ROUNDTABLE PROCEEDINGS:

Energy in Agriculture.

FOOD, AGRICULTURE, RESEARCH & POLICY.

THE SIMPSON CENTRE. THOUGHT FOR FOOD.

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THE SIMPSON CENTRE. THOUGHT FOR FOOD.

ENERGY IN AGRICULTURE:

ENERGY + AGRICULTURE + COLLABORATION.

Roundtable Report.

Event date: April 13, 2023.

Location: School of Public Policy, University of Calgary Downtown Campus.

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Executive Summary

Alberta's economy has been based historically on its abundant natural resources, particularly energy and agriculture. The agriculture and energy sectors in Canada are deeply interconnected, since energy is a key input in agricultural production and agriculture provides feedstocks for bioenergy and biofuels. As the world transitions towards a low-carbon economy, both sectors face challenges and opportunities for decarbonization, sustainability and innovation. The Simpson Centre for Food and Agricultural Policy hosted a roundtable event that aimed to promote cross-sectoral collaboration and problem-solving for energy optimization in the agricultural sector. The event showcased the latest research and initiatives for energy production and consumption on Canadian farms and explored optimized energy solutions through collaborations between energy and agriculture. The discussions centered around co-production of agriculture and energy, and featured entrepreneurs, researchers and representatives from government and industry. The ultimate goal was to provide farmers with accessible, relevant, and trustworthy information to support them in their journey towards diversification of their farm operations.

The keynote speaker discussed the potential for collaboration between the agriculture and energy sectors in Western Canada, emphasizing opportunities for innovation and sustainability. Panel discussions focused on the history of the Alberta advantage, the relationship between agriculture and energy and the importance of collaborative transition to sustainability in both sectors. Renewable fuels, made from various feedstocks, can be used as blended or drop-in fuels in place of fossil fuels. Canadian government is driving investment into the industry by backstopping the demand for renewable fuels. Canada is implementing its own credit system in July, similar to the California Low Carbon Fuel Standard (LCFS) to govern renewable fuels. The use of biodigesters is a way to capture value from manure and advance sustainability. Biodigesters can convert manure into renewable energy and fertilizer, and the resulting renewable natural gas (RNG) can be sold to energy markets. Collaboration between stakeholders and supportive policies are crucial for Alberta to capitalize on its potential to capture and convert manure into renewable energy and fertilizer with the adoption of biodigesters. Another example is production of RNG and fertilizer from waste using anaerobic digesters, with opportunities for sustainable aviation fuel production. Alberta has untapped potential in its biomass and can lead Canada in renewable energy, but technology companies are needed to create more value opportunities.

The roundtable discussions shed light on various challenges in the agriculture industry, particularly in energy consumption during fertilizer production. Another significant challenge is securing funding for innovative practices in agriculture due to the lack of investment in the sector. To achieve sustainable agricultural practices, risk mitigation and innovation are crucial, and data sovereignty is a major concern. The discussions also highlighted the importance of effectively measuring progress towards sustainability, resiliency and diversification in the agriculture and agri-food industry. Participants emphasized the need for consistency in measurements, collaboration and innovation, as well as the availability of resources in Alberta's innovation ecosystem. These efforts can help achieve profitability while sustaining different sectors of the industry, mitigating risks and ensuring sufficient food production in the future.

The roundtable concluded with the recommendations to promote sustainable practices and innovation in agriculture. The utilization of microbiome manufacturing techniques and genetically modified plants can boost organic matter and minimize energy consumption. Institutions should consider the environmental, social, and corporate governance (ESG) impact of innovative technologies and collaborate to advance recycling components in agriculture. Incentivizing the adoption of new technologies requires understanding the economic and financial gaps associated with sustainable agriculture and bridging the gap between energy and agriculture through government policy. Additionally, establishing clear and consistent metrics, promoting the use of renewable energy and encouraging innovation and resiliency through better communication and resource connectivity are crucial. Ultimately, collaboration and partnerships among various stakeholders are essential to create innovative solutions and promote sustainable practices in the agriculture industry. The main goal is to provide farmers with accessible, relevant and reliable information to support them in their journey towards diversification and optimization of their farm operations.

Objectives and Introduction

The Simpson Centre for Food and Agricultural Policy organized and led a series of roundtable discussions aimed at promoting cross-sectoral collaboration and problem-solving for energy optimization in the agricultural sector. The discussions showcased the latest scientific research, providing attendees with useful and accessible information to help support the energy transition. Through knowledge brokering activities, research findings will be transferred and disseminated to a wider audience with the assistance of Glacier Farm Media. The ultimate goal of these discussions was to generate awareness and open pathways that can support and accelerate energy optimization in agriculture.

The objective of the roundtable event was to showcase the latest research and initiatives that can help broaden the understanding of energy production and energy consumption on Canadian farms. The event aimed to explore optimized energy solutions stemming from cross-sectoral collaborations between energy and agriculture that could support a whole system approach for the energy transition. The primary focus was on using energy more efficiently to reduce greenhouse gas (GHG) emissions and help deliver on Canada's climate plan.

The roundtable discussion format was intended to bring together participants from a broad range of perspectives, including energy, agriculture, research and government, with a strong representation of small and medium-sized enterprises (SMEs) in Western Canada. The organizers believe that the tooling and pathways for sustainability gains, such as energy efficiency for emissions, land, water, soil and waste management, can be found with improved connections and actioned efforts across energy and agriculture sectors.

The event also aimed at generating awareness about and to open pathways that can support and/or accelerate the energy transition in agriculture. The outcome of these discussions will deliver support to Canadian farmers by providing them with accessible, relevant and trustworthy information that can help them in their journey towards energy optimization.

The discussion in the event centered around the potential, challenges, and world best practices around co-production of agriculture and energy. The panellists were entrepreneurs, researchers, and representatives from government, including its research agencies, as well as representatives from industry and the private sector.

The event featured Wilson Acton, a managing partner at Tall Grass Ventures, as keynote speaker, followed by two panel presentations, each of which was followed by a roundtable discussion.

