The Petroleum Technology Research Centre (PTRC) is a not-for-profit corporation founded in 1998 by the University of Regina, the Saskatchewan Research Council, Saskatchewan Energy and Resources, and Natural Resources Canada. It is located in the Innovation Place Research Park in Regina, Saskatchewan, adjacent to the University of Regina campus. Its diverse portfolio of research projects is funded through ongoing contributions from several federal, provincial and private sector partners, including direct funding from:

- Government of Canada: Western Economic Diversification, Sustainable Development, Technology Canada, Networks of Centres of Excellence, and Natural Resources Canada.
- Private sector: Western Canadian and internationally based oil and gas companies, utilities and technology providers.

In addition, in-kind research support is provided by the University of Regina’s Petroleum Systems Engineering faculty and the Energy Division of the Saskatchewan Research Council—both of which are housed in the PTRC building.

The PTRC is governed by a Board of Directors comprising representatives of the founding partners and of industry leaders operating in western Canada. Its laboratory and modeling (physical and numerical) facilities in Regina, shared with the University of Regina and Saskatchewan Research Council, are among the most advanced and complete in North America.

**PTRC Mission Statement**

The PTRC’s mission is to develop world-leading enhanced oil recovery and CO₂ geological storage technologies that ensure sustainable and environmentally sensitive development of Canada’s energy resources. The PTRC manages enhanced oil recovery research and delivers basic and applied research results and technologies to its partners for field application. It serves as the managing agency for major research consortia. The organization enables governments and industry to combine resources and fund research in areas thought to be key to the nation’s and, by extension, the world’s energy security.
Message from the Chair

"Its future may rest in the rising acclaim of its universities, researchers and industry captains."

Saskatchewan can thank geological time for the magnificence of its natural resources, but its future may rest in the rising acclaim of its universities, researchers and industry captains, who are creating the companies and institutions where the future of Canada’s energy industry and, indeed, the R&D pre-eminence of its two biggest cities are rooted. You’ll notice a change in this year’s PTRC annual report over previous years. The careers created by the PTRC are front and centre on our cover for the first time. Last year, we made a sly wink towards Regina by including it in our cover for the first time. Last year, we made a sly wink towards Regina by including it in our cover for the first time. Last year, we made a sly wink towards Regina by including it in our cover for the first time.

On my last trip to Regina I was taken with the changes that had happened to Innovation Place Research Park, the location of the PTRC’s building.

Across the street a brand new provincial disease control centre had just been completed, and researchers were moving into their new digs. In our meetings at the PTRC’s building, leaders in the oil industry from Saskatchewan, Alberta and across the country gathered to discuss the future direction of research in enhanced oil recovery and carbon storage. Just next door the University of Regina’s International Test Centre for CO2 Capture was hosting international delegates anxious to find out about its world-leading capture technologies.

So let’s hear it for a world-class energy future for Saskatchewan – one that recognizes and pays tribute to agrarian roots and resources, while celebrating one of its most important research assets: the Petroleum Technology Research Centre.

I’d like to close by personally thanking two departing members of the Board of Directors – Dr. R.W. (Bob) Mitchell and John Zahary – who have greatly supported and steered the PTRC into the 21st century. Their contributions have been significant and appreciated.

This left an immediate void at fiscal year end, into which I was asked to step on a temporary basis. I am confident in the strong day-to-day management skills of Dr. Steve Whittaker and his PTRC team, and have found my brief tenure rewarding.

The fiscal year ended with a departure, and also an opportunity for renewal. We bid farewell to our Executive Director of over two years, Dr. Carolyn Preston, who resigned from the PTRC to pursue career options elsewhere. This left an immediate void at fiscal year end, into which I was asked to step on a temporary basis. I am confident in the strong day-to-day management skills of Dr. Steve Whittaker and his PTRC team, and have found my brief tenure rewarding.

Sustainable Technologies for Energy Production Systems (STEPS) – the new Business-Led Network of Centres of Excellence (B-LENE) – had its first request for proposals in heavy oil. STEPS has an exciting future, and researchers were moving into their new digs.

As this annual report went to press, another PTRC project – Aquistore and Saskatchewan Phanerozoic Fluids and Petroleum Systems – illustrate the lead that Saskatchewan is taking in both carbon capture and storage and geological characterization.

Aquistore began preparations for the drilling of a CO2 injection well and initiated its public communications and consultation efforts. The Fluids project held its first meetings, and research began into mapping and understanding the location of fluids in the Saskatchewan subsurface – a critical activity for oil exploration.

As the PTRC moves towards completion of some projects and the expansion of others, we are discovering that the most important resource of all is our people – both within the PTRC and within the many research organizations that receive funding from us. As this year’s annual report suggests, Saskatchewan is fast becoming an economy that is driven by its research potential.

The Joint Implementation of Vapour Extraction (JIVE) Project wrapped up most of its research in 2009-2010, and we are awaiting the final reports on this very successful field demonstration project. Likewise, the IEA GHG Weyburn-Midale CO2 Monitoring and Storage Project completed its penultimate year of research, and preparations have begun on the project’s final goal: a best practices manual to help CO2-EOR operations transition into long-term storage.

Perhaps most importantly, the two newest PTRC projects – Aquistore and Saskatchewan Phanerozoic Fluids and Petroleum Systems – illustrate the lead that Saskatchewan is taking in both carbon capture and storage and geological characterization.

This year the PTRC faced a number of challenges head on, continuing to adapt to the demands of industry, government and researcher organizations while remaining focused on our main goal: the development of more environmentally friendly and economically enhanced hydrocarbon recovery and carbon storage technologies.

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Hydrocarbon Research Keeps Talent Here, and Draws It From Abroad

Capital spending by oil and gas companies exceeded $2 billion.

Saskatchewan’s Changing Face

The PTRC Board of Directors as photographed in March 2010.

Front Row (Seated): Left to Right: Chantal Abou Debs, Networks of Centres of Excellence; Brian Watt (Vice Chair), Husky; Dr. Vincent Saubestre, Total E&P Canada; Dr. Carolyn Preston (Chair) Nexen; Ernie Pappas, SRC. Back Row (Standing): Left to Right: W.A. (Bill) Jackson, Apache; Dr. Malcolm Wilson, U of Regina; Ingrid Uhryn, University of Regina; Kent Campbell, Saskatchewan Energy and Resources; Adam Fehler (Vice Chair), Saskatchewan Research Council.

Knowledge in these areas has been working with numerous 50 Best Employers in Regina. Project coordinator Rongle Li (Lee for short) gained a bachelor’s in business administration from the University of Regina after arriving in Canada from Changsha, China. Saskatchewan Research Council scientist Gay Renouf has been working on the PTRC’s enhanced oil recovery research for more than ten years. Kyle Worth is the longest-standing employee at the PTRC, hired in 2001 immediately after graduating from University of Regina with a B.Sc. in environmental systems engineering. His project work led him to gain a P.Eng. designation in 2005. Adam Fehler is following in his footsteps; hired this past fiscal year, immediately after graduating with a B.Sc. in industrial systems engineering, he’s gaining knowledge of the cutting-edge R&D of the STEPS Business-Led Network of Centres of Excellence.

