the science of a sustainable future

BRINGING TOGETHER TECHNOLOGY, PEOPLE & IDEAS

Alberta Upstream Petroleum Research

2021-2022 ANNUAL REPORT

Alberta Upstream
Petroleum Research

AUPRF / əʊ-pərˈf / is ...

RESOURCEFUL / rɪˈsɔrs fəl /

Able to meet situations: capable of devising ways and means

AUPRF is an efficient and effective mechanism to coordinate, initiate, fund, complete and communicate about the environmental research most relevant to the petroleum industry and to government regulators. This work enables a prosperous upstream oil and gas industry, achieving socially and environmentally responsible recovery of Canada's petroleum resources through practical, market-driven collaboration.

INDUSTRY-LED / ˈɪn də stri / lɛd /

Guided by experts working in a particular business

AUPRF is an industry-sponsored fund supported by the Canadian Association of Petroleum Producers (CAPP) and the Explorers and Producers Association of Canada (EPAC). The AUPRF Fund is managed and administered through PTAC Petroleum Technology Alliance Canada. PTAC is a neutral facilitator of multi-stakeholder industry research and technology development projects.

COLLABORATIVE / kəˈlæb əˌreɪ tɪv, -ər ə tɪv /

Defined by a joint effort of multiple individuals working together to accomplish a task or project

AUPRF research is not undertaken in isolation. Industry funds are leveraged by government, institutional, and other stakeholder support, often at a rate of four to five to one. PTAC facilitates industry's close collaboration with all stakeholders to ensure research projects are aligned with the most relevant issues facing the oil and gas sector, and that research efforts are coordinated with other organizations. This collaboration between industry and government from the early design phase of research projects improves efficient use of financial and technical resources during a project and increases buy-in and uptake of results. It also assists government in developing smart policies and regulations.

While focused on concerns of the Alberta-based industry, AUPRF considers the broader implication of these issues in the entire Western Canada Sedimentary Basin. The collaboration extends to organizations and companies in British Columbia and Saskatchewan who are dealing with similar issues.

who is AUPRF?

The **Alberta Upstream Petroleum Research Fund** ("AUPRF") funds environmental research to address critical air, ecological, reclamation and remediation, water, and well abandonment challenges related to conventional oil and natural gas operations. AUPRF is wholly funded by Alberta oil and natural gas operators on a voluntary basis. Petroleum Technology Alliance Canada (PTAC) is the neutral third-party administrator of the AUPRF program.

Through the AUPRF program, industry (supported by Canadian Association of Petroleum Producers (CAPP) and the Explorers and Producers Association of Canada (EPAC)) collaborates with policymakers and regulators to identify and prioritize research needs that support:

- Improved environmental outcomes
- Informed environmental policy and regulatory development
- Process efficiency gains
- Cost-effective compliance with environmental regulations; and/or
- Accelerated technology development and deployment

AUPRF supports applied, peer-reviewed research that increases knowledge, assists in decision-making, and addresses high-priority issues impacting industry, environment, and health and safety. AUPRF projects are based on independent, peer-reviewed research performed by consultants as well as university and government scientists. The thorough, objective reports arising from this research identify required improvements and practical, cost-effective solutions.

OUR OBJECTIVE

To provide an efficient and effective mechanism to coordinate, initiate, fund, complete and communicate on environmental research needed by the industry and government regulators, enabling a prosperous upstream oil and gas industry and achieving socially and environmentally responsible recovery of Canada's petroleum resources through effective, market-driven collaboration.

OUR PURPOSE

AUPRF supports practical, science-based studies that develop credible and relevant information to address knowledge gaps in the understanding and management of high-priority environmental and social matters related to oil and gas exploration and development in Alberta. Research reports are shared with the oil and gas industry funders as well as regulators and government agencies that serve on the technical committees.

growing value

The oil and gas industry's relationship with the environment has changed significantly over the past two decades. Economics have shifted; priorities have adapted; new research and new technology have changed operations. Through it all, AUPRF's more than 450 environmental research projects have always focused on the high-priority concerns of the day.

In October of 1996, the Canadian Association of Petroleum Producers (CAPP) and Petroleum Technology Alliance Canada (PTAC) entered into a Memorandum of Understanding (MOU) on enhancing the pace of innovation, research, and technology development, demonstration, and deployment in the upstream petroleum sector.