Panel Discussion 1	**Panel Discussion 2**
What Could Incentivize Adoption of Climate-Friendly Policies without Harm to Producer Economics?	An Innovation Ecosystem for Reducing GHG Emissions in the Food System
Panelists: 1. Bill Whitelaw: Managing director at Geologic and director at Ag for Life. 2. Riley Moss: Senior valuation analyst, TC Energy. 3. Kendra Donnelly: Chief financial officer, Rimrock Feeders Ltd.	**Panelists:** 1. Kevin Hoppins, Chair of the board at UFA Co-operative Ltd. 2. Karen Schuett, Co-founder and CEO, Livestock Water Recycling. 3. Ginni Braich, Senior manager, Alberta Innovates.
03 Roundtable Discussions	**03 Roundtable Discussions**
What do we need to do to achieve the energy transition for agriculture? Listening to different perspectives.	How do we define success? What indicators can be used to track progress in the energy transition for agriculture?

After panel presentations and Q&A sessions, participants broke out into small roundtable groups to discuss specific questions around these topics, associated challenges and recommendations. The groups reconvened and summarized the points of view of the various stakeholders.

Participants

The "Energy in Agriculture" event was attended by a total of fifty-three individuals hailing from academia, provincial and federal governments, and the private sector, including the agriculture and energy industries, finance, SMEs and the non-government sector. The attendees were deliberately selected to ensure a diverse and well-rounded representation of industry, government and research sectors.

The participants, who were experts in their fields, provided valuable insights into various areas including agricultural research, federal and provincial policy, financial solutions, perspectives and attitudes. The event generated constructive suggestions for enhancing diversification of agriculture industry.

Keynote Address:

WILSON ACTON: MANAGING PARTNER, TALL GRASS VENTURES.

The proceedings of the event commenced with opening address by Wilson Acton, following which the panelists shared their insights on the subject matter.

Acton stated that Western Canada, and Alberta in particular, has positioned itself as a world leader in both agriculture and energy, and it now has the opportunity to become a world leader in sustainability and technology as well. Canada is home to six of the world's major agricultural production regions and six major energy basins. Agriculture and energy are foundational sectors in any economy; however, the abundance of resources in Western Canada can also be a curse, as it can lead to complacency and forgetting how lucky the region is to have such deep energy and agricultural production capacity.

"Both sectors are going through significant sustainability transitions, and historically Western Canada has been in the shadows, but they are now embracing change."

For example, the world needs to double its protein production just to feed itself, and this does not even take into account the other aspects around food for fuel or the decline in total acreage for production. We are at the cusp of a generational shift in agriculture, and energy is in the same spot. A sector's adoption of a new innovative technology or practice typically follows an S-curve. Any company's ability to transition between these curves is key to long-lasting success. Acton provided examples of companies that have successfully transitioned between S curves, such as John Deere transitioning into a software business. Energy is moving towards sustainability and technology, creating a huge opportunity for innovation.

Agriculture is currently at the baseline foundational stage in terms of sustainability and technology, but in terms of business and enterprise software the industry has not evolved since the early 90s. SAP and Oracle didn't exist at that time but now have a dominant position in the market. There is a significant overlap between energy production and agricultural production globally, and this has led to innovations such as biofuels and bioproducts. The convergence of agriculture and energy brings a lot of potential, especially as we face land loss to climate change and urbanization. The US ethanol policy in the seventies provides an interesting example of this convergence, in which farmers were encouraged to grow corn for energy due to a major energy crisis. Today, we have opportunities for decarbonizing supply chains through hydrogen and ammonia, which requires the intersection of agriculture and energy. This presents a tremendous opportunity for these two sectors to come together with advanced materials. There is a huge opportunity for further innovation at this intersection, and that bringing together the expertise and resources from both industries can lead to even more impactful solutions.

The Inflation Reduction Act is a large package that aims to drive a more aggressive strategy in greening the US economy. One part of the legislation focuses on advanced materials and the Department of Energy has a mandate to get $180 billion out the door in the next twelve months.

The lines between traditional industries are blurring, and companies in the agriculture and energy sectors are increasingly collaborating and working together. The example of sustainable aviation fuel highlights the challenges of meeting sustainability goals and the opportunities that exist for innovation and growth. JetBlue Airways and United have set ambitious targets to be carbon neutral by 2030 and 2040, respectively. However, the current investment in sustainable aviation fuel is not enough to meet these goals. This creates an enormous opportunity for companies to develop new technologies and processes to produce sustainable aviation fuel at scale. The question is, who will lead the way? Will traditional energy companies take the lead, or will agricultural companies, such as those producing canola, become the new energy powerhouses?

The emergence of companies like livestock water recycling and Divert in the energy sector is also worth noting, as they may become the next energy powerhouses. These companies are focused on upcycling food waste and recycling livestock water, which has the potential to transform the energy sector in the same way that multistage fracking and shale gas did in the past. It remains to be seen whether these companies will be able to scale up and become major players in the energy industry, but they are certainly worth watching.

Energy companies such as Enbridge and TransCanada may become agriculture companies as they invest in building the infrastructure for biogas and RNG production. Similarly, companies like Chevron and BP may become seed genetics companies as they work on developing sustainable aviation fuels. A company called Zila Bio works has found a way to make epoxy resin out of vegetable oils such as hemp seed, linseed, and flax. They have partnered with Winnebago to replace panels in RVs with these eco-friendly materials. As these lines between industries start to blur, there is a huge opportunity for the energy and agriculture sectors to work together. For example, solar farms can be combined with regenerative agriculture practices to maintain protein production on the same lands.

The blurring lines between traditional sectors also raise questions about the impact on food production and supply chains. If companies start producing sustainable fuels and materials using crops traditionally used for food, will this affect food production and prices? Will companies have to double the yield of their crops by 2030 just to meet the needs of the aviation industry? It important to consider the potential impacts on other sectors, such as agriculture and water management, as we make these transitions and strive for achieving net-zero emissions. There are many unanswered questions and opportunities for growth, and it will take a collaborative effort from industry, government, and society as a whole to move towards a more sustainable future.

