

# HARNESSING ALBERTA'S INNOVATION ADVANTAGE







## MANDATE

Alberta Innovates - Energy and Environment Solutions (AI-EES) is the lead agency for advancing energy and environmental technology innovation in Alberta. AI-EES serves as a catalyst for the development of innovative, integrated ways to convert Alberta's natural resources into market-ready, environmentally responsible energy and the sustainable management of Alberta's water resources.

## VISION

Alberta leads the world in developing innovative energy and environmental technologies building on our natural advantages to achieve a socially responsible, diversified and prosperous economy.

## MISSION

To increase Alberta's capacity to develop, adapt and commercialize innovative technologies that maximize the value of the province's natural and renewable resources while protecting the environment and Alberta's water resources.

## VALUES

Innovation	Leadership	Trust
Entrepreneurship	Collaboration	Respect





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**BRINGING THE RIGHT  
PARTNERS TOGETHER  
TO SOLVE THE BIGGEST  
CHALLENGES FACING  
THE PROVINCE**

# MESSAGE FROM THE BOARD CHAIR



It is my pleasure, on behalf of our Board of Directors and the team at AI-EES, to present our 2014-15 Report on Outcomes to the Government of Alberta and people of this province.

This year, we continued to advance our mandate by bringing together decision makers from government, industry and Campus Alberta, as well as research, technology and venture capital organizations to develop solutions for a wide range of sector issues. AI-EES is well positioned to support the Government of Alberta's strategic plan and the Alberta Research and Innovation Plan, which is aimed at building a more innovative and competitive Alberta.

At AI-EES, we focus on strengthening Alberta's research and innovation capacity with the ultimate objectives of:

- » Improving environmental health through integrated land use and management, and the reduction of greenhouse gas emissions
- » Developing cleaner energy while reducing the environmental impacts of energy development
- » Pursuing partial upgrading to make oil sands more cost competitive in international markets and eliminating the need for diluent for pipeline transportation
- » Diversifying the energy economy by turning waste streams into value added products
- » Managing water resources better by supporting Alberta's Water Research and Innovation Strategy.

Each year, the Corporation evaluates its performance using an established methodology and reports on outcomes and performance measures. This year's results

show that with additional resources AI-EES will be on track to achieve its 2030 targets.

Taking innovation through to commercialization takes time; AI-EES will soon undertake a disciplined process with its partners to establish its long-term directions (i.e. 2050), showing the Corporation's 30-year planning horizon.

AI-EES' tight focus on energy and the environment and the Corporation's success bringing the right partners together to solve the biggest challenges facing the province, will continue to deliver tangible outcomes for Alberta. However, I am most proud of the fact AI-EES and CanmetENERGY are leading the establishment of three national programs in the areas of partial upgrading, tailings and non-aqueous extraction. Equally noteworthy, AI-EES achieved an employee engagement score of more than 90 per cent this past year. This is an outstanding achievement and demonstrates a key reason why this Corporation has been so successful in advancing its mandate in such a short period of time.

On behalf of the Board, I am incredibly proud of all that AI-EES has achieved and look forward to the year ahead.

Sincerely,

A handwritten signature in blue ink that reads "Eric Newell". The signature is fluid and cursive, written over a faint horizontal line.

Eric Newell, Chair of the Board  
October, 2015



# MESSAGE FROM THE CEO



For delivering on outcomes, this past year has proven to be our most fruitful yet. AI-EES takes pride in being ahead of emerging issues and I am pleased to say the Corporation made solid progress on its initiatives in 2014-15.

While our primary focus has been on market access and improving Alberta's competitiveness in this challenging economic time; we have not lost sight of our commitment to the environment. Top priorities are to reduce greenhouse gas emissions, ensure safe and secure water resources, reduce the size of tailings ponds above government directives and preserve the province's biodiversity by supporting monitoring and reclamation programs.

## HIGHLIGHTS FROM THIS PAST YEAR INCLUDE:

- » Investing \$17.5 million in 89 projects aligned to meet our goals for cleaner hydrocarbons and renewable energy, reducing greenhouse gas emissions (GHGs) and advancing tailings and sustainable water initiatives. The value of these projects over their lifetime is \$312.2 million, of which AI-EES will have provided \$82.9 million – leading to an approximate leverage factor of 2.8
- » Securing an additional \$25 million in funding over five years to support the priorities of our Water Innovation Program
- » Working with the Alberta Government and agencies to ensure a common and well aligned strategic approach and to undertake research projects and analysis that will inform policy and ministry strategies
- » Providing technical counsel, adjudication and project management for 76 Climate Change and Emissions Management Corporation projects (valued at over \$1.5

billion) aimed at reducing GHGs by 10.7 megatonnes by 2020

- » Supporting the development of innovation capacity by investing \$7.7 million at universities (University of Alberta, University of Calgary, University of Lethbridge, University of Waterloo, University of Regina, and the Norwegian University of Science and Technology). This included support for two Centres, 12 Chairs, and 36 individual research projects all aimed at building the capacity to position Alberta for a successful future.

One of the projects I am very proud of is our Oil Sands Competitiveness Study. Today, there are many questions about the future of Alberta oil. Through our Competitiveness Study, AI-EES brought together the governments of Alberta, Saskatchewan, and Canada, and six companies to determine the bitumen crude qualities needed in refineries in Asia, North America and Europe and evaluate technologies capable of producing these desired product qualities with the lowest environmental impact. In addition, we are partnering on partial upgrading projects that show promise in taking value-added bitumen products to world markets (see story page 20).

When considering the questions of the future of oil, I think it's useful to analyze where we have come from. In my opinion, we are living in the golden age of oil. Consumption has more than tripled in 50 years and though it is predicted to slow, the International Energy Agency, the U.S. Department of Energy Information Agency as well as other sources, predict global demand will continue to grow.

The transition away from burning fossil fuel is already happening but it will take several decades before we will be able to complete the transition. For oil, until there is a ready-made replacement – beyond current substitutes such as biofuels, natural gas, and electric or battery options – we need to work as hard as we can to make oil resources more sustainable.

Looking into the next few years, we are eager to advance the innovation that will allow us to add renewables and provide greener energy options into the mix. We are also keen to advance a landfill-free initiative that would see at least 80 per cent of the municipal solid wastes recovered through recycling and conversion to higher-value products (see story page 14).

As our Board Chair, Eric Newell pointed out in his letter, AI-EES is making sound progress toward our 2030 targets. We will continue to rely upon our unique strategic approach to achieve our mission and advance government priorities – working alongside our partners in government, industry and academia to mine technology intelligence and provide the innovation leadership that will ensure our province continues to thrive.

Sincerely,



Eddy Isaacs, CEO  
October 2015

# AI-EES IS MAKING SOUND PROGRESS TOWARD OUR 2030 TARGETS



# 2014-15 HIGHLIGHTS

## ENERGY TECHNOLOGIES

### BITUMEN VALUE-ADDED

- » AI-EES' Oil Sands Competitiveness Study phase two brought together the governments of Alberta, Saskatchewan and Canada and six companies to determine the bitumen crude qualities needed in refineries in Asia, North America and Europe and evaluate technologies capable of producing these desired product qualities.
- » AI-EES, working with the Ministries of Innovation and Advanced Education (IAE) and Energy, completed a study to screen and evaluate new modular gas-to-liquid (GTL) technologies to convert low value natural gas to high value liquid products. The study was instrumental in attracting industry participation in the phase two study to evaluate and select sites and technologies and conduct preliminary technical and economic feasibility.
- » AI-EES originated a study conducted at the Alberta Sulfur Research Limited to examine the efficacy of visbreaking of bitumen using acidic compounds to improve its quality. Results from this study are providing mechanistic understanding of the potential to prevent fouling in visbreaking applications.
- » The CarbonSaver Technology pilot to produce hydrogen directly from natural gas is being tested at the Irving refinery in New Brunswick. AI-EES is supporting the project and evaluating progress for applications to field upgrading of bitumen in Alberta.
- » AI-EES launched research projects at Alberta universities to build a platform for future partial upgrading technologies and is supporting industrial chairs in bitumen upgrading and petroleum thermodynamics.
- » AI-EES is managing on behalf of the CCEMC a multimillion dollar/multiyear demonstration project of partial upgrading technology. The technology has been successfully proven at a pilot scale and now needs to be tested at a near commercial scale to validate the technical and economic benefits.

### ADVANCED RECOVERY

- » AI-EES is partnering with industry to manage on behalf of the CCEMC, two multimillion dollar/multiyear demonstration projects involving pilots on cyclic solvent recovery and electromagnetic heating with solvent injection. Early stage results for the cyclic solvent are promising.
- » AI-EES encouraged the successful evolution of the Institute for Oil Sands Innovation (IOSI) at the University of Alberta, and has now embarked on an initiative to promote a new AI-EES - CanmetENERGY initiative focused on non-aqueous extraction. The first stage is to build a continuous flow pilot plant to test a hybrid solvent aqueous process developed under the AI-EES supported Industrial Research Chair in Oil Sands Engineering at the University of Alberta.
- » A major emphasis for AI-EES is in enhancing oil sands operations, which it fosters through support of the AACI Program, the Institute for Oil Sands Innovation and Industrial Research Chairs in reservoir geomechanics, reservoir simulation, energy and environment systems engineering and petroleum microbiology. Taken together these initiatives are transformative and will result in production operations that use much less water, consume less energy, generate lower GHG emissions and lower operating costs.



## RENEWABLES AND EMERGING TECHNOLOGIES

### MUNICIPAL SOLID WASTE-TO-VALUE-ADDED

- » Hosted a BioProducts workshop to identify and attract the most promising bio-products technology providers (as identified by a Jacobs Consultancy study) to Alberta by engaging them with feedstock providers, oil and gas companies, and researcher providers.
  - » To address information gaps for converting waste into valuable products:
    - Collaborated with the Tri-Municipal region (i.e. Parkland, Stony Plain and Spruce Grove) on a Pre-front-end engineering design study working towards the construction of a showcase facility for converting municipal solid waste (MSW) into valuable products.
    - A unique decision-analysis model was developed in partnership with the University of Alberta to help municipalities with the siting for new landfills, as well as evaluating value-added options versus landfilling. This model could be used by the municipalities in making decisions regarding the utilization of their MSW. This study also included the assessment of the amount of MSW generated in the province through the development of GIS maps.
    - Supported a University of Calgary study regarding an advanced thermal treatment to turn MSW into liquid fuels and bio char, and integrating this with biological treatment. Such technologies could convert 80 per cent of Alberta's municipal solid waste into valuable products.
    - Commissioned an Alberta biowaste inventory study to develop a comprehensive biowaste database, which will be publicly available.
    - Developed an Information Management system to inform project developers about the location, technology and capacity of Alberta's biofacilities.
  - » A discussion paper titled, Zero Organic Waste in Alberta: Policy Recommendations, was completed and shared with government departments. Its objective was to review similar policies in other jurisdictions and recommend policies for a Zero Organic Waste Innovation Strategy
- in Alberta. A combination of the best available technologies and policies could divert organic wastes and eventually lead to a landfill-free Alberta.
- » Generated scientific information of GHG generation potential of landfilled wastes to help Alberta Environment and Parks to refine its landfill gas GHG quantification protocol.
  - » Formed a working group to develop a Bioenergy Technology Roadmap for Alberta, to identify the most relevant technology and policy gaps that need to be addressed to provide a foundation for establishing a vibrant and sustainable bioenergy industry.

### ENERGY STORAGE AND RENEWABLE ENERGY

- » Issued a \$2 million Call for Proposals titled Next-Generation Energy Storage Technologies for Accelerating the Deployment of Intermittent Renewable Electricity in Alberta, which resulted in 54 responses and approval of six novel energy storage projects.
- » Collaborated with AdvEn Solutions (University of Alberta spinoff) and Lockheed Martin to accelerate the commercialization of a breakthrough battery storage technology with improved performance and lower cost. This promising battery technology has applications for electricity storage, electric vehicles, and electronic devices such as mobile phones.
- » Invested in a solar photovoltaic research project with the University of Alberta, to develop thin, nanotech-based solar cells which can be sprayed or rolled onto a surface or even woven into fabric, making them cheaper to manufacture and making solar energy more accessible to everyone.
- » A CO<sub>2</sub>-enhanced geothermal study was initiated at the University of Alberta to investigate the feasibility of using carbon dioxide (instead of water) as a working fluid for making use of Alberta's deep geothermal reservoirs. This study could lead to a field pilot that would allow Alberta to harness a greater geothermal resource for electricity generation, and sequester carbon dioxide in the process.

## WATER AND ENVIRONMENTAL MANAGEMENT

### TECHNOLOGY INTELLIGENCE AND SYSTEMS MODELLING

- » A technology intelligence study on Solid Organic Waste technologies was successfully completed. Over 100 technology developers from across the world were assessed for their suitability for converting solid organic waste into valuable products. Based upon a set of key intelligence parameters, the top five companies best suited for Alberta feedstocks and climate were identified.
- » A second technology intelligence study was initiated on high-temperature steam assisted gravity drainage (SAGD) oil-water separation technologies designed to identify technologies that have the potential to treat in situ oil sands produced water at elevated temperatures (~120 Celsius) and at greater than atmospheric pressure (> 500 kPa). Such technologies would reduce heat losses currently associated with cooling the produced water to the conditions required for oil-water separation, and then re-heating the separated water to convert it into steam.
- » Completed modelling studies on the assessment of energy efficiency improvements options for Alberta's residential, commercial, transportation, mining and agricultural sectors. The intent was to identify the most cost-effective options for GHG reductions. For example, in the residential sector the best options are to replace regular furnaces with high-efficiency furnaces and to improve the insulation in walls and windows.
- » Completed a study on the techno-economic and life cycle assessments of transportation of diluted bitumen (Dilbit) and synthetic crude oil (SCO) by rail and pipeline. Engineering based models were developed to calculate the cost and GHG footprint of the two modes. The study results are being used by the oil and gas industry and the government to make investment decisions and policy formulation.

### WATER MANAGEMENT

- » Invested in studies in South Saskatchewan River Basin management, source water protection, and water supply as a function of climate variability, which are all contributing to ensure a future water supply for a growing population and economy in Alberta. Studies were also sponsored to provide an improved understanding of urban and rural waste water treatment options, and the by-products of water disinfection processes. This will contribute to the goal of ensuring quality water supply at the community level.
- » Research in aquatic ecosystems (rivers, lakes, and wetlands) has supported or is providing information for policy development to protect the health of aquatic ecosystems.
- » Research in groundwater quality baseline, recharge mechanism, and contamination by arsenic and pesticides will lead to the protection of groundwater quality and sustainable use of groundwater resources.
- » Investments in a new Irrigation Demand Model, recycling and reuse of water from SAGD operations, and the treatment of processed water from mining operations are assisting us in achieving improvements in the conservation efficiency and productivity (CEP) of water use across the province.

