2024

Smart Farm
Impact Report

CELEBRATING SIX YEARS
ON THE SMART FARM
EST. 2018

OLDS COLLEGE
OF AGRICULTURE & TECHNOLOGY

SMART Farm

CONTENTS

ADVANCING
Canada's Agriculture Industry

Olds College of Agriculture & Technology is a technical institution offering industry demand-driven programming with an intensive focus on agriculture and technology.

In addition to high-tech, hands-on agriculture education, Olds College is known for its innovative applied research that lays the foundation for solving real-world problems in farming, food and land – and is one of Canada's top five research colleges. In 2024, Olds College was also the gold recipient of the Applied Research and Innovation Excellence Award from Colleges and Institutes Canada (CICan).

As technology continues to influence the way we live, work and farm, smart farms and technology development have a critical role to play in the global grand challenge of feeding a growing population with fewer resources while reducing the environmental impact.

The Olds College Smart Agriculture Ecosystem is accelerating the progress and innovation needed to grow Canada's agriculture industry – **and the Olds College Smart Farm is at the heart of it all.**

From the President

As agriculture evolves with a growing demand for automation, digitalization and sustainability, Olds College of Agriculture & Technology is proud to be leading innovation within the global agriculture industry and educating the next generation of thought leaders.

Over the last year, Olds College has become one of Canada's top five research colleges and the gold recipient of the Applied Research and Innovation Excellence Award from CICan. We also just celebrated our largest graduating class with a total of 939 graduates.

As a post-secondary institution in Alberta, Olds College plays an important role in research, industry support and knowledge sharing in the agriculture industry — and the Olds College Smart Farm is key to our success.

The Smart Farm supports teaching and learning across many of our academic programs in addition to being a world-class smart agriculture applied research environment. Having the Smart Farm connected to campus allows our students to gain hands-on work experience with leading-edge technologies, data compilation, livestock and farm infrastructure so they are prepared for work in the future. Work-integrated learning on the Smart Farm is extremely valuable, and helps our students apply what they've learned in the classroom to real-world environments.

We are extremely proud of the positive impacts our applied research activities on the Smart Farm have within the industry. Being able to support start-up development, validation, scaling and demonstration of smart agriculture technologies and practices benefits producers, innovators and industry stakeholders.

We want to advance Olds College's role in delivering innovative solutions to the agriculture industry with the resources of the College, the knowledge of our employees and an eager group of students willing to apply their hands-on learning in real-world environments.

I'd like to thank every donor, industry partner, producer, company and institution we have collaborated with to advance and transform the agriculture industry together.

I'm pleased to present the 2024 Smart Farm Impact Report to showcase our industry-driven applied research, education and training — and the positive impact we're making in the global ag industry as we continue *transforming agriculture for a better world.*

Dr. Ben Cecil
President, Olds College of Agriculture & Technology

From the Vice President, Research

I'm beyond proud of what we've accomplished in the last six years on the Smart Farm. The impact Olds College of Agriculture & Technology has made in the agriculture industry is highly visible, and we're thrilled to be one of Canada's top five research colleges and the recent gold recipient of the Applied Research and Innovation Excellence Award from CICan.

To compile the 2024 Smart Farm Impact Report, we used surveys, data and feedback from the partners and stakeholders we engaged with over the past six years. The results and feedback continue to show that the expertise, infrastructure, and capacity available through the Smart Farm is accelerating the development and adoption of ag technologies and practices. In addition to supporting the ag tech innovation ecosystem, the Smart Farm is a 3,000-acre learning environment for Olds College students to get hands-on experience and ensure the next generation of innovators and technology users is well positioned to succeed.

I want to give my utmost appreciation for the dedication of our research team, faculty and staff over the past six years, and thank everyone that has engaged and partnered with us. As I move along from Olds College, I am excited to watch as the College continues to expand the Smart Farm ecosystem and builds on the positive impact it has on the agriculture industry.

Dr. Joy Agnew
Vice President, Research,
Olds College of Agriculture & Technology

CELEBRATING
Six Years on the Smart Farm

In June 2018, Olds College officially launched the Olds College Smart Farm on 110 acres. Six years later, the Smart Farm is more than 3,000 acres in five different geographic locations across two provinces — focused on accelerating the progress and innovation needed to grow Canada's agriculture industry.

The College is implementing some of the world's best digital and smart agriculture technologies and practices on the Smart Farm such as autonomous agriculture equipment, drones, soil sensors, weather stations, floating island technology, livestock management technologies, animal health studies and data collection.

The Smart Farm is also integrated into College programming to provide students hands-on learning opportunities to leverage what they've learned in the classroom.

Olds College and the Smart Farm would like to thank government, industry, partners, donors and investors for their support over the last six years to the advancement of technology in agriculture. We look forward to seeing what we'll do together in the future!

OLDS COLLEGE
Smart Farm

The Olds College Smart Farm is made up of more than 3,000 acres of land for crop and forage production including state-of-the-art equipment and technology, 1,000-head capacity feedlot, commercial cow/calf herd, purebred Red Angus herd and sheep flock – as well as expertise and leadership in agriculture technology research and development. The Smart Farm also has access to greenhouses, labs, incubator space, a brewery, the National Meat Training Centre, plus additional infrastructure at Olds College of Agriculture & Technology.

The purpose of the Smart Farm is to implement the world's best digital agriculture technologies for crop and livestock production; improve farming operations and efficiencies through smart technologies and practices; and utilize technologies for world class education, demonstration and applied research.

New technologies for agriculture require in-field testing and validation in the setting of an operating farm to move through the innovation chain, and into the hands of farmers and producers. Since the Smart Farm is connected to a post-secondary institution, it has the space and flexibility to incorporate projects, activities and initiatives into day-to-day farming operations.

The ability to develop, validate and test products using technology and applied research in real agriculture settings continues to bring new projects to the Smart Farm.

The Smart Farm creates a place for producers, industry partners, students and faculty to look at the opportunities and challenges facing the agriculture industry and investigate solutions to evolve agriculture practices.

Work-integrated learning is fundamental to the Olds College student experience. The 3,000-acre Smart Farm is integrated into programming to provide students hands-on learning opportunities with land, livestock, technology and data.

As Canada's Smart Agriculture College, Olds College is proud to be working to achieve its social purpose of **transforming agriculture for a better world.**

AREAS OF FOCUS

Primary research areas on the Smart Farm are focused on crop production, livestock production, environmental stewardship, cereal breeding, technology integration and data utilization.