The oil and gas industry in this new Saskatchewan, according to the Ministry of Energy and Resources, was responsible for over 27,000 jobs in 2009-2010. Direct revenues to provincial coffers totaled over 1.3 billion dollars, and capital spending by oil and gas companies exceeded $2 billion. The PTRC – through helping to foster and encourage new technologies that extract the unique hydrocarbons located here – has contributed towards that economic success. More and more, Saskatchewan is seen as a scientific leader in enhanced oil recovery, environmental technologies, and greenhouse gas solutions such as carbon capture and storage.

This year’s Annual Report, for each of the PTRC’s research projects and programs, presents an individual who has either remained in Saskatchewan, or arrived here from locales around the globe to contribute to our world-leading research and development. We hope this personal touch to our research illustrates the value, and diversity, that the PTRC continues to bring to the province, to Canada, and to the international research community.
Sustainable Technologies for Energy Production Systems (STEPS)

2009-2010 has been a challenging year for the PTRC’s newly inaugurated Business-Led Network of Centres of Excellence. The former Enhanced Oil Recovery program became Sustainable Technologies for Energy Production Systems (STEPS) – an expanded research centre utilizing increased financial contributions of both the governments of Canada and Saskatchewan – and actively pursued the participation of additional research institutions through requests for proposals (RFPs). To help manage those new RFPs, which are also aimed at expanding the focus of STEPS to include research in bitumen, oil sands, and emerging resources such as oil shales, the PTRC hired Adam Fehler, a recent graduate of the University of Regina’s Industrial Systems Engineering program.

“I had heard that an entry level position was open at the PTRC, and so I applied. I had diverse experience through my co-op placements at U of R, everything from working in a pulp and paper plant in Thunder Bay, to the General Motors plant in Oshawa in 2006.” It was Fehler’s diversity of training during his degree, across different sorts of manufacturing and engineering companies, that impressed the PTRC – in need of someone who could be trained to manage the reporting on a diverse portfolio of ongoing and new research projects offered Fehler the position in August 2009.

“I currently manage the reporting on 48 projects under STEPS,” Fehler notes. “Some of those have the research complete and we’re awaiting final reports, others are just beginning, and I assure that proper documents and budgets have been received.” Fehler has also been tasked with reviewing and suggesting improvements to final reports that are received, and handling stakeholder requests about research and the progress of projects. In 2009-2010 STEPS had nine industry sponsors contributing over $800,000 towards research. Those same sponsors play a role in shaping the research program by participating on the STEPS Technical Advisory Group, which evaluates proposals that come in and determines those that go forward.

“This has been a great job, and I’m learning a lot about request for proposal processes and the needs of our clients. I’ve been able to develop templates for our RFPs, and improve them over time.” Fehler has seen change outside of work, too. At 25, he and his fiancé Faye are to be married in October 2010. They met on the first day of university back in 2001. She graduated the same year as Fehler in environmental systems engineering.

“STEPS is continuing to evolve,” he notes. “And so am I. I think it’s amazing that this sort of opportunity exists right here at home for a new engineer such as myself.”

The PTRC gratefully acknowledges the Governments of Canada and Saskatchewan for their funding of the STEPS Business-Led Network of Centres of Excellence.

Gay Renouf

Scientific Method is on the Run

A newer database will allow clients to see what kinds of heavy oil fields respond most favourably to different waterflood methods.

Gay Renouf successfully completes the Boston Marathon in 2010.

On a computer screen before her, Gay Renouf surveys spreadsheets detailing the latest statistics on a heavy oil flood in western Saskatchewan. Those particular sheets include data from individual heavy oil production wells, but a second, newer database will show the relationships between injector production well pairs, allowing researchers and clients in the STEPS Network to see with even more clarity what kinds of heavy oil fields respond most favourably to different waterflood methods.

“The first year we introduced the database,” Renouf recalls, “it was sort of a reassurance for companies that they were on the right path with the choices they were making in their own heavy oil waterfloods. That year, it was like generating a report card about which fields and operators had been better at producing oil.”

She laughs.

“Of course why would anyone want that? Who wants a bad report card?” Renouf, herself, has been scoring high marks from clients for her database. A graduate of the University of Saskatchewan in chemistry, Renouf is a senior research operator at the PTRC.

“The data comparison between heavy and medium oil reservoirs, but many medium oil (from 20° to 30° API) waterfloods are as well. Overall, clients can turn to results generated from the database to help develop new methods to optimize recovery from their own reservoirs. Future work may include recording the additives used in different floods to greatly enhance the data.

The database details not only heavy oil recovery, but many medium oil (from 20° to 30° API) waterfloods as well. Overall, clients can turn to results generated from the database to help develop new methods to optimize recovery from their own reservoirs. Future work may include recording the additives used in different floods to greatly enhance the data.

“The data comparison between heavy and medium is useful, even though they’re creatures of a different sort,” notes Renouf, smiling. “Just like the comparison between running styles. My son also runs marathons and, well, I’d be a poor scientist if I didn’t admit we’d learned from each other despite our differences.”

Read more about the researchers involved in STEPS in the five profiles that follow.

The PTRC gratefully acknowledges the Governments of Canada and Saskatchewan for their funding of the STEPS Business-Led Network of Centres of Excellence.
Peter Gu

“Re-creating” SVX Research

“We’ve moved into a more exciting phase of development.”

Floor hockey has become a passion for Dr. Gu since his arrival in Regina.

When Saskatchewan Research Council principal research technologist Ray Exelby began laboratory work with Dr. Norm Freitag on STEPS-sponsored experiments in the area of in-situ combustion, he brought with him an awareness of how such technologies had fared in the past.

“I knew that there’d been a few in-situ combustion recovery efforts tried in the 1980s in a couple of Saskatchewan’s heavy oil fields,” he says. Those field trials, while they showed initial promise, were not successful.

Researchers at both SRC and other organizations began to investigate what conditions might make the technology work better in the field, focusing on a particular aspect: establishing a stable combustion front in the reservoir. In-situ combustion works by creating a controlled burn within the reservoir and allowing the generated heat to advance in the field. The generated heat lessens the viscosity of the trapped heavy oil so it flows more successfully to production wells. It’s a technology that could be used in heavy oil reservoirs that are already depleted and contain wormholes after regular cold production methods.

“I’ve been involved with our simulation and modelling work,” Exelby notes. “Dr. Freitag has been using simulations to predict the stability of the combustion fronts in different sorts of reservoirs, and to understand the chemical reactions that determine whether or not a combustion front remains stable.”

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Heating Up the Prairie

It’s a technology that could be used in heavy oil reservoirs that are already depleted and contain wormholes after regular cold production methods.

Principal research technologist Ray Exelby works with SRC’s Dr. Norm Freitag on a PVT apparatus.