Panel Discussion 1: Energy — Innovation — Agriculture

Panelists — Bill Whitelaw, Riley Moss, Kendra Donnelly

BILL WHITELAW, MANAGING DIRECTOR AT GEOLOGIC AND DIRECTOR AT AG FOR LIFE

Whitelaw referred to Wilson Acton's Venn diagrams that illustrate the current "sweet spot" of opportunity that exists in Alberta and provided gave a brief history lesson on the Alberta advantage, specifically in relation to the energy and agricultural sectors. The federal government under Sir John A. Macdonald incentivized companies and individuals to move west, settle along the rail line and homestead on 160-acre plots. The homesteaders received rights to the minerals and resource wealth beneath their feet, which many of them did not realize until the first oil well was drilled in Medicine Hat. The companies that were not homesteaders received mineral rights and resource wealth, and this relationship between agriculture and energy has been present in Western Canada for a long time.

Whitelaw discussed the importance of using the concept of transition as a framework for discussing the evolution of the agriculture and energy sectors. The concept of transition is semantically elastic and contested in both sectors, but it is ultimately progressive, constructive, and full of opportunity. However, the path ahead is littered with obstacles, and the transitions in both sectors are contested by different components of society. Therefore, good policy thinking, and dialogue must be the starting point for addressing these challenges, and the School of Public Policy is a critical home base for this conversation.

The Alberta advantage was formerly a popular concept in the province and was used to attract foreign investment and migration from within Canada. The advantage was based on a tax trifecta of low personal and corporate tax rates and no sales tax. This approach was successful for several years, until other jurisdictions improved their tax structures and became more competitive. However, the concept can still be revived in a creative way to suit different contexts. Two industries in Alberta, fracking and feedlots, face disadvantages related to water stewardship. The amount of water consumed, and the wastewater produced by a single cow in the finishing process is alarming, and fracking operations in the Montney area also draw water from local watersheds, produce wastewater, and inject it back downhole, creating problems. There is an opportunity to have better conversations about water stewardship and related technologies and business processes.

Another issue that needs to be addressed is achieving net-zero emissions, particularly for the oil sands and oil seeds industries. The Pathways Alliance is doing good work in terms of emissions management, but there is still a fundamental problem with achieving net zero. The human capital in the energy and agri-food industries also presents a challenge, as the younger generation may see these industries as a "sunset sector" and not want to dedicate their careers to them. However, with the right approach and spin on the transition dynamics, this narrative can be changed. Transitioning to a decarbonized grid is also a mammoth undertaking that involves multiple actors, and it is essential to consider the implications of global events such as the conflict between Ukraine and Russia, which has historical ties to Alberta. Canada's energy and food privilege also needs to be taken into account when thinking about transitioning to a more sustainable future.

"There is a need to engage younger generations in the agriculture and energy sectors, and this can be achieved through the establishment of an ESG secretariat."

The ESG secretariat will enable Alberta to attract future human and financial capital and will be vital to framing the discussion around deliberating on future developments in the province. The post-secondary ecosystem can play an important role in achieving this. Whitelaw mentioned several organizations in the agriculture and energy sectors and highlighted the need to harness all these moving parts to bring stakeholders into the conversation. Innovative companies are adapting to the changing world and creating value through innovative ideas. For example, Kiwetinohk Energy, an oil and gas company drilling for natural gas, generates power at its own gas costs, negotiating a new agriculture tax system, and decarbonizing the grid to make itself more attractive to shareholders. Another company, Accelerator, has developed a technology to reduce the viscosity of bitumen in heavy-oil contexts without steam, burning gas, water or emissions. Whitelaw emphasized the importance of watching and learning from these companies to accelerate momentum in the agriculture and energy sectors. The University of Calgary also possesses some fantastic assets, including the W.A. Ranches, the Energy Transition Center and the School of Public Policy, which, through cross-faculty and cross-disciplinary research, training and learning, can greatly facilitate this collaborative consultation to accelerate the energy transition conversation, a collaboration that Whitelaw likened to the permeability of hydrocarbons in the ecosystem.

RILEY MOSS, SENIOR VALUATION ANALYST, TC ENERGY

Moss, who works at TC Energy in the Power and Energy Solutions group, gave a presentation on building a renewable energy portfolio. The group has been exploring solar and wind power and hydro battery storage, and last year they added RNG. Renewable fuels are those that can replace or be blended with fossil fuels, and their feedstocks can come from sources such as manure, crop by-products, forestry by-products, landfill gas and municipal waste. These markets have been emerging over the last few years and require fossil-fuel producers to purchase their products. Those who create renewable fuels earn credits that they can in turn sell. Fuel producers who sell traditional gasoline must buy these credits, which gives them credit value. This market puts the onus on fossil fuel producers to buy more and more renewable fuels and gives the creators of these fuels an opportunity to earn money from their efforts.

Renewable fuels can be used as a blended fuel or a drop-in fuel in place of fossil fuels. They are made from various feedstocks such as manure, crop by-products, forestry by-products, landfill gas and municipal waste. There are three main laws that govern renewable fuels: the Renewable Fuel Standard (RFS) in the US, the LCFS, and the Canadian Clean Fuel Regulation (CFR). The RFS requires fuel blenders in the US to procure a certain percentage of their fuel from a certain type of renewable fuel each year, and each gallon of renewable fuel creates a Renewable Identification Number (RIN) that represents a different emissions reduction. The LCFS in California sets a benchmark carbon intensity for fuels, and anyone selling above that baseline must purchase credits from

those who create renewable fuels. The CFR in Canada is similar to the LCFS. The government is backstopping the demand for renewable fuels to drive investment into the industry. Prices for renewable fuel credits in California have recently collapsed, but the government is taking steps to address the issue.

"Starting in July of this year, Canada will be implementing its own credit system that emulates the Low Carbon Fuel Standard."