CROP PRODUCTION

With 3,000 acres of farmland to work with, the crop research team is able to perform in-field crop research with both small plots trials and full-field commercial scale investigations.

LIVESTOCK PRODUCTION

The facilities and assets of the Technology Access Centre for Livestock Production (TACLP) – including 1,000-head capacity feedlot, commercial cow/calf herd, purebred Red Angus herd and sheep flock – can be utilized to demonstrate and advance the use of technology to improve animal health and welfare, increase production efficiency and enhance environmental sustainability.

ENVIRONMENTAL STEWARDSHIP

Environmental stewardship applied research focuses on five main areas of innovation which include surface water quality remediation, agricultural climate change management practices, by-product development and utilization, co-production of agricultural commodities and renewable energy, and agriculture land stewardship.

SMART AGRICULTURE

Smart agriculture applied research supports the refinement and optimization of technologies, and provides manufacturers and users with information on functionality, accuracy and value of technologies – particularly in Alberta stubble, soil and climate conditions.

DIGITAL AGRICULTURE

Smart and precision agriculture are heavily reliant on data, and the Smart Farm prioritizes the collection, integration and utilization of agricultural data for evidence-based decision making.

AUTONOMOUS AGRICULTURE EQUIPMENT

Olds College finalized a four-year applied research project on the evaluation and improvement of economic, environmental and logistical benefits of autonomous agricultural equipment for broadacre crop production.

OLDS COLLEGE
Centre for Innovation

Olds College Centre for Innovation (OCCI) is the applied research division of Olds College of Agriculture & Technology, and focuses on practical, industry-driven applied research that can be easily implemented by the agriculture industry.

Olds College Centre for Innovation (OCCI) is the applied research division of Olds College of Agriculture & Technology, focused on practical, industry-driven applied research that can be easily implemented by the agriculture industry.

Industry partners connect with OCCI for support in the development and testing of innovative products in the core areas of crop production, livestock production, environmental stewardship, technology integration and data utilization. These focus areas align with infrastructure at the College, available expertise and gaps identified by the agriculture sector.

The Smart Farm was built to support start-up development, validation, scaling and demonstration of smart agriculture technologies and practices. Olds College is connected with Alberta Innovates, the Central Alberta Regional Innovation Network (CARIN), SVG Thrive and UCeed with the goals of:

• Encouraging innovation, creating and sustaining a healthy economy, and solving problems within the agriculture industry.

• Supporting businesses by guiding them to the right partners through Olds College networks of businesses and organizations throughout Alberta and Canada.

• Providing training and resources to developers to help them market their products effectively.

Since 2018, OCCI has had discussions with 390 organizations looking to engage with the College – resulting in very high success rates. To date, almost 230 organizations have engaged on a project with OCCI, and a large percentage of those are small and medium-sized enterprises (SMEs). Many of these projects are Alberta-based and have significant relevance and value to local and regional producers.

OCCI also incorporates its applied research activities into work-integrated learning opportunities for Olds College students.

OLDS COLLEGE CENTRE FOR INNOVATION
PROJECT ENGAGEMENT
(since 2018)

390 COMPANIES & ORGANIZATIONS CONNECTED WITH OCCI TO DISCUSS OPPORTUNITIES

306 PRIVATE SECTOR CLIENTS

264 SMALL & MEDIUM-SIZED ENTERPRISES (SMES)

161 SMES ENGAGED ON A PROJECT WITH OCCI

17 FUNDERS

17 ENGAGED ON A PROJECT WITH OCCI

28 RESEARCH COLLABORATORS

22 ENGAGED ON A PROJECT WITH OCCI

36 NETWORKS/NOT-FOR-PROFITS

28 ENGAGED ON A PROJECT WITH OCCI

3 PUBLIC SECTOR CLIENTS

1 ENGAGED ON A PROJECT WITH OCCI

One of Canada's
Top Five Research Colleges

Olds College of Agriculture & Technology has been ranked fourth in Canada's Top 50 Research Colleges according to Research Infosource Inc. The continued growth of the Smart Agriculture Ecosystem and applied research activities on the Smart Farm launched the College into the top five.

In addition to being ranked number four overall in the country, Olds College was listed nationally as number two for college research intensity (dollar per researcher) and number eight for college research income growth. In the small-tier college category, Olds College made the top 10 for research partnerships and paid student researchers, and is number 11 for completed research projects.

CANADA'S TOP
50
RESEARCH COLLEGES
2023 RE$EARCH Infosource Inc.

Applied Research & Innovation Excellence Award
Gold Recipient

Olds College of Agriculture & Technology was the gold recipient of the 2024 Applied Research and Innovation Excellence Award from Colleges and Institutes Canada (CICan).

The Applied Research and Innovation Excellence Award recognizes a college or institute that has improved the productivity of small and medium-sized enterprises (SMEs) and community partners through the development of new and improved products, processes and services, and has provided students and graduates with real-world innovation experience.

The applied research activities with Olds College Centre for Innovation (OCCI) and the Smart Farm are connected to campus and integrated into programming to provide students hands-on learning opportunities with land management, livestock, leading-edge technology and equipment, and extensive amounts of agriculture-focused data to analyze and learn from in the classroom.

APPLIED RESEARCH:
PROJECT DEVELOPMENT

Applied research at Olds College Centre for Innovation (OCCI) focuses on practical, industry-driven applied research that can be easily implemented by the agriculture industry.

The Olds College Smart Farm supports research at OCCI by being the venue for the start-up development, validation, scaling and demonstration of smart agriculture technologies and practices.

Industry partners connect with OCCI for support in the development and testing of innovative products in the core areas of research which align with infrastructure at the College, available expertise and gaps identified by the agriculture sector.

OCCI strives to share the knowledge and learnings generated on the Smart Farm with people and organizations who will continue to spur the adoption of agriculture technologies which benefit producers, innovators and industry stakeholders.

On average, OCCI works on 80 to 100 projects per year – with 98 projects happening throughout 2023 and 2024.

This research includes both public-facing projects that are promoted externally as well as confidential projects where the privacy of all work and results are protected.