Principal research technologist Ray Exelby works with SRC’s Dr. Norm Freitag on a PVT apparatus.

Sustainable Technologies for Energy Production Systems (STEPS)

Ray Exelby

Exelby has been with SRC’s Energy Division since its beginnings, in the early ‘80s. He was with SaskOil in 1984 when it sold its energy division to SRC, ushering in a new era of research for the Treasury Board crown corporation.

“In the lab, I use a low temperature oxidation/pyrolysis reactor to study the reactions of the oil at that combustion front. Where you create the controlled burn, the front ahead of that reaction will be hot, but that heat — in the absence of oxygen — upgrades and cracks the oil.”

Exelby draws his knowledge in the lab from two different training courses — a mechanical engineering diploma from Saskatchewan Institute of Applied Science and Technology in 1982, and an additional certification in electronics technology in 1990. But he also understands the geography and lay of the land in Saskatchewan. He and his wife of 24 years farm a quarter section of land just north of Craven.

“We love to farm. And we’ve raised our two boys — they were big into soccer, and in fact I coached for over ten years — so now we’ve got some time for ourselves,” he notes, but then comes back to the research at hand. “For me, I think I’d like to see some of Dr. Freitag’s research actually tested in some depleted heavy oil fields.”

In part, the earlier field experiments with in-situ combustion failed because of the weak oil prices and economic conditions of the early 1980s. But with today’s better oil prices, finding a company or consortium of companies to field test SRC’s technology may not be far off.

Sustainable Technologies for Energy Production Systems (STEPS)
Mars Luo

To the Land of Ice and Oil

“When I discovered there was an actual program, funded by the PTRC, looking at miscible and immiscible solvent flooding, it was a perfect fit.”

Andy Li

Steps Towards a Ph.D.

One of the goals of the PTRC’s STEPS Network is to foster the next generation of researchers.

In just a few years, Dr. Mars Luo has learned of the best locations to catch jackfish at Regina Beach.

“I love to ice fish! It’s one of my favourite things. In winter I head out to Katepwa Lake, and also fish for pike at Regina Beach in summer.”

“Everyone is very, very friendly here. And although I lived in northern China, where it can be cold, it’s not nearly as cold as here in the winter. In the winters, I swim a lot at the pool on campus. It’s how I stay in shape.”
Joint Implementation of Vapour Extraction

Since he began his professional engineering career at the PTRC, the word ‘field’ has come to conjure up different meanings to Kyle Worth than it did when he was a teenager and student. Growing up in Semans, Saskatchewan, Worth was — and still is — very active in sports. From double A hockey, to volleyball, and ultimately to baseball (his team won the provincial championship) — fields, arenas and rails have been places to test his skills.

The technology offers significant environmental benefits over steam-assisted gravity drainage.

“I suppose it really hasn’t changed all that much since I graduated and began to work at the PTRC, except that now the challenges in the field, and the skills needed to meet them, are about oil recovery and environmental stewardship, not athletics.”

With nine years of experience at the PTRC, Worth is the longest serving employee of the organization, and has seen his role move from assisting with the management of the Weyburn-Midale CO2 Monitoring and Storage Project through to his current role as project manager for both the Joint Implementation of Vapour Extraction (JIVE) Project and Aquistore.

JIVE has been a particularly rewarding and challenging project for Worth. Solvent vapour extraction technology is an enhanced oil recovery process involving the injection of a gaseous hydrocarbon (usually butane or propane) into a heavy oil reservoir. The solvent is miscible with the heavy oil and diffuses into it, reducing the viscosity of the oil and causing it to flow more easily. The technology offers significant environmental benefits over steam-assisted gravity drainage by virtually eliminating water use and reducing greenhouse gas emissions because steam does not have to be produced during production.

JIVE employed solvent vapour extraction technology in five separate field trials. Three participating companies – Nexen Inc., Husky Energy, and Canadian Natural Resources Ltd. — tested combinations of solvents in heavy oil fields with differing characteristics. The trials ended in 2009, showing positive results for increasing oil recovery. Worth says that, given the right reservoir and solvent price, the SXV process could be economically viable.

“One particularly valuable result was the 3D scaled physical modeling completed in 2009-2010 which helped to analyze the SXV process and also identified asphaltene precipitation as a potential operations issue.”

“The JIVE project is a successful example where three companies co-operated to more effectively address EOR issues that they all were facing. It advanced the technology much faster than would have happened had each done the work alone. It’s the sort of teamwork that I’ve seen succeed in all sorts of fields of operation, from baseball to industry. I’m proud to have been a part of it.”

The JIVE project trials involved injecting solvent into one well, and drawing the combined oil and solvent up in a production well, as indicated here.

Managing the Expectations of a Worldwide Audience

“This project is as much about knowledge sharing and public acceptance for the technologies as it is about research and science.”

Steve Whittaker

In 2008, when Steve Whittaker joined the PTRC to oversee the management of the IEA GHG Weyburn-Midale CO2 Monitoring and Storage Project, he was already largely familiar with the research that had been done up to that point. As one of the co-authors of the project’s first phase report he had been in charge of the geological characterization of the site while employed as a senior research petroleum geologist at the Saskatchewan Geological Survey.

“Weyburn had been an ongoing and significant project for a number of years,” he notes. “Getting the job as the overall project manager gave me the opportunity to fully understand and study all the sides of the project — from geochemical and geophysical modeling, to wellbore integrity, to risk assessment and public engagement. I came to realize this project is as much about knowledge-sharing and public acceptance for the technologies as it is about research and science.”

Whittaker graduated with a Ph.D. in geology from the University of Saskatchewan in 1989 and, after postdoctoral work at both Queen’s University (1990-1992) and McGill (1993-1994), he returned to Saskatchewan to work both with the provincial government and in the private sector. He and his wife, Jean, make their home in Lumsden in the Qu’Appelle Valley just north of Regina, and he has an active life that includes hockey and, more frequently, running.

“I recently threw my back out,” he says. “That led to a lot more lying around than running, but I try to get out as often as I can.”

Under his tenure in 2009-2010, the Weyburn-Midale project moved into its penultimate year of scientific research, a best practices manual, the project’s final deliverable in 2011, will help other CO2 enhanced oil recovery operations transition into long-term storage. A number of key scientific projects and public engagement initiatives moved forward.

“This past year we got approval to do the field wellbore integrity testing, and have developed the various tools specifically for that purpose. As well, as part of the legacy Weyburn will leave on a broader public level, a website was built that is one of the most comprehensive educational tools ever put together on carbon capture and storage (www.ccs101.ca).”

Whittaker is also aware of the importance being placed on the best practices manual, particularly from the perspective of the Canadian and United States governments who are major sponsors of the research, and who committed in 2009-2010 to additional funding to cover the Wellbore integrity research.

“Weyburn is going to help instruct the world in the best practices for transitioning EOR into long-term storage,” he says. “Our corporate and government sponsors see this as the key deliverable and our research this past year has set us up well for achieving that deliverable in time by the close of 2011.”