### LAND RESTORATION

- » AI-EES supported new research that shows atmospheric deposition rates of metals in north-eastern Alberta seem to be comparable to levels detected in reference and rural settings elsewhere in the world and are lower than previously reported for the Athabasca oil sands region. However, deposition rates do increase with proximity to the oil sands mines and upgraders.
- » Acoustic recording devices and motion sensor cameras (innovative monitoring systems) are being tested under the Alberta Biodiversity Conservation Chair program. The research program, supported by AI-EES, is providing new insights into patterns and abundance of species in Alberta. Data from the new monitoring systems suggests some species in Alberta are not as rare as previously thought.



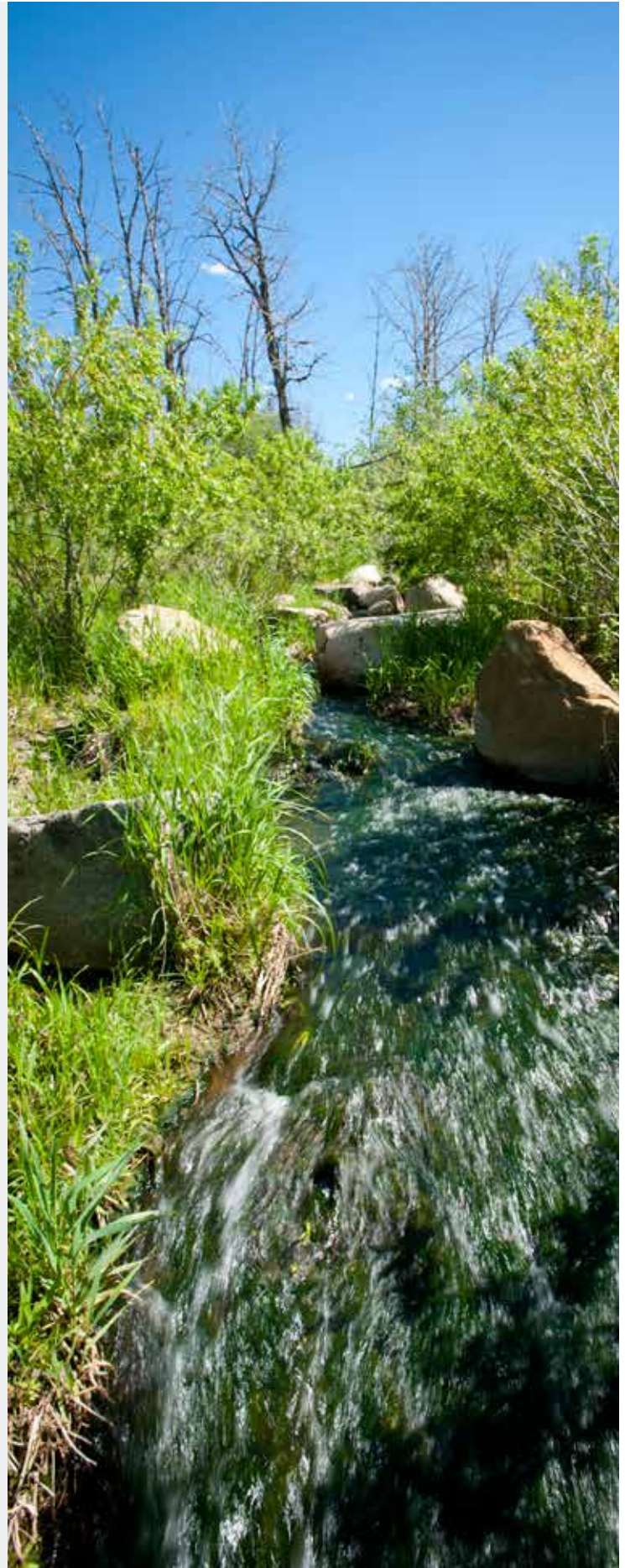
- » AI-EES support aided in the calibration and operational deployment of the state-of-the-art DiAL LIDAR unit in 2014 for monitoring GHG emissions by Environment and Parks and the Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA). AI-EES is also building a portfolio of projects to enhance the scientific understanding and develop the best practices in managing atmospheric deposition, wetlands, land disturbance, ecosystem health, biodiversity conservation, environmental monitoring, and restoration ecology.

#### **TAILINGS MANAGEMENT**

- » Technologies such as in-line dewatering and electro kinetic settling are being demonstrated and will reduce and minimize the generation of mature fine tailings. These studies are at the research pilot stage and will move to actual field demonstrations in the next two years.
- » Research is being conducted through an NSERC industry research chair to treat tailings water for safe release into the environment. Industry development in this area has been initiated for field demonstration of the technologies.

#### **GHG MANAGEMENT**

- » Through AI-EES and the CCEMC, 10 carbon capture technologies are being developed that offer the potential to reduce carbon capture cost by 50 per cent. Four of the technologies are being tested at a field pilot stage and others at laboratory development stages.
- » Through CCEMC funding, AI-EES has assisted technology deployment to reduce fugitive emissions in natural gas production and improve energy efficiency. In total, emission reductions of more than 100,000 t/yr CO<sub>2</sub>e were achieved.

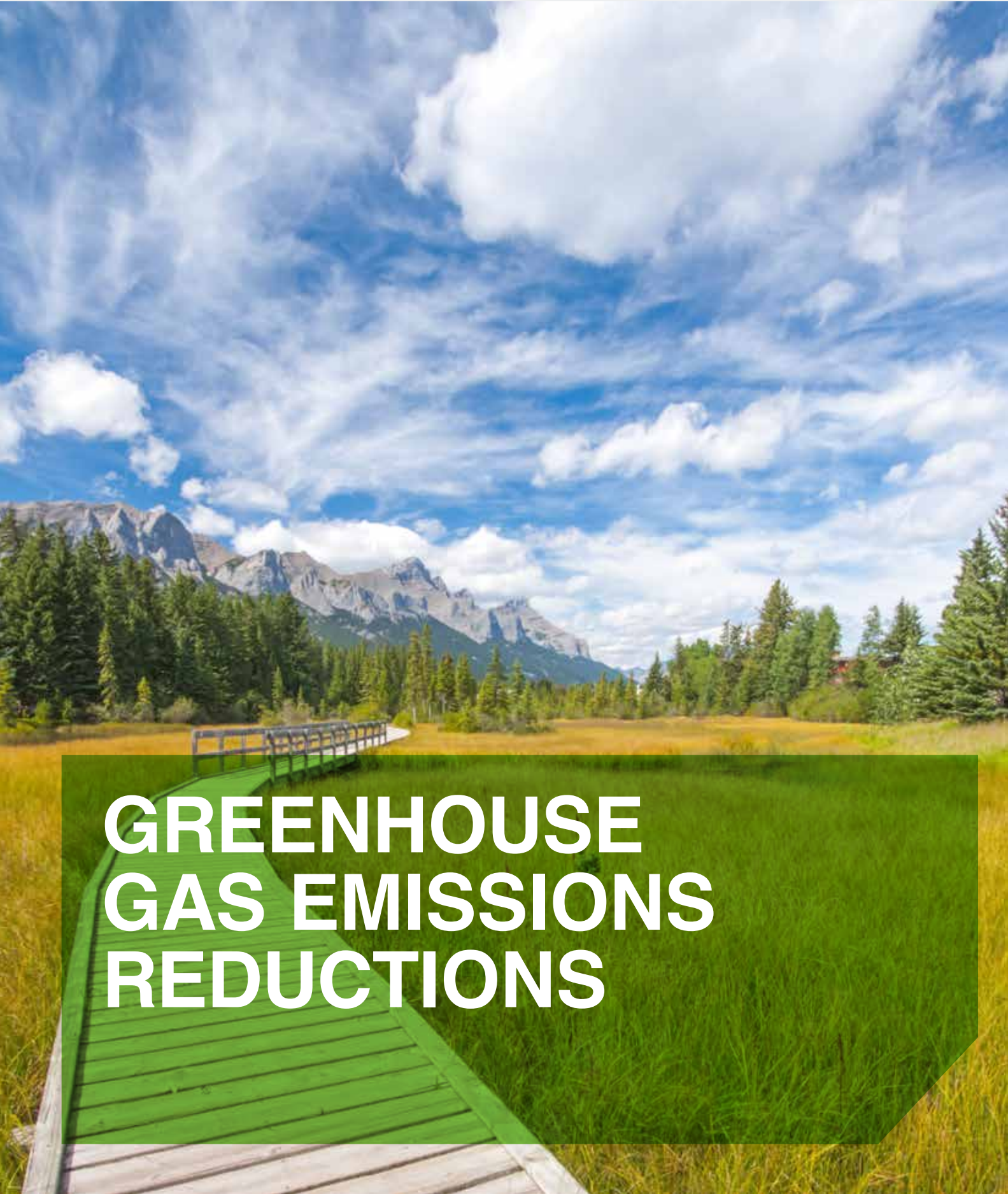




# SUCCESS STORIES

It takes 20 to 30 years to take an idea from the lab to commercialization. AI-EES' raison d'être is to significantly reduce the time lag for innovation. The measuring of year-by-year results – while an important indicator of progress – does not show the full impact of our investments in research, development and innovation. The stories that follow are the best method to represent our annual progress and the impacts of our work this year. However, we ask readers to consider that these stories represent a snapshot in time and the total impact of our work – real economic and environmental gains – requires long-term monitoring of these specific projects.





# GREENHOUSE GAS EMISSIONS REDUCTIONS

GHG EMISSIONS  
REDUCTIONS

# LASER SENSING TECHNOLOGY HELPS MONITOR GREENHOUSE GAS EMISSIONS (GHGs)

Imagine shooting a laser beam into the air over an industrial plant and being able to tell how much and what kind of greenhouse gas it is emitting. While that may sound far-fetched, that's exactly what Alberta's new Differential Absorption Lidar (DiAL) is capable of.

## FOCUS AREA

GHG Capture

## IMPACT

With greater monitoring capacity the DiAL unit will help measure, track and understand fugitive emissions and will help Alberta best manage industry compliance to reduce GHG emissions.

## 2030 TARGET

50 per cent intensity reduction in Alberta's GHG emissions

The Alberta Government is challenged with monitoring and mitigating the environmental impacts of energy development in Alberta. While the province has made significant commitments to reduce GHG emissions, there remains uncertainty regarding sources and amounts of fugitive emissions.

In 2013, AI-EES teamed up with Alberta's Environmental Monitoring, Evaluation and Reporting Agency (AEMERA) (then still part of the Ministry of Environment and Parks) to acquire and field test Canada's first Differential Absorption Light Detecting and Ranging unit from the Space Dynamic Lab of Utah State University. With a target of helping the province reduce GHG emissions by 50 per cent by 2030, AI-EES is working closely with its stakeholders to improve understanding of fugitive gas emissions and how they can be reduced.

"This will be an important piece of technology," says Dr. Long Fu, Director of Standards and Technologies for AEMERA. "There is no other technology in Canada that can do this. Really, you can't manage what you don't measure and this technology will help us with reliable emission information to help inform our policies and decisions."

Housed in a 36-foot mobile trailer, the unit has been tested and is now being deployed to monitor the particulate matter (PM), carbon dioxide (CO<sub>2</sub>) and methane (CH<sub>4</sub>) at industrial sites around the province.

"AI-EES played a significant role early on in this project supporting the identification and then evaluation of the vendor (SDL) before they were chosen to design and then fabricate the DiAL unit," says Dr. John Zhou, Chief Technical Officer, AI-EES.

**LIDAR**, stands for Light Detection and Ranging, and is a remote sensing method that uses pulsed lasers to measure variable distances. Differential Absorption Lidar (DiAL) is a technology where two laser beams are shot into the air and are able to determine information about gas and particles by recording how the laser interacts with different gases in the air.





### WHAT IS AEMERA?

AEMERA is the provincial organization established to monitor, evaluate and report on key air, water, land and biodiversity indicators to better inform decision-making by policy makers, regulators, planners, researchers, communities, industries and the public.

The mobile unit can easily be moved from site to site and because it can measure concentrations and plumes of gas up to two kilometres away it can be located outside commercial sites, so as to not interfere with daily operations. The remote sensing technology is particularly suited for measuring oil, gas, and coal plant emissions, including oil sands areas like mine sites and in situ operations.

Data from the DiAL unit may be used to understand and control production practices, characterize source emissions, determine emission factors, locate fugitive emission leaks, assess plume dispersion, and confirm air dispersion modeling. This technology could provide regulators with the quantity of greenhouse gases being released at a particular location and pinpoint their sources.

GHG EMISSIONS  
REDUCTIONS

# LANDFILL-FREE ALBERTA: A TRANSFORMATIVE VISION

At 1,052 kg per capita/year, Alberta has the highest municipal solid waste (MSW) generation rate in Canada – and most of this waste is landfilled. There are around 150 active landfills and 600 wastewater lagoons in Alberta and the government spends \$80 million per year providing municipalities with landfill funding.

## FOCUS AREA

Bio-waste to fuel

## IMPACT

Significant GHG mitigation potential: Environment Canada estimates that the opportunities for Alberta to reduce GHG emissions from municipal waste alone are 1.5 megatonnes of CO<sub>2</sub>e/year. Taking into account the additional opportunities to convert agriculture, forestry and other biowastes to fuels that displace traditional transportation fuels and chemicals, the GHG benefits are of the order of 16 megatonnes of CO<sub>2</sub>e/year.

## 2030 TARGET

50 per cent reduction in organic waste to landfill

In 2007, the Alberta Government released its Too Good to Waste strategy, stating that at least 80 per cent of the material being sent to municipal landfills could be recovered through recycling and conversion to higher-value products. However, the strategy's 2010 target for reducing the amount of MSW going to landfills by half (500 kg per capita/year) has yet to be achieved.

"There are a couple of key reasons we haven't achieved these goals yet," says Xiaomei Li, Senior Advisor, Bioenergy for AI-EES. "Most rural municipalities don't have the technical knowledge about which technologies are most suited for converting their municipal solid waste to value-added products, and there is a lack of policy regulations and incentives to help municipalities achieve these goals."

Over a 10-year period, AI-EES worked alongside the City of Edmonton and Enerkem to open the world's first full-scale waste to fuels facility, which will divert 90 per cent of Edmonton's waste from its landfill by 2016.