Intellectual property (IP) gained throughout the duration of all projects stays with the industry partner.
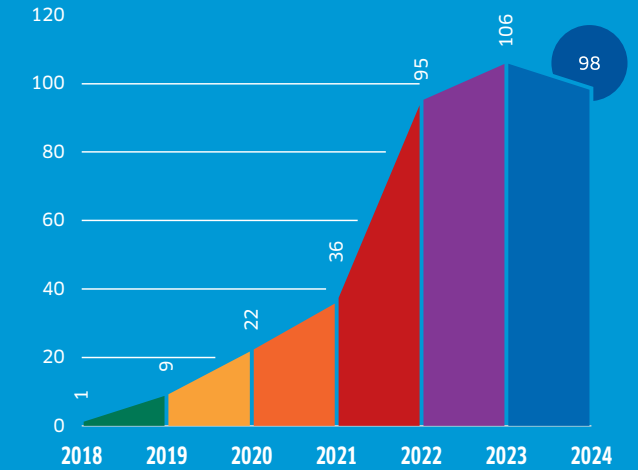
PROJECT FUNDING

• 75% - Public funding

• 25% - Industry & partner funding

PROJECT TYPE

• 75% - Grant-based research

• 25% - Fee-for-service contracts

ANNUAL PROJECT GROWTH

Year	Projects
2018	1
2019	9
2020	22
2021	36
2022	95
2023	106
2024	98
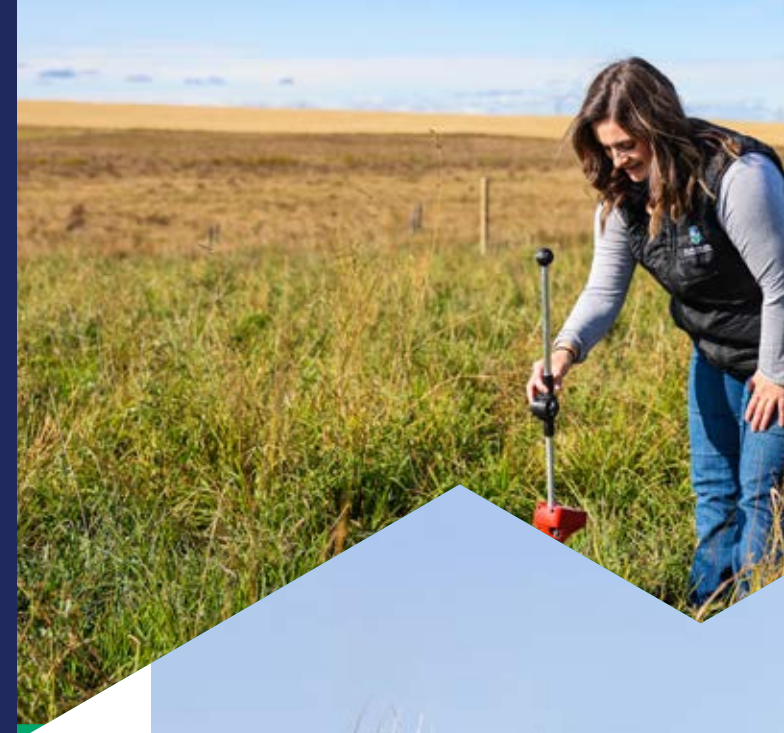
MEASURING THE
SMART FARM'S IMPACT

Based on internal tracking for OCCI & the Smart Farm since 2018

Based on OCCI client feedback surveys during 2024

ENGAGED WITH

390	COMPANIES & ORGANIZATIONS
306	PRIVATE SECTOR CLIENTS
36	NOT-FOR-PROFIT ENTITIES & NETWORKS
28	RESEARCH COLLABORATORS
17	FUNDERS

JOBS CREATED WITHIN OLDS COLLEGE

17 FULL-TIME EQUIVALENT **STUDENT POSITIONS**

25 FULL-TIME EQUIVALENT **HIGHLY QUALIFIED PERSONNEL POSITIONS** (E.G. TECHNICIANS, INTEGRATION SPECIALISTS, DATA SCIENTISTS, PROJECT LEADS, PROJECT MANAGERS)

8 FULL-TIME EQUIVALENT **POSITIONS** (E.G. FARM OPERATION SERVICE WORKERS, ADMINISTRATIVE SUPPORT)

AUDIENCE REACH

3,000 VIA **AGSMART** PER YEAR

1,200 VIA **SMART FARM TOURS** PER YEAR

15,000 VIA **SMART FARM NEWSLETTER** PER YEAR
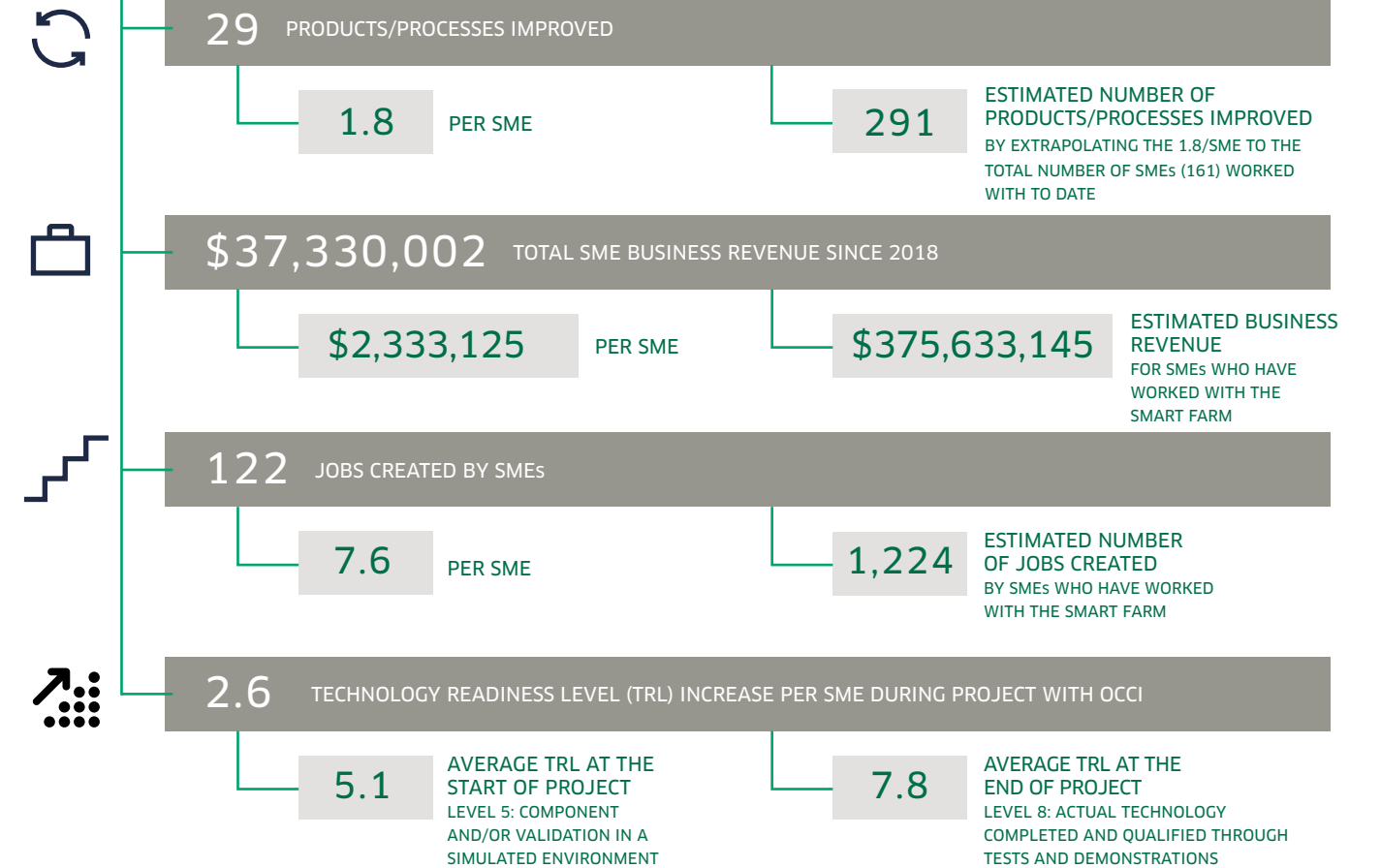
PLUS A LARGE AUDIENCE – IMPOSSIBLE TO MEASURE – ACROSS CANADA DUE TO
EARNED MEDIA, SOCIAL MEDIA, INTERVIEWS, EXTERNAL EVENTS, FIELD DAYS, CONFERENCES & MORE