"Aquistore will be one of the first integrated carbon capture, transport, injection, storage and research projects operating in the world."

Scott Rennie
Transporting the Best to Saskatchewan

"From a technical standpoint," says Scott Rennie, Project Manager with Schlumberger Carbon Services, "Aquistore makes a lot of sense for us as a project. It provides an opportunity for Schlumberger to demonstrate its carbon dioxide (CO₂) geological storage capabilities in Canada, bringing experience from other CCS projects we are involved in around the world; and PTRC’s team is great to work with."

Rennie, like the burgeoning carbon capture and storage (CCS) industry itself, has a background that is a diverse compilation of technology and research skills, in his case resulting from different roles held over a decade in the oil and gas industry. His father, a Canadian petroleum engineer, travelled the globe with his young family to France, Turkey, and Indonesia. It was in Turkey where Scott was born, and he attended an expatriate high school in Indonesia. A love of baseball drew him to the United States for university, where he completed an M.Sc. in mechanical engineering at Rice University (Houston) in 1998.

I didn’t plan to work in the oil industry. But an offer came in from Atlantic Richfield Company on the North Slope in Alaska and I took it right out of university. I worked in Alaska until 2005, and actually met my wife there. By that time the company, through some mergers and acquisitions, had become ConocoPhillips, and I moved with them to Houston and Venezuela over the next couple of years. After returning to Houston from Venezuela in 2007, I took a job that gave me the opportunity to both develop CCS projects and undertake research to adapt oilfield technologies to the application of CO₂ storage." Now settled in Calgary, but travelling frequently to Regina to help Aquistore establish its injectors and monitoring wells, Rennie took the job with Schlumberger Carbon Services after actively investigating the companies that were leaders in CCS.

"I know which companies were active in CCS research and projects, and really it was down to a few that have the intent and capability to lead in CO₂ storage. Also, when I returned to Houston in 2007 after my time in Venezuela, I was interested in getting back to Canada."

Schlumberger, with extensive experience in subsurface characterization and reservoir management, had already positioned itself at the forefront of CCS technology. Rennie joined Schlumberger Carbon Services in part because of the significant projects in the works north of the border. Aquistore is proving to be one of the most exciting.

"Aquistore will be one of the first integrated carbon capture, transport, injection, storage and research projects operating in the world, and maybe the first involving saline CO₂ storage in Canada. The team working on it is exceptional – the PTRC, Consumers’ Cooperative Refineries Limited, SaskEnergy, Enbridge, ourselves, SaskPower and Canadian leaders in CCS research."

For Aquistore, 2009-2010 saw the achievement of some key milestones, and significant progress on others. The Scientific and Engineering Research Committee (SERC), made up of members from the major universities and organizations that will be conducting the research accompanying the project, completed a plan that outlines the full program – from site characterization prior to injection, to post-closure and ongoing monitoring. Likewise, the Aquistore Communications Steering Committee, made up of communicators from all the major participating companies, finalized an engagement plan that seeks to keep the general public and other stakeholders informed about project development.

A broad area north of Regina has been carefully screened and a specific site identified for the possible location of the CO₂ injection and monitoring wells. The well permit application process has begun, and the PTRC has initiated discussions with local stakeholders and municipal leaders. As well, Schlumberger Carbon Services was engaged by Aquistore to begin the well engineering and design work, leading to the identification of a specific site. The actual drilling of the well is scheduled to occur in the fiscal year 2011-2012.

"CCS projects are challenging due to the mix of commercial, regulatory, technical and social factors that need to come together to create a viable project. In that sense, it’s great to be working on Aquistore, which has real legs," Rennie notes. "I’m back in Canada, working on things I’m really interested in, and in a city (Calgary) where my wife and I can do the sorts of outdoor activities we love. We backpack, and bike, and I’m willing to go just about anywhere to kayak."

"I love travelling and seeing new places and cultures. It’s hard to shake my own family history in that department. And now that same history has also, in a curious way, brought me to Regina and this project."

The actual testing of the well is scheduled to occur in 2012-2013.
The following project descriptions are snapshots, at March 31, 2010, of the work being carried out in the PTRC’s STEPS research program.

Heavy Oil (Post) Cold Flow

Heavy Oil Cold Production Optimization The main objectives of this research project are to understand the critical effects of wettability structures on primary cold production and post-cold production. In turn, this will help optimize the field operation and cold production system so as to improve the recovery of heavy oil, and to suggest field drilling locations. The project will evaluate CHOPS well performance, and support decision making during post-cold production processes. Project Leader: G. Zhao, University of Regina.

Cyclic Solvent Stimulation for Cold-Produced Reservoirs This project is aimed at providing a more accurate simulation of the cyclic solvent stimulation processes for cold produced reservoirs (field) in which sand was deliberately co-produced with the oil, creating high-permeability channels called wormholes. SRC’s multi well cold production numerical model will be modified to better simulate the dynamics in which wormholes grow in such reservoirs. The proximity of wormhole networks that develop from each cold production well influences the sweep efficiency of the solvent in cyclic solvent stimulation processes. Once the model is improved, it will be used to investigate the effect of the solvent flow (CO2, propene or methanol) on the process. Project Leader: B. Yeeleeg, SRC.

Utilization of CO2 for Pressure Maintenance and Improving Oil Recovery from Heavy Oil Reservoirs Pressure maintenance through gas injection has been implemented in large oil reservoires for many years, but the suitability of CO2 for this purpose in heavy oil reservoirs has not been investigated. This project aims at conducting a comprehensive study, both experimentally and through simulation scenarios, for utilizing CO2 for pressure maintenance in heavy oil reservoirs. Project Leader: C. (Tong) Yang, University of Regina.

Post-Cold Production EOR: Air Injection Pilot Projects This multi-year project is devoted to a new air injection process for heavy oil fields that have matured under cold production with significant water production. The project is designed to establish a production consortium to prepare for implementing a pilot field. Meanwhile, the ongoing goal of reliable simulation methods for air injection will be advanced through laboratory kinetics tests to the point where genuine prediction of combustion front stability may become possible. In addition, pilot operating conditions will be screened with the use of currently developed simulation model that incorporates wormholes from cold production. Project Leader: N. Finlay, SRC.

Pyrolysis Kinetics of Low-Temperature Oxidation Residues from Heavy Oil Reservoirs This project will determine the reaction kinetics for the pyrolysis of LTO residues formed by heavy oils and incorporate this into an overall reaction model to be assessed in numerical simulations of an air injection process. It offers a fundamental study of multi-phase flow at high temperatures during an injector process. Project Leader: N. Mahapatra, University of Calgary.