By 1998, they recognized the need to increase the amount of environmental research projects being conducted within the Canadian oil and gas industry. Their discussions resulted in a framework and process model for collaborative R&D for the upstream oil and gas industry. This work provided an efficient and effective early mechanism to coordinate, initiate, fund, complete, and communicate the environmental-related R&D they knew industry and government regulators both needed. They created the Environmental Research Advisory Council (ERAC) fund. It was agreed that PTAC would facilitate the projects and manage administration.

Environmental research projects were launched each year in the areas of air research (with a focus on methane), water issues, ecological and biodiversity, remediation and reclamation, and well abandonment. In 2010, ERAC was renamed the Alberta Upstream Petroleum Research Fund (AUPRF) to represent the objective of the fund more clearly. By the end of 2019, industry had invested $26 million into 461 projects. A study assessing the value created by AUPRF projects reviewed the nine highest-value projects from each of the five technical areas and estimated that they were saving producers $78 million per year. The program was proving successful, but when the pandemic hit, stakeholders took the opportunity to evaluate how AUPRF might continue to provide the best value to all stakeholders.

In early 2021, CAPP conducted a governance review with an industry task group. The AUPRF Oversight Committee was formed as a result of their findings, and new AUPRF **Terms of Reference** were established. Moving forward, PTAC will continue to facilitate the Alberta Upstream Petroleum Research Fund (AUPRF) delivered in partnership with CAPP and EPAC.

At the end of Fiscal Year 2021, the AUPRF program had conducted a total of 474 environmental research projects addressing air research with a focus on methane, water issues, ecological and biodiversity, remediation and reclamation, and well abandonment at a cumulative cost of $180 million. Oil and gas producers provided $31.4 million of that and

secured financial leveraging of six to one. A recent evaluation of the AUPRF program concluded that these collaborative, science-based environmental research projects have saved industry $93 M in operating costs per year.

This past year, AUPRF launched 21 new projects or project phases and facilitated 10 ongoing projects and completed five projects. Each of these projects provides practical, science-based research to fill knowledge gaps related to the intersection between environmental science and oil and gas exploration and development. Research results will assist in the development of smart policies, regulations, and best practices.

As industry moves forward, AUPRF will continue to facilitate science-based applied research projects that not only reduce the oil and gas industry's environmental footprint, but spark innovation that improves regulations, assists in the ease of operations, and helps industry maintain its social license to operate.

WHO'S WHO IN AUPRF?

CAPP represents companies, large and small, that explore for, develop, and produce natural gas and oil throughout Canada. CAPP's mission, on behalf of the Canadian upstream oil and natural gas industry, is to advocate for and enable economic competitiveness and safe, environmentally and socially responsible performance.

EPAC advocates on behalf of its member companies for sound government policy that promotes a thriving independent oil and gas sector. Members invest billions of dollars each year finding and developing new energy reserves while providing the North American market with a secure, reliable energy source.

PTAC is a not-for-profit association that facilitates collaborative research and technology development to improve the financial, environmental, and safety performance of the Canadian hydrocarbon energy industry. PTAC promotes industry participation in research and development, and assists with securing funding from a variety of sources.

AUPRF OVERSIGHT COMMITTEE (AOC)

(As of March 31, 2022)

David Lye (Chair)
VP Environmental, Ovintiv Canada

Scott Volk (Vice-Chair)
Technology & Innovation Lead, Tourmaline Oil Corp.

James Agate
Manager, Liability Reduction, Canadian Natural Resources Limited

Vicki Ballance
VP Operations, EPAC

Jason Brunet (non-voting)
Director, Technical Science & External Innovation, Alberta Energy Regulator (AER)

Tony Jackson
Energy and Environmental Leader, Cenovus Energy

Kim Lalonde (non-voting)
Executive Director, Lands Planning, Alberta Environment and Parks

Tara Payment
Manager, Operations and Water, CAPP

Alexandra Robertson (non-voting)
Principal Engineer, Alberta Energy Regulator (AER)

Jaclyn Schmidt (non-voting)
Director, Water Quality Policy, Alberta Environment and Parks

"The new governance arrangement between CAPP, EPAC and PTAC demonstrates a long-term commitment to value-added research and development. Our new AUPRF Oversight Committee will be a highly effective and responsive group to help voice the priorities of CAPP and EPAC in a way that improves the delivery by PTAC of technology and process solutions to reduce oil and gas supply-side environmental impacts."