CLIENT FEEDBACK

16 SURVEYS COMPLETED BY SMALL & MEDIUM-SIZED ENTERPRISES (SMEs) WHO ENGAGED WITH THE SMART FARM SINCE 2018

29 PRODUCTS/PROCESSES IMPROVED

1.8 PER SME

291 ESTIMATED NUMBER OF PRODUCTS/PROCESSES IMPROVED BY EXTRAPOLATING THE 1.8/SME TO THE TOTAL NUMBER OF SMEs (161) WORKED WITH TO DATE

$37,330,002 TOTAL SME BUSINESS REVENUE SINCE 2018

$2,333,125 PER SME

$375,633,145 ESTIMATED BUSINESS REVENUE FOR SMEs WHO HAVE WORKED WITH THE SMART FARM

122 JOBS CREATED BY SMEs

7.6 PER SME

1,224 ESTIMATED NUMBER OF JOBS CREATED BY SMEs WHO HAVE WORKED WITH THE SMART FARM

2.6 TECHNOLOGY READINESS LEVEL (TRL) INCREASE PER SME DURING PROJECT WITH OCCI

5.1 AVERAGE TRL AT THE START OF PROJECT LEVEL 5: COMPONENT AND/OR VALIDATION IN A SIMULATED ENVIRONMENT

7.8 AVERAGE TRL AT THE END OF PROJECT LEVEL 8: ACTUAL TECHNOLOGY COMPLETED AND QUALIFIED THROUGH TESTS AND DEMONSTRATIONS

Pillars of the Smart Ag Ecosystem

There are seven pillars of the Smart Ag Ecosystem at Olds College of Agriculture & Technology, and these are fundamental to the success of the Smart Farm – a true ecosystem where producers, industry partners, small and medium-sized enterprises (SMEs), students, and faculty can collaborate and work towards advancing agriculture.

View our interactive Smart Farm map with this QR code or go to **oldscollege.ca/smartfarm**

SMART FARM & SMART FARM OPERATIONS

At the heart of the Smart Ag Ecosystem is the **Smart Farm and Smart Farm Operations**. This leading-edge learning environment has grown to include 3,000 acres of farmland, infrastructure and staff who are experienced in ag tech research and development.

APPLIED RESEARCH

Practical and industry-driven **Applied Research** is key to accelerating the development and adoption of technologies and practices. The research experts on the Smart Farm work with innovators and SMEs to move their ideas and products through the innovation chain – and into the hands of farmers and producers.

STRATEGIC PARTNERSHIPS

Strategic Partnerships and investors allow Olds College to build and operate the Smart Farm with the flexibility needed to support innovation and development.

ACADEMIC PROGRAMMING

Academic Programming in a post-secondary institution that provides training, skills and work-integrated learning for the next generation of users and developers of ag technology is at the core of Olds College.

PHYSICAL INFRASTRUCTURE

The **Physical Infrastructure** at Olds College – including a national meat training centre, brewery, greenhouses, wetlands and more – provides endless opportunities for students and everyone in the ag sector to learn and grow.

DIGITAL AG INFRASTRUCTURE

The **Digital Ag Infrastructure** is a growing piece of the ecosystem and critical component that allows Olds College to launch and execute Smart Ag research. The world of agriculture is becoming reliant on the 'internet of things', and this infrastructure is essential for the ag tech evolution.

KNOWLEDGE MOBILIZATION PLATFORM

The **Knowledge Mobilization Platform** ensures the information generated on the Smart Farm gets into the hands of producers, researchers and industry stakeholders who can accelerate the progress and innovation needed to grow Canada's agriculture industry.

PARTNERSHIPS

Partnerships are truly the foundation of the work at Olds College of Agriculture & Technology. Whether financial, academic or experiential, these partnerships raise the bar for what can be delivered throughout the year.

The strategic intent of Olds College and the Smart Farm is to advance the agricultural industry. This happens by educating students, performing research, testing products and services and communicating the benefits of those products and services in the marketplace.

The Smart Farm provides partners with a unique means of gaining boots-on-the-ground testing and learnings for their technologies and practices. This includes support in disseminating results to producers and other industry stakeholders through communications and events, such as the College's annual educational expo – AgSmart.