Gasoline or diesel importers or producers who import or produce more than 400 cubic meters must purchase credits if they are not buying enough renewables. There are four different methods to create credits in Canada. The first is reducing the lifecycle emissions on fossil fuels. The second is creating low carbon intensity fuels. The third is displacing diesel and gasoline by investing in EV charging infrastructure. The fourth is an emission-reduction funding program.

In Canada, a non-profit organization must be responsible for the commercialization or deployment of emission-reduction programs, and for every $350 donated to them, adjusted for inflation, one credit is given for one ton of CO_2 avoided. TC Energy entered a deal last year to purchase RNG from a facility in Lynchburg, Tennessee. They are now exploring how to sell the RNG, given the new credit system in Canada. TC Energy has invested in Three Rivers, a company that is building a digester at the Lynchburg facility. The digester converts the waste from the whiskey-making process into methane gas, which is then sold to TC Energy. This deal represents TC Energy's first foray into the RNG market, which is rapidly growing, with over $18 billion of merger and acquisition activity in the space in the last two years alone. There is a significant opportunity for Alberta to capitalize on its deep expertise in both energy and agriculture to collaborate and drive progress in this area.

KENDRA DONNELLY, CHIEF FINANCIAL OFFICER, RIMROCK FEEDERS LTD.

Donnelly owns three feedlots in Alberta and has partnered with Tidewater Renewables, a leader in energy transition and production of low carbon fuels. The partnership is aimed at constructing an on-farm biodigester facility next to one of her feedlots in High River, Alberta. The biodigester will be next to its feedstock source, making it an on-Confined Feedlot Operations (CFO)- biodigester. The partnership combines the agriculture and agri-food industry with the energy industry to successfully deploy this project. The proposal will see the production of low carbon fuel, which is essential for the energy transition that is taking place globally. Their High River Project involves reducing waste, producing renewable energy and decreasing emissions. The project takes manure and turns it into renewable natural gas without losing any nutrients. The circular loop of the project involves using the nutrients from the manure to produce food or fuel with different crops grown nearby the feedlot.

"Alberta produces over four million tons of manure, which is a perfect feedstock for biogas production. We just need to monetize on that feedstock."

To collect the manure, the feedlot uses rolled compacted concrete flooring, which improves the performance of the cattle and reduces maintenance costs. The collected manure is then prepared for injection into the anaerobic digester, which produces two products: RNG and digestate. RNG is upgraded from biogas and is used for renewable energy, while the digestate is a nutrient-rich product that can be used as organic fertilizer or soil amendment. Partnering with an energy company is important, as the process of upgrading biogas to RNG is complex.

They are also constructing an upgrading system, which will take biogas and convert it to RNG that can be injected into the pipeline for use in High River. The environmental attributes of the RNG will be sold to Fortis, BC, presenting a huge opportunity. The circular system ensures that the nutrients are not lost and the solid and liquid digestate produced can be used as a nutrient source for cattle. The speaker emphasizes the importance of the beef sector staying competitive to be able to buy products like canola crushing meal and wet dried distillers grains (DDGs). In sum, manure is upgraded into RNG and is ultimately returned to the land, creating a loop. Donnelly concluded her talk by suggesting that finding a source for every product and turning liabilities into valuable products can be achieved through collaboration in sustainability projects, which can drive discussions to create great policy and help different industries thrive.

Biodigesters are used to convert the manure produced by feedlot operations into renewable energy and fertilizer. The biodigesters work by breaking down the organic material in the manure and producing biogas, which can be further processed into RNG that can be injected into the pipeline and sold to energy markets. The solid and liquid digestate by-products can also be used as fertilizer. This circular system is not new, but it is a unique approach for the feedlot sector. It has the potential to be a global opportunity, as manure is a feedstock that has not yet been fully utilized for renewable energy production.

It is crucial to have supportive policies and infrastructure in place to facilitate the adoption of biodigesters. Additionally, collaboration between various stakeholders such as industry, government and academia is essential for success. Alberta has a strong energy sector and regulation, and it is important to build on that foundation while also thinking differently about how to stay competitive in the face of investment going into other sectors. The use of biodigesters is a way not only to capture value from manure but also to advance the technology and thinking around sustainability.

Roundtable Discussion I — What Do We Need to Achieve the Energy Transition?

The participants broke out into three roundtable discussions to discuss each of three clusters: agriculture, energy, and government policy. The discussion revolved around the following questions:

i. What does reduced energy consumption look like?

ii. What are the opportunities for energy production on the farm?

iii. What does energy efficiency look like recycling, and how does it translate into different SMEs and companies that play in those spaces?

A summary of the discussion is presented below:

I. ENERGY CONSUMPTION IN AGRICULTURE

Energy consumption in agriculture remains a significant concern, given that the production of one calorie of food often requires twenty calories of energy. Notably, fertilizer production contributes to this high energy consumption, with up to seventy-seven gallons of fuel required to produce one ton of fertilizer. The decline of organic matter in soil presents a further challenge, but farmers can address this issue by adopting microbiome manufacturing techniques that produce biostimulants, which can increase organic matter and reduce reliance on fertilizers.

Fortunately, advances in plant technology have significantly reduced energy consumption in agriculture. For instance, genetically modified plants have doubled production while reducing energy consumption, thus representing a viable option for sustainable agricultural practices. When assessing energy consumption in agriculture, it is crucial to consider alternative uses for crops. For example, crops may be diverted from food production to energy production, potentially exacerbating food shortages and driving up prices. In this context, price stability and environmental impacts are also crucial considerations.

Ultimately, doubling production while using the same amount of energy can help lower emissions intensity and reduce the environmental impact of agriculture. Therefore, it is critical to continue exploring innovative solutions and technologies that promote sustainable and energy-efficient agricultural practices.