– **David Lye**, Chair, AOC

environmental research projects

21 NEW PROJECTS LAUNCHED

10 ONGOING PROJECTS

5 PROJECTS COMPLETED

474 AUPRF PROJECTS FACILITATED TO DATE

$31.4 MILLION INDUSTRY INVESTMENT LEVERAGED TO FUND **$180 MILLION** IN PROJECT COSTS

PROJECTS COMPLETED IN FY21

- Algar Caribou Habitat Restoration Project
- FEMP EA Phase II
- FlareNet (year 4 of 5)
- Identify GHG Level for Well Repair and Monitoring of Sweet Natural Gas Wells to Identify Acceptable Leak Rate
- Methods to Identify Product Placement Behind Pipe & Identify Drilling Practices to Optimize Well Integrity with Primary Cementing

PROJECTS LAUNCHED IN FY21

AIR

- Evaluation of Current & Emerging Emission Quantification Tools
- Evaluation of Surface Casing Vent Flows at Inactive Wells: Database Analysis and Field Measurements in Alberta
- Methods for Estimating Emissions from Tanks
- NSRC FlareNet Strategic Network (Year 5 of 5)
- State of Science on Emission Rate Thresholds for Upstream Petroleum Industry Leaks Corresponding to a Range of ppm Concentration Thresholds

PROJECTS LAUNCHED IN FY21 (continued)

WELL ABANDONMENT

- Development of a Quantitative Framework for Methane Emissions from Soil Gas Migration Issues in the Oil and Gas Sector
- Minimum Acceptable Emissions and Closure Guidelines for Leaking Abandoned Wells
- Plug and Abandon Strategies for Canada's Oil & Gas Wells (Year 4 of 4)

REMEDIATION & RECLAMATION

- Agronomic Receptor Evaluation for Direct Soil Contact
- Background Metals and Salinity Database and Analysis Tool
- Development of a Chloride Water Quality Guideline Based on Hardness and Consideration for Cation Toxicity
- Drilling Waste Compliance
- Evaluation of Reclamation Practices on Forested Upland and Peatland Well Sites
- Finalization of Research and Preliminary Selenium Soil Quality Guideline Derivation
- Low Probability Receptor Demonstration Project
- Plant Uptake of Petroleum Hydrocarbons and Salt (NaCl) and Derivation of Soil-to-Plant Uptake Factors
- Re-Evaluation of F2 and F3 Petroleum Hydrocarbon Management Limits
- Regulatory Approval of Risk Assessment Tools
- Soil and Groundwater Guideline Calculator
- Standardizing Risk Assessment Approaches Based on Residual Mass vs. Numerical Endpoints

WATER

- Alberta Water Tool – Open Access

ONGOING PROJECTS IN FY21

- Environmental Sensor Monitoring – Improving the Processing Efficiency of Acoustic Big Data to Support Alberta's Land Managers
- Feasibility Study
- IM3S – LDAR SIM
- Investigate the potential for surface casing vent flow/groundwater migration issues
- Measurement of Associated Gas and Venting Volumes at CHOPS Sites in Alberta and Saskatchewan (CHOPS GOR)
- Multi-Year Compositional, Isotopic and Microbial Investigation of Methane Migration Issues to Develop "Best-Practices" for Industry
- Quantification of Transient Methane Venting through Fixed Roof Liquid Storage Tanks
- Salt Affected Soils: Quantifying Impacts to Develop Scientifically Based Remediation Criteria for Alberta
- STV Phase I
- Testing Alternative Products for Well Remediation and Decommissioning/Abandonment – Phase I

spotlight on air

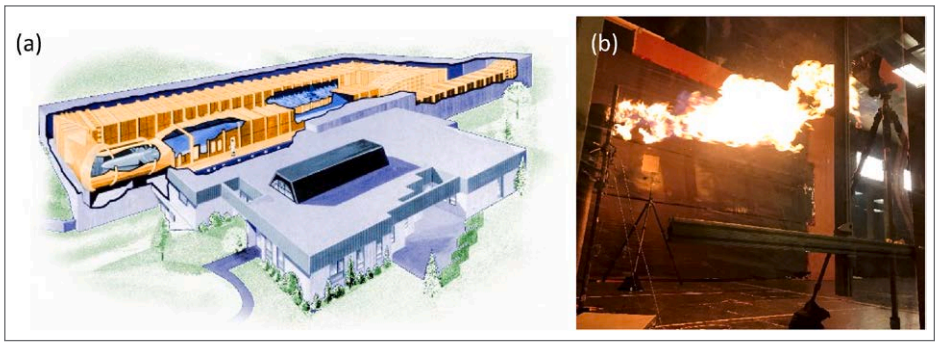
ADVANCING EMISSIONS MONITORING TECHNOLOGIES

FlareNet, a multi-institute collaboration led by Carleton University's Energy & Emissions Research Lab, continues to make progress on the challenging problem of quantifying and modelling flare emissions. Funded through AUPRF and NSERC, the project first started in 2017 with the goal of gaining a better understanding of emissions pathways and the technologies that could be used to monitor them. The initial industry funding was significantly leveraged with government contributions.