The Smart Farm provides researchers and partners with the ability to take things that are new and novel, and may still require development, and apply them to a real-world environment. This gives strategic partners the opportunity to truly see their technology in action. The Smart Farm is a place that can bring everyone together to **transform agriculture for a better world.**

A Memorandum of Understanding (MOU) connects two organizations who agree to work together to develop a meaningful working relationship. Since 2018, Olds College signed MOUs with more than 30 partners including NuFarm, AGTECH ACCELERATOR, Calgary Economic Development Ltd., Nufarm Agriculture Inc., University of Saskatchewan and SaskTel.

Olds College continues to partner with industry leaders in the agriculture world. SeedMaster Manufacturing Ltd. announced a 10-year partnership with Olds College to sponsor seeding equipment for the Smart Farm. In addition, Rocky Mountain Equipment (RME) delivered a brand-new New Holland sprayer to Olds College to be used during the growing seasons for the next three years on the Smart Farm.

The Producer Panel at Olds College is a critical partnership that connects academics, research and innovation back to the farmers, ranchers and producers they are ultimately serving. Producers from crop and livestock backgrounds in Alberta and Saskatchewan began meeting in 2021 to discuss and provide feedback on the applied research being done at OCCI to ensure it's applicable and useful for producers, and to ensure academic programming is developing the skills that industry needs.

PAN-CANADIAN
Smart Farm Network

The Pan-Canadian Smart Farm Network – led by Olds College of Agriculture & Technology – is a network of Smart Farms supporting Canada's agriculture sector to enhance efficiency, sustainability and resilience in response to emerging opportunities and challenges. The network fosters collaboration among researchers, producers, industry partners and other stakeholders nationwide to drive innovative projects that address critical issues in ag tech development and adoption. The network facilitates knowledge exchange and capacity building, and serves as a platform for real-world testing and validation of new technologies.

With funding from the Canadian Agri-Food Automation and Intelligence Network (CAAIN), the network also includes Discovery Farm Langham located just north of Saskatoon, Sask.; Lakeland College located at Vermilion, Alta.; University of Saskatchewan (USask) Livestock and Forage Centre of Excellence (LFCE) located near Saskatoon, Sask.; Manitoba Beef & Forage Initiatives Inc. (MBFI) located near Brandon, Man.; Enterprise Machine Intelligence & Learning Initiative (EMILI) located near Winnipeg, Man.; Lethbridge College located in Lethbridge, Alta.; and Discovery Farm Woodstock located in Southwestern Ontario.

The continued expansion and collaboration in different agricultural zones and land bases across Canada brings more depth to the projects and technology evaluations conducted at Canada's smart farms, which benefits farmers and developers.

The Pan-Canadian Smart Farm Network initiative will accelerate the development and adoption of ag technologies and systems, helping producers manage their risk of production to improve the productivity and sustainability of their farms.

THE
Research Team

Olds College of Agriculture & Technology is incredibly proud of the research teams, instructors and staff who drive applied research in the areas of crop production, livestock production, environmental stewardship, technology integration and data utilization.

Expertise on the Smart Farm continues to grow with research team members, managers, scientists and technicians as well as students, interns and seasonal staff running the various applied research projects throughout the year. Notable designations of the professionals and experts at Olds College include: Ph.D., M.Sc., B.Sc., Diploma, P.Ag., P.Eng., MBA, and a combined total of decades of practical science and agricultural experience.

In addition to the 3,000-acre Smart Farm, Olds College has extensive assets and infrastructure to provide the testing ground and lab space for applied research, training and education. Combined with world-class talent and subject matter experts, these assets create an unparalleled opportunity for technological innovation and development. Additional assets and infrastructure at the College include:

- Smart Ag Innovation Centre
- Short-Term Drop Down Office Space
- Technology Access Centre for Livestock Production (TACLP)
- Labs & 1,000-head capacity feedlot
- Beef & Livestock Centre
- National Meat Training Centre
- Smart Farm Operations Centre & Equipment
- Brewery
- Greenhouses
- Soils, Plants & Chemistry Labs
- Incubator Space
- Equine & Rodeo Centre
- Conference Services
- Industry Training & Continuing Education Services

Olds College is always open to new projects and partnerships and has top facilities to deliver real-world results.

Expertise on the Smart Farm continues to grow with research team members, managers, scientists and technicians as well as students, interns and seasonal staff running the various applied research projects throughout the year.

AREAS OF AGRICULTURAL EXPERIENCE AND EXPERTISE AT OLDS COLLEGE OF AGRICULTURE & TECHNOLOGY

Agricultural Engineering

Agriculture Business Management

Animal Health, Science & Welfare

Crop Production

Data Science & Agronomy

Instrumentation

Land & Water Reclamation

Livestock – Genetics, Reproduction, Nutrition, Production & Management

Machine Automation

Molecular & Environmental Plant Science

Plant Pathology, Entomology & Nematology

Precision & Digital Agriculture

Project & Ag Business Management

Rangeland Health

Remote Sensing Technology

Soil Science

Technology Development

Telematics & GIS/GPS

Crop Production

With 3,000 acres of farmland to work with, the crop research team at Olds College of Agriculture & Technology is able to perform small plot, strip plot or full-field commercial scale crop production trials.

The key goals for crop research are to develop and test ways to improve agronomic practices – including nutrient application or pest management – in order to enhance crop yield while consuming fewer resources. Ultimately, the intent is to transition the food production sector to a climate-resilient, agricultural, circular economy. In 2023, the crops research team worked on more than 50 projects to meet these goals.

Services include conducting regional variety trials (RVTs) as well as fertility, herbicide, fungicide and insecticide trials. Field, greenhouse and laboratory studies focus on chemical and biological integrated pest management, soil health, crop rotation, nitrogen use efficiency, new crop evaluation and crop variety testing programs.

A project on the feasibility of growing teff crop under the unique growing conditions in central Alberta was conducted in 2023. The team has also been testing winter rye versus spring rye – with great success over the last three years – along with examining winter survivability, winter kill, disease resistance and yield. The findings are encouraging and should provide a good option for cereal growers – especially during drought-prone years.

A pest-related project is exploring the prevalence of insect pests in cereal fields. For the coming year, the focus will be on root lesion nematodes and investigating possible spatial correlation with wire worm infestations. A second project is underway exploring the effectiveness of beneficial nematode species as a biological control measure for mitigating damage to canola crops caused by black cutworms and root maggots.

The crop research team delivers results that can be applied to real farms to meet the goals of efficiency, profitability and sustainability.

Livestock Production

The Technology Access Centre for Livestock Production (TACLP) is a specialized division of the Olds College Centre for Innovation (OCCI) committed to applied research in livestock production.