"AI-EES is focused on helping the government deliver on its landfill-free strategy for eliminating most landfills in Alberta. Based

on the waste-to-value-added innovation and demonstration initiatives AI-EES has supported to date, we believe converting MSW into energy and other value-added products is achievable and will support Alberta's new Climate Change Strategy by mitigating greenhouse gas (GHG) emissions," says Dr. Surindar Singh, Executive Director, Renewables and Emerging Technologies for AI-EES.

AI-EES is now collaborating with rural municipalities, such as Parkland County, Spruce Grove and Stony Plain on developing a Waste-to-Value-Added demonstration project. The pre-Front-End Engineering Design (pre-FEED) study will be completed in early 2016, and then significant funding would be needed to build the demonstration facility.

Our team has also been in discussions with several other municipalities, including Lac La Biche, St. Paul, Leduc, Devon, Drayton Valley, Calmar, Red Deer, Calgary, Canmore, Banff, Vulcan, Coaldale, Taber and Lethbridge.

To further accelerate its landfill-free strategy, AI-EES is working with Alberta Municipal Affairs, the Ministry of Environment and Parks, and the University of Alberta. Next steps will include:



- » Identifying the right location and size of regional waste-to-energy facilities
- » Launching waste-to-value-added projects that would demonstrate and set an example of how municipalities can participate and achieve environmental, economic and GHG benefits over the long-term
- » Identifying best available accounting standards for GHG benefits and supporting the offset system in developing the scientific validation for specific waste-to-biofuels application
- » Developing an international business strategy for assisting other countries in becoming landfill-free. This strategy fits international sustainability requirements.



**The challenges most municipalities face in waste diversion include:**

- » The lack of sufficient capital funds for waste-to-value-added initiatives
- » The need for technical expertise to understand which technologies are most suited to their unique needs. Expertise AI-EES can provide at no cost to the municipality
- » The need for several small municipalities and other waste generators in the region to collaborate by providing sufficient feedstock and type of waste for a commercial facility.

**The financial cost of landfilling**

- » Landfill tipping fees vary between \$50/tonne and \$100/tonne. Assuming an average fee of \$75/tonne and 4 million tonnes/year of MSW, annual landfilling costs are around \$300 million per year. MSW gathering and transportation costs are extra.



A photograph of a male scientist with dark hair and glasses, wearing a white lab coat, leaning over a blue workbench in a laboratory. He is looking down at a piece of equipment on the bench. In the background, there are server racks and other laboratory equipment. The image has a white diagonal cutout in the top-left corner.

# VALUE-ADDED AND PRODUCTION





VALUE-ADDED  
AND PRODUCTION

# TURNING ABUNDANT NATURAL GAS INTO HIGHER VALUE LIQUIDS

Natural gas prices are based on supply and demand. With an abundance of natural gas in North American markets – and 3.72 trillion cubic feet of marketable natural gas in Alberta alone – the province is focused on getting the most value from its cleanest burning fossil fuel.

## EMERGING AREA

Gas-to-liquids

## IMPACT

Small-scale, modular gas-to-liquids technology has the potential to vastly increase the value of Alberta's natural gas resources.

## 2030 TARGET

Development of technologies to add value to gas, including at least one gas-to-liquid commercial demonstration plant

Converting natural gas into higher value products such as diesel, diluent and lubricants is a current focus for AI-EES.

“The gas price is where it was in the 80s,” says Neil Camarta, President and CEO of Field Upgrading. “We have this huge resource, and a lot of jobs are at risk if we can't find economic ways to continue producing it.”

Current gas-to-liquids (GTL) technologies are capital intensive and are only economically viable at large scale, according to Nevin Cimolai, Manager, Energy Systems, AI-EES.

“Right now, we're evaluating new small-scale, scalable and expandable technologies that may be well suited to Alberta.”

New lower cost modular technologies can potentially produce competitively priced products from conventional sources of natural gas as well as from shut-in gas at remote locations or flare gas.

AI-EES, working with industry and government, established a steering group that is guiding and overseeing its GTL project. Participating companies have already gained

fast access to the economic analysis they need to select the technologies best suited to their business and to advance toward the first commercial demonstration plants in Alberta.

Companies are already considering the launch of field pilots based on the technology analysis completed.

“We are a technology development company. We're always looking for new ways to create value,” adds Camarta. “By investing in this project, we got a front row seat to a first class review of the viability of turning cheap natural gas into liquids.”

Camarta's company is already at the pilot plant stage to remove sulphur, heavy metals and acids from oil sands bitumen and other heavy oils. The upgraded product can be tailored to meet the new “low sulphur” regulations for marine bunker fuels in Canada, the U.S. and Europe and power generation markets in Asia. Adding a GTL play to this portfolio would be very valuable.





VALUE-ADDED  
AND PRODUCTION

## STUDY COMPARES THE ENVIRONMENTAL IMPACTS OF DILUTED BITUMEN WITH CONVENTIONAL CRUDES

Safe, reliable transportation of Alberta's oil sands resources to markets outside the province is crucial for the sustainability of the industry. Media coverage frequently calls into question the safety of transporting oil sands products, and public concerns about safety and environmental risks are major issues facing oil sands producers.

### FOCUS AREA

Dilbit transportation

### IMPACT

Understanding the environmental impacts of diluted bitumen if spilled in the environment directly affects market access. AI-EES' work on the effects of diluted bitumen in comparison to conventional crudes has shown the acute environmental risks associated with diluted bitumen are less or no more than those of conventional crudes.

### 2030 TARGET

50 per cent of total production in bitumen and heavy oil is produced sustainably

AI-EES has been working with government and industry since 2012 to better understand the properties of Alberta's oil sands products, and continues to study how they react with the environment if spilled to provide evidence-based science about these resources when compared to other products.

### MARKET ACCESS

"Understanding the properties of [diluted bitumen] compared with conventional crudes is important because it directly impacts the market access of dilbit," says Dr. John Zhou, Chief Technical Officer, AI-EES. "The environmental impact of a diluted bitumen spill has become an important scientific question for dilbit transportation and a critical aspect of market access.

"Market access is certainly a very important issue for both government and industry in Alberta. Our findings were presented to the NAS [National Academy of Sciences] Committee in Washington D.C., scientific conference, and technical journals, and have contributed to the scientific discussion at NAS.

"AI-EES has been working with government and stakeholders to investigate concerns and provide possible solutions for several years. The Corporation's first study, to investigate the corrosive properties of dilbit was commissioned in 2012. Due in large part to this study, that compared dilbit to conventional crudes, it is now well accepted that there is very small risk for corrosion in pipelines and dilbit's corrosion propensity is no more than that of conventional crude oils," says Zhou.

### CONTINUED WORK THAT INVESTIGATES THE PROPERTIES OF DILBIT

AI-EES has since completed several studies that look at pipeline safety, comparing the flammability of dilbit with conventional crudes, how dilbit reacts with the environment when spilled, and most recently, investigating the potential effects of a diluted bitumen spill in fresh water environments. AI-EES' project partners on this study were the University of Calgary, University of Alberta, University of Lethbridge, Alberta Innovates – Technology Futures (AITF), Natural Resources Canada (NRCan), the Ministry of Energy and Ministry of Environment and Parks.

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*AI-EES has been working with government and industry since 2012 to better understand the properties of Alberta's oil sands products, and continues to study how they react with the environment if spilled to provide evidence-based science about these resources when compared to other products.*

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"Alberta is committed to filling in the knowledge gaps for the safe transportation of dilbit and AI-EES has been at the centre of the federal and provincial collaborations taking place," says Amar Bokhari, Director with the Market Diversification Branch at Alberta Energy.

Alberta Energy has partnered with AI-EES on a number of studies to evaluate the behavior of dilbit in fresh water, including assessing how both dilbit and conventional light crudes would weather if spilled in water environments.

"We want to ensure we understand the products we're transporting and how they behave in different environments," says Bokhari. "These studies that AI-EES is involved in will enhance our understanding of the chemical and physical properties of dilbit, so we can ensure we are able to quickly and effectively respond if a spill occurs."

#### **LATEST WORK ON FRESHWATER SPILLS**

Because historically there have been more spills of conventional crudes in fresh water environments than diluted bitumen, it was important to compare the fate, behavior, and environmental impacts of diluted bitumen with those of conventional crudes. In this study diluted bitumen and conventional crudes were compared through the analysis of the physical and chemical properties, laboratory spill test experiments, and field spill cases.

The study explained that physical and chemical properties of crude oils influence their fate, behavior and impacts when spilled in fresh water environments. The properties of diluted bitumen products were compared with those of conventional crudes from the Western Canadian Sedimentary basin. Properties such as density, viscosity, and

contents of benzene, toluene, ethyl benzene, xylenes (BTEX), polycyclic aromatic hydrocarbons (PAHs), acids (total acid number or TAN), sulphur, and metals, including vanadium and nickel, were compared.

"The results show that diluted bitumen products are similar to those of conventional heavy crudes in these properties. In comparison to the properties of conventional crudes, diluted bitumen products have lower contents of low boiling components which are associated with high flammability and acute toxicity," says Dr. Heather Dettman, Research Scientist at NRCan. "These data correlate and support previous lab studies that suggest the risks associated with diluted bitumen are less or no different from those of conventional crudes."

Using a batch spill test tank facility, laboratory experiments are being conducted to determine the behavior of dilbit in comparison to conventional crudes. Dettman explains that by simulating aquatic environments, the results indicate that diluted bitumen would stay afloat in fresh water. In agreement with results in the literature, wave tank studies found that under spill conditions where the diluted bitumen remained floating, conventional crude was dispersed into the water environment, becoming submerged in the sediment.

"Diluted bitumen products tested to date will stay afloat on fresh water or seawater for more than eight days," which Dettman indicates is a critical timeframe associated with oil spill clean-up. "Both diluted bitumen and conventional crudes will sink when mixed with enough sediments but diluted bitumen has relatively low tendency to disperse into the water column and so interacts with sediment much less than conventional crudes," she concludes.

#### **AI-EES commissioned studies on Environmental Effects of Dilbit Compared with Conventional Crudes**

Properties of Dilbit and Conventional Crudes (2013, conducted by AITF)

Innovation Roadmap for Transmission Pipeline Transportation of Petroleum Products (2014, with CEPA and conducted by PTAC and University of Calgary)

Light Ends Composition in Dilbit and Conventional Crudes (2014, conducted by Omnicon)

Weathering Tests for Dilbit Films (2014, with Alberta Energy, conducted by University of Calgary)

The Effect of Weathering on Dilbit and Conventional Crude in Freshwater Systems (2014, with Alberta Energy, conducted by AITF)

Biological Impacts of Dilbit Spills in Freshwater Aquatic and Riparian Ecosystems - A Knowledge Synthesis and Gap Analysis (2015, conducted by University of Lethbridge)

A Comparative Toxicity Assessment of Diluted Bitumen (Dilbit) to Conventional Oils (2015, conducted by University of Alberta)

High Energy Dilbit Weathering in Fresh Water Systems (2015, conducted by NRCan, results provided to AI-EES in kind)

VALUE-ADDED  
AND PRODUCTION

# ENHANCING ALBERTA'S COMPETITIVENESS / SECURING THE MOST VALUE FOR BITUMEN

Alberta bitumen-derived crudes are at a disadvantage in world markets because they need to be blended with higher quality crudes to meet the requirements of certain refineries. Getting higher values for our resources is a priority for Alberta and AI-EES has long believed that getting better value for our products can lead to job creation and greater returns for everyone in the province.

## FOCUS AREA

Partial upgrading

## IMPACT

This study will help prioritize future research focus and direction in partial upgrading – which is of strategic importance for AI-EES, the province and Canada.

## 2030 TARGET

20 per cent of in situ production will become partially upgraded to improve the quality, reduce the need for diluent and improve transportation and access to new markets

Results of our Competitiveness Study are now in and show a partial upgraded crude product could net an additional \$5 to 10 billion in annual gross revenue for western Canada producers by 2035.

Started as the 'next generation upgrading' initiative over 10 years ago, AI-EES realized that given the market conditions, full upgrading was uneconomic for the near future. Therefore, our Competitiveness Study quickly evolved into an exercise to quantify the partial upgrading opportunities for Alberta's bitumen. In this three-stage study, we worked with industry and governments of Alberta, Saskatchewan and Canada to understand:

- » The refining value of Western Canadian bitumen in different regions
- » Which types of partial upgrading technologies offer the most potential
- » The potential value back to the producer for a partially upgraded product in Western Canada.

According to Dr. Duke du Plessis, Senior Advisor, Energy Technologies, AI-EES,

nine regions in North China, Japan, South Korea, India, Europe and the U.S. Gulf Coast have been identified as potential markets for partially upgraded Alberta bitumen.

Each refinery region has a different capability for refining, which means we get different values and increased volumes for our products in the different regions. As part of this study, AI-EES had a predictive model developed to understand the value of partially upgraded crudes in each unique market. With this information in hand, we moved to the next phase of our study, including a technology assessment of six partial upgrading technologies that are representative of different processing types.

This assessment considered the technical viability, commercial applicability, costs, integration and overall readiness for commercialization of each technology.

In phase three of this study, we completed a production forecast for Canadian heavy crude oil and partially upgraded bitumen up to 2035. The projections were established by our industry steering committee and reflect an





incremental increase in price that they believe is reasonable over time.

If it weren't for AI-EES, "Individual companies would rely only on their internal processes to be looking at the future," says Robin Penner, CNRL process engineer. "Every company is asking: what's my long range plan? How do I develop this resource? This project engages multiple viewpoints and how this comes into play. It's good to have access to this range of perspectives at a reasonable cost."

"There's a win here for industry and government. Whatever market there is, this study shows the value differential will be there," adds du Plessis.

"We share borders," says Rick Musleh, Energy Sector Development, Government of Saskatchewan. "We both want to attract an upgrader to our province. Alberta has a thicker crude, so if partial upgrading technologies work on that product, it will work on ours. If we can find the right technology, this could mean investment in both provinces. Working together on a topic of mutual interest is great."

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*Results of our Competitiveness Study are now in and show a partially upgraded product could gross an additional \$5 to 10 billion in annual revenue for Western Canada producers by 2035.*

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#### **NATIONAL PARTIAL UPGRADING PROGRAM**

Thanks to synergies between AI-EES and NRCan, a national program on partial upgrading was initiated in 2015. The goal of this program is to support the 2030 target that 20 per cent of in situ production will become partially upgraded to improve the quality, reduce the need for diluent and improve transportation and access to new markets.

To ensure work is focused in the right area, a background study and white paper is now underway to provide a current status of understanding and best-in-class capability for partial upgrading and to identify remaining gaps needing to be addressed through further research. This involves:

- » An exploration of diluent reduction opportunities

Two partial upgrading demonstration plants being built in Alberta

AI-EES has supported the advancement of two partial upgrading projects in Alberta:

- » MEG
- » Field Upgrading: Western Hydrogen Ltd.