Researchers have recently achieved several key milestones. Work done at the Western University Boundary Layer wind tunnel facility (shown in the image below) has now been successfully upgraded to permit experiments with vaporized liquid fuels. This enables measurements on realistic flare gas mixture comprising C1-C7+ hydrocarbons with included CO2 and N2. The right side of the image shows a 4-inch diameter flare burning in the wind tunnel during experiments earlier this summer.

In August 2022, the researchers published a peer-reviewed journal article[1] detailing the experimental methodology and comprehensive uncertainty analysis for measuring flare carbon conversion efficiency and species emission rates (e.g., methane). The article is open access, so everyone is able to **read** it. Results to date are also quoted in the recently released new CSA Z620.3 standard for Flaring, Incineration, and Enclosed Combustion.

Looking ahead, the researchers are working to complete experiments characterizing NOx and Black Carbon emissions under turbulent crosswind conditions. They are focused on understanding the drivers of observed trends in flare efficiency data, which is a critical step toward developing practical models relevant to a range of conditions.



[1]*D.C. Burtt, D.J. Corbin, J.R. Armitage, B.M. Crosland, A.M. Jefferson, G.A. Kopp, L.W. Kostiuk, M.R. Johnson* (2022) A Methodology for Quantifying Combustion Efficiencies and Species Emission Rates of Flares Subjected to Crosswind, Journal of the Energy Institute, 104:124–132. (doi: 10.1016/j.joei.2022.07.005)*

spotlight on ecological

ALGAR CARIBOU HABITAT RESTORATION PROJECT: IMPROVING FEN RESTORATION OUTCOMES

The Algar Caribou Habitat Restoration Program was one of the earliest large-scale linear restoration programs implemented in Alberta. It started in 2011 as a collaboration between six oil sands companies to improve undisturbed caribou habitat. The project proposed restoring 340 km historic linear footprint off-lease and within the East Side Athabasca River caribou range in boreal region of northeast Alberta.

As linear restoration activity begins to scale up as part of Alberta's approach to caribou habitat recovery, learnings from monitoring the outcomes of Algar can help inform treatment strategies and the Draft Provincial Restoration and Establishment Framework for Legacy Seismic Lines in Alberta (the Framework) to deliver effective and efficient restoration projects.

Previous ground-based monitoring projects in Algar have shown that the treatments (mounding & planting) have been successful on many sites, establishing tree cover and placing the land on a trajectory to match the surrounding habitat. However, fens were particularly challenged compared to the relative success of other ecosites (e.g., bogs).

In 2021, through support of the AUPRF, a further examination of fen outcomes in Algar were analyzed through an aerial survey which acquired high resolution imagery. This was also an opportunity to test the Framework's monitoring survey procedures and gain further insights on fen restoration outcomes. The results of the analysis show that restoration can be successful on fens. However, just under half of the sites surveyed were not achieving the Framework's targets. This suggests that there may be further microsite factors within fens that are important to consider and alternative treatment types such as hummock-transfer could be trialed in linear restoration. As we move forward, alternative Framework targets may need to consider other vegetation types that predominate fens, and not just trees to determine recovery success.

The learnings from this research project will benefit both industry and government as they seek innovative and cost-effective solutions for restoring caribou habitat.

"The collaboration with industry partners and regulators leading to more 'fit for risk' policy and technological solutions is invaluable to achieve the ultimate goal of closing more sites with finite resources."

– **Linda Eastcott**, Imperial Oil

spotlight on well abandonment

PLUG AND ABANDON STRATEGIES FOR CANADA'S OIL & GAS WELLS

Jointly funded by PTAC-AUPRF and NSERC, The Plug and Abandon Strategies for Canada's Oil & Gas Wells project supports researchers from three universities across Canada: Concordia, Laval and UBC as they seek to understand and solve key difficulties with well leakage.