The TACLP uses its resources – which include a 1,000-head capacity feedlot, commercial cow/calf herd, purebred Red Angus herd, sheep flock and broadacre native and tame pastures – to demonstrate and optimize technologies with the potential to improve animal health and welfare, increase production efficiency and enhance environmental sustainability.

Leveraging the funding support from the Natural Sciences and Engineering Research Council of Canada (NSERC), the TACLP provides access to every stage of the production cycle – from seedstock to feedlot. Recent projects highlight the team's ongoing efforts to advance livestock production through innovative technologies and practices that prioritize animal welfare, efficiency and environmental sustainability.

The TACLP completed a research project aimed at identifying and quantifying a panel of predictive blood biomarkers for feed efficiency and sheep parasite infection by using genomics and metabolomics technologies. The study aimed to substantially improve the detection of parasitic infection in sheep, focusing on early detection through the use of blood biomarkers and enabling targeted treatment to reduce the development of parasite resistance and minimize costs associated with anthelmintic purchases.

The TACLP is further evaluating rapid on-farm forage nitrate testing through expanded sample collection across Alberta. In collaboration with Union Forage and Blue Rock Animal Nutrition, the TACLP is assessing the accuracy of the HORIBA nitrate metre and is developing a best management practice for forage nitrate testing that integrates this rapid testing method.

Ongoing applied research between Olds College, Carbon Asset Solutions (CAS), Wyvern, Union Forage and AdvancedAg aims to develop and validate remote carbon monitoring technologies to increase rancher access to carbon credit programs, as well as improve productivity and environmental sustainability in tame and native pastures in Western Canada.

A completed project assessed Ranchbot's suite of remote livestock water monitoring technologies, including a base station for data transmission, water level sensors, rain gauge and flow metre at the Pitstra Farm. The goals were to evaluate the ease of use, operational performance, connectivity, accuracy, usability and resilience for livestock water supply management under Western Canadian rural conditions.

The TACLP continues to be integrated into Olds College academics, supporting knowledge transfer, in-field training and volunteer experiences for students.

Environmental Stewardship

Environmental stewardship applied research at Olds College of Agriculture & Technology focuses on five main areas of innovation:

- **Surface water quality remediation**

- **Agricultural climate change management (mitigation and adaptation)**

- **By-product development and utilization (zero waste agricultural sustainability strategy)**

- **Agrivoltaic production systems (co-production of agricultural commodities and renewable solar energy)**

- **Agricultural land stewardship (green infrastructure development, e.g. shelterbelts and eco-buffers)**

Olds College is most active in water quality remediation applied research as fresh water is fast-becoming a limited resource across the prairies and around the world. Researchers are specifically assessing low-cost, but highly effective, water treatment technologies.

With investments from provincial and federal grant funding agencies, private industry, producers, and agricultural and non-agricultural organizations, the College has been working on industrial and agricultural water quality remediation research.

Olds College Centre for Innovation (OCCI) is focused on finding natural and sustainable ways to produce high-quality recycled water. After the successful completion of insightful and controlled greenhouse trials from 2018 through to 2020, OCCI researchers have progressed to the implementation of a real-world, four-year environmental study titled "Floating Island Technology for Livestock Water Remediation."

This research study aims to provide producers with a sustainable, low-cost, water treatment technology that can improve feedlot run-off water quality for subsequent use as uncontaminated livestock drinking water, or for irrigation of fresh agricultural produce like fruits and vegetables.

In another project, OCCI is working with a private industry partner to develop a conceptual plan for a naturalized stormwater treatment system (including constructed wetlands) in an industrial park (grey infrastructure). Once implemented, the stormwater treatment system will form a "living laboratory" where the effectiveness of using cold-climate, native wetland plants for stormwater treatment (phytoremediation) in an industrial area can be explored. This would be the third "living laboratory" of its kind that Olds College has been involved with over 12 years.

Environmental stewardship comes in many forms and plays a pivotal role in almost every applied research project implemented on the Smart Farm.

Smart Agriculture

Smart agriculture applied research is focused on evaluating, demonstrating and validating agriculture technologies, tools and practices in order to provide manufacturers and users with information on their functionality, accuracy and value — particularly for broadacre, dryland farming in Alberta soil and climate conditions.

Researchers collaborate on industry-driven applied research related to smart agriculture technologies with goals of saving producers time or money, and improving efficiency and environmental sustainability. These technologies include prescription maps, trace gas analyzers, drone and satellite imagery, soil moisture probes, soil nutrient sensors, disease and pest monitoring systems, weather stations, in-bin monitoring systems, rural connectivity solutions and data collection. The research team is also contracted by companies who need support in validating a recently developed innovative product, technology or process.

In 2023, several projects provided compelling results and the continued opportunity to build new partnerships and programs.

Due to success from previous years of research, the team continues work with Agriculture Financial Services Corporation (AFSC) to see if drone imagery of hail-damaged fields can assist the adjustment process.

Over the last five years, Olds College Centre for Innovation (OCCI) has established a strong partnership with Wilde Ag Ventures and Top Grade Ag. This year, researchers continue to collect in-bin drying datasets in combination with Top Grade Ag in-bin drying devices and conduct proof-of-concept testing for renewable energy.

Eight LI-COR chambers were installed on the Smart Farm in 2023 to monitor nitrous oxide emissions (N2O), a greenhouse gas, from the soil. The project continues in 2024 with a few minor changes.

OCCI is in the second year of a project using drone and satellite imagery to aid in detailed site assessments for lease reclamations on cultivated land. Researchers have also been collaborating with UAV Threshold to evaluate the use of swarm drones to detect and map rocks in a field. This year, OCCI is working with SimpleHedge to evaluate its grain hedging mobile application, focusing on the producer's perspective.

BioScout is an Australian company with a specialized device designed to identify and quantify disease spores. Pan-Canadian Smart Farm Network members are conducting a multi-year project with BioScout to sample this technology and help improve its use in Western Canadian agriculture.

OCCI is also working with Trochu Motors and Precision Planting to compare the agronomic and economic impact of using a precision planter compared to a conventional air seeder during canola seeding in a field trial.

Carbon Asset Solutions has worked with OCCI over the years on several projects. Researchers completed an evaluation on the autonomous operation of the Series 150 Unit, which is used to measure, record and verify sequestered carbon dioxide in soil. Additionally, the overall safety of the unit was assessed and recommendations for further autonomous development were provided.