II. OVERCOMING FUNDING CHALLENGES

Securing funding for innovative practices in the agriculture industry in Canada presents a significant challenge. The economics of agriculture, merging public and private interests and understanding financial gaps are critical to driving innovation and sustainability. The funding landscape for ag and ag tech in Canada is challenging, with few funds focused on these sectors and traditional general partners not investing due to lower returns compared to other sectors. Early-stage SMEs working on ag and ag tech are having a tough time raising capital. To shift the investment focus to these sectors, institutional funds need to move away from looking solely at cash-on-cash return and instead consider the ESG impact that these technologies can have on society, such as health outcomes and reduced energy consumption. The energy sector also presents opportunities for innovative practices with strong ROI, but partnerships and policy support will be critical to their success.

Recycling components in agriculture present a great opportunity for farmers to reduce waste and improve sustainability. However, the energy sector requires front-end investment, community support, partnerships and policy support for innovative practices.

Collaboration between different government ministries is crucial to promoting initiatives related to the environment and the circular economy. Despite successful collaborations in the past, declining energy prices have decreased interest in bioplastics and other initiatives, making it harder to secure funding and support.

In Alberta, the circular economy initiative brought together the energy, agriculture and environmental sectors to promote sustainable practices. However, the declining economic incentives for alternative production methods have led to a decrease in the initiative's popularity in recent years. To incentivize the adoption of new technologies and innovations, it is critical to understand the economics and financial gaps associated with sustainable agriculture. This requires engaging with farmers, operators and other stakeholders to gain a comprehensive understanding of the situation and find ways to make the economics work for producers to adopt sustainable practices and make innovative decisions that make economic sense.

The issue of red tape in the agricultural industry, specifically the amount of paperwork and regulations that farmers must deal with also hinders investments. While there are incentives such as carbon credits that could potentially motivate farmers to comply with these regulations, many farmers simply do not have the time or resources to deal with the extra paperwork. Farmers want to focus on farming, not on administrative tasks.

III. RISK MITIGATION AND INNOVATION

Innovation is about building a community of risk-takers who are willing to take calculated risks to bring new ideas to fruition. Innovation often comes with risk, especially in the agricultural industry, in which changes in production practices and energy consumption can be met with resistance from farmers and communities. Participants considered how farmers can be risk averse. The term “seventh picker-upper” was used to describe the idea that individuals often do not want to be first to adopt an innovation or project, but want to know that it works before they adopt it. However, opportunities for energy production on the farm, such as biogas and renewable energy projects, exist, and it is essential to address concerns and find ways to make the transition more accepted and understood by all stakeholders to move forward with innovation in agriculture and energy production. Building linearly scaled systems that reduce risks and entry points for new innovations is suggested, and education and the use of test farms can provide proof of concept to help reduce risks for farmers. Participants discussed the need for opportunities to demonstrate successful projects, so that those interested in creating a similar project can see a demonstration of it. The ability to see these demonstrations would allow people who want to invest in these projects to see clearly how these projects could change returns on investment and impact soil carbon and new jobs created for community members. Collaboration, communication and support are necessary to drive innovation and manage associated risks in the agricultural industry.

IV. DATA SOVEREIGNTY

Data sovereignty is a major concern in the agricultural sector, particularly with regards to input companies and their ownership of valuable data. The friction between buyer and seller can also make it challenging to share data up and down the value chain, especially when it comes to price discovery. Consumers are increasingly demanding information, which creates a need for pre-competitive conversations to effectively share data. One potential solution is to create incentives for innovation through investment tax credits rather than transactional incentives. In terms of government policy, there is a need to bridge the gap between energy and agriculture so that they can work together to produce both food and energy without one taking away from the other's productive capacity.

V. INCREASED COLLABORATION AND PARTNERSHIPS

In addition to the discussion about creating a community of risk-takers, participants discussed the idea of creating collaboration among the many different partners involved in energy and agriculture. Bringing conversations together between the energy and agriculture industries is crucial in creating innovative solutions to challenges and capturing environmental goods and services. Additionally, the participants discussed the challenge of high-capital expenditures required in building new plants in emerging technologies and the need for SMEs to step in as brokers and intelligence brokers to bring together different partners and funding sources. Bringing these conversations together is crucial in building trust, which takes a long time to establish but can be destroyed in minutes. The discussion emphasized the need to be open to new ideas and the willingness to try new things, even if it starts with a trial. There are challenges of collaboration and ideation in the agricultural industry and there is a need for better communication and trust between different parties, including farmers, businesses and post-secondary institutions. The lack of a centralized entity to coordinate ideation and scaling also presents a challenge. This gap needs to be filled by considering scale, funding and feasibility when developing solutions, as well as the need for extension services to support farmers.

The government has a role in setting policies to promote collaboration between the energy and agriculture industries. For example, there is a concern that solar and wind projects are taking up valuable farmland, and there is a need to figure out how to balance agricultural production and energy production. There is also some potential for the agricultural industry to collaborate with environmental services companies for land reclamation. Overall, the role of collaboration and trust is critical in driving innovation and growth in various industries.

VI. COMMUNITY ENGAGEMENT AND EDUCATION

Community engagement is a crucial aspect when it comes to large-scale renewable energy projects such as wind and solar farms. Despite the benefits of renewable energy, there is often community pressure that can make the adoption of such projects challenging. This pressure can stem from concerns about being ostracized from the community, which can be tangible and measurable. However, there is a need to move towards a way to accept and understand renewable energy and its benefits. This can be achieved through proactive communication and partnerships that demonstrate the sustainability of these projects. By working with sources that are compatible with regenerative agriculture, it is possible to make significant progress towards sustainable primary production.

Decarbonization is a crucial factor driving the adoption of new technologies, with carbon credits serving as the key driver. Alberta's abundance of space and resources has historically led to a lack of mindfulness towards environmental impacts, but the provincial government is becoming increasingly aware of the consequences. The use of simple and relatable messaging that can be easily understood by all stakeholders is crucial to promoting the adoption of sustainable practices. The term "sustainability" is being questioned, as it may suggest a desire to maintain the status quo rather than promote innovation and progress. It is important to merge land stewardship and agricultural production to improve communication with consumers. Therefore, community engagement and education are crucial in promoting renewable energy projects and achieving sustainable outcomes.