**PARTIALLY****UPGRADED MEANS:**

diluent is reduced and the value of the product is increased and meets pipeline specifications.

**FOCUS AREA**

Partial upgrading

**IMPACT**

This study will help prioritize future research focus and direction in partial upgrading – which is of strategic importance for AI-EES, the province and Canada.

**2030 TARGET:**

20 per cent of in situ production will become partially upgraded to improve the quality, reduce the need for diluent and improve transportation and access to new markets

- » Solutions to stabilize partially upgraded products to make certain they are pipelineable
- » By-product mitigation (i.e. minimizing the production of low value or waste products)
- » Process integration, which means simplifying the partial upgrading process and reducing the cost by integrating different processing steps.

This paper, to be completed in the fall of 2015, will inform the next stages of this national program, which has been endorsed by AI-EES' industry steering committee:

- » Test new process innovations
- » Bench-scale advancement, which involves testing the most promising concepts in continuous flow small scale reactors

Industry would take over at a more advanced stage, moving to:

- » Detailed process flow and economics
- » Field pilot and demonstration of selected technologies

"We appreciate the role the steering committee is playing - contributing to the success of the study," says du Plessis.

**Competitiveness Study  
Industry Steering committee**

- » Six industry partners
- » Government of Saskatchewan
- » Alberta Energy
- » Alberta Innovation and Advanced Education
- » Natural Resources Canada (NRCan)

# AI-EES CONNECTION CREATES OPPORTUNITY TO INTRODUCE ALBERTA CRUDE PRODUCTS INTO SOUTH KOREA

One of the ways AI-EES fulfills its purpose, in positioning Alberta to achieve superior environmental performance while growing and diversifying the energy economy, is through the strategic connections established and fostered throughout the course of its technology development and innovation initiatives.

In August of 2013, Dr. Duke du Plessis, Senior Advisor, Energy Technologies at AI-EES, gave an invited Plenary address to the 9th World Congress of Chemical Engineering (WCCE) in Seoul, Korea. Connections made at conferences and events such as these has allowed AI-EES to open up opportunities for Alberta-based technology developers.

“The people that AI-EES introduced us to have given us an opportunity to get more of a margin for our product,” said Neil Camarta, President and CEO of Field Upgrading. “It’s simple. AI-EES knows where we can make more money with our technology. They have a great network, and moreover, they understand our process and how it can be adapted to meet a potential business opportunity.”

Discussions at the WCCE conference later led du Plessis to connect SK Innovation (a major Korean refining corporation)

with Alberta-based MEG Energy. With the support of AI-EES, MEG has been developing a technology (HI-Q®) to market a new partially upgraded crude product.

“The connection with SK was timely, important, and accelerated our understanding whether a non-coking, high conversion refinery could process a partially upgraded bitumen product. We were able to confirm with this customer that we may be able to double the market for our bitumen products. These learnings build confidence with potential investors who can see there’s a larger market out there for bitumen products,” said Darius Remesat, Manager of Marketing Development, MEG.

With the successful SK interactions, MEG may consider similar collaboration activities involving their HI-Q® partial upgrading technology.

## FOCUS AREA

Partial upgrading

## IMPACT

AI-EES’ Competitiveness Study confirms the significant economic benefit to Alberta and Canada for partially upgrading Athabasca’s bitumen.

## 2030 TARGET

20 per cent of in situ production will become partially upgraded to improve the quality, reduce the need for diluent and improve transportation and access to new markets





# PRESERVING WATER AND LAND

WATER AND  
LAND MANAGEMENT

# TECHNOLOGIES TO REDUCE TAILINGS REMAIN MAJOR FOCUS

Some of the most common photos used by the media when writing about oil sands development are images of tailings ponds. Finding those images is not difficult given the surface area of oil sands process-affected water is over 88 square kilometres as of 2013.

This footprint is associated with 975 million m<sup>3</sup> of mature fine tailings, which is why finding solutions to reduce tailings – and ultimately eliminate them – is a major focus area for AI-EES.

According to Rick Nelson, AI-EES' Senior Director, Oil Sands Tailings, the Corporation's work in this area is focused on two critical priorities:

- » Working to identify and implement technologies that will help oil sands mining operators meet the regulatory requirements of the Tailings Management Framework
- » Ensuring that Albertan's are not left with legacy tailings ponds on the landscape after a company has finished operations.

During AI-EES' 2015–18 planning cycle, its key initiative is the phased scale-up of next generation technology pilots that minimize produced and legacy tailings, including End Pit Lake reclamation. This year, the Corporation is reporting on three active projects aligned to this task.

## ELECTRO-KINETIC RECLAMATION TECHNOLOGY SHOWS POTENTIAL TO CREATE STABLE, SOLID LANDFORMS

It was in 2010 when Jim Micak, CEO of EKS, first contacted AI-EES to discuss the potential of his company's electro-kinetic reclamation technology. Simply put, this technology is the application of electricity into tailings to change the structure of clay particles causing them to consolidate and compact while removing the water without the use of chemicals. The separated water can then be reused for bitumen extraction.

Oil sands operators obtain most of their process recycled water from the upper levels of the tailings pond. However, they also have to dredge the mature fine tailings (MFT) in the lower levels of the tailings pond and put these tailings into other containment structures for treatment. Using EKS' technology, the MFT can be treated in situ (while it is still in the tailings pond).

"We approached AI-EES when they were sponsoring the request for submissions for Tailings Road Map and Action Plan. We saw their ad in the *Globe and Mail* and put

## FOCUS AREA

Tailings

## IMPACT

These treatment technologies, once proven, will allow more effective reuse, recycle and, if necessary, the safe release of oil sands process-affected water to the environment.

## 2030 TARGET:

100 million m<sup>3</sup> reduction from legacy mature fine tailings over and above that which is mandated by government directives





*The indoor tank at the C-FER facility is capable of holding up to 135 cubic meters of material. The electrode array sits beneath the surface where the suspended fines gather and compact at the base of the tank while the extracted water collects on the surface.*

## IMPACT

If implemented commercially within the next five years, EKS' technology has significant potential to help achieve the AI-EES 2030 target of stabilization and decline of MFT volumes and oil sands mined areas are being progressively reclaimed.

## IMPACT

If in-line dewatering technology can be successfully demonstrated and commercialized, it will significantly reduce the size of tailings ponds and eventually lead to their elimination.

our submission forward. Rick was skeptical initially. He said, 'Do you know how big some of these lakes are?'

Although EKS was not a technology pursued through the Tailings Road Map project, AI-EES has since taken a keen interest as electro-kinetic dewatering could significantly enhance dewatering of oil sands tailings (fluid tailings in the ponds), leading to both a reduction in the size of tailings ponds as well as more progressive reclamation of MFT.

According to Micak, there is a long history of using electrical processes but they have been cost prohibitive and there have been challenges with the electrodes burning out.

"Our technology is cost effective, and we can do it without burning the electrode. We have a unique electric signature that we apply to the process – the amount of electricity we apply and the voltage applied in a certain way – allows for the transformation of the MFT and consolidation and separation to occur."

Shell Canada has been the primary oil sands industry partner on this AI-EES project and more recently, Suncor has joined the collaboration. Still in the development phase, there remain scale-up questions that need to be answered before an operator like Shell can use the technology directly in their tailings pond.

"If it works at large scale, it offers a compelling solution to manage these tailings. The advantage of our EKS technology is that it can be applied in several different ways," adds Micak.

"We can treat tailings in situ, drop in our electrodes and there's no handling of the tailings. No other input beyond electricity," says Micak. "We can apply the technology in mined out pits, we can turn the tailings into cells and reclaim that land. We can provide a cost effective technology and offer a solids content that is as high and perhaps higher than any other technology out there. I make these comments based on what we've seen through our lab work. The question remains: can it work at large scale?"

AI-EES has now facilitated EKS' connection with C-FER in Edmonton. They are using C-FER staff to help them with the logistics of testing but also relying upon their technical expertise with the electrical configuration issues.

"There's a skillset we've been able to tap into that has saved us time and resources," Micak says.

## IN-LINE DEWATERING OF OIL SANDS TAILINGS SHOWS PROMISE

In-line dewatering technology essentially squeezes or drains the water out of oil sands tailings before they reach the pond.

"We produce unique dewatering systems for the mining industry to allow them to reduce both the water usage and environmental impact of mine tailings," said Dr. Dave Sego, President and CEO, In-Line Dewatering Ltd.

"We need revolutionary tailings technology in Alberta, so we can speed up reclamation efforts," says Rick Nelson. "In-Line Dewatering novel technology has the potential to both



reduce the footprint of a mine by reducing the number and size of tailings ponds as well as enhance the recycle of hot process affected water back to the extraction process, significantly reducing GHG emissions.”

AI-EES has been working with In-Line, alongside Suncor, Shell and the Government of Canada, since 2013. The project has successfully moved through the phase 1 bench-scale demonstration and is currently going through phase 2 hydraulics scale-up demonstration. If successful in phase 2, the tentative plan is to move the technology into a field scale-up demonstration onto the lease of one of the surface mining operations.

#### WORKING TOWARD THE SAFE RELEASE OF OIL SANDS PROCESS-AFFECTED WATER (OSPW)

Initiated in 2011, the purpose of the OSPW program is to develop and assess water treatment strategies that will lead to the safe recycle, reuse or return of tailings water to our natural environment. With the right strategies, the OSPW can be remediated to ensure its safe release to the environment with no negative impact on the aquatic environment and public health.

AI-EES, in partnership with federal and provincial governments and industry – those companies who have the most to gain from these technological advancements – have invested in the Senior Industrial Research Chair, Oil Sands Tailings Water Treatment, led by Dr. Mohamed Gamal El-Din.

The benefit of a program like this is the potential impact on the long-term environmental sustainability of oil sands operations, which is why a team of approximately 30 researchers at the University of Alberta are focused on



*Sample cores of the treated material are being analyzed for geotechnical properties to determine suitability for reclamation activities.*

identifying the most effective and efficient treatment processes, under Gamal El-Din's leadership.

“The hardest part of this task is finding the right way to treat the tailings water,” says Dr. Gamal El-Din.

According to Rick Nelson, AI-EES' Senior Director, Oil Sands Tailings, a variety of treatments are now being studied, including:

- » New coagulants
- » Adsorbents
- » Advanced oxidation processes
- » Membrane processes
- » Biological treatment process
- » Filtration processes.

In addition, the Chair has initiated some toxicity assessment and characterization of the dissolved organic fraction of oil sands process-affected waters to better understand the treatment options.

#### IMPACT:

These treatment technologies, once proven, will allow more effective reuse, recycle and, if necessary, the safe release of OSPW to the environment.

#### WHAT IS OIL SANDS PROCESS-AFFECTED WATER?

Oil sands process-affected water (OSPW) refers to the water that has been in contact with oil sands or released from tailings deposits and is primarily used for bitumen extraction.

WATER AND  
LAND MANAGEMENT

# MINIMIZING INDUSTRIAL IMPACT KEY TO ALBERTA BIODIVERSITY CHAIR PROGRAM

The Boreal Forest is a diverse and rich landscape, filled with trembling aspen, spruce, jack pine, tamarack and balsam fir.

## FOCUS AREA

Land Restoration

## IMPACT

The Biodiversity Chairs program leverages Alberta's strengths and is the nucleus of a scientifically credible research program that ensures Alberta has an ecosystem with strong biodiversity.

## 2030 TARGET

Habitat restoration rates meet or exceed disturbance on lands affected by energy development

Deep in this forest covering most of northern Alberta one finds wetlands, lakes and species that can only be found in this region. It's the ideal landscape for Caribou herds. Wolves roam free here and Yellow Rails nest in abundance that previously have been greatly underestimated.

"The ecosystem is important for maintaining biological diversity, storing carbon, purifying air and water and regulating climate," says Dr. Brett Purdy, Senior Director, Integrated Land Management, AI-EES. "However, the region is also rich in oil sands resources and is home to much of the province's resource development. Finding balance in this region, and methods to minimize and mitigate human impact, is critically important to our mandate."

In 2013, AI-EES and project partners made a commitment to invest \$5.2 million over five years to support the Alberta Biodiversity Chairs. Their work will help us understand how the combined effects of human activities, particularly the energy industry, affect biodiversity in the boreal forest. But most importantly, their work will lead to the design and testing of local strategies to mitigate those effects.

## LEVERAGING STRENGTHS TO TACKLE BIODIVERSITY CONSERVATION ISSUES IN ALBERTA

"The Biodiversity Chairs combine field research information with what industry is doing," explains Dr. Stan Boutin, Alberta Biodiversity Chair and Alberta Biodiversity Monitoring Institute Co-Director. "Working together, we identify challenges and working with industry we find solutions."

The Chairs Program, now in its second year, relies on participation from industry and government for success. AI-EES is working in collaboration with the Canada's Oil Sands Innovation Alliance's (COSIA) Land Environmental Protection Area, Alberta Innovates - Bio Solutions, the Natural Sciences and Engineering Research Council of Canada (NSERC), and the University of Alberta on this Program.

"AI-EES played a critical instigator role launching the Biodiversity Chairs Program," says Dr. Ted Nason, Science Liaison, AEMERA (Alberta Environmental Monitoring Evaluation and Reporting Agency). "AI-EES created the framework and did the legwork required to get connected to key stakeholders, such as COSIA, and the provincial government."



## PROGRAM OUTCOMES

The results from the Chairs Program research enable a recovery strategy that relies on multiple approaches. The Caribou Population Restoration Strategy is being tested for implementation including:

- » Controlling wolf populations within caribou habitat
- » Fenced areas for birthing and young caribou to remain while particularly vulnerable
- » Ensuring wildlife can go under, over or around above ground pipelines and other industrial infrastructure
- » Longer-term habitat recovery restoration practices that includes the recovery of seismic lines and reclamation with native plant species.

Improved rare species monitoring: research is leading to a greater understanding of the distribution and abundance of rare plants and animals. Using new monitoring technologies it has been noted that some rare species are much more abundant than previously thought.

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*In 2013, AI-EES and project partners made a commitment to invest \$5.2 million over five years to support the Alberta Biodiversity Chairs. Their work will help us understand how the combined effects of human activities, particularly the energy industry, affect biodiversity in the boreal forest.*

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Improved recording devices: new census tools are providing rich data on Alberta's biodiversity in volumes never seen before. Multiple remote/unmanned technologies are being tested including:

- » Acoustic devices to track numbers and locations of birds
- » Motion sensors to track mammal movement
- » Optical technologies, using unmanned aerial vehicles (UAVs), to identify vegetation and plant communities.