Enhanced Waterflooding Optimized Surfactant-Polymer Waterflooding for Heavy Oils This study aims to demonstrate the feasibility of the surfactant-polymer flooding technique for enhanced heavy oil recovery. Several important properties of the chemical solution in contact with the heavy oil are considered: viscosity, density and ability to form emulsions, and long-term thermal stability will be evaluated. A chemical mixture that tolerates high salinity and hardness will be designed that can minimize polymer degradation, chemical adsorption, and viscous fingering. Confined tests will then be conducted using the optimized chemical mixture. Project Leader: M. Lu, SRC.

2D Model Study of Chemical Flooding This project is to develop a process of enhanced heavy oil recovery by chemical flooding. On the basis of previous research results, 2D physical model tests and a scaled-up study will be conducted. This project will produce the chemical formulations for improving sweep efficiency, and enhanced oil recovery by chemical flooding, and develop injection strategies. It will scale up parameters for heavy oil recovery by chemical flooding and provide a field scale production of oil by chemical flooding. Project Leader: M. Dong, University of Calgary.

Optimizing Resin-coated-Bitumen Waterflooding for Heavy Oils This project continues SRC’s statistical work on heavy oil wettability, with a new focus on determining best operating practices at different time stages of the floods. These stages are classified by thermal regime: (i) oil only; (ii) water injected; and finally (iii) oil wattle trapping clams of emulsions. Other researches consider Resin II to be the most productive waterflood period, but SRC’s ongoing statistical studies suggest that Resin IV may perform better. We will examine the factors that apparently contribute to success during Resins II and IV. Project Leader: G. Renouf, SRC.

Severity of Heavy Oil Waterfloods - Factors and Predictions: Development of Neural Networks Tools This project aims to complete a comprehensive study on developing and testing a neural network model for predicting the performance of waterflooding of heavy oil reservoirs. This will be done by evaluating the effect of a variety of field information on the outcome of this model. The project will incorporate additional geological data in the model. Project Leader: F. Torabi, University of Regina.

Improving Conformance Control Technologies This project will address the effects of tile drainage and diverting oil content as well as polymer shear history on polymer adsorption on unconditioned heavy oil reservoir sands. Polymer gel injection patterns and the effects of gel volume and their history on gel performance will be evaluated using a 3D physical model with a vertical injection well. In both cases, numerical simulation will be used to history match the laboratory experiments. Project Leader: M. Luo, R. Witton, SRC.

Solvent Vapour Extraction (SVX) Numerical Simulation of SVX Processes This project includes extensive numerical simulation studies using previous 3D physical modeling data sets to improve numerical simulations of the SVX processes by better representing the three most important physical parameters: relative porosity, capillary curves, total effective solvent mass transfer, and non-equilibrium solvent solubility. The work will build on previous simulation studies, and introduce a novel history matching approach using a non-equilibrium solubility parameter derived from experimental data. Project Leader: K. Xin, SRC.

Asphaltene Precipitation and its Effects on CO2 Enhanced Heavy Oil Recovery When CO2 contacts heavy oil at certain pressures and temperatures, asphaltene precipitation occurs, the heavy oil in the reservoir is induced to precipitate. Meanwhile, some precipitated asphaltenes may gel deposit onto the reservoir solid particles and, thus, reservoir permeability may be significantly reduced. Since CO2 induced asphaltenes can be rather different from those induced by light hydrocarbons, this project will not only study the beneficial and detrimental effects of asphaltene precipitation and deposition on CO2 enhanced heavy oil recovery but also analyze the physicochemical properties of CO2 induced asphaltenes from crude oil samples under different experimental and heavy oil reservoir conditions. Project Leader: K. Xin, University of Regina.

Evaluation of Solvent Vapour Extraction (SVX) Processes Using a 3D Physical Model SVX processes offer an attractive alternative to thermal methods because they are less energy consuming and avoid CO2 production, and is more suitable for thermal shalow, or partially depleted reservoirs. This study includes are experiment on SRC’s 3D physical model, field scale, and numerical simulation. It will determine the dependence of oil production rates and recovery on the combined effects of the solvent mass transfer rate and solubility by reducing the solvent injection rate while maintaining the total injected solvent mass. The results will be compared with a previous laboratory run. Project Leader: K. Xin, SRC.
Phased Behaviour of Single(s)-CO₂-Heavy Oil Systems under Subcritical and Supercritical Conditions

Conventional thermal methods often do not work for recovering heavy oil in reservoirs. CO₂ injection may recover additional oil through an immiscible process. Addition of solvents to a CO₂ stream will generally accelerate the process of splitting the oil and reducing its viscosity, and thus achieve higher oil recovery. This project will study phase behaviour of the solvent(s)-CO₂-heavy oil system under subcritical and supercritical conditions and subsequently determine the potential of CO₂-gaseous solvent mixtures for increasing oil recovery for heavy oil reserves.

Project Leader: D. (Chang) Yang, University of Regina.

Investigation of Two- and Three-Phase Relative Permeability

This project will investigate the three-phase relative permeability relation for CO₂-oil-water systems through a series of carefully designed laboratory experiments. It is expected that the outcome of this research will gain fundamental understanding of the flow of CO₂ in oil reservoirs in the presence of both water and oil. In addition, the scientific findings will be of great benefit to oil companies that are interested in CO₂ flooding for reservoirs. Project Leader: F. Torabi, University of Regina.

Improving Heavy Oil Predictability

Three-Phase Relative Permeability for Heavy Oil Systems

This project aims at experimental measurement and mathematical development of two- and three-phase relative permeability during multicomponent flow of fluids in porous media containing heavy oil, water and solvent. Two- and three-phase relative permeability are key parameters for both history matching and future forecasting of multiphase recovery processes at experimental and field scales. The effect of parameters such as oil viscosity, temperature, and rock wettability on three-phase relative permeability will be evaluated. Results obtained will then be used to develop a series of correlations that can predict the relative permeability trends for systems containing heavy oil. Project Leader: F. Torabi, University of Regina.

Improved Recovery for Heavy Oil Reservoirs Using Simultaneous Thermal and Chemical Flooding

This project is studying a process for enhanced heavy oil recovery using simultaneous injection of chemical/thermal flooding. In the proposed processes, thermal/thermal fluids will be used to improve sweep efficiency, and deploy heavy oil as oil of reservoirs. Research will be conducted to test chemical formulas for improving sweep efficiency and oil recovery. Project Leader: D. (Chang) Yang, University of Regina.

Solubility and Diffusion Coefficients of Gases in SARA Fractions and Heavy Oils

In this project, the solubility and diffusion coefficients of carbon dioxide, ethane and propane will be measured for several Canadian heavy oils and their SARA fractions. A gravimetric microbalance will be used for pressures up to 2 MPa, and equation of state and Solubility Parameter Theory models will correlate and predict the solubility data. Determining the solubilities of oils in critical to help companies understand the amount and type of solvents to use in reservoirs, to help optimize recovery rates.

Project Leader: E. (Charley) Sherriff, A. Hess, University of Regina.

