed efficiency to create tools that can assist selection for feed efficient lactating dairy cows	Plastow	UofA; UCVM	2017		AAF	Dairy	Efficiency