WATER AND  
LAND MANAGEMENT

# WATER INNOVATION PROGRAM AIMED AT SECURING ALBERTA'S WATER FUTURE

Alberta's population is expected to double by 2050. The province anticipates continued growth in Alberta's resource economy and we are home to an agricultural system that provides some of the most productive crop yields in North America.

## FOCUS AREA

Water Management,  
Land Restoration and  
Tailings Management

## IMPACT

Knowledge gained through research and innovation is key to well-informed policy, management decisions, and water management practices in Alberta.

Even with the progress made in water conservation, efficiency, and productivity, demand for water will continue to increase due to population growth, increased recreational use, and economic expansion. At the same time, climate change induced variability and human activity will impact the health of Alberta's aquatic ecosystems.

Nowhere else in the world do all of these water challenges exist in a single jurisdiction.

In 2012, AI-EES received a three-year \$15.2 million grant from the Government of Alberta to continue to address the evolving water innovation priorities of Alberta. In 2015, AI-EES received an additional \$25 million over five years to deliver on the actions and desired outcomes identified in the Alberta Water Research and Innovation Strategy (2014).

AI-EES' Water Innovation Program (WIP) is a flagship program for the Government of Alberta in water innovation and a key tool to support the Water for Life strategy focused on the following goals:

- » Building projects to enhance scientific understanding and developing best practices in managing water security, risk and vulnerability
- » Ensuring excellence in watershed stewardship and ecosystem management
- » Developing energy efficient treatment technologies for increased water conservation, efficiency and productivity in the energy industry.

"AI-EES helps the Government of Alberta deliver on its innovation objectives," says Daphne Cheel, Executive Director for Science and Research, Innovation and Advanced Education. "AI-EES has the knowledge, skills and business processes, as well as the technical competencies that give the government the confidence that the right investments in water research are being made."

"The goals for Alberta's Water for Life strategy may seem simple: provide Albertans with safe, secure drinking water, protect healthy aquatic ecosystems, and ensure reliable quality water supplies for a sustainable economy," says AI-EES' CEO,

## WORKING WITH ALBERTA'S WATER COMMUNITY

Ongoing communication with Alberta's water community will ensure AI-EES continues to build an adaptive Water Innovation Program that responds to and addresses Alberta's needs to deliver on the Water for Life goals.

### AI-EES' key innovation partnerships:

Government of Alberta

The Alberta Environmental Monitoring, Evaluation and Reporting Agency (AEMERA)

The Alberta Energy Regulator (AER)

Key federal Government Departments (Environment Canada, Parks Canada, Fisheries and Oceans)

Canada's Oil Sands Innovation Alliance (COSIA)

Alberta Water Council (AWC)

Environmental Law Centre

Watershed Planning and Advisory Councils (WPACs)

Water Stewardship Organizations

Campus Alberta, universities and colleges

Alberta Irrigation Projects Association (AIPA)

Alberta Urban Municipalities Association (AUMA)

Alberta Association of Municipal Districts and Counties (AAMDC)

Canadian Water Network (CWN)

Canadian Water Resources Association (CWRA)

Alberta Lake Management Society (ALMS)

Water Environment Research Foundation (WERF).

*In 2012, AI-EES received a three-year \$15.2 million grant from the Government of Alberta to continue to address the evolving water innovation priorities of Alberta. In 2015, AI-EES received an additional \$25 million over 5-years to deliver on the actions and desired outcomes identified in the Alberta Water Research and Innovation Strategy (2014).*

Dr. Eddy Isaacs. "However, achieving these goals – in an ever-changing time with greater demands on Alberta's water system than ever before – will be no easy matter."

Ensuring the province has the quality and quantity of water, where and when it is needed will be at the heart of decision making for the Government of Alberta in order to support the desired quality of life, health of communities, families, our economy and the environment.

"AI-EES is seen as the organization best positioned to deliver on knowledge and technology gaps associated with fulfilling the goals of Water for Life and associated research strategies," says Cheel. "Knowledge gained through research and innovation is key to well-informed policy, management decisions, and water management practices in Alberta."

### Alberta's water challenges

Alberta has a unique water landscape. There are few places on the globe where so many critical water challenges exist within a single jurisdiction:

- » Population growth
- » An expanding economy
- » Agricultural production
- » Increased energy development
- » Increased expectations for environmental performance
- » Climate change and variability.

### 2030 TARGET

Alberta will have safe, secure and reliable water resources for six million people while maintaining or enhancing the health of aquatic ecosystems

Improve the overall efficiency and productivity of water use in Alberta by 30 per cent from a 2010 baseline

100 million m<sup>3</sup> reduction from legacy mature fine tailings over and above government directives

Habitat restoration rates that meet or exceed disturbance on lands affected by resource development

# RESULTS ACHIEVED

## BASED ON THE CORPORATION'S GOALS, OUTCOMES AND PERFORMANCE MEASURES

To meet its goals, AI-EES is continuously improving its business processes and performance metrics. As a result, new measures have been introduced in the 2015-18 Business Plan (aligned to 2030 targets) and will be used for reporting in the next edition of the AI-EES Report on Outcomes.

In 2014-15, AI-EES invested in several initiatives that promote partnerships, assist in addressing Alberta's key challenges, and advance its leadership in Energy and Environment:

- » A total of \$17.5 million in 89 research projects aligned to meet the goals for cleaner hydrocarbons and renewable energy, reduce greenhouse gas (GHG) emissions, and advance the management of tailings and sustainable water initiatives
- » The total value of these projects over their lifetime is approximately \$312.2 million, of which AI-EES will have provided \$82.9 million. This is an approximate leverage factor of 2.8
- » Energy Technologies strategic area invested \$5 million (28 per cent of total) in 23 projects
- » Renewables and Emerging Technologies invested \$3.3 million (19 per cent of total) in 15 projects
- » Water and Environmental Management invested \$9.3 million (53 per cent of total) in 51 projects (this includes projects from the Water and Tailings and Alberta Water Research Initiative restricted funds)
- » Worked with the Alberta Government and agencies to co-develop research projects that will inform policy and ministry strategies: AI-EES invested \$2.5 million in 15 Technology Informing Policy projects
- » AI-EES supported the development of innovation capacity by investing \$7.7 million at universities (University of Alberta, University of Calgary, University of Lethbridge, University of Waterloo, University of Regina, and the Norwegian University of Science and Technology). This included funding for two Centres, 12 Chairs, and 36 individual research projects.

### ENERGY TECHNOLOGIES STRATEGIC AREA

invested \$5 million (28 per cent of total) in 23 projects

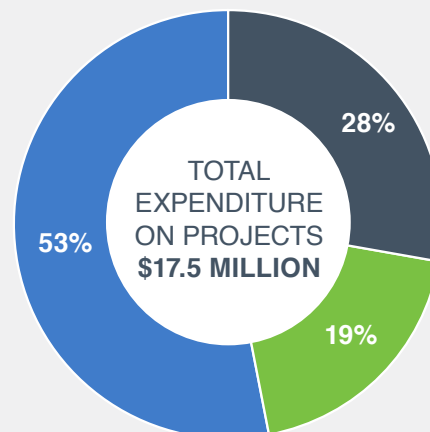
### RENEWABLES AND EMERGING TECHNOLOGIES

invested \$3.3 million (19 per cent of total) in 15 projects

### WATER AND ENVIRONMENTAL MANAGEMENT

invested \$9.3 million (53 per cent of total) in 51 projects (this includes projects from the Water and Tailings and Alberta Water Research Initiative restricted funds)

*A list of projects by strategic area is provided on pages 47-48.*





## MAINTAINING A BALANCED PORTFOLIO

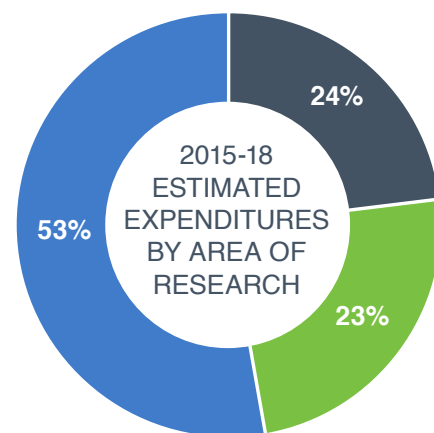
**GOAL STATEMENT** AI-EES maintains a balanced portfolio of projects in its three strategic areas.

AI-EES tracks projects by strategic area to ensure that its efforts are appropriately weighted across each of the Corporation's portfolios and aligned to its major and minor focus areas. This chart shows the Corporation's investments aligned to each strategic area for 2015-18.

**ENERGY TECHNOLOGIES** \$15.8 million

**RENEWABLES AND EMERGING TECHNOLOGIES** \$15.6 million

**WATER AND ENVIRONMENTAL MANAGEMENT** \$35.8 million



## ACCELERATE COMMERCIALIZATION TECHNOLOGY READINESS LEVELS

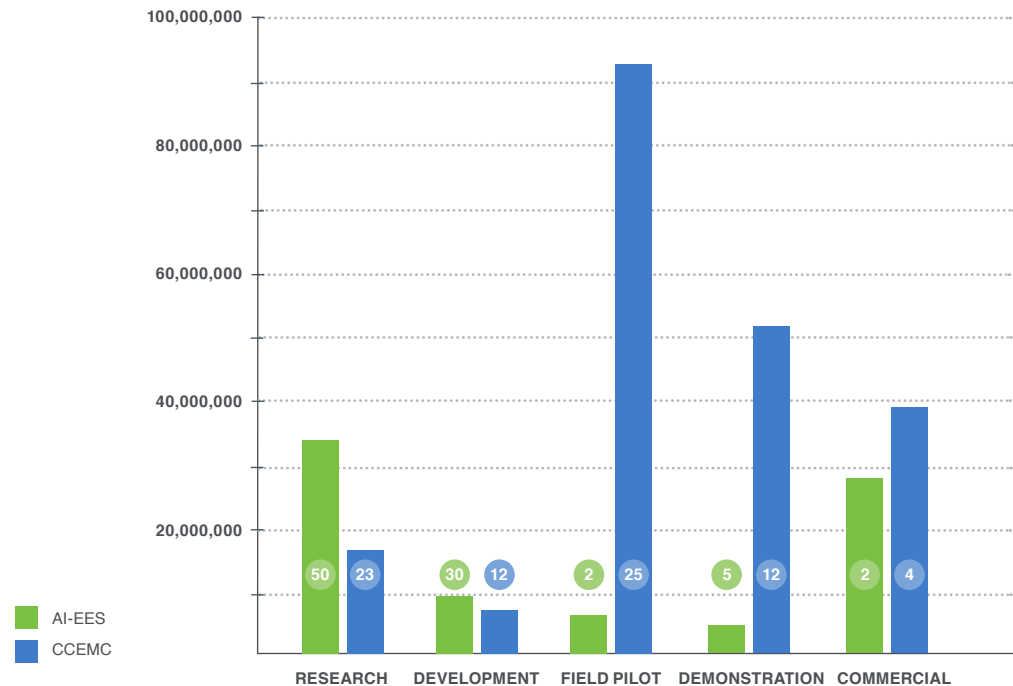
**GOAL STATEMENT** AI-EES invests in a portfolio of projects along the Technology Readiness Levels (TRL) scale.

AI-EES evaluates projects and tracks their success by assessing their TRL relative to progress towards commercial applications and milestones achieved (see the following graph). This allows AI-EES to maintain a balanced portfolio of projects along the pathway towards commercialization, keeping a number of projects entering the spectrum at the early ideas stage and developing technology transfer strategies when projects move closer to commercialization.

As of March 31, 2015, the 89 active projects in the AI-EES portfolio were analyzed and placed on the simplified TRL scale of research, development, pilot, demonstration and

commercialization. AI-EES, as the project manager for projects of the Climate Change and Emissions Management Corporation's (CCEMC), also tracks the 76 active projects in the CCEMC's portfolio. The chart shows a balanced portfolio with AI-EES projects mostly at the earlier stages of development and CCEMC projects towards the commercialization end. Some projects originally developed with AI-EES and that fit the CCEMC mandate, have transitioned to being funded by the CCEMC to see them through the more expensive stages of pilot and demonstration.

Mapping AI-EES' active projects along the innovation path. Number of projects in each level is noted on the bar.



## OVERALL ACHIEVEMENT OF LONG-TERM TARGETS – BUSINESS TRACKING

**GOAL STATEMENT** AI-EES is working toward achieving its 2030 targets.

AI-EES' vision is that Alberta leads the world in developing innovative energy and environmental technologies that build on the province's natural advantages. To achieve this outcome, AI-EES has established long-term targets aligned with provincial strategies. These targets ensure the Corporation's initiatives are aligned to Alberta priorities.

AI-EES uses the ProGrid methodology to measure overall progress towards its 2020 and 2030 targets. This methodology provides a way to measure assets that do not necessarily show up on a balance sheet – the Corporation's strategic approach, the effectiveness of staff and management systems, effectiveness of partnerships, the ability to influence directions and outcomes relative to

the defined targets. In its three operating areas AI-EES fine-tuned its major and minor areas of focus based on the shift in challenges facing the province this year. Results across these areas continued to be solid in 2014-15:

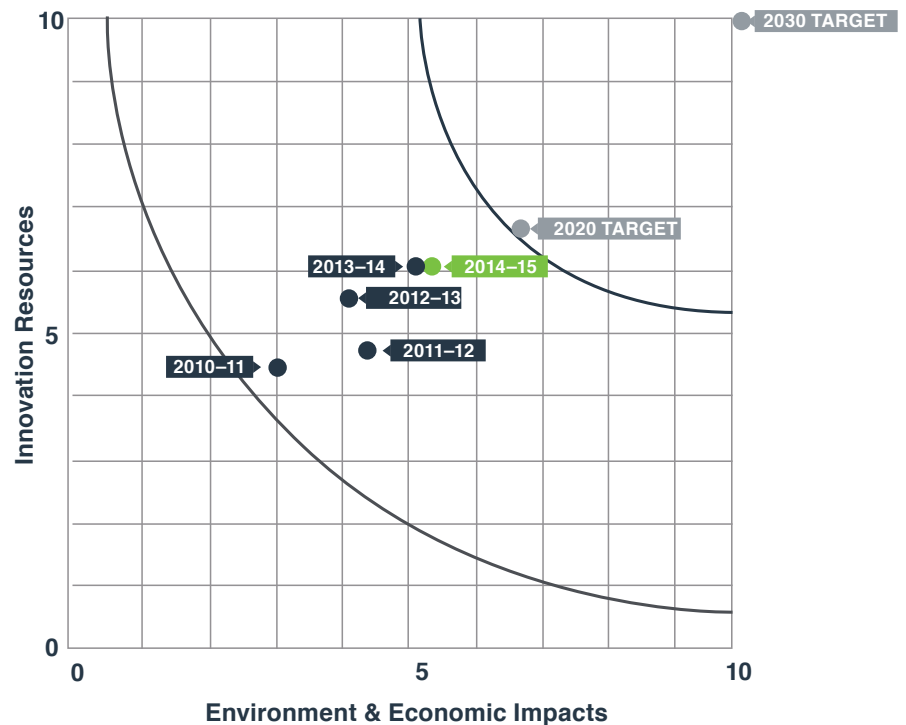
- » The Energy Technologies team continues to grow the strong partnerships needed to advance technology readiness for future commercial processes, and is making progress in its five specific program areas (i.e. bitumen and heavy oil; upgrading and processing; value-added products; clean carbon; and tight oil and unconventional gas) as well as addressing international pressures facing the hydrocarbons industry (i.e. market access).