Recommendations

Sustainable and energy-efficient agricultural practices

1. Encouraging the use of microbiome manufacturing techniques and genetically modified plants can lead to sustainable and energy-efficient agricultural practices. These approaches can increase organic matter, reduce reliance on fertilizers and double production while reducing energy consumption.
2. To shift the investment focus to the agriculture sector, institutional funds should consider the ESG impact of innovative technologies, such as health outcomes and reduced energy consumption, instead of looking solely at cash-on-cash return.
3. Integrated systems that can work within a community and the excess energy produced by bio-digesters can be put back into the greenhouse, as seen in some communities in the US.

Collaboration for environmental initiatives

1. Collaboration between different government ministries is crucial to promoting initiatives related to the environment and the circular economy. Recycling components in agriculture presents a great opportunity for farmers to reduce waste and improve sustainability.
2. Collaboration is crucial in building SMEs and making the local area hubs a profitable centre for everyone who participates.
3. It is also essential to include underrepresented groups such as Indigenous peoples in economic growth. One way to achieve this is through partnerships with the government and the First Nations.

Removing barriers to innovation and technology adoption

1. To incentivize the adoption of new technologies and innovations in agriculture, it is critical to understand the economics and financial gaps associated with sustainable agriculture. Engaging with farmers, operators and other stakeholders to gain a comprehensive understanding of the situation can help find ways to make the economics work for producers to adopt sustainable practices and make innovative decisions that make economic sense.

2. Building linearly scaled systems that reduce risks and entry points for new innovations can provide proof of concept to help reduce risks for farmers. Collaboration, communication, and support are necessary to drive innovation and manage associated risks in the agricultural industry.
3. Bridging the gap between energy and agriculture so that they can work together to produce both food and energy without one taking away from the other's productive capacity can be achieved through government policy.
4. Pre-competitive conversations to effectively share data can be encouraged through creating incentives for innovation, such as investment tax credits rather than transactional incentives.

Panel Discussion II: Energy — Innovation — Agriculture

Panelists — Kevin Hoppins, Karen Schuett, Ginni Braich

KEVIN HOPPINS, CHAIR OF THE BOARD AT UFA CO-OPERATIVE LTD.

Hoppins, a fourth-generation farmer, gave a talk on energy consumption in farming. He challenged the stereotype that farmers are resistant to technology and stated that they are eager to adopt new methods to improve their farms. His farm operations include growing wheat, barley, peas, canola and raising commercial cow calf operations. The farm employs seven families, who work together towards the common goal of feeding the world. The farmers are environmentally conscious and care about the animals they raise. Kevin shared an experience he had with a cow that followed him after he picked up some carcasses, which he sees as an example of the deep connection farmers have to the land and their understanding of what it takes to raise food for the world.

Hoppins quoted Henry Wise Wood, a farmer from Carstairs, Alberta, who played a key role in the formation of the province and the United Farmers of Alberta (UFA): "Farmers may not be ready to take over the government, but we're going to do it anyway." He pointed to Wood's visionary spirit and how it still resonates with farmers and ranchers today. He also discussed UFA's purchase of Maple Leaf Petroleum in 1953, which was initially criticized but turned out to be a great decision.

The need to reduce fuel consumption on farms and ranches has been realized by farmers who have made changes to be more efficient, such as the direct seeding movement that saved fuel and conserved soil moisture. Hoppins emphasized that farmers and ranchers have an innovative spirit and a willingness to adapt to changing times to improve their efficiency and productivity.

However, farming is always subject to time constraints and at the mercy of Mother Nature. Farmers need to produce food to feed the world, and insurance doesn't feed the world. The use of technology such as microwave-assisted grain drying, which has been applied in oil extraction from ponds, presents an intriguing possibility for grain drying applications. There are other grain drying methods available, such as solar-powered grain dryers that use renewable energy to dry crops, reducing reliance on electricity or propane. Another option is natural air drying, which involves using high-volume, low-speed fans to blow ambient air through the grain. This method can take longer than other methods, but it can be more cost-effective in the long run. He also mentions the use of a diesel generator and propane to power a high-throughput, high-efficiency grain dryer and the possibility of using an electric tractor on the farm. He suggested weighing the costs and benefits of different grain drying methods and choosing the one that works best for one's specific situation.

"I'll just close with a little story of a farmer who was asked to list his assets. And he said, Well, that's quite simple. It's the land, the water, and the grass. Everything else you see on my farm are just tools to manage my assets."

Hoppins encouraged farmers to be open to learning more and exploring new options to improve their farm's efficiency and sustainability.

KAREN SCHUETT, CO-FOUNDER AND CEO, LIVESTOCK WATER RECYCLING

Schuett talked about how her company's technology addresses the issues of energy consumption and production on livestock farms by managing assets, particularly water and waste. Farmers are leading the transition towards achieving net zero and reducing GHGs, and they are early adopters and entrepreneurs who are not resistant to new technology. Livestock Water Recycling is working towards finding waste solutions in the US, and they are currently working on thirty locations to produce renewable natural gas from farm and food waste. The process involves converting waste such as manure and wastewater into valuable resources such as methane and nutrients for agricultural use. It uses anaerobic digesters to extract volatile solids from waste, producing methane that can be used for energy production. The process also involves microwaving manure to produce a dry solid that can be transported more easily and used as a nutrient-rich fertilizer. There are opportunities for energy production and sustainable aviation fuel production from waste, and the Hub and Spoke model is an effective way to optimize digester sizing and overall system capital expenditures. The purchase of equipment for this process is supported by the Inflation Reduction Act, which provides tax credits for equipment purchased on energy producing properties.