Equation-of-State Characterization of Heavy Oils

The conventional correlations of the physical properties of oils, which are mainly based on light oils, generally become increasingly inaccurate when heavier oils are considered. This multi-year project addresses the overall need to provide reliable heavy-oil correlations that can be trusted during numerical simulations. Current year research uses a novel and promising approach for predictive viscosity correlations. The team will use SARA-Theory data from the experimental side of this program. A literature search for additional improvements will be conducted, and a recently uncovered, alternative correlation for oil viscosity will be tested. Project Leader: F. Torabi, University of Regina.

Incubation Projects

Inspectional Monitoring of Low Yield Oil Wells

Low productivity and marginally economic oilfields require careful management of expenses, human resources and equipment in order to maintain productivity and profitability. This project's short-term goal is to combine storage tank and individual well data in an integrated instrument package and provide a low-cost, low-maintenance communications system to enable simple remote access to the data. The long-term goal is to acquire and integrate other data such as pumpjack performance and downhole pressure.

Project Leader: K. (Heather) Runtz, T. Conroy, University of Regina.

Increasing Temperature of Injection Water to Improve Heavy Oil Recovery

This project is studying the performance and applicability of hot waterflooding and comparing it with conventional waterflooding performed in heavy oil reservoirs, through simulation of the process using CMG STARS. Increasing the temperature of injected water could reduce oil viscosity, which in turn could improve oil recovery, delay breakthrough, and reduce the water cut of heavy oil. Since viscosity of heavy oil has an exponential relationship with temperature, only a slight increase in temperature could result in a significant reduction of viscosity. Increasing the temperature of injection water can be accomplished with only minimal modification of facilities. In addition, the efficiency of other IOR techniques, such as CO₂, EOR techniques, may be increased when combined with hot waterflooding.

Project Leader: F. Torabi, University of Regina.

Applying Precipitation and its Effects as the SVF Heavy Oil Recovery Process

When a solvent is injected into a heavy oil reservoir, significant heavy oil viscosity reduction is achieved through solvent dissolution (molecular diffusion and convective transport). Solvent dispersion may greatly accelerate the solvent dissolution into heavy oil through solvent variation extraction. In practice, it has been found that solvent dispersion is strongly affected by several important operational factors, such as solvent type, injection conditions, horizontal well spacing and configuration, and reservoir characteristics. This project will examine the detailed effects of these factors on heavy oil and solvent production rates. A novel theoretical model will be developed to predict heavy oil production during the SVF process. Project Leader: Y. (Peter) Gu, University of Regina.

Underground Sand for Detecting the Growth of the Chamber in SVF Processes

This project aims at utilizing acoustic sonar for detecting the shape and size of the vapor chamber in SVF processes. An experimental tank has been designed and digital signal processing algorithms have been developed and tested to help determine the shape and size of the vapor chamber in an environment of water saturated sand. Currently, experiments in oil environments are underway. Project Leader: R. Paranjape, University of Regina.

Gas Flooding (Miscible/Immiscible)

Maximizing the Performance of Immiscible Gas Flooding in Heavy Oil Reservoirs

This research aims at optimizing immiscible gas flooding for heavy oil through improvements to displacement efficiency and reduction in oil viscosity. A comprehensive review will be conducted of SRC's previous research results for immiscible gas coreflooding for heavy oils and gases. Based on previous results, more adsorbed gas will be tested including CO₂ to confirm the most economical and effective immiscible gas injection flooding. In condensate-bearing, various factors – slug size, injection rate, and injection scheme – will be evaluated to improve displacement efficiency. Project Leader: M. Luo, SRC.

To the Members of Petroleum Technology Research Centre Inc.

We have audited the financial position of Petroleum Technology Research Centre Inc. as at March 31, 2010, and the statements of operations and unrestricted net assets and cash flows for the year then ended. These financial statements are the responsibility of the Centre's management. Our responsibility is to express an opinion on these financial statements based on our audit.

We conducted our audit in accordance with Canadian generally accepted auditing standards. Those standards require that we plan and perform an audit to obtain reasonable assurance whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. In our opinion, these financial statements present fairly, in all material respects, the financial position of the Centre as at March 31, 2010, and the results of its operations and cash flows for the year then ended in accordance with Canadian generally accepted accounting principles.

REGINA, Saskatchewan
May 19, 2010
Auditors’ Report
Chartered Accountants
## Statement of Financial Position

**Petroleum Technology Research Centre Inc.**

**Statement of Financial Position for the Year Ending March 31, 2010**

### ASSETS

**CURRENT ASSETS**

<table>
<thead>
<tr>
<th>Category</th>
<th>2010 Total</th>
<th>2009 Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash</td>
<td>7,950,416</td>
<td>3,332,551</td>
</tr>
<tr>
<td>Accounts receivable</td>
<td>4,966</td>
<td>1,928</td>
</tr>
<tr>
<td>Prepaid expenses</td>
<td>5,468</td>
<td>814,222</td>
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<tr>
<td>Property, Plant &amp; Equipment</td>
<td>5,960,010</td>
<td>3,334,479</td>
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### LIABILITIES AND NET ASSETS

**CURRENT LIABILITIES**

<table>
<thead>
<tr>
<th>Category</th>
<th>2010 Total</th>
<th>2009 Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounts payable and</td>
<td>424,987</td>
<td>182,966</td>
</tr>
<tr>
<td>accrual liabilities</td>
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<td>6,548,915</td>
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**DUE TO (FROM) OTHER FUNDS**

<table>
<thead>
<tr>
<th>Category</th>
<th>2010 Total</th>
<th>2009 Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>DUE TO (FROM) OTHER FUNDS</td>
<td>547,704</td>
<td>1,212,282</td>
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**DEFERRED REVENUE**

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<tr>
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</tr>
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**NET ASSETS**

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<tr>
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</tr>
</thead>
<tbody>
<tr>
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<td>329,966</td>
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### REVENUE

**Funding**

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<th>2009 Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saskatchewan Energy &amp; Resources</td>
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<td>514,950</td>
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<tr>
<td>Enterprise Saskatchewan</td>
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<td>552,119</td>
</tr>
<tr>
<td>Western Economic Diversification Canada</td>
<td>-</td>
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<tr>
<td>Business-led Networks of Canada</td>
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<td>3,186,050</td>
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<tr>
<td>Natural Resources Canada</td>
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<td>1,000,000</td>
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<tr>
<td>US Department of Energy</td>
<td>-</td>
<td>5,186,050</td>
</tr>
<tr>
<td>Industry other leveraged sources</td>
<td></td>
<td>5,186,050</td>
</tr>
<tr>
<td>Other - Note 9</td>
<td>369,185</td>
<td>31,575</td>
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**OPERATING EXPENSES**

<table>
<thead>
<tr>
<th>Category</th>
<th>2010 Total</th>
<th>2009 Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,261,181</td>
<td>31,130</td>
<td></td>
</tr>
</tbody>
</table>

**PROJECT EXPENSES**

<table>
<thead>
<tr>
<th>Category</th>
<th>2010 Total</th>
<th>2009 Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,261,181</td>
<td>31,130</td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL EXPENSES**