First, very little is routinely or easily measured in either primary cementing or plug and abandonment (P&A) operations. This is coupled with a series of processes that are physically very complex and, although routinely practiced, are not understood in depth. This knowledge gap has resulted in a prescriptive regulatory environment which may not lead to proper assessment of risk or operational effectiveness.

Project researchers Dr Frigaard, Dr. Karimfazli, and Dr. Taghavi are exploring how to redress this disconnect between regulation and operation by combining data analysis, physical modelling of the processes, and laboratory-scale experiments to achieve better understanding.

Project outcomes include:

- A comprehensive review of P&A practices in British Columbia.
- A model of BC well leakage that suggest that shrinkage micro-annuli are responsible for most surface casing vent flow (SCVF), but do not explain the observed distributions of either low or high leakage rates. An answer to the mystery of why dense cement slurry pumped over water, in placing an off-bottom plug, does not simply fall to the bottom of the well.
- Extensive insights into mixing processes during both off-bottom plug placement and in the use of dump bailers.
- Development of detailed models for squeeze cementing, beginning to address the question of how deep a cement slurry penetrates.
- Growing knowledge of how jets will interact with perforation holes in being able to remove soft solids from behind the casing.

The researchers hope to pursue these topics in a project continuation which is currently awaiting NSERC approval.

With the project now in its fourth year, the researchers have published more than 35 refereed journal articles and conference papers, and key results of the project will form the basis of five PhD theses, all completing their final year. The project has also held an open technical forum online to share their growing understanding of P&A/well integrity topics. However, they hope to be able to present in person at an upcoming event in 2023.

spotlight on reclamation and remediation

EVALUATION OF RECLAMATION PRACTICES ON FORESTED UPLAND AND PEATLAND WELL SITES

InnoTech Alberta, Vertex Resource Group Ltd., Enviro Q&A Services, and the Northern Alberta Institute of Technology are excited to share the revised 'wellsite certification tools' for both legacy upland (forested) sites that have natural encroachment and peatland sites that were constructed using imported mineral soil material.

These tools provide environmental practitioners with streamlined processes to follow and recommended supporting data to include in variances or a change in end land use applications. More 'complete applications' should in turn allow faster decisions around appropriate management and certification of these sites.

This PTAC-sponsored project is a phenomenal example of 'collaboration in action'. Numerous environmental practitioners, including industry, environmental consultants, and regulators, participated in this project. The feedback they provided was used to enhance the applicability, usefulness, and accuracy of the tools being developed. But the work isn't over yet.

The AUPRF program recently awarded the Project team funding to complete a field research program. This final stage of the project will address key priority areas for research for sites constructed using imported mineral soil pads in peatlands.

The findings associated with this final stage of the research program will be used to update the decision framework and support tools. It will also improve consistency in approvals for changes in land use and certification of mineral soil pads that have been left in place in peatlands. Depending on the findings of the research, the outcomes may support leaving pads in place more often and would also help operators to prioritize areas and circumstances where pads should be removed to reduce off-site impacts.

> *"The Alberta Upstream and Petroleum Research Fund (AUPRF) provides a forum for supporting collaborative conversations among Alberta Environment and Parks (AEP), the Alberta Energy Regulator, and Industry to help identify knowledge gaps in areas such as reclamation, water resources, and impacts to wildlife. AEP appreciates being involved in discussions concerning how industry funds are invested in research projects to address these gaps."*
>
> – **Steve Wallace**, Alberta Environment & Parks

spotlight on water

THE ALBERTA WATER TOOL

The **Alberta Water Tool** was developed by western-Canada based Foundry Spatial to provide information on water supply, demand, and the needs of the environment in every river, stream, and lake across more than 40% of Alberta. This web-based tool shows the location of both surface water and groundwater licenses.

Now, with the click of a mouse, users can define a location of interest and produce a comprehensive report describing when water is available, how much remains available for human use considering the natural variability of supply, as well as the existing demands of other water users and the environment. Users can also access historical data describing actual reported monthly water usage from each water license and information on historical and current measured streamflow (where measurements exist).

In 2021, more than 1,000 users accessed the tool, using the information it provides to understand new potential water sources, sustainable supply limits, and other information quickly and easily about Alberta's watersheds and water users.