The project includes extracting volatile solids from cow manure and using them to produce biogas through a digester. The digester is located on one of the dairy farms and receives volatile solids from other farms within a 100-mile radius. After biogas production, the leftover nutrients, such as nitrogen, phosphorus, and magnesium, are extracted and can be used as fertilizer for local crops or sold in the market. The US government has invested in programs to promote local fertilizer production, and there is potential for similar programs in Alberta. Total cost of the project is around $500 million, and there are seven dairy farms involved, with a total of just over seventeen thousand cows. There are further contracts of about half a million cows in the US, and a billion gallons of manure are treated annually. Schuett's company collects the volatile solids from the seven farms and transports them to four digester hubs, totaling 28 systems, where they undergo processing.

The digester-produced gas is upgraded and sold in the LCFS market by an Albertan company. The project has faced economic challenges due to fluctuations in the LCFS market, but the company is working on increasing the extraction of volatile solids from manure, with the current extraction rate at 85 percent and a goal of increasing it to 95 percent. This technology development is aimed at producing more biogas and improving the gas economics of the operation. They are also exploring other waste streams, such as meat processing waste, as potential sources of biogas. The company uses data analytics to optimize nutrient, water, biogas and fertilizer output. They are also working on a machine learning application for beef to biogas, which they hope will be supported by the federal government.

"There is just a ton of untapped potential in our manure markets, and we're helping them as a community into this market and producing more food and energy for Alberta and helping with this transition."

There is a huge opportunity for project development in Alberta due to its leadership in energy and livestock production. There is untapped potential in the manure markets, particularly with beef, and the advantages lie in its agriculture and energy industries and its biomass. Alberta can lead the way in Canada in terms of renewable natural gas, hydrogen, and sustainable aviation fuel. We need to investigate how technology companies can help prove the viability of the technology in other markets and create more value opportunities in Canada.

GINNI BRAICH, SENIOR MANAGER, ALBERTA INNOVATES

Braich discussed the impact of innovation in her organization, particularly in the agri-food industry. Alberta Innovates is the largest research and innovation funder in the province, which also serves as a convener, connector, collaborator, partner and service provider through its two subsidiaries, Inno-tech and C-FER technologies. The organization's innovation priorities are Smart Agriculture, clean resource technologies and digital health, while entrepreneurial ecosystems across the province and AI serve as enablers to ensure economic benefit, environmental and social outcomes. With over thirteen hundred active projects, Alberta Innovates has a portfolio value of over $1.2 billion for the last fiscal year.

Braich discussed energy consumption in agriculture, revealing that diesel is the largest energy use in Alberta farms, followed by motor gasoline, electricity, and natural gas. The energy use intensity of GHGs has not been going down but has gone up in the last ten years. Alberta Innovates is currently funding two projects to address these issues. The first project is on-farm grain drying, which aims to minimize spoilage risk, ensure timely and uniform drying, and increase energy efficiency through the use of sensors and automated controls. The project is being led by Lethbridge College and OPI Systems, and trials in 2022 had thirty-five participants.

The second project is on farm logistics planning, which uses AI and sensors to optimize the pathways of farm equipment to improve decision-making for operator time, fuel consumption and soil compaction. The project is being conducted by Alberta-based company Verse.

Braich discussed three examples of companies that are using technology to improve agricultural practices. The first was of a company called Decisive Farming, which uses GPS technology and data analytics to optimize farming practices. They offer a variety of services including variable rate fertilizer application, crop scouting, and yield mapping. The second example was a company called Verge Technologies, which uses artificial intelligence to optimize equipment performance and improve efficiency. Their technology allows farmers to optimize by different parameters such as speed, operator time, and fuel efficiency. The third example was IntelliRain, a company focused on developing an adaptive irrigation control system that uses variable rate irrigation control to improve crop health and increase yields.

"Entrepreneurial ecosystems and artificial intelligence play a critical role in driving economic growth while also promoting the environmental and social outcomes we desire."

Alberta innovates is funding the Agriculture and Bio-Industrial Program, which has a broad focus on optimizing crop productivity, adding value and increasing sustainability and social benefits. The program is open to anyone who fits within the umbrella of the ecosystem, and it offers maximum funding of $500,000 with up to 50 percent matching. There are other initiatives of Alberta Innovates, such as renewable and alternative energy, bioenergy in circular economy and water innovation. It recently launched a $50 million hydrogen Centre of Excellence and is involved in stewardship and work in the irrigation zones of Alberta.

Roundtable Discussion II — *The "How-Tos" of the Energy Transition*

After the second panel discussion and Q&A session, the participants broke out into three roundtable discussions to discuss these specific questions:

- How do we define success?
- What indicators can be used to track progress in the energy transition for agriculture?

I. MEASUREMENT: DEFINING OUR AUDIENCE, MEASURING IMPROVEMENT

Effectively measuring progress towards sustainability, emissions reduction and increased productivity in agriculture is critical for achieving the energy transition. This involves identifying what to measure, determining units of measurement, and finding sustainable ways to collect and communicate data. Creating a baseline is important to track improvements and capture carbon credits, but it is crucial to have consistency in the measurements to create trust in the system. Consistency in measurement is essential to ensure trust and prevent exploitation. Measurements must be economical, easy and accurate. Carbon sequestration is a challenging measurement process, and the agriculture and agri-food industry have different measurement practices, making it difficult to have a one-size-fits-all approach. For example, accurately measuring carbon intensity and efficiency in agriculture is important in order to decrease the carbon footprint as well as obtaining detailed data to enable improvements and to reward farmers who demonstrate excellence in reducing carbon emissions. It's essential to balance sustainability costs while also recognizing the importance of granular data and rigour in carbon offsetting, while at the same time acknowledging the difficulties surrounding the fungibility of carbon offsets.

Different audiences require different metrics, and timing is crucial. Successful measurement involves monitoring and verifying changes in practices and their impact on various metrics. The conversation covers topics such as competitiveness, collaboration, lifecycle assessment and market potential for innovations. The goal is to achieve profitability while sustaining different sectors of the industry and mitigating risks.