Data and information collection methods have advanced and are allowing researchers to draw informed conclusions faster to provide better guidance to the agriculture industry.

Digital Agriculture

During the past few years, a massive amount of data has been collected from agricultural operations and fields on the Smart Farm.

The harvesting of data represents a revolution in agriculture, which allows for greater opportunities with data-based decisions. However, the digitalization of agriculture can represent a challenge due to an immense introduction of technology and data. A producer might have questions like: How will I fix these new tools? Will I be able to operate them? How can I translate data into practical decisions?

These are very important questions – and the Smart Farm has leveraged its physical and intellectual infrastructure to develop applied research focused on answering or supporting the development of solutions.

Digital agriculture is integrated into many academic courses at the College, and the Smart Farm continuously supports its development. The Smart Farm provides staff and students access to the latest (and developing) technology for agriculture. This allows students to be trained and prepared to handle current and future agriculture technology tools while also being exposed and trained to interpret the millions of data entries collected annually.

While data collection is important through the process of digitalization of agriculture, there is no value to this data if producers can't easily understand and apply it to their decision process. The HyperLayer Data Concept project has been developed with this principle as a foundation.

An extensive and high-resolution dataset for the Smart Farm has been generated – including topographical data, detailed soil organic matter, nutrient and moisture mapping, multispectral and hyperspectral imagery, and yield data. The information carried by this dataset allows for a better understanding and management of the Smart Farm fields, along with supporting the development of other applied research projects.

The digital agriculture team developed a database to organize and store this dataset as well as a web platform that makes sharing and accessing the data easy. Currently, this platform is also capable of managing and processing data. Operations that could take practitioners hours to perform can now be easily generated through the platform, a huge step towards facilitating the use of the immense dataset currently collected from the farm.

Additionally, using the powerful dataset generated since the establishment of the Olds College Smart Farm, next-generation analytical algorithms were built and implemented in the project's platform. Industry partners have recognized the latest version of these algorithms, such as for plant-available nutrients, as revolutionary in the ag industry – and that could contribute directly with agricultural production decisions.

All the data and knowledge acquired through the HyperLayer Data Concept project is being used to improve the management practices of the Olds College Smart Farm, introduce solutions to practitioners and train/prepare the next generation of agricultural professionals.

Autonomous Agriculture Equipment

Olds College of Agriculture & Technology finalized a four-year applied research project on the evaluation and improvement of economic, environmental and logistical benefits of autonomous agricultural equipment for broadacre crop production on the Canadian Prairies. The Raven OMNiPOWER™ platform represents a significant first step towards autonomy applied to agricultural operations.

In 2020, Olds College purchased OMNiPOWER with three compatible implements for academic, training, farming, research and evaluation purposes. In 2023, the team also was gifted a new OMNiPOWER 3200 platform from Raven Industries, Inc. Over the past four years, more than 20,000 autonomous acres of broadacre cropland were farmed on the Smart Farm and three different producer partner sites.

KEY LEARNINGS & SIGNIFICANT TAKEAWAYS

- Autonomy relies heavily on the implement's ability to monitor proper function and report irregularities to the supervisory controller.

- Autonomous turning (following an optimum path) is not impacted by non-autonomous practices, such as human-operator error or turn mismanagement.

- Frequent field boundary mapping is recommended especially if the operator is not familiar with the field-to-audit obstacles, such as low/wet areas, tree-line debris or fence-line modifications.

- Reliable cellular connectivity is crucial for both autonomous operations and safety.

- Non-autonomous or manual operation will always be required for support of autonomous missions.

- During the four years of operating, the OMNiPOWER total autonomous operation time was 425 hours.

- The GCS API (ground control station application programming interface) worked well during the four years of operation (although a skilled employee was available to be the lead operator at the College).

The results of this four-year study demonstrate how autonomous equipment could be a beneficial agricultural asset for a producer – and that specifically OMNiPOWER efficiency and fuel usage has improved over the past few years to a point where it rivals typical equipment used on Canadian Prairie farms. Olds College is looking forward to continuing its work with autonomous agriculture equipment.

ECONOMICS

Labour costs were calculated on a per-acre basis during field operations using OMNiPOWER over four seasons and with conventional equipment operating in 2022. Actual work rates were calculated from data collected during these field activities with both OMNiPOWER and conventional equipment.

Labour cost comparison between OMNiPOWER and conventional equipment.

Labour Costs		Work Rate (acre/hour)	Labour Cost ($)	OMNiPOWER Labour ($/acre)	Conventional Labour ($/acre)
Seeding	2022 Conventional	16.6	26.31	-	1.58
	OMNiPOWER 4-Year Average	7.4	25.85	3.78	1.58
Spraying	2022 Conventional	102.6	26.31	-	0.26
	OMNiPOWER 4-Year Average	39.2	25.85	0.68	0.26
Spreading	2022 Conventional	86.6	26.31	-	0.30
	OMNiPOWER 4-Year Average	32.0	25.85	0.82	0.30

A general summary of the route, field and fuel efficiencies for the past four years of the project are summarized below. Route efficiency is a parameter quantifying the environmental footprint during an operation. This parameter was not found in existing literature, so it was developed during this project as a way to account for overlap, turning, excessive driving and other spatial obstacles leading to reduced route efficiency and driving/operational pathways. Additionally, field efficiency is a common metric used for assessing performance of agriculture equipment.

Average efficiency parameters measured for autonomous and conventional operations during the 2022 field season (April - October 2022).

	Field Efficiency (%)		Route Efficiency (%)		Fuel Efficiency litre/hectare (US gallon/acre)	
	Autonomous	Conventional	Autonomous	Conventional	Autonomous	Conventional
Seeding	74.2	45.6	83.8	69.3	5.3 (0.57)	6.3 (0.67)
Spraying	65.6	61.8	68.7	77	0.8 (0.09)	0.5 (0.05)
Spreading	55	59.8	67.0	72.4	2.5 (0.27)	1.1 (0.12)

ENVIRONMENTAL

Compaction area caused by implement tires used by OMNiPOWER and conventional equipment was compared for seeding, spraying and spreading operations. OMNiPOWER greatly outperformed conventional seeding equipment, which resulted in a 65 per cent reduction in compacted area. However, OMNiPOWER compacted more area than conventional equipment while spraying and spreading.

Comparison of compacted area between OMNiPOWER and conventional equipment using operation implement width, measured route efficiency and 100% route efficiency. Note: 100% route efficiency means the perfect field with no extra driving on it.

Operation	Implement Width & Measured Route Efficiency (RE)				Compacted Area Per Acre at 100% Route Efficiency				Compacted Area Per Acre at Measured Route Efficiency			
	OMNiPOWER		Conventional		OMNiPOWER		Conventional		OMNiPOWER		Conventional	
	Width (ft)	RE (%)	Width (ft)	RE (%)	Area (ft2)	(%)	Area (ft2)	(%)	Area (ft2)	(%)	Area (ft2)	(%)
Seeding	30	83	70	69	5343	12.3	12658	29.1	6437	14.8	18344	42.1
Spraying	121.6	68	120	77	1318	3.0	995	2.3	1939	4.5	1292	3.0
Spreading	80	67	82	72	2004	4.6	1434	3.3	2991	6.9	1992	4.6

Conventional Spreader: John Deere 4940 with New Leader L3030G4 (420/85R34 Tires)

Conventional Sprayer: John Deere 4940 (420/85R34 Tires)

Conventional Seeder: 2017 New Holland T9.600 (710/70 R42 Tires) with New Holland P4580 Tow-Between Air Cart (800/70R38 Tires), New Holland 70 ft P2060 Air Drill (11Lx15FI Tires)

OMNiPOWER: (540/70 R24 Tires)

Seeding with OMNiPOWER had a fuel efficiency environmental benefit as it used 16 per cent less fuel than its conventional counterpart. OMNiPOWER, being a lighter machine, requires less energy to propel and a higher route efficiency makes it perform better. OMNiPOWER used 60 per cent more fuel during spraying field operations – mainly due to a lower route efficiency. OMNiPOWER used 227 per cent more fuel while spreading also due to a lower route efficiency – but mainly due to differences in field conditions.

LOGISTICAL

Both non-autonomous and autonomous operations of OMNiPOWER require coordinated efforts with a support team for successful deployment of field activity outcome. Non-autonomous or manual operation will always be necessary to prepare for an autonomous field operation, and servicing OMNiPOWER requires specialized equipment. The use of a wireless hand-held remote control has proved to be a safe and an optimum method of maneuverability.

These figures illustrate two spraying missions on the same field. The image on the left shows an autonomous spraying operation in 2021. The image on the right shows the same field sprayed by a conventional self-propelled sprayer in 2022.

Comparisons between autonomous and conventional spraying equipment for the same field in 2021-22.

	OMNiPOWER	Conventional
In-Field Time (hours)	2.33	1.76
Total Distance Traveled (miles)	13.40	14.00
Average Working Speed (mph)	5.91	12.12
Field Efficiency (%)	74.22	50.96
Route Efficiency (%)	76	78

Work-Integrated Learning
ON THE SMART FARM

Through applied research and work-integrated learning, Olds College of Agriculture & Technology provides a unique student experience with advanced learning environments where students connect with real-world opportunities and businesses.

The core mandate of the Olds College Smart Farm is to provide a hands-on learning environment for lifelong learning, build the skill sets required to accelerate the development and adoption of agriculture technologies and practices, and train the next generation of agricultural leaders. Olds College students receive game-changing learning opportunities on the Smart Farm by:

- Leveraging Smart Farm data and analysis.

- Working with Smart Farm equipment and livestock.

- Supporting land management.

- Leveraging Smart Farm tracking processes.

- Participating in Smart Farm applied research.

These opportunities help students leverage what they've learned in the classroom and apply it to challenges and opportunities in agriculture so they are better prepared for work in the future. Many academic courses are integrated into Smart Farm-based learning activities including agriculture,

agriculture technology, horticulture, land and environment management, animal health, equine, food production, business and trades.

Every year, Olds College Centre for Innovation (OCCI) welcomes students working as summer research technicians and interns completing their eight-month directed field study at the Smart Farm. These students and interns work alongside researchers who are experts in their respective fields providing them with valuable opportunities to explore career paths and specializations. They also have the chance to network and build their resumes as they prepare to enter the workforce.

In this advanced learning environment, students have the opportunity to apply their classroom knowledge on the Smart Farm, resulting in a unique educational experience. Olds College also benefits from a diverse range of student perspectives including those from around the globe, students who grew up in farming communities and students without prior agriculture experience who come to the Smart Farm to gain industry knowledge.

Founded in 1913, Olds College has been offering quality hands-on education for over a century. As Canada's Smart Agriculture College, Olds College is working to achieve its social purpose of **transforming agriculture for a better world.**

TESTIMONIALS

It has been an absolute pleasure working with Herman Simons, Daniel Stefner and the rest of the Smart Ag team at Olds College. We had excellent communication throughout the research process – and the findings were very valuable.

- Glenn Wilde, Founder, Top Grade Ag

We have been working with Olds College of Agriculture & Technology for several years to prove the commercial viability of our soil scanning technology. Olds College brought the technical expertise to the table to help answer our questions about field durability, measurement and autonomous operation. They also delivered great networking advice on other opportunities they saw that could align with our business. Their background knowledge on agriculture and smart ag applications have proved they are Canadian leaders many times over.

- Robin Woodward, Director, CAS Canada

Our experience was outstanding. The crew at Olds College provided top-notch care for our cattle, provided excellent value in both data and education, and gains. They were very responsive to our queries and needs – and we are still utilizing the data collected.

- Kim Wachtler, Secretary Treasurer, Burke Creek Ranch

Working with the team at OCCI to assist in the development of ZEET's grain drying system was a great experience. OCCI's personnel are awesome – they are very knowledgeable and an absolute pleasure to work with.

- Riley Milford, President, ZEET Inc.

I have been RFI testing my bulls at Olds College every winter since 2012. Folks at Olds College have been good to work with and I know my bulls are well looked after. They spend five months being developed on a proper ration, come out clean and well muscled, and are easy to sell.

Don't miss the chance to measure feed efficiency in your breeding stock. Feed efficient cattle eat less and are better for our environment. We all need to do our part to help the beef industry become more efficient and sustainable.

- Don Richardson, Ranch and Veterinarian, Richardson Ranch, Tlell Polled Herefords, Century Farm located on Haida Gwaii

OLDS COLLEGE OF AGRICULTURE & TECHNOLOGY

SMART Farm

Stay up-to-date on the latest activities, research and results on the Olds College Smart Farm by:

VISITING OUR WEBSITE
oldscollege.ca/smartfarm

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