Each report produced by the Alberta Water Tool represents a value of more than $5,000. Producing comparable information through conventional approaches would require highly qualified hydrologists and technicians to collect data from multiple different sources, model conditions for a location of interest, analyze the data and produce a report. The tool's value accrues to oil and gas industry operators, water management consultants, academics, and local communities.

With the support of AUPRF, the Alberta Water Tool is free and open for any member of the public to use. This system ensures that anyone interested in the management of water resources has equitable access to rich information. By helping to level the playing field, researchers hope the Alberta Water Tool facilitates meaningful engagement around water management at the intersection of regulatory management, industrial use, and public interest.

technical steering committees

AIR RESEARCH PLANNING COMMITTEE

Moruf Aminu	Encana
Jacob Bayda	Saskatchewan Ministry of Energy and Resources
James Beck	Suncor Energy
Don D'Souza	BC Oil and Gas Commission
Randy Dobko	Alberta Environment and Parks
Richelle Foster	Canadian Natural Resources Limited
Colin Hennel	Bonavista Energy Corporation
Sean Hiebert	Cenovus
Neuczki Mathurin	TC Energy
Johnny Matta	Environment and Climate Change Canada
Don McCrimmon	Canadian Association of Petroleum Producers (CAPP)
Sean Mercer	Imperial
Rekha Nambiar	Suncor Energy
Graham Noble	Saskatchewan Ministry of Energy and Resources
Filiz Onder	Encana
Koray Onder	TC Energy
Gerald Palanca	Alberta Energy Regulator
Amanda Stevado	Environment and Climate Change Canada
Carolyn Ussher	Alberta Energy Regulator

REMEDIATION AND RECLAMATION RESEARCH COMMITTEE

Sara Blacklaws	Alberta Energy Regulator
Christopher Boyd	Shell Canada Limited
Nadia Cruicshank	Alberta Energy Regulator
Jason Desilets	Cenovus
Linda Eastcott	Imperial
Shawn Glessing	Cenovus
Sonia Glubish	Canadian Natural Resources Limited
Paul Hartzheim	Canadian Association of Petroleum Producers (CAPP)
Tom Knapik	Plains Midstream Canada ULC
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Jeff Mills	Orphan Well Association
Premee Mohamed	Alberta Environment and Parks
Jack O'Neil	COSIA
Rick Rohl	ARC Resources
Devin Scheck	BC OIL & GAS COMMISSION
Debbie Tainton	Canadian Natural Resources Limited
Lisa Warren	Husky Energy

continued on the next page

ECOLOGICAL RESEARCH PLANNING COMMITTEE

Mark Boulton	Suncor Energy
Lisa Bridges	Alberta Energy Regulator
Carol Engstrom	Independent
Ben Hale	Husky Energy
Lori Neufeld	Imperial
Shane Patterson	Alberta Environment and Parks
Krista Phillips	Canadian Association of Petroleum Producers (CAPP)
Danielle Plommer	Ovintiv
Jeremy Reid	Canadian Natural Resources Limited
Jennifer Shalagan	Cenovus
Jordan Smith	Canadian Natural Resources Limited

WELL ABANDONMENT RESEARCH INITIATIVE COMMITTEE

Emile AbouKhalil	Alberta Energy Regulator
Leah Davies	Imperial Oil Limited
Claudette Fedoruk	Canadian Association of Petroleum Producers (CAPP)
Shawn Forster	Cenovus
Ben Fraser	Imperial Oil Limited
Wade Hartzell	Canadian Natural Resources Limited
Cassidy Juhasz	Crescent Point Energy
Ryan McDowell	Crescent Point Energy
Benjamin Ringrose	Orphan Well Association
Alexandra Robertson	Alberta Energy Regulator
Dave Samuelson	Cenovus
Rajan Varughese	Alberta Energy Regulator
Richard Wong	Cenovus