<table>
<thead>
<tr>
<th>Category</th>
<th>2010 Total</th>
<th>2009 Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,261,181</td>
<td>31,130</td>
<td></td>
</tr>
</tbody>
</table>

**EXCESS OF REVENUE (EXPENSE)**

<table>
<thead>
<tr>
<th>Category</th>
<th>2010 Total</th>
<th>2009 Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,261,181</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

**UNRESTRICTED NET ASSETS — beginning of year**

<table>
<thead>
<tr>
<th>Category</th>
<th>2010 Total</th>
<th>2009 Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>329,966</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

**UNRESTRICTED NET ASSETS — end of year**

<table>
<thead>
<tr>
<th>Category</th>
<th>2010 Total</th>
<th>2009 Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>329,966</td>
<td>-</td>
<td>106,850</td>
</tr>
</tbody>
</table>

See accompanying notes to financial statements.
Notes to the Financial Statements
March 31, 2010

1. NATURE OF ORGANIZATION

Petroleum Technology Research Centre Inc. (The Centre) is an internationally recognized innovative leader in the petroleum research and development area that delivers world-class basic and applied research for the benefit of the people of Saskatchewan, Canada and their customers around the globe. The Centre is incorporated under the Canada Business Corporations Act as a non-profit corporation and is exempt from income taxes on its income.

2. SIGNIFICANT ACCOUNTING POLICIES

These financial statements are prepared in accordance with Canadian generally accepted accounting principles and the significant policies are as follows:

The accounts of the Centre are maintained in accordance with the principles of not-for-profit accounting. For financial reporting purposes, accounts with similar characteristics have been combined into the following major funding groups:

i) PTRC Operations

The PTRC Operations Fund reflects the general operations of the Centre primarily funded by Saskatchewan Ministry of Energy & Resources. In 2009-2010 initial work with a project focused on testing technology with the potential to reduce water usage and carbon dioxide (CO2) emissions in the oil sands was included in the PTRC Operations Fund. The Centre has removed itself from further participation in the project and therefore will not experience any related additional costs in the future.

ii) Aquistore

The Aquistore project reflects the operations for the research project looking into capture of CO2 from a Regina refinery for storage in a Saskatchewan deep saline formation. This is a multi-year project and is funded by a consortium that includes Sustainable Development Technology Canada (SDTC), Saskatchewan Ministry of Environment and three industry partners. This is the first fiscal year that this project is reported separately; initial work was done on the project in 2008-2009 and was reported under the PTRC Operations Fund.

iii) Fluids

The Saskatchewan Phanerozoic Fluids and Petroleum Systems (Fluids) project examines how basins, hydrocarbons and other fluids in the Saskatchewan subsurface have evolved over geologic times. This project is new in 2009-2010 and is funded by Saskatchewan Ministry of Energy & Resources.

iv) JIVE

The JIVE project reflects the operations for the collaborative project entitled Joint Implementation of Vapour Extraction. This multi-year project is funded by a consortium that includes Saskatchewan Ministry of Energy & Resources, Sustainable Development Technology Canada (SDTC) and three industry participants.

Statement of Cash Flows
For the year ended March 31, 2010

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPERATING ACTIVITIES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excess of revenue</td>
<td>(218,169)</td>
<td>418,979</td>
</tr>
<tr>
<td>Item that does not affect cash:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Amortization - Notes 3, 5</td>
<td>75,537</td>
<td>101,277</td>
</tr>
<tr>
<td>- Loss on disposal of property, plant and equipment</td>
<td>128,955</td>
<td>-</td>
</tr>
<tr>
<td>Net change in current assets</td>
<td>5,904,711</td>
<td>(5,805,981)</td>
</tr>
<tr>
<td>Net change in current liabilities</td>
<td>188,009</td>
<td>(305,596)</td>
</tr>
<tr>
<td>Net change in deferred revenue</td>
<td>3,913,004</td>
<td>8,664,088</td>
</tr>
<tr>
<td>Net cash from operating activities</td>
<td>9,992,045</td>
<td>3,062,767</td>
</tr>
<tr>
<td>INVESTING ACTIVITIES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purchase of property, plant and equipment</td>
<td>(25,203)</td>
<td>(38,208)</td>
</tr>
<tr>
<td>Net cash (used by) investing activities</td>
<td>(25,203)</td>
<td>(38,208)</td>
</tr>
<tr>
<td>INCREASE IN CASH RESOURCES</td>
<td>9,966,842</td>
<td>3,024,559</td>
</tr>
<tr>
<td>CASH - beginning of year</td>
<td>7,550,785</td>
<td>4,526,226</td>
</tr>
<tr>
<td>CASH - end of year</td>
<td>17,517,627</td>
<td>7,550,785</td>
</tr>
</tbody>
</table>

See accompanying notes to financial statements.
2. SIGNIFICANT ACCOUNTING POLICIES continued

Use of Estimates
The preparation of financial statements in accordance with Canadian generally accepted accounting principles requires management to make estimates and assumptions that affect the reported amount of assets and liabilities and disclosure of contingent assets and liabilities at the date of the financial statements and the reported amount of revenues and expenses during the reported period. Since actual results may differ from the estimates, these estimates are reviewed periodically, and as adjustments become necessary, they are reported in earnings in the period in which they become known.

Financial Instruments – Recognition and Measurement
Financial assets and liabilities are initially recognized at fair value and their subsequent measurement is dependent on their classification. Their classification depends on the purpose for which the financial instruments were acquired or issued, their characteristics and the Centre’s designation of such instruments. The standards require that all financial instruments, including all derivatives, be measured at fair value with the exception of loans and receivables, debt securities classified as Hold to Maturity (HTM), and Available for Sale (AFS) financial assets that do not have quoted market prices in an active market.

Financial assets are classified as held-for-trade or loans and receivables. Cash is designated as held-for-trade and is carried at fair value. All receivables are designated as loans and receivables and are accounted for at amortized cost.

Financial liabilities are classified as other liabilities and are accounted for at amortized cost, with gains and losses reported in excess of revenue in the period that the liability is derecognized.

Financial Instruments – Disclosure and Presentation
The Centre has elected to continue to apply Section 3861, Financial Instruments – Disclosure and Presentation.

3. PROPERTY, PLANT AND EQUIPMENT

<table>
<thead>
<tr>
<th>2010</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost $</td>
<td>Acumulated Amortization $</td>
</tr>
<tr>
<td>Computers</td>
<td>53,211</td>
</tr>
<tr>
<td>Office furniture</td>
<td>53,312</td>
</tr>
<tr>
<td>Subtotal</td>
<td>106,523</td>
</tr>
<tr>
<td>Leasehold improvements</td>
<td>14,794</td>
</tr>
<tr>
<td>Research assets</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>$ 121,317</td>
</tr>
</tbody>
</table>

Research asset amortization of $54,746 (2009 - $78,209) is included in project expenses.
3. PROPERTY, PLANT AND EQUIPMENT continued

In the current year, The Centre recognized $128,953 as a loss on disposal of property, plant and equipment due to the obsolescence of the GRID networking computer research asset and other computer equipment. The Centre’s net investment in property, plant and equipment represents $61,503 (2009 - $58,301) of net unrestricted assets, calculated as total net book value less deferred revenue related to research assets.