- » The Renewables and Emerging Technologies team has strengthened its management capacity and its response to enable renewable energy through energy storage technologies. Its waste-to-value added program made the most impact in 2014-15.
- » The Water and Environmental Management team has established AI-EES as a leading agency in developing knowledge and innovation to support Alberta's Water for Life strategy. Its investments in Integrated Land Management and Tailings Management have led to advances in fundamental understanding, monitoring methods, and reclamation technologies, all of which

contributed to informing policy development. In GHG management, novel technologies are advancing to the pilot stage to reduce carbon capture cost by 50 per cent.

Progress within each strategic area is measured annually against a set of criteria that mirror the 2030 targets. The summary grid shown below illustrates that AI-EES is making progress toward its long-term goals overall. Although progress in 2014-15 appears to have stalled, advancements are still being made in Renewables and Emerging Resources and Water and Environmental Management. Larger investments are required to move the Energy Technologies goals further to commercialization and to attainment of the 2030 targets.

The overall corporate results indicate the performance level of the AI-EES organization (2014-15).





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## OUR TEAM IS PRESENTING IDEAS AND SHARING ALBERTA'S STORIES AROUND THE WORLD

We are building Alberta's brand and reputation as an innovator. Our technical staff are recognized worldwide and are invited to be panelists or speakers on a range of topics from the safe transportation of dilbit to managing

water resources to partial upgrading and maintaining biodiversity. In 2014-15, AI-EES staff delivered more than 70 presentations in eight countries and 21 cities related to innovation in energy and environment.

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## BUSINESS DEVELOPMENT FOR ALBERTA

AI-EES takes pride in the relationships we have built around the world. The Corporation often hosts delegations from countries who are interested in innovation in the energy and environment fields, working directly with global non-government organizations or with businesses to showcase Alberta technologies in an effort to attract either new

technologies to Alberta or business development. In 2014-15, AI-EES worked in partnership with the Canadian Clean Power Coalition, Japan's New Energy and Industrial Technology Development Organization as well as a Japanese consortium, IHI. Talks on clean coal technologies led to development of an Oxy-fuel project in partnership with TransAlta.

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## KNOWLEDGE TRANSFER

Sharing outcomes that can lead to the acceleration of commercialization across industry sectors is core to AI-EES' business planning. This year, steps were taken toward achieving 2014-15 business plan objectives to be a key player in the innovation network, by creating value through the improved facilitation of knowledge, intellectual property, technology and skills transfer. AI-EES has embarked on a

plan to be digital by 2020 to improve business processes and allow for effective knowledge sharing and collaboration within the innovation system. Access to the Corporation's research outcomes anytime by anyone will facilitate the open innovation required to leverage past investments to advance effective technology development and generate science-based knowledge to inform policy and decisions.

# AI-EES 2014-2015 PRESENTATIONS

## EDDY ISAACS

CEO

**Oil Sands Innovation**, presented at the Energy Canadian Oil Sands Business Opportunities Seminar, Pop-up Canada, Pittsburgh, PA, *April, 2014*

**The Future of Oil Sands**, presented to Energy Class BGI Bainbridge Graduate Institute, Seattle, WA, *April, 2014*

**Innovation and Technology Development in Alberta's Oil Sands Sector**, presented at the Energy Innovation Seminar, *April, 2014*

**Keynote speaker** at the Petroleum Technology Alliance of Canada's 2014 Oil Sands Forum, *October, 2014*

**Speaker and Panelist** at the International Shale Gas Development, the Gas Technology Institute (GTI) Shale Exchange, *October, 2014*

**Carbon Capture & Storage Innovation in Alberta**, presentation to Norwegian CCS study tour to Canada, *November, 2014*

**The Pivotal Role of Industrial and Environmental Processes in the Sustainable Development of Alberta's Oil Sands**, Plenary Speaker CIC and ACPA Conference on Industrial and Environmental Chemistry, *November, 2014*

**Panelist**, Alberta Chamber of Resources Strategic Framework Leader Panel – Creating Our Desired Triple Future, *February, 2015*

**Speaker** at the Canadian Oil Sands Innovation Forum, Minneapolis, MN, *February, 2015*

## JOHN ZHOU

Chief Technical Officer and Executive Director of Water and Environmental Management

**GHG Mitigation Options for Alberta**, a presentation at the School of Business, University of Alberta, *May, 2014*

**Advancement and Opportunities in Oil Sands Process Water Treatment**, presented at Nanyang Technological University, Singapore, *June, 2014*

**Innovation for Sustainable Oil Sands Development in Alberta**, presented to ConocoPhillips, Calgary, *July, 2014*

**Carbon Capture Development in Alberta: AI-EES and the CCEMC Portfolio**, presented at the Government of Alberta CCS Cross Ministry Meeting, Edmonton, *August, 2014*

**Sustainable Resource Development and Responsible Environmental Management in Alberta**, presented to the USA Congressional Staffers Delegation, Edmonton, *August, 2014*

**Partnership for Solutions**, presented at the Helmholtz Alberta Initiative Annual Conference, Edmonton, *September, 2014*

**GHG Reduction in Bitumen Production through Energy Efficiency and CO<sub>2</sub> Utilization**, presented at the Alberta GHG Summit, Alberta Energy Efficiency Alliance, Calgary, *October, 2014*

**Effect of Diluted Bitumen on Freshwater Environments: Comparison with Conventional Crude**, presented to the Royal Society of Canada Expert Panel - The Behavior and Environmental Impacts of Crude Oil Released into Aqueous Environments, Edmonton, *February, 2015*

**Introduction of Alberta Innovates – Energy and Environment Solutions (AI-EES)**, presented to the Science and Technology in Society (STIS) Japan Delegation, Waterloo, *February, 2015*

**Carbon Capture Development and Demonstration in Alberta: An Update,** presented to the Ministry of Environment, Edmonton, *March, 2015*

**Introduction of Alberta Innovates – Energy and Environment Solutions (AI-EES),** presented to the Ambassador of Belgium, Edmonton, *March, 2015*

**Carbon Capture Development and Demonstration in Alberta: An Update,** presented at the U.S.- CANADA CCS/ CCUS Fourth Bilateral National Conference Innovation in CO<sub>2</sub> Capture: Increasing Performance And Decreasing Cost, Birmingham, Alabama, U.S., *March, 2015*

**Effect of Diluted Bitumen on Freshwater Environments: Comparison with Conventional Crudes,** presented to the U.S. National Research Council (NRC) Committee on Effect of Diluted Bitumen on the Environment: A Comparative Study, *March, 2015*

**AI-EES Water Innovation Program,** presented to the Alberta Water Council, Edmonton, *March, 2015*

**A Brief Overview of Water Research and Innovation Activities in the Government of Alberta Innovation System,** presented at the Alberta Water Research and Innovation Strategy Workshop, Edmonton, *March, 2015*

## SURINDAR SINGH

Executive Director,  
Renewables and  
Emerging Technologies

**Bio Products Opportunities from Waste and Biomass Feedstock in Alberta,** presented at the AI-EES Bio Products Symposium, Edmonton, *June, 2014*

**Panelist at the Renewable Energy Forum: How Can Renewable Energy Grow in Alberta's Market Based Electricity System,** presented at the Town Hall Meeting hosted by Donna Kennedy-Glans, MLA for Calgary Varsity, Calgary, *June, 2014*

**Accelerating Energy Innovation in Alberta: Role of Alberta Innovates – Energy and Environment Solutions,** presented to the Research Managers Delegation from India, Edmonton, *July, 2014*

**Future of Renewable Energy in Alberta,** presented at AI-EES' Annual Technology Talks, Calgary, *October, 2014*

**AI-EES Waste-to-Value-Added Initiatives,** presented at the Biorefining Conversions Network's Waste Management and Diversion Workshop, Edmonton, *February, 2015*

**Innovation Support for Sustainable Resource Development and Environmental Management,** presentation to the European Delegation, Edmonton, *March 10, 2015*



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**LES LITTLE**

Executive Director,  
Energy Technologies

**Hydrocarbon Extraction and Production, Panel Discussion**, presented at the NRCan Energy Workshop, Ottawa, *April, 2014*

**Cold Production/Advanced Heavy Oil EOR**, presented at the SPE Heavy Oil Conference, Calgary, *June, 2014*

**Bitumen Upgrading Technologies and Transportation**, Panel Discussion Bitumen at Bitumen Markets Workshop, Toronto, *June, 2014*

**AI-EES Mandate, Strategy and Opportunities in Advanced Recovery Process of In Situ Bitumen**, presented at the Husky Technology Meeting, Calgary, *July, 2014*

**AI-EES Introduction, Strategy, Mandate and Opportunities for Collaboration**, presented at the Consulate of Japan, Calgary, *July, 2014*

**Carbonate Recovery Development in Alberta**, presented at the Carbonates Recovery Meeting, Calgary, *August, 2014*

**AI-EES General and Needs and Challenges; High Temperature, High Pressure Applications**, presented at the Metering and Monitoring Meeting, Edmonton, *August, 2014*

**Improving the Environmental Performance of In Situ Recovery Processes**, presented at the Bitumen Recovery Process Workshop, Calgary, *August, 2015*

**AI-EES Priorities and Initiatives in Energy Technologies**, presented at the Nexen Technology Meetings, Calgary, *September, 2014*

**AI-EES Priorities, Strategies, Energy Technology Portfolio, and Opportunities for Collaboration**, presented at Statoil Technology Meetings, Calgary, *September, 2014*

**Technical Considerations for Bitumen Recovery Process Improvements**, presented at the Bitumen Extraction Workshop, Calgary, *September, 2014*

**AI-EES Priorities and Initiatives in Energy Technologies**, presented at the Suncor Technology Meetings, Calgary, *October, 2014*

**AI-EES Introduction, Strategy, Priorities, and Energy Technologies Strategy for Natural Gas**, presented at the United Kingdom Consulate, Calgary, *December, 2014*

**AI-EES Partial Upgrading Strategy and Initiatives**, presented at the Bitumen Upgrading Development Meetings, Edmonton, *January, 2015*

**AI-EES General and Solvent Recovery Application Challenges**, presented at Exxon-Mobil In Situ Bitumen Recovery Meeting, Calgary, *February, 2015*

**AI-EES Strategy, Mandate and Priorities**, presented to Shell, Calgary, *February, 2015*

**BRETT PURDY**

Senior Director,  
Integrated Land  
Management

**Integrated Land Management (ILM): A Project Portfolio to Support Sustainable Management, Biodiversity Conservation and Restoration in Alberta**, presented at the AI-EES Government of Alberta Learning Session, *June, 2014*

**Reducing the Environmental Footprint of Energy Development in Alberta**, presented to the Suncor Reclamation and Environment team, *July, 2014*

**Restoring Ecological Function to Disturbed Landscapes in Alberta – Multiple Challenges Addressed by Reclamation and Remediation science**, presented at the Biological Solutions Forum, *October, 2014*

**Restoring Ecological Function to Disturbed Landscapes in Alberta: 7 Key Steps**, presented at AI-EES' Annual Technology Talks, *October, 2014*

**Innovation for Sustainable Resource Development and Environmental Management in Alberta**, presented at the European Union Energy Study Mission, *September, 2014*

**Innovation at the Interface of Energy and Environment to Support Sustainable Management, Biodiversity Conservation and Restoration in Alberta**, presented at the Forest Management Branch Innovation workshop, *February, 2015*

**Innovation for Sustainable Resource Development and Environmental Management in Alberta**, presented at the Pan-Prairie Energy Tour, *March, 2015*

**JON SWEETMAN**

Manager, Water Resources

**Alberta's Water for Life Strategy and the Role of Bio Resource Engineering**, Edmonton, *June, 2014*

**Water futures: Challenges and Opportunities for Sustainable Water Management**, presented at the University of Lethbridge, *January, 2015*

**XIAOMEI LI**

Senior Advisor, Bioenergy

**Biogas Production from Household Waste: Opportunities and Challenges**, presented at Shanxi Agricultural University, China, *April, 2014*

**Policy Recommendations for Zero Organic Waste in Alberta**, presented to the Waste Policy Section, the Ministry of Environment and Sustainable Resource Development, *December, 2014*

**Exploring Opportunities for Working with AI-EES**, presented to the Public Works Committee, Lac La Biche County, *December, 2014*

**Waste-to-Value Added**, presented at the Bioenergy Technology Roadmap Workshop, Edmonton, *January, 2015*

**VICKI LIGHTBOWN**

Senior Manager,  
GHGs and Water Treatment

**Exploring Emerging Technologies for Water Treatment**, presented for Hatch Sustainability Week, *April, 2014*

**Emerging Technologies for SAGD Water Treatment**, presented at the AI-EES Government of Alberta Learning Session, *June, 2014*

**High Temperature De-oiling of SAGD Produced Water**, presented at the World Heavy Oil Congress, *March, 2014*

**MARK SUMMERS**

Director, Renewable Energy

**CCEMC Grand Challenge: Innovative Carbon Uses**, presented at the 13th Annual Carbon Capture, Utilization, and Storage Conference, Pittsburgh, PA, *May, 2014*

**Accelerating Energy Storage in Alberta**, presented at Project Development in Grid-Scale Energy Storage Technologies, Vancouver, *May, 2014*

**CCEMC: An Overview of the Organization and its Work to Reduce GHG Emissions in Alberta**, presented at the Canadian Bar Association: National Environmental, Energy and Resources Law Section, Edmonton, *May, 2014*

**Reducing Emissions: Funding a Way Forward**, presented at the Global Petroleum Show, Calgary, *June, 2014*

**Energy Storage for Intermittent Renewable Electricity in Alberta**, presented at the AI-EES Government of Alberta Learning Session, Edmonton, *June, 2014*

**Green Power for Alberta: The Promise of Energy Storage**, presented at AI-EES' Annual Technology Talks, Calgary, *October, 2014*