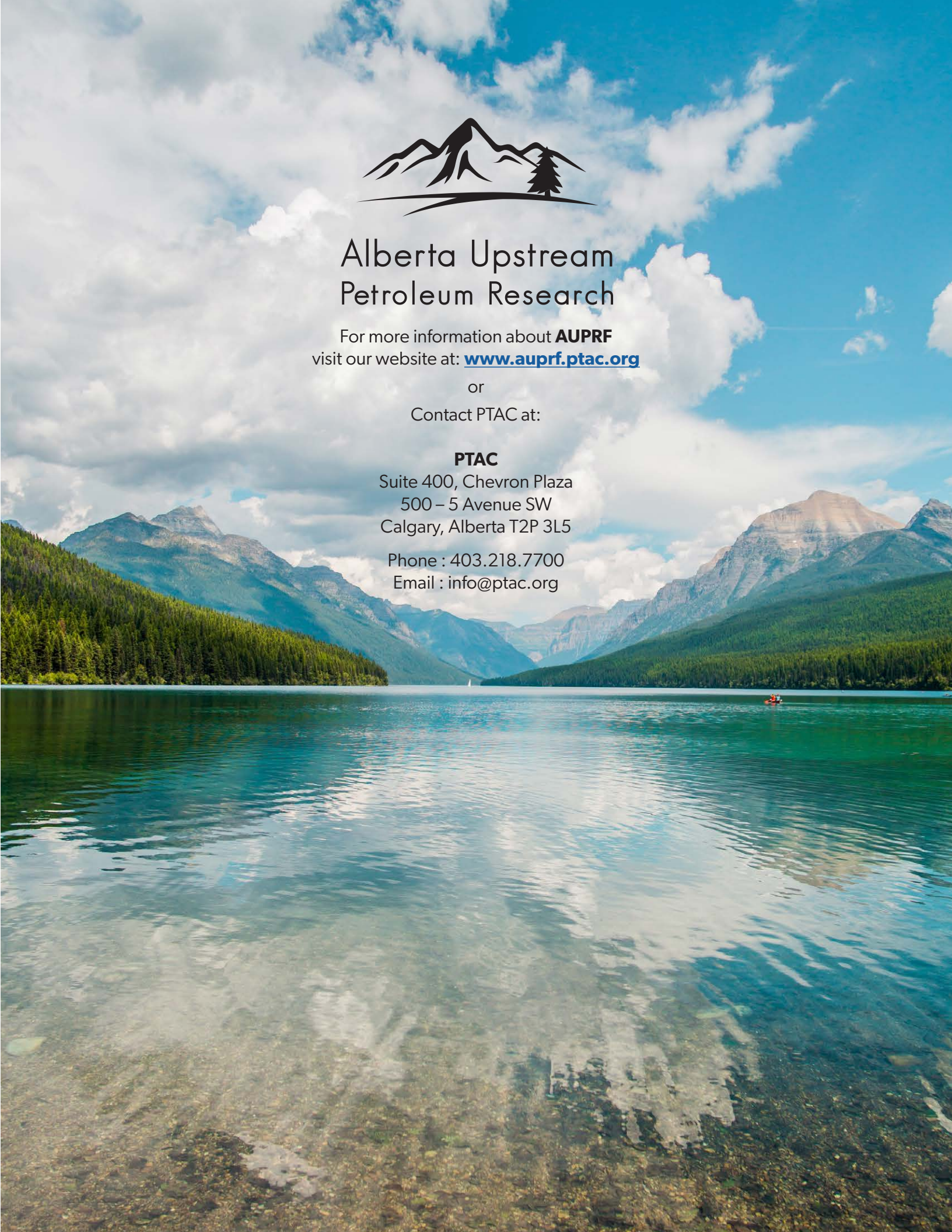
WATER INNOVATION PLANNING COMMITTEE

Jarred Anstett	Murphy Oil Company
Sarah Belak	Tourmaline
Michael Bevan	Alberta Energy Regulator
Courtney Blackmore	MEG Energy
Neil Fricke	Suncor Energy
Rodney Guest	Suncor Energy
Anil Gupta	Alberta Environment and Parks
Scott Hillier	Cenovus
Paul Martin	ConocoPhillips Canada
Matt Mclean	Cenovus
Tara Payment	Canadian Association of Petroleum Producers (CAPP)
Scott Rayner	MEG Energy
Susan Satterthwaite	Alberta Environment and Parks
Geoff Webb	Canadian Natural Resources Limited
Leah Wilson	Ovintiv

"Being a member of the AUPRF WIPC provides a different perspective on water issues (and solutions) related to energy development – the perspective of the energy developer. Having a better understanding of the goals and challenges of developers allows for creation of more effective regulation, as well as opportunities to share the regulators perspective on the issues."

– **Michael Bevan**, Alberta Energy Regulator


"WE CANNOT SOLVE OUR PROBLEMS WITH THE SAME THINKING WE USED WHEN WE CREATED THEM."
– ALBERT EINSTEIN



Alberta Upstream Petroleum Research

For more information about **AUPRF**
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or

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