4. DEFERRED REVENUE

The Centre receives contributions from government and industry for specific projects or programs. These funds are restricted in use as directed by the external sponsors. The Centre recognizes revenue for these projects on the same basis as expenditures are incurred. Any excess revenue in the year is deferred and recognized in future years as expenditures are incurred. Funding for research assets and prepaid maintenance contracts are also recorded as deferred revenue until such time as the related assets are put in use and amortized.

<table>
<thead>
<tr>
<th>Beginning Deferred Revenue – March 31, 2009</th>
<th>Funding Received 2010</th>
<th>Revenue Recognized 2010</th>
<th>Ending Deferred Revenue – March 31, 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTRC Operations</td>
<td>1,616,680</td>
<td>-</td>
<td>1,068,976</td>
</tr>
<tr>
<td>Aquistore</td>
<td>3,006,818</td>
<td>525,000</td>
<td>499,526</td>
</tr>
<tr>
<td>Fluids</td>
<td>390,000</td>
<td>200,000</td>
<td>208,639</td>
</tr>
<tr>
<td>JIVE</td>
<td>2,530,430</td>
<td>1,389,429</td>
<td>1,839,106</td>
</tr>
<tr>
<td>STEPS</td>
<td>2,805,000</td>
<td>7,005,220</td>
<td>2,463,531</td>
</tr>
<tr>
<td>Weyburn-Midale</td>
<td>4,230,980</td>
<td>5,294,622</td>
<td>4,311,690</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>14,489,908</strong></td>
<td><strong>14,214,271</strong></td>
<td><strong>10,301,268</strong></td>
</tr>
</tbody>
</table>

The beginning deferred revenues for Aquistore, Fluids and STEPS were included in the deferred revenue total for the PTRC Operations Fund at March 31, 2009 but have been separated above to reflect the actual activity of each project in 2009-2010. The deferred revenue is held to match with future project expenditures.

5. SIGNIFICANT AGREEMENTS

The Centre has funding agreements in place at March 31, 2010 to support the future financial activity of each of the projects. The agreements specify the contribution schedule and the required spending deadlines. The Aquistore project has contributions committed by SDTC totaling $5,000,000 over four years with expenses to be applied by December 31, 2013. Saskatchewan Ministry of Environment has committed $5,000,000 over five years to be used by March 31, 2014. Industry participants will contribute a total of $2,100,000 over three years with expenses to be through by December 31, 2015.

The Fluids project has an agreement with the Saskatchewan Ministry of Energy & Resources for contributions totaling $1,000,000 over four years with all funds to be used by March 31, 2013.

The JIVE project has contribution agreements requiring funds to be used in their entirety by the expiration date of October 5, 2010.

The STEPS project has contribution agreements with the Natural Sciences and Engineering Research Council (“NSERC”) and the Social Sciences and Humanities Research Council (“SSHRC”) representing a total award of $10,500,000 to be paid through 2012 and funds to be used by March 31, 2013. Saskatchewan Ministry of Energy & Resources has two annual funding agreements in place, the first a three-year agreement for $4,500,000 expiring on March 31, 2011 and the second, a three-year agreement for $3,120,000 expiring on March 31, 2012. A portion of the Saskatchewan Ministry of Energy & Resources contributions will be designated to PTRC Operations Fund as required to cover general operating expenses.

The Weyburn-Midale project has contribution agreements requiring the funds to be used in their entirety by the expiration date of December 31, 2011.

6. DUE TO (FROM) OTHER PROJECTS

The PTRC Operations Fund holds the cash and makes payment on behalf of the STEPS Fund. On occasion, each project may make payments on behalf of another and at March 31, 2010 amounts due to and due from each project were outstanding.

<table>
<thead>
<tr>
<th>PTRC Operations</th>
<th>Aquistore</th>
<th>Fluids</th>
<th>JIVE</th>
<th>STEPS</th>
<th>Weyburn-Midale</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTRC Operations</td>
<td>(3,624)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Aquistore</td>
<td>81,699</td>
<td>4,756</td>
<td>46,043</td>
<td>6,967,536</td>
<td>115,420</td>
</tr>
<tr>
<td>Fluids</td>
<td>(4,758)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>(396)</td>
</tr>
<tr>
<td>JIVE</td>
<td>(46,043)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>(357)</td>
</tr>
<tr>
<td>STEPS</td>
<td>6,967,536</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>(3,621)</td>
</tr>
<tr>
<td>Weyburn-Midale</td>
<td>(3,621)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td><strong>Total (2010)</strong></td>
<td><strong>6,719,676</strong></td>
<td><strong>81,823</strong></td>
<td><strong>5,354</strong></td>
<td><strong>46,200</strong></td>
<td><strong>110,862</strong></td>
</tr>
<tr>
<td><strong>Total (2009)</strong></td>
<td><strong>2,325,922</strong></td>
<td><strong>NA</strong></td>
<td><strong>NA</strong></td>
<td><strong>2,317,138</strong></td>
<td><strong>NA</strong></td>
</tr>
</tbody>
</table>
7. UNREALIZED GAIN (LOSS)
In the Weyburn-Midale project the unrealized gain of $15,579 (2009-$261,404) has been reclassified as other income. The reversal of the unrealized gain from the previous year is significant due to the appreciation in the Canadian dollar in 2009.

8. COMMITMENTS
The minimum payments under lease agreements for office premises and equipment are as follows:

<table>
<thead>
<tr>
<th>Year Ending March 31</th>
<th>Minimum Lease Payments</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>59,417</td>
</tr>
<tr>
<td>2012</td>
<td>4,014</td>
</tr>
<tr>
<td>2013</td>
<td>4,014</td>
</tr>
<tr>
<td>2014</td>
<td>4,014</td>
</tr>
<tr>
<td>2015</td>
<td>2,007</td>
</tr>
<tr>
<td></td>
<td>73,466</td>
</tr>
</tbody>
</table>

9. FINANCIAL INSTRUMENTS

Fair Value of Financial Instruments
The carrying amount of cash, accounts receivable and accounts payable approximates their fair market value because of the short-term nature of these items.

Credit Risk
The Centre does not believe it is subject to any significant concentration of credit risk related to accounts receivable.

10. CAPITAL MANAGEMENT

The Centre’s objective when managing capital is to meet its current objectives as set out within its current strategic operating plan within its annual operating budget. This objective has remained unchanged from the prior period.

The Centre’s capital consists of net assets plus deferred revenue contributions.

11. COMPARATIVE FIGURES

Certain comparative figures in the financial statement balances have been reclassified to conform to the financial statement presentation adopted for the current year.