**CCEMC Investments in CCS: Challenges, Progress, and Opportunity**, presented at the Enabling Successful Deployment of CCS Technology: A Canada-UK Workshop, London, UK, *March, 2015*

**NEVIN CIMOLAI**

Manager, Energy Systems

**Oil Sands Competitiveness and Market Access**, presented to AI-EES' Annual Technology Talks, Calgary, *October, 2014*

**Water and Energy Efficiency Challenges in Oil and Gas Development**, presented to a delegation of Germans in the water-purification business, Calgary, *March, 2015*



**BRUCE DUONG**

Project Specialist,  
Technology Development

**Improving In Situ Oil Sands Recovery,** presented at AI-EES' Annual Technology Talks, Calgary, *October, 2014*

**DUKE DU PLESSIS**

Senior Advisor,  
Energy Technologies

**The Competitiveness of Western Canadian Oil Sands and Heavy Oil in North American and International Markets: Opportunities and Challenges,** presented at the Canadian Heavy Oil Association Technical Lunch, Edmonton, *March, 2014*

**Innovation and Technology Use in the Hydro-carbon Sector, Executive Panel,** presented at the CERI 2014 Oil Conference, Calgary, *April, 2014*

**Adding Value to Alberta's Oil Sands and Natural Gas Resources Overview of AI-EES Activities,** presented to Tian'an Group, China, Calgary, *August, 2014*

**Building an Innovation Support Network,** presented to the Collaborative, Multi-Stakeholder Forum to Envision and Prepare for the Future of Canada's Oil and Gas Industry, ARC Financial Corporation, Calgary, *May, 2014*

**Gas to Liquids Technologies with Potential for Adding Value to Alberta's Natural Gas Resources,** presented to the Gas Producers Association of Canada, Technical Lunch, Calgary, *May, 2014*

**Gas to Liquids and Biomass to Liquids Initiatives in Alberta: Opportunities and Challenges,** presented at the Partial Upgrading Workshop, Calgary, *May, 2014*

**The Competitiveness of Western Canadian Oil Sands in North American and International Markets: Opportunities and Challenges,** presented at the International Refining and Petrochemical Conference (IRPC), Verona, Italy, *June, 2014*

**The Competitiveness of Western Canadian Oil Sands in North American and International Markets: Opportunities and Challenges,** presented at the Japan Petroleum Institute (JPI) Petroleum Conference, Tokyo, Japan, *October, 2014*

**Partial Upgrading of Western Canadian Oil Sands: Opportunities and Challenges,** presented at the World Heavy Oil Congress, Edmonton, *March, 2015*

**ALEXANDER ZEHNDER**

Scientific Director,  
Water Resources

**Lessons Learned from Eliminating Arsenic from Drinking Water in Indo-China,** AAAS 2014 Annual Meeting | Meeting Global Challenges: Discovery and Innovation, Chicago, IL, *February, 2015*

**Water Lecture,** University of Alberta, Edmonton, *September, 2014*

**Alberta's Water Challenges and Opportunities,** Waser Berlin International GWP Forum: Challenges in North America, | International Trade Fair and Congress for Water Management, Berlin, Germany, *March, 2015*

# OUR TEAM

**Eddy Isaacs**

*Chief Executive Officer*

**John Zhou**

*Chief Technical Officer and Executive Director, Water and Environment Management*

**WATER AND ENVIRONMENTAL MANAGEMENT**

**Rick Nelson**

*Senior Director, Oil Sands Tailings*

**Brett Purdy**

*Senior Director, Integrated Land Management*

**Jon Sweetman**

*Manager, Water Resources*

**Vicki Lightbown**

*Manager, Water and Environmental Management*

**Alexander Zehnder**

*Scientific Director, Water Resources*

**Dianne White**

*Program Officer, Water Resources*

**ENERGY TECHNOLOGIES**

**Les Little**

*Executive Director, Energy Technologies*

**Shunlan Liu**

*Director, Processing and Products*

**Kate Wilson**

*Director, Technology Development*

**Bruce Duong**

*Project Specialist, Technology Development*

**Duke du Plessis**

*Senior Advisor, Energy Technologies*

**Nevin Cimolai**

*Manager, Energy Systems*

**RENEWABLES AND EMERGING TECHNOLOGIES**

**Surindar Singh**

*Executive Director, Renewables and Emerging Technologies*

**Maureen Kolla**

*Manager, Renewable Energy*

**Xiaomei Li**

*Senior Advisor, Bioenergy*

**Mark Summers**

*Director, Renewable Energy*

**Arifa Sultana**

*Project Specialist*

**KNOWLEDGE TRANSFER**

**Lisa Spinks**

*Technology Transfer Manager*

**Christine Stewart**

*Enterprise Content Management Specialist*

**Hilary Stamper**

*Information and Resource Specialist*

**Janet Lilly**

*Records Analyst*

**Traci Kwan**

*Information Officer*

**OPERATIONS STAFF**

**Alice Barr**

*Director, Strategic Planning and Operations*

**Joan Adams**

*Payroll and Benefits Specialist*

**Marta Bor**

*Administrative Support*

**Michelle Gurney**

*Communications Director*

**Donna Kostuik**

*Executive Assistant*

**Libuse Kuzel**

*Director, Human Resources*

**Lolita Ledesma**

*Administrative Support*

**Bruce Marpole**

*Communications Support*

# OUR BOARD

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## ERIC NEWELL (CHAIR)

### Chancellor Emeritus University of Alberta

Mr. Newell is a retired Alberta business executive with a stellar history of corporate leadership and achievement, as well as an exemplary record of service to industry and community. His career has taken him to Imperial Oil Limited and Esso Petroleum Canada, but he is perhaps best known for his tenure at Syncrude Canada Ltd. where he served for 14 years as CEO (1989-2003) and for nine years as Chairman (1994-2003). He also served as President from 1989 to 1997. Under his leadership, Syncrude, which is the world's largest producer of crude oil from oil sands, became a key player in the western Canadian economy, an increasingly significant source of energy supply for the entire nation, and a model of a reliably operated, environmentally efficient corporation. He was appointed an Officer of the Order of Canada in 2000 and was inducted into the Alberta Order of Excellence in 2004.

Mr. Newell currently serves on a number of boards, including: Board Chair, CAREERS - The Next Generation Foundation; Director, Gairdner Foundation; Director, Melcor Developments Ltd., Director, The Canadian Ditchely Foundation; and is the former Chair of the Climate Change and Emissions Management Corporation. Mr. Newell was selected as Canada's 2003 Energy Person of the Year and inducted into the Canadian Petroleum Hall of Fame in 2010.

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## KATHLEEN SENDALL (VICE CHAIR)

### Former Senior Vice President, North American Natural Gas Petro Canada

Ms. Sendall is a corporate director, serving on the Boards of CGG, based in Paris; Enmax Energy Corporation; Alberta Innovates - Energy and Environment Solutions (AI-EES); and the Climate Change Emissions Management Corporation (CCEMC). She is Chair of the CCEMC Board and Vice-Chair of AI-EES. She also participates on two federal advisory councils— the Sustainable Development Technology Member Council and the Advisory Council for Promoting Women on Boards. She has advised federal and provincial governments on climate change, carbon capture and storage, environmental legislation, and Arctic foreign policy. Kathy also chaired the Canadian Council of Academies Assessment Panel on the State of Industrial R&D in Canada. Previously, Ms. Sendall led Petro-Canada's North American Natural Gas

Business Unit and was responsible for the company's North American conventional oil and gas production and exploration and natural gas marketing.

Ms. Sendall has contributed her time to a number of not-for-profit Boards, and is currently a Director of the Manning Foundation for Innovation. She is past president and former director of the Canadian Academy of Engineering, and a former Governor and Board Chair of the Canadian Association of Petroleum Producers (CAPP). Ms. Sendall has received many awards including the YWCA Women of Distinction Award, and two honorary degrees, including an Honorary Doctor of Laws from the University of Calgary in 2013. She has been twice named one of Alberta's 50 Most Influential People by Alberta Venture. She was named four times as one of Canada's Top 100 Most Powerful Women in the Corporate Executive category and inducted into Canada's Most Powerful Women Hall of Fame. She was awarded the 50 Key Women in Energy Global Award and the Women Who Make a Difference Award from the International Women's Forum, named as a Member of the Order of Canada in 2011 and awarded the Queen's Jubilee Medal in 2012. In 2014-15 Ms. Sendall was the Jarislowsky Fellow at the Haskayne School of Business.

Ms. Sendall graduated from Queen's University with a Bachelor of Science (Honours) degree in Mechanical Engineering, and attended the Ivey Executive Program at the Ivey School of Business.

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## DOUG BEEVER (BOARD MEMBER)

### Senior Director, Sustainability and Stakeholder Relations, Agrium Inc.

Mr. Beever joined Agrium in 1987 and has held roles of increasing responsibility, including: Manager, Marketing Services, Senior Director, Corporate Relations and his current role as Senior Director, Sustainability & Stakeholder Relations. He is responsible for Agrium's Government Relations and Corporate Social Responsibility communications. Prior to joining Agrium, Doug worked for Monsanto Canada Inc. He is a graduate of the University of Manitoba, where he earned his Masters degree in Soil Science. Doug is involved with a number of industry associations including the Canadian Fertilizer Institute, The Fertilizer Institute, the International Fertilizer Institute and the International Plant Nutrient Institute and sits on many of their respective committees. He also sits



on the boards of the Nutrients for Life Foundation Canada, the Climate Change Emission Management Corporation, Alberta Innovates - Energy and Environmental Solutions, and Agriculture for Life.

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#### **PAUL CLARK (BOARD MEMBER)**

##### **President and Chief Visioneer, VisionGain Consulting**

Mr. Clark is the President of VisionGain Consulting, a firm specializing in visioning, strategy building and technology management. From 1994 to 2006, he served as Vice President, Research and Technology for Nova Chemicals Corporation. He has received several awards including the NSERC Synergy Award (2003), Alberta Science and Technology (ASTech) Awards (2002 and 2003), APEGGA Award for Technology Commercialization (2004) and the Purvis Memorial Award (Society for Chemical Industry - 2008). He serves on a number of boards including the Climate Change and Emissions Management Corporation, Canadian Light Source Inc., and BioIndustrial Innovation Canada.

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#### **AARON FALKENBERG (BOARD MEMBER)**

##### **President, Skyline Poultry Farms Ltd.**

Mr. Falkenberg is President of Skyline Poultry Farms Ltd. For his many years in agriculture leadership, he received an honorary degree from Olds College. As an AI-EES Board member, Aaron brings a diverse range of expertise. He is a businessman, a successful poultry farmer, software developer, and real estate developer. He currently serves on a number of boards and previously on the Climate Change and Emissions Corporation board.

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#### **CHARLIE FISCHER (BOARD MEMBER)**

##### **Former President and Chief Executive Officer, Nexen Inc.**

In 2010, Mr. Fischer was selected as Canada's Energy Person of the Year. From 2001 to 2008 he was the President and CEO of Nexen Inc. Prior to that, he was Executive Vice President and Chief Operating Officer of the company, responsible for Nexen's conventional oil and gas business in western Canada, the U.S. Gulf Coast, and all international locations as well as oil sands, marketing and information systems activities worldwide. Charlie has worked for Dome Petroleum, Hudson's Bay Oil and Gas and Bow Valley Industries. He is a past President for TransCanada Pipelines

upstream oil and gas subsidiaries, TCPL Resources Ltd. and Encor Energy Corporation Inc. In addition to his role on the AI-EES Board, Charlie serves on numerous boards including the board for Enbridge and Enbridge Income Trust.

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#### **PETER FRITZ (BOARD MEMBER)**

##### **Scientific and founding Director (ret.), Helmholtz Centre for Environmental Research UFZ (Leipzig, Germany)**

Dr. Fritz began his academic career in the hot-bed of isotope hydrology as a doctoral student in one of the world's first environmental isotope laboratories at the University of Pisa (Italy) in 1962. He has since done extensive research with environmental isotopes, including studies in isotope hydrology, paleoclimatology, and the development of methods for dating of groundwater. He was responsible for the development of isotope hydrology in Canada, first at the University of Alberta in Edmonton and then until 1987 at the University of Waterloo.

Following a short stay at the Helmholtz Research Centre Munich, as director for the Institute of Hydrology, he moved in 1991 to Leipzig as Founding and Scientific Director of the first Centre for Environmental Research in Germany where a staff of more than 1,000 scientists and technicians are entirely devoted to environmental research.

He is a fellow of the Royal Society of Canada, the German National Academy of Sciences Leopoldina, and the Polish Academy of Sciences. Peter is chairman of the Scientific Advisory board of the Zuckerberg Institute for Water Research at Ben Gurion University in Israel, he serves on the Scientific Advisory Group for Nuclear Applications (SAGNA) of the International Atomic Energy Agency, Vienna, Austria, and is member of the board of the BDZ - a Training and Demonstration Centre for decentral waste water treatment in Leipzig.

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#### **EDDY ISAACS (EX OFFICIO)**

##### **Alberta Innovates - Energy and Environment Solutions (AI-EES)**

As CEO of AI-EES, Dr. Eddy Isaacs is responsible for Alberta's strategic directions and technology investments in the areas of energy, renewables and emerging resources, as well as water and environmental management. Alongside his team, Eddy works to broaden collaborations and strengthen

partnerships with industry and governments to leverage the expertise and resources needed to position our province as a leader in energy and environmental innovation.

Eddy has been instrumental in promoting innovation across Canada and has served as co-Chair of the Energy Technology Working Group of the Canadian Council of Energy Ministers. He is regularly called upon to provide his expert opinion and insight into Alberta's energy and environment technology thrusts.

Eddy holds a Ph.D. from the University of Alberta and a B.Sc. from McGill University. He has over 70 publications and six patents in the energy field, and in 2014, earned the ASTECH Foundation's award for his outstanding contribution to the Alberta science and technology community. He is a Fellow of the Canadian Academy of Engineering and serves on the Boards of the Petroleum Technology Alliance of Canada and the Alberta Chamber of Resources.

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#### **DAVID LEWIN (BOARD MEMBER)**

##### **Former Senior Vice President, IGCC Development, Capital Power Corporation**

Dr. Lewin has over 30 years of experience in the field of power generation using fossil fuels both internationally and in Alberta. Formerly the Senior Vice President, IGCC (Integrated Gasification Combined Cycle) Development for Capital Power Corporation, David was responsible for completing the final phase of a Front End Engineering and Design (FEED) for a 252 MW IGCC Development at Genesee, Alberta. Prior to this role, David served as Senior Vice President Environment with EPCOR Utilities Inc. where he led the utilities team in negotiating the deregulation of power generation in the province. He has served on a number of boards including Chair of the Canadian Clean Power Coalition and previously as Vice Chair of the Climate Change and Emissions Management Corporation. His participation as a member of the AI-EES Board provides David with the opportunity to effect change and continue to pursue the challenge of delivering electrical energy in an environmentally acceptable way.