II. RESILIENCY AND DIVERSIFICATION

Resiliency is an important quality to have in Western society, where we often take basic necessities like food security and warmth for granted. Long-term messaging is crucial to promote proactive measures that ensure sufficient food production in the future. Reducing energy consumption in the agriculture sector is a key aspect to achieving this goal. However, using synthetic energy to increase yield synthesis is not a viable solution, as it leads to yield leakage and lack of yield. To address this issue, it is important to

measure, monitor and verify the impact of practice changes on various metrics such as carbon levels in the soil, disease and insect pressure.

The discussion also focused on intensifying farms rather than expanding them by finding ways to better utilize land. Continuous improvement is also necessary to reduce energy consumption and improve the overall agricultural landscape. Farmers can also benefit from leasing their land for solar or wind energy projects and reinvesting the money elsewhere on their properties. Finding the least productive parts of a farmer's land to use for renewables, as well as the potential for dual use of land for energy production and grazing, is something they can look into.

Success of these ventures can be measured by various indicators such as profit, soil health, nutrient density of food, input costs and diversified revenue sources. The importance of measuring resilience was also discussed, including stress testing and social factors such as mental health and social success. Participants also discussed being the preferred supplier globally, increasing sole supply arrangements and competitiveness. Collaboration with competitors was emphasized as a way to achieve success and learning from both successful and failed attempts was highlighted as important in creating a resilient farming industry.

III. ALBERTA'S INNOVATION ECOSYSTEM

Businesses need to be aware of the availability of resources in the innovation ecosystem of Alberta, including various programs and subsidies supporting SMEs. Some emphasized the need for better communication and connection of resources. Challenges in accessing funding and navigating program criteria and restrictions were also discussed. It was suggested that starting small and growing incrementally may be a more effective approach to innovation than relying on large investments. Ongoing public policy conversations and audits of innovation programs were highlighted to ensure their efficient and effective use.

Regarding commercializing university innovations, it was noted that there is a lot of innovation happening, but there is a lack of competence to commercialize them. Cooperating with business-minded people who can scale innovations is needed, along with more funding to help young companies move forward. The process of commercializing innovations can be slow and risky, and there needs to be more incentivization to fail faster. The policy within industries, such as oil and gas and agriculture, can be risk-averse and lead to delays in commercializing innovations. Universities do not need to commercialize all their technology, but more cooperation with technology companies is necessary to bring innovations to market.

Recommendations

The participants discussed the suggestions on how to encourage climate-friendly practices on the farms by removing the barriers to adoption of new knowledge and technologies. They also discussed the strengths and weaknesses for the Canadian innovation ecosystem and how it can be leveraged to support the transition to a sustainable agriculture. The following recommendations from the roundtable discussions were presented before the larger audience of the event.

Measuring success

1. Establish clear, consistent, and economically viable metrics for measuring progress towards sustainability and emissions reduction in the agriculture industry. This should involve collaboration between stakeholders and should take into account the needs of different audiences.

Encouraging resiliency and diversification

2. Encourage resiliency and diversification in the agriculture industry by promoting the use of renewable energy, intensifying farms, and finding ways to better utilize land. This should involve measuring the impact of practice changes by various metrics and promoting collaboration with competitors.
3. Encourage innovation in Alberta's agriculture industry by making resources more accessible and creating incentives for failure. This should involve better communication and connection of resources, cooperation with business-minded individuals to scale innovations and more funding to help young companies move forward.
4. Prioritize consistent and effective public policy conversations and audits of innovation programs to ensure their efficient and effective use.

The way forward would be to promote sustainable practices and innovation in agriculture and collaboration and partnerships among the energy and agriculture industries. This can be achieved by bringing conversations together among different stakeholders to create innovative solutions to challenges and thereby drive sustainable practices in the agriculture industry.

Concluding Remarks

IAN GATES, DIRECTOR OF THE GLOBAL RESEARCH INITIATIVE IN SUSTAINABLE LOW CARBON UNCONVENTIONAL RESOURCES, UNIVERSITY OF CALGARY.

The event concluded with a note of thanks by Ian Gates. He highlighted the history of energy research at the University of Calgary and the impact that research has had on society. He mentioned several success stories, including the work of Roger Butler on steam assisted gravity drainage to extract oil from the Athabasca Oil Sands, which has brought billions of dollars of value to Alberta and Canada as a whole. The University of Calgary has gone beyond petroleum-based energy research, with contributions from many different fields, including public policy, economics, humanities, law and regulation. The University of Calgary has invested heavily in energy research, raising $340 million in funding over a ten-year period. Ian Gates heads a $75 million program within the university's Global Research Initiative, which has attracted additional funding and helped to advance energy research both locally and internationally. He emphasized the importance of impactful research that benefits society and industry, rather than simply pursuing academic goals.

The University of Calgary has achieved its goal of becoming one of the top five universities for energy research in the world, according to a recent speech given by Dr. Ed McCauley, President of the University of Calgary. The achievement comes six and a quarter years after the university’s Energy Research Strategy was launched, with $75 million of funding committed. The university has achieved top rankings based on measures such as publication, patents, technology transfer and commercialisation, outstripping other leading energy research institutions such as the University of Texas Austin, Stanford University and Pennsylvania State University. The University of Calgary now has twenty-three researchers who rank in the top 2 percent in the world for energy research. However, McCauley noted that the university had fallen short in developing its research capabilities in agriculture and is now seeking to work more closely with the sector.

There are opportunities for integrating synergies with other products in the urethane industry. Urethane is widely used, and many of its chemicals can be reused. Similarly, we can diversify from raw materials to plant oils and solid products such as char base products and carbon. Water is also a key part of this digital trend. However, Gates expressed trepidation about relying too heavily on machine learning to solve issues like climate change and stated that he had not seen any significant success stories from machine learning in the oil and gas industry. The key in this industry is material and energy balances, and the goal is to make money. The transition to alternative energy sources is not a recent development; it has been in progress for quite some time. The key challenge lies in harnessing the current momentum for change. Factors such as colocation, modularity, and flexibility in the energy mix are crucial. The focus should not solely be on a single form of energy but on the integration of multiple sources.

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