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#### **DAVID LYNCH (BOARD MEMBER)**

##### **Former Dean, Faculty of Engineering, University of Alberta**

Dr. Lynch was the Dean of Engineering at the University of Alberta from 1994 to 2015. During this time engineering undergraduate and graduate student enrolments more than doubled to over 6,000 students, over 190 new engineering professors were hired, over 50 Chair positions (endowed, industrial and government funded) were established, and five new buildings were constructed for engineering education and research. David, along with others, has provided the leadership to establish several major initiatives including the National Institute for Nanotechnology, the Helmholtz – Alberta Initiative, the Imperial Oil – Alberta Ingenuity Institute for Oil Sands Innovation, and the Canadian Centre for Clean Coal/ Carbon and Mineral Processing Technologies. Throughout his career he has received many awards, including the 2001 APEGA Centennial Leadership Award, the 2004 ASTech Award for Outstanding Contribution to the Alberta Science and Technology Community, and the Queen Elizabeth II Diamond Jubilee Medal in 2012. David serves on a number of boards including Waste RE-solutions Edmonton, and the Pure North S'Energy Foundation and was previously a Board Member for the Climate Change and Emissions Management Corporation.

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#### **ROBERT MANSELL (BOARD MEMBER)**

##### **Interim Director, and Academic Director, The School of Public Policy, Emeritus Professor of Economics, University of Calgary**

Dr. Mansell served as a Department Head, Dean and Advisor to the President on Energy and Environment at the University of Calgary from 1996-2007. He has authored over 100 studies on energy and regulatory issues, as well as many other studies on regional economics. His teaching includes courses on public utility regulation, industrial development and regional economics. In addition to frequently appearing as an expert witness before regulatory bodies, he provides extensive service on various provincial and national committees and boards. Examples include the Council of Canadian Academies Study on Hydrates, the Energy Strategy Advisory Committee for the Government of Alberta, the Canadian Academy of Engineering Energy Pathways Taskforce and the Alberta Chamber of Resources Task Force on Resource Development and the Economy. As an AI-EES Board member, Robert is able to use his life's-work and vast industry knowledge to provide value to the resource sector while giving back to the greater community. He also serves on a number of other boards including the Climate Change and Emissions Management Corporation.

# PROJECT LIST

## ENERGY TECHNOLOGIES

AACI program

Acid Enhanced Bitumen  
Visbreaking

Application of New Gas to  
Liquids Technologies to  
Reduce Emissions

Canadian Clean Coal Carbon  
Center for Mineral Processing  
Technologies (C5MPT)

CarbonSaver Field  
Demonstration Project

Catalytic Light Olefin  
Upgrading - Using Natural  
Gas for Gasoline Quality  
Improvement

Canadian Clean Power  
Coalition Phase 5

Institute for Oil Sands  
Innovation (IOSI)

Energy Efficiency Field Study:  
Application of Best Operating  
Practices in Alberta's Oil and  
Gas Sector

Field Demonstration of  
Advanced Membranes for  
Syngas Cleanup and CO<sub>2</sub>  
Capture

Innovative Application of  
Electricity for Oil Sands  
Development

Modelling and Simulation  
Study of Underground Coal  
Gasification

NSERC Foundation CMG  
Chair in Reservoir Simulation

NSERC Foundation CMG  
Industrial Research Chair in  
Reservoir Geomechanics for  
Unconventional Resources

NSERC Industrial Research  
Chair in Petroleum  
Microbiology

NSERC Industrial  
Research Chair in Oil  
Sands Engineering

NSERC NEXEN Chair  
in Bitumen Upgrading

NSERC/AERI Industrial  
Research Chair in Petroleum  
Thermodynamics

Opportunities to Improve the  
Competitiveness of Alberta's  
Oil Sands Products for U.S.  
Refineries

Simulation of Multiphase  
Flow in SAGD Wells and  
Production Systems

Technology Opportunities  
in the Unconventional  
Duvernay Play

Tight Oil Consortium

## RENEWABLES AND EMERGING TECHNOLOGIES

An Integrated Process to  
Simultaneously Convert  
Natural Gas and Low-Cost  
Carbon Resources to Liquid  
Fuels

An Organic Waste Inventory  
for Alberta

Conversion of Tri-Municipal  
Region Organic Waste to  
Bio-Energy

Critical Assessment  
of Pembina Institute  
Methodology and Conclusions  
on Renewable Energy

Determine Heating  
Value of Wastes

Developing Alberta's  
Geothermal Reservoirs  
with Enhanced Geothermal  
Systems - CO<sub>2</sub> Method

Development of a Waste to  
Energy Decision Analysis  
Model for a Municipality in  
the Province of Alberta

Edmonton Municipal Waste  
P3 Biowaste Demo

Electrochemical Engineering  
Innovation by Combining  
iF Cathode Technology  
with Porous Silicon Anode  
Technology for Advanced  
Battery Commercialization

Feasibility Analysis of a  
Geothermal Based Steam/  
Electricity Generation  
Application in Alberta

Feasibility of Converting  
Municipal Solid Wastes (MSW)  
into Liquid Fuel using a Novel  
Methanolysis Process

Identification of Best Energy  
Efficiency Opportunities  
in Alberta's Industrial and  
Agricultural Sector – Phase 3

Lethbridge Landfill Drill  
Sample Methane Potential  
Measurements and Molecular  
Characterization

NSERC/Cenovus/Alberta  
Innovates Associate  
Industrial Research Chair in  
Energy and Environmental  
Systems Engineering

Spray on Nanoparticle Solar

## WATER AND ENVIRONMENTAL MANAGEMENT

A Comparative Toxicity  
Assessment of Diluted  
Bitumen (dilbit) to Sour  
and Sweet Crude Oils

Advanced Air LiDAR

Advanced Approaches  
to Dealing with Water  
Disinfection Byproducts

Alberta Applied Biodiversity  
Conservation Chairs

Alberta WaterPortal,  
Phase 3

Arsenic in Rural Alberta's  
Ground Water

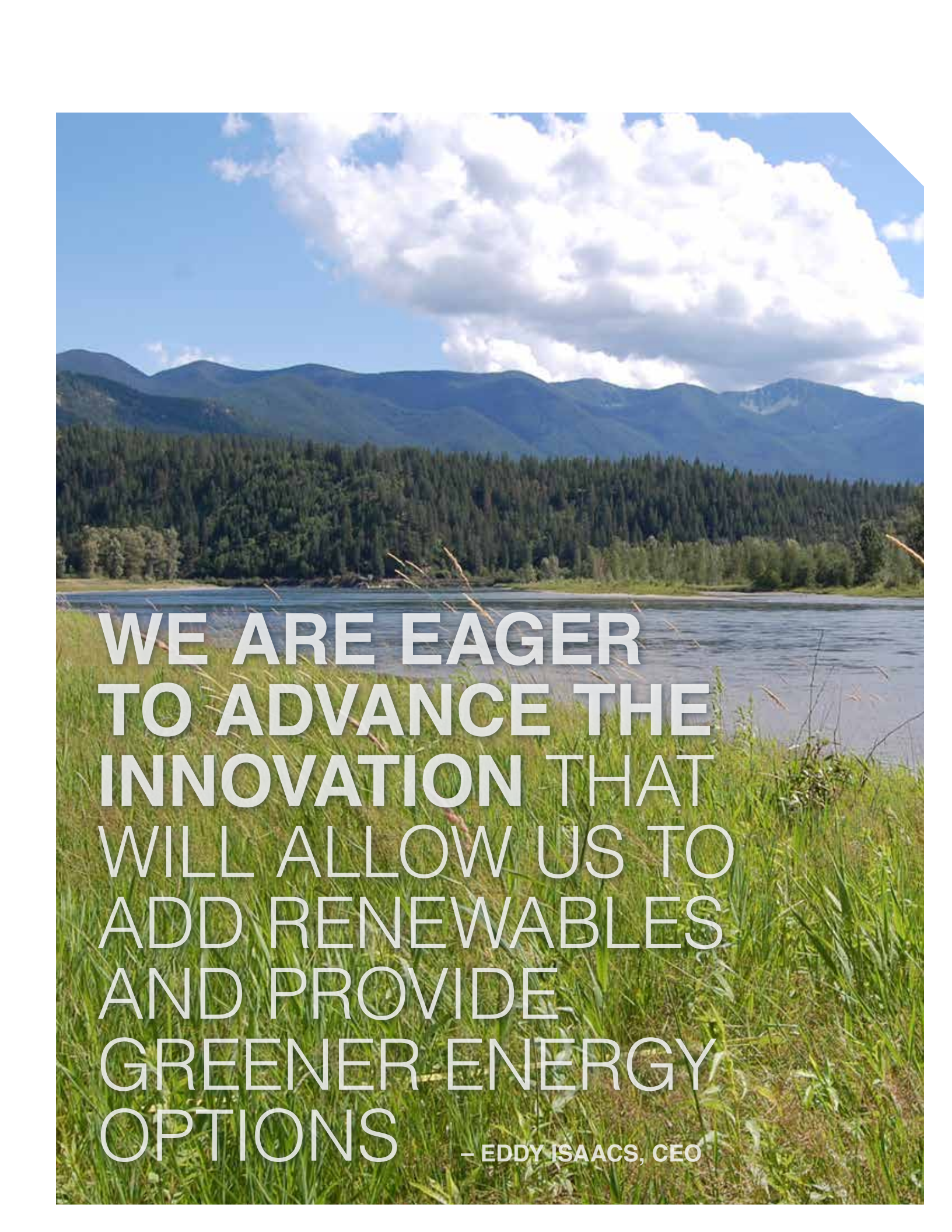
Assessing the Ecological  
Impacts of Water Extraction  
on Stream Hydrology and  
Alberta's Fish Community  
Structure and Function

Assessing Water Quality,  
Microbial Risks and  
Waterborne Pathogens  
in Rural Alberta using  
a One Health Framework

Atmospheric Metal  
Deposition in North  
East Alberta



Atmospheric Organics Deposition in North East Alberta	Electro Kinetic Remediation Work Program EKS Phase 2	Investigation of the Speciation, Toxicity, and Fate of Oil Sands Processed Water Organic Fractions During Advanced Oxidation	Resolving Natural and Anthropogenic Influences to Groundwater and Surface Water Environments in the Lower Athabasca Region
Baseline Isotope Geochemistry of Alberta Groundwater	Field Scale Demonstration of EKS	LiDAR/Wet Areas Mapping Linear Corridors Forest Recovery Project	South Saskatchewan River Basin Adaptation to Climate Variability
Biological Impacts of Dilbit Spills in Freshwater Aquatic and Riparian Ecosystems: A Knowledge Synthesis and Gap Analysis	Enhancing Accessibility and Use of Alberta's Natural Water Recreation Areas Through Prevention of Swimmer's Itch Transmission	Membranes for CO <sub>2</sub> capture: FSC-PVAm Membrane	South Saskatchewan River Basin Flood Mitigation Assessment – Bow River Basin
Ceramic Membrane Deoiling and Desilication	Evaluation of Existing Legal Instruments to Promote Integrated Water Management Decision Making	NSERC Industrial Research Chair in Water Quality Management for Oil Sands Extraction	Sustainable Urban Water Management in the Context of Climate Variability and Change
Research Chair in Advanced Oxidation of Oil Sands Process-Affected Water - Process Fundamentals	Expanding Wastewater Reuse in Alberta through Application of a Quantitative Microbial Risk Assessment Framework	Nutrient Status and Retention in Reconstructed Sandy Soils	Sustainable Wetland Habitat: Reclamation Targets, Design Criteria and Wetland Policy Implementation
Climate Vulnerability and Sustainable Water Management in the South Saskatchewan River Basin (SSRB) - Part of the Watershed Stewardship and Ecosystem Management Focus Area	Flood Indicators: Improving Forecasting in Alberta	Oil and Water: Stakeholders' Framing of Resources in Alberta's Oil Sands	Test Facility to Demonstrate Emerging Energy Efficiency Technologies Applicable to Oil and Gas Operations
Conceptual Engineering Study of Technologies for Reducing Solution Gas Venting in Cold Heavy Oil Production	Functional Flows: A Practical Strategy for Healthy Rivers	Oil Sands Alberta Campus Project (OSCAP)	The Effect of Weathering on Dilbit and Conventional Crude in Fresh Water Systems
Creating a Predictive Eco-site Classification Platform for Alberta P1 Feasibility Assessment, Technology Development and Piloting	High Pressure De-Oiling of SAGD Produced Water	Oil Sands Tailings Geotechnique Chair	Towards Integrated Source Water Management in Alberta
Economics of Adaptation to Extreme Hydrological Events	IDE's Collaborative Development Program in Alberta	Perceptions of Water Quality Among Rural Albertans and Association with Livestock	Water Reuse and Management of SAGD Processed Waters
	InLine Dewatering of Oil Sands Tailings	Predicting Alberta's Water Future	Water Reuse in Alberta: Case Studies and Policy Development to Support Continuing Economic Development
	Inside Education, Leading Edge Science in the Classroom	Quantifying Groundwater Recharge for Sustainable Water Resource Management	
	Investigation of the Occurrence of Pesticides in Groundwater of Southern Alberta	Redevelopment and Enhancement of the Irrigation Demand Model as a Tool for Basin Water Management	



**WE ARE EAGER  
TO ADVANCE THE  
INNOVATION THAT  
WILL ALLOW US TO  
ADD RENEWABLES  
AND PROVIDE  
GREENER ENERGY  
OPTIONS**

– EDDY ISAACS, CEO



## ALBERTA INNOVATES

is part of the province's research and innovation system supporting interplay between government, industry and academia. We provide solutions to global challenges and are committed to driving the growth and diversification of Alberta's economy. Funded by the Government of Alberta, our outcomes are aligned with the strategies and priorities of the province.



Bio Solutions invests in research and innovation to grow prosperity in Alberta's agriculture, food and forestry sectors.



Technology Futures supports research and innovation activities directed at the growth and development of technology-based sectors, the commercialization of technology, the provision of business and technical services, and initiatives that encourage a strong science, technology and entrepreneurial culture in Alberta.



Health Solutions manages research to further our understanding of health and disease, and produce results that will make a difference to the health, economy and societal well-being of Albertans and people around the world.



Energy and Environment Solutions seeks out new ideas and invests in technology development that will reduce the environmental impacts of the energy sector and foster exceptional water